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ABSTRACT

of the dissertation submitted for the degree of Doctor of Philosophy

DRAGONFLY (ODONATA) LARVAE OF LAKES AROUND THE KURA (species composition, quantity, biology, ecology)

Specialty: 2401.01 - "Zoology"

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INTRODUCTION

Relevance of the topic and completion degree. Dragonflies are one of the oldest groups of animals with high biological properties. They are believed to have formed 300 million years ago. These are invertebrates with a high biodiversity in the animal kingdom. There are currently 4500 species of dragonflies recorded worldwide. They are amphoteric and carry out the first stages of development in the aquatic environment and the adult (imago) stages on land.

Dragonflies, especially their larvae, play an important role in the nutrition of benthivorous and other fish, as well as they are involved in regulating the number of larvae of harmful insects (for example, malarial mosquitoes, etc.) in the aquatic environment¹.

The complexes of dragonfly larvae formed and forming in the aquatic environment, their biodiversity, distribution by biotopes in the environment, etc. the information obtained is a very important source of information for the formation water quality in these reservoirs. Unfortunately, the study of these groups of animals with such important and unusual features has not been studied in detail in our country. Although our bentologists have mentioned only hydrobiological studies, some types and quantitative indicators of dragonflies larvae, and to a lesser extent their role in reservoir productivity, etc. provide information about.² In fact, the biodiversity and biomass of dragonflies both in the aquatic environment and on land should be considered as a result of their significant contribution to the metabolism of matter and energy in biogeocenoses.

It is known that most of the country's territory is occupied by the Kura lowland. This area is rich in lakes and ditches. These reservoirs occupy not only large areas, but also small ones, are rich in vegetation and are prone to swamping, which creates favorable conditions for the development and spread of dragonfly larvae in these reservoirs. However, with the exception of some information recorded at the moment

¹ Gasimov, A.H. Group of dragonflies // Animal world of Azerbaijan // Baku, Science 2002, pp. 102-104.

² Aliyev, S.I., Garabeyli, O.Z. On the study of dragonflies in the inland water basins of Azerbaijan // Ecology, philosophy, culture. Baku, 2004, № 38. p. 144-147.

by our hydrobiologists, no consistent, comprehensive and continuous studies of the larval stages of dragonflies, as noted above, have been carried out. Therefore, this work can be considered as the first step in a detailed study of dragonfly larvae.

Object and goal of the research. The object of the study are dragonfly larvae (Odonata larvae) of the lakes around the Kura (Aggol, Mehman, Nakhalikhchala, Hajigabul) and ponds (Yetim Kur, Garaoglan, Garkhun, Marzli, Aynali). The subject of the study is the species composition, abundance, biology and ecology of dragonfly larvae living in water bodies.

Aims and objectives of the research. Based on the relevance of knowledge about the dragonfly fauna in the lakes and ditches around the Kura, the purpose of our work is to study the species composition, abundance, ecological characteristics of dragonfly larvae in these reservoirs, assess the ecological situation in lakes, etc. is to prepare practical proposals.

In this regard, the following issues are being addressed:

1. To study the species composition of coniferous larvae in lakes and ditches around the Kura, to determine the biotope of their distribution, to study and analyze the dynamics of development by seasons.

2. Analysis of larvae of dragonflies in the water basins of the area, to determine the parameters of the water in the water basins studied during the year.

3. To determine the regularity of the distribution of dragonfly larvae both on lakes and on ponds and, on this basis, to determine their high faunistic complexes.

4. Assess the consequences of anthropogenic impact on the species diversity of dragonflies and develop a system of measures for their protection.

Research methods. To carry out the dissertation work, field studies were carried out in chapters and the necessary materials were collected using classical and modern hydrobiological methods.

When sampling, the bucket should be equipped with a mesh, a lifting device from the bottom, a secca disc, a photo camera, glass and plastic containers of different capacities, tweezers, etc.The collected

samples were cleaned on the spot from foreign impurities, fixed with 4% formalin or 70% alcohol solution and taken for laboratory analysis.³

The main provisions of the defense:

1. Results of species composition and quantitative indicators of dragonfly larvae in the lakes of around Kura,

2. The results of the dynamics of development of species and quantities of larvae of dragonflies by lakes, seasons and years,

3. The role of dragonfly larvae in the diet of bentophagous and predatory fish, etc.

4. The role of dragonfly larvae in the biological productivity of water bodies,

5. Determine the distribution of dragonfly larvae in biocenoses.

Scientific innovation research. As a result of our research, for the first time for these lakes, the distribution, development, and some ecological features of dragonfly larvae in lakes and ditches in the Kura water area are presented.

Theoretical and practical significance of the research. Collecting information on dragonfly larvae, their distribution and ecology provides a basis for monitoring, assessing and using the regional cadastre of the animal world, dragonfly fauna and associated natural complexes and their use in bioindication of water quality in reservoirs, etc.

Approbation and application of research. Discussed at the Scientific Seminars of the Laboratory of Hydrobiology of the Institute of Zoology of ANAS and UNEC (2015 - 2017) and at the Republican and International Scientific-Practical Conferences listed below.

- Republican scientific conference "Prospects for the development of experimental biology" dedicated to the 80th anniversary of the Faculty of Biology of BSU (Baku - 2014);

- Materials of the Republican Scientific and Practical Conference "Modern Problems of Economic Science" (Zagatala - 2019);

- Economic and social development, 37th International Scientific Conference on Economic and Social Development - Socio-Economic

³ Guliyeva, S.A. Species composition and distribution of dragonfly larvae (Odonata larvae) in lakes and reservoirs around Kura // – Lankaran: Journal of Scientific News, Department of Natural Sciences, – 2018. № 1, – pp.133-136.

Problems of Sustainable Development, (Warsaw - 2019);

- Economic and Social Development 56th International Scientific Conference on Economic and Social Development, Aveiro, (Portugal - 2020);

- Republican scientific-practical conference Fundamental and applied scientific research in zoology: topical issues, achievements and innovations, dedicated to the 85th anniversary of the Institute of Zoology of ANAS and the 100th anniversary of academician Musa Musaev (Baku - 2021).

Name of the organization where the dissertation work is performed. Hydrobiology laboratory of the Institute of Zoology of the Azerbaijan National Academy of Sciences.

Publications. 13 scientific works (12 articles, 1 thesis) dedicated to the materials of the dissertation were published. 4 of the articles are included in the database of the international index.

Volume and structure of the dissertation. The dissertation consists of 225035 characters, consists of an introduction (6159 characters), 6 chapters (213657 characters), conclusion (4554 characters), practical suggestions (665 characters), a list of 162 titles of literature in Azerbaijani, Russian and other languages and appendices. 21 tables, 30 pictures and 5 graphs are given in the main part of the dissertation, 30 tables are given in the appendices.

CHAPTER I. REVIEW OF LITERATURE ON THE GEOGRAPHICAL DISTRIBUTION OF GRAGONFLY LARVAE (ODONATA) AND THEIR STUDY IN THE FRESHWATER BASINS OF AZERBAIJAN

This chapter presents an analysis of data from the study of dragonfly larvae (Odonata) and a summary of the literature on the position of these animals in the ecosystem.

According to the available data, although this ancient group of invertebrates originated millions of years ago, we do not have enough information about it. The study of dragonfly larvae, which we consider important and with unusual symptoms, has been ignored in our country.

CHAPTER II. PHYSICAL AND GEOGRAPHICAL FEATURES OF TRE REGION AROUND THE KURA AND THE CHARACTERISTICS OF THE LAKES THERE

One of the relatively lakes-rich territories of the republic is the Kura region around the Kura-Araz lowland.

Analysis of data on the geography and hydrography of the region shows that the main reason for the formation of lakes here is associated with the displacement of the Kura and Araz rivers in the lowlands during the geological period. The basins of large lakes Aggol and Sarisu formed in the paleo-ponds of the Kura river, and the basin of lake Hajigabul was formed as a result of regression of the Caspian Sea, and then as a result of erosion of floods of the Kura river. Numerous ponds on the right and left banks of the Kura were formed as a result of the separation of meanders from the main river.

The area around the Kura covers the central and lower parts of the Kura-Araz lowland both in the center and in height. The northern border of the plain is the southern slopes of the Greater Caucasus mountains, the western borders are the eastern slopes of the Lesser Caucasus mountains, the southern border is the Araz river, the southeastern border is the northern slopes of the Talysh mountains and the river. eastern borders - the Caspian Sea.



Figure. Kura-Araz lowland and studied lakes (With geographical coordinates).

Aggol lake - N 40°00'39, "E47°38'45", Mehman lake - N 40°06'57", E 47° 44' 30", Nakhalikhchala lake - N 40° 02'35", E 48°10'14", Hajigabul lake - N 39° 58' 32", E48°55'21".

It is known that a large part of the country's territory is the Kura lowland. This area is rich in lakes and ponds (Aggol, Mehman, Nakhalikhchala, Hajigabul lakes and Yetim Kur, Garaoghlan, Garkhun, Marzli and Aynali ponds). These reservoirs not only cover large areas, but also small ones, are covered with vegetation and have a tendency to waterlogging, which creates favorable conditions for the development and distribution of dragonflies and their larvae in these reservoirs. However, with the exception of some data recorded by our hydrobiologists, no consistent, comprehensive and continuous studies of the larval stages of dragonflies or their adult stages, as noted above, have been carried out. Therefore, this work can be considered as the first positive step in the study of dragonfly larvae.

CHAPTER III. MATERİAL AND METHODOLOGY OF WORK

From winter 2013 to the end of 2016, materials related to dragonfly larvae were collected in 4 lakes and 5 ponds around the Kura (Aggol, Mehman, Nakhalikhchala, Hajigabul and Yetim Kur, Garaoghlan, Garkhun, Marzli, Aynali) by months and seasons. The collection of 600 quality samples and 228 quantity samples from the lakes and ponds mentioned above is based on methods considered important in hydrobiological research (Table 1). Basically, used a mesh and a Peterson-type⁴ dirt lift with an area of 0.025 m².

In the laboratory, the analysis of materials was performed under a binocular microscope (MBC-1 and MBC-9). Species characteristic of the species were compared with the information given in the books of designation (A.Popova 1953), "Личинки стрекоз" (Odonata larvae) and other media (scientific journals, Internet information, etc.)⁵. In addition, there are predominant or characteristic species among the

⁴ Guliyeva, S.A. // Composition and distribution of insecta larvae (Odonata larvae) in lakes and waterfalls // Economic and Social Development 56th International Scientific Conference on Economic and Social Development Aveiro, Warsaw-Portugal - 2020, pp.144 - 148.

⁵ Popova, A.N. Dragonfly larvae of the fauna of the USSR (Odonata) // Izd. AN SSSR L., 1953, 234 p.

dragonfly larvae formed in individual lakes, as well as species that are rarely found in lakes, and so on has also been identified.

Table 1

	Samples			
Basins	quality	quantity		
	(species composition)	(quantity)		
Aggol	130	50		
Nakhalikhchala	127	44		
Mehman	103	40		
Hajigabul	121	38		
Ponds	119	56		
Total	600	228		

Materials collected on dragonfly larvae from lakes and ponds around the Kura in 2013-2020

The generality coefficient proposed by Chekanovsky⁶ and Sorensen⁷ was used to identify similarities and differences in the distribution of dragonfly species recorded in lakes and streams in the studied reservoirs.

Ecological indicators of dragonfly larvae - Faunal similarity indicators are characterized and implemented using the statistical software package BioDiversity Professional - 2.0.

CHAPTER IV. SPECIES AND QUANTITY COMPOSITION OF GRAGONFLY LARVAE FORMED IN THE LAKES AROUND THE KURA, THEIR TAXONOMIC SPECTRUM

Aggol, Mehman, Nakhalikhchala (Sarisu), Hajigabul and others located along the lower reaches of the Kura river. The fishing importance of the lakes has been very high at the time. These lakes have always been flooded by the Kura river. The last major flood occurred in 2010. During this period, the ecological conditions in the lakes have

⁶ Czekanowski, J. // Zarys metod statystycznych wzastosowaniu do antropologii // Warszawa: – 1913, 178 p.

⁷ Sorensen, T.A. Metod of establishing grups of equal amplitude in plant spciolgy-Kgl // Danske vidensk. Selsk., 1948, № 4, pp.1-34.

changed significantly. It should be noted that no hydrobiological research has been conducted in these lakes for more than 30 years. It is important to conduct hydrobiological studies to identify changes in the fauna. For this purpose, it is important to study the fauna of dragonfly larvae, which are part of the macrobenthos.

As a result of our research, a total of 61 species of dragonfly larvae were found in the lakes and ponds around the Kura. The species found are unevenly distributed over lakes and ponds. In 2020, the highest species diversity was found in Aggol (31 species), and the lowest diversity was found in lake Nahalikhchala (20 species).

First of all, about Aggol lake. Aggol lake is the largest lake in the country after the Sarisu lake system. The geographical coordinates of the lake are as follows: N 40° 00' 39", E 47° 38' 45". It does not have a special catchment area, its natural water supply is the flood waters of the Gargarchay and the waters that reach the lake during the strong floods of the Kura river. During periods of high water in the lake, excess water flows through the Bozgobu-Sherbatgobu canal, which starts from the eastern part of the lake, into the system of lakes Mehman and Sarisu.

Lake Aggol has been a national park since 2003 and plays a special role in protecting native and migratory birds. Up to 70% of the lake area is covered with higher aquatic plants, which, along with other hydrobionts, contribute to the reproduction of lake dragonfly larvae.

Over the years of research, 28 species of dragonfly larvae were found in lake Aggöl in 2011/12, 26 species in 2013, and 31 species in 2020. Three of the identified species were first recorded for the lake fauna (*Sympetrum striolatum*, *S.sanguineum*, *S.meridionale*). The total number of species in the 2011 survey year ranged from 17 to 26, and in 2012 from 18 to 27 species⁸. In the winter of 2011, 26 species of dragonflies were recorded. *C.scitulum*, *C.pulchellum*, *A.imperator*, *S.flaveolum* species differ in the intensity of occurrence. In winter

⁸ Guliyeva, S.A. // Specied composition and quantitative distribution of larvae of dragonflies (Odonata) in the new ecological conditions of the lake Aggol. // Republic of Ukraine, Zaporozhye city, International University, VESNIK journal, 2015, № 2, pp. 93-99.

2011, 26 species were found, in spring 13, in summer 7, and in autumn 17 species. In winter, 27 species were recorded in winter, 10 in spring, 6 in summer and 18 in autumn. In 2020, 25 species of larvae were recorded from the lake in winter, 19 species in spring, 13 species in summer and 20 species in autumn. In the main place in all seasons (*L.sponsa, L.macrostigma, C.pulchellum, L.depressa, O.sabina, S.striolatum, S.meridionale*) or in 3 seasons (*L.barbarus, İ.elegans, İ.pumilio, Coenagrion sp., S.fonscolombii, S.vulgatum*) were found.

The main food of Mehman lake is the flood waters of the Kura River, which occur almost every year. The geographical coordinates of the lake are as follows: N 40° 06′ 57″, E 47° 44′ 30″. In the years of successive drought, the lake was approaching the point of drying up. Despite the development of a dry steppe climate around the lake, the lake is rich in biodiversity and fishing⁹. In 2015-2016, 25 species of dragonflies were recorded in Mehman lake. 5 of the identified species belong to the genus *Coenagrion (Coenagrion puella, C.hastulatum, C.mercuriale, C.ornatum, C.scitulum*). The remaining genera are represented by 1-3 species. The number of species in a research year varies between 15-22 species.

Thus, 15 species in winter (mainly Lestes virens, Ischnura elegans, Coenagrion hastulatum, C.mercuriale, C.scitulum, Crocothemis servilia, Libellula sp. etc.) 16 species in spring (mainly Lestes virens, L.sponsa, Ischnura elegans, Coenagrion hastulatum, C.mercuriale, C.scitulum, etc.), 13 species in summer (mainly Ischnura elegans, Coenagrion scitulum, Erythromma sp., Sympetrum vulgatum), and 18 species in autumn (mainly Ischnura elegans, Coenagrion hastulatum, C.mercuriale, C.scitulum, C.puella, Erythromma sp., Orthetrum albistylum).

In order to further clarify the fauna of the dragonfly larvae of Mehman lake, repeated studies were conducted in 2020. The purpose of

⁹ Guliyeva, S.A. // Species composition and quantitative distribution of larvae of dragonelies (Odonata) in the new ecological conditions of the lake Mehman // Economic and Social Development, 37th International Scientific Conference on Economic and Social Development –"Socio Economic Problems of Sustainable Development" Warsaw - 2019, pp. 985-989.

the study was to study the changes in the fauna of the lake after 2015 - 2016. The study showed that during this period, there was almost no radical change in the fauna of conifers in the lake. As a result of observations, 24 species of dragonfly larvae were found in the lake. Of the registered species, 14 species were found in winter, 12 species in spring, 9 species in summer, and 14 species in autumn. Among the species found, the genus *Coenagrion* has preserved its biodiversity. All this is one of the important indicators of the lake's sustainable fauna.

Table 2

		Seasons				Average
N⁰	Species	Winter	Spring	Summer	Autumn	annual
1.	Lestes virens	12	14	-	9	9
		0,06	0,07		0,07	0,05
4.	Ischnura pumilio	10	6	-	-	4
		0,07	0,04			0,03
3.	Coenagrion puella			4	9	3
		-	-	0,04	0,06	0,02
4.	C.hastulatum	-	5	-	10	4
			0,06		0,04	0,02
5.	C.mercuriale	15	-	6	8	7
		0,04		0,04	0,08	0,04
6.	C.scitulum	5	+	-	12	4
		0,09			0,06	0,04
7.	Erythromma sp.	8	-	3	9	5
		0,08		0,05	0,07	0,05
8.	O.albistylum	13	-	-	5	4
		0,06			0,05	0,03
9.	Libellula sp.	17	-	-	7	6
		0,09			0,07	0,04
10.	S.vulgatum	-	9	9	-	4
			0,08	0,08		0,04
	Total	80	34	22	69	50
		0,49	0,25	0,21	0,50	0,36

Number of dragonfly larvae and biomass in Mehman lake in 2020



Graph 1. Number of dragonfly larvae and biomass in Mehman lake in 2020

Lake Nakhalikhchala is part of the Sarisu lake system and is located in Saatli, Sabirabad and Imishli districts. The geographical coordinates of the lake are as follows: N 40° 02′ 35″, E 48°10′14″.

In 2011-2012, 28 species of dragonfly larvae were found, of which 2 species (*Lestes viridis, Sympecma fusca*) were recorded for the first time for the lake. From these species, *L.viridis* was obtained in the winter and autumn of 2011, *S.fusca* in the spring and summer of 2011, and in the winter and autumn of 2012. In the 2011 research year, the number of species varied between 7-17 species, and in 2012 between 9-16 species. The distribution of species by season is also different. In the winter of 2011, 17 species were recorded from lake Nakhalikhchala.

Species such as Sympecma fusca, Enallagma cyathigerum, Coenagrion sp., C.scitulum, C.ponticum, Erythromma lindenu, Lindenia tetraphylla, Orthetrum coerulenscens, Libellula pontica, Aeschna affinis were not found in this chapter. During the research years (2011 and 2012), the number of species of conifer larvae is minimal in summer, and more abundant development and biodiversity in winter, spring and autumn¹⁰. In 2020, additional research was conducted on

¹⁰ Aliyev, A.R., Aliyev, R.A., Guliyeva, S.A. Species composition and quantitative development of dragonfly larvae (Odonata) of lake Nakhalikhchala // – Baku; Azerbaijan National Academy of Sciences, Works of the Society of Zoologists, – 2014. volume 6, № 2, – pp. 32-37.

the seasons. According to the results of the research, 20 species of larvae were recorded, of which 14 species were found in winter, 9 species in spring, 9 species in autumn and 4 species in summer. 4 species of the identified species belong to the *Cooenagrion* genus. The remaining genera are represented by 1-3 species.¹⁰

Hajigabul lake has long been fed by the Kura river, and its fauna was formed almost on the basis of this river. Geographical coordinates of the lake - N 39° 58′ 32″, E 48° 55′ 21″.

It is known that dragonfly larvae grow more abundantly in shallow water reservoirs rich in plants, in lakes, ponds and ditches. In this regard, the small Hajigabul lake can be considered a very favorable environment for the development of dragonfly larvae¹¹.

As a result of seasonal surveys conducted in 2013/14, 36 species of dragonfly larvae were recorded in Hajigabul lake. 17 species of them belong to the subfamilies (Zygoptera) and 19 species to the subfamilies (Anisoptera).

The genus *Coenagrion* (7 species) belonging to the family Coenagrionidae and the genus *Sympetrum* (8 species) belonging to the family Libellulidae differ in biodiversity.

The following species are more common in the lake: *S.fusca*, *S.paedisca*, *Coenagrion pulchellum*, *C.scitulum*, *Lindenia tetraphylla*, *Stylurus ubadschii*, *Anaciaeschna isosceles*, *Aeschna affinis*, *Orthetrum brunneum*, *Sympetrum fonscolombii*, *Sympetrum sp*. və *S.depressiusculum*. The intensity of occurrence of these species in the lake was between 45-50%. Among them are *Coenagrion pulchellum*, *Sympetrum depressiusculum* and *Sympetrum sp*. dominant, others *Sympecma fusca*, *S.paedisca*, *Enallagma cyathigerum*, *Coenagrion scitulum*, *Lindenia tetraphylla*, *Aeschna affinis*, *Anax imperator*, *Orthetrum brunneum* and *O.sabina* were registered as subdominant species. In addition to these background species of Hajigabul lake, such species as *Sympecma fusca*, *S.paedisca*, *Coenagrion scitulum*, *Lindenia tetraphylla*, *Aeschna affinis*,

¹¹ Aliyev, A.R., Guliyeva, S.A. The first information on the study of larvae of dragonfly (Odonata) of lake Hajigabul // - Baku: Dedicated to the 80th anniversary of the Institute of Zoology of Azerbaijan National Academy of Sciences, Works of the Institute of Zoology of ANAS, - 2016. vol. 34, № 2, - pp. 90 - 98.

etc. are more common in benthos.

In 2020, 24 species of needle larvae were found in the lake. Their maximum biodiversity was recorded in winter (19 species) and autumn (18 species).

Lake Hajigabul is also important for the protection, feeding and recreation of both local and migratory water and marsh birds.

Ponds are closed and unique natural reservoirs formed in the old deposits of large rivers or in the pits near them. This reservoir is either connected to the river or not. This creates a "permanent" pool of water called a pond. Observations were made on 5 ponds. Research work was mainly performed in 2017 and in addition in 2020 by seasons.

Yetim Kur pond is located in Yevlakh region. 18 species of dragonfly larvae were found in the Yetim Kur pond. According to the number of species, the main species are representatives of the genus *Coenagrion* (3 species), and according to the intensity of encounters, such species as *Coenagrion scitulum*, *İschnura elegans*, *Crocothemis servilia*. These species can be considered the dominant species of pond. In addition, very rare species (*Calopteryx virgo*, *Coenagrion mercuriale*, *Ophiogomphus sp.*, *Cordulegaster sp.*, *Libellula depressa*, *Sympetrum fonscolombii və S.vulgatum*) were also found during the study. We note these species as rare species of ponds.

Table 3

		9					
Ма	Species		Average				
JNO		Winter	Spring	Winter	Autumn	annual	
1.	Lestes viridis	10	22	-	-	8	
		0,05	0,04			0,2	
2.	L.sponsa	20	24	14	15	19	
		0,06	0,05	0,06	0,08	0,7	
3.	Coenagrion puella	6	22	10	-	9	
		0,07	0,07	0,06		0,5	
4.	C.scitulum	24	12	5	14	14	
		0,06	0,05	0,04	0,09	0,6	
5.	Sympetrum vulgatum	27	-	-	-	6	
		0,06				0,1	
	Total	87	80	29	29	56	
		0,30	0,21	0,16	0,17	0,21	

Number and biomass of dragonfly larvae in the Yetim Kur $(\frac{ind}{a}m^2)$ in 2020



Graph 2. In 2020 - Number and biomass of dragonfly larvae in the Yetim Kur $(\frac{ind}{g}m^2)$

Garaoghlan pond (2017) recorded a total of 23 species of dragonfly larvae. According to the number of species, the main place is occupied by members of the genus Coenagrion - 4 species. According to the intensity of encountering species, species such as Sympecma fusca, Coenagrion puella, C.scitulum, Anax imperator (40%) differ in the pond. The predominance of these species in the samples collected from the pond should be recorded as an indication that they are dominant in the fauna in the Garaoghlan pond. In addition, rare species were found during the study. These include Lestes barbarus, L.macrostigma, Platycnemis dealbata, İschnura elegans, Coenagrion mercuriale, Erythromma viridulum, Cordulegaster sp., Libellula depressa, Crocothemis erythraea, Sympetrum vulgatum, etc. The performance of some of these species was also low in other ponds studied. Maximum growth in winter (124 ind/m²; 0.64 g/m²), minimum development in summer 51 ind/m², was 0.16 g/m². The development of organisms in the spring of the same research year (89 ind/m², biomass 0.30 g/m^2), in the autumn 88 ind/m², and the biomass 0.32 g/m^2 . The maximum number of species of dragonflies is in winter (11 species) and the minimum (7 species) is in summer.

In 2020, a repeat survey was conducted on the seasons. According to the results of the research, only 16 species of dragonflies were recorded in the ponds, 12 species of these species were found in winter, 8 species in spring, 6 species in summer and 8 species in autumn. Three species of the identified species belong to the genus *Coenagrion* (*Coenagrion puella, C.mercuriale, C.scitulum*).

Garkhun pond - research work was carried out mainly in the seasons of 2017 - 2020. 18 species of dragonfly larvae have been recorded in the pond. The Garkhun pond, as well as the other ponds, is dominated by members of the genus *Coenagrion* - 3 species. Other breeds are represented by 1-2 species. Species such as *Calopteryx virgo, Coenagrion scitulum* and *Anax imperator* with the exception of summer, differ in the intensity of encounter in the samples collected from the pond.

10 species took part in the formation of the biological productivity of the Garkhun pond. Among them are *Lestes viridis*, *İschnura elegans*, *Coenagrion puella*, *Coenagrion sp.*, *C.scitulum*, *Erythromma sp.*, *E.viridulum*, *Anax imperator*, *Libellula sp.*, *Sympetrum vulgatum* and others, species play a special role. The total biomass of dragonflies surfaced between 0.27-0.52 g/m² and the number between 82-209 ind/m². Maximum growth in winter (209 ind/m², 0.52 g/m²), minimum development in summer 82 ind/m², was 0.27 g/m². The number and biomass of individuals by species varied from chapter to chapter. Thus, 8-31 individuals in winter (biomass 0.03-0.07 g/m²), 7-19 individuals in spring (biomass 0.02-0.04 g/m²), 4-20 individuals in summer (biomass 0.02-0.07 g/m²), and in autumn it was 6-18 individuals, 0.02-0.07 g/m², respectively. According to the number, the maximum development was observed in the *Anax imperator* type 31/0,06.

In 2020, 15 species of dragonfly larvae were recorded in the pond. 11 species were found in winter, 8 species in spring, 4 species in summer and 9 species in autumn. Two of the found species belong to the genus *Coenagrion (C.scitulum, Coenagrion sp.)*.

There are 22 species of dragonfly larvae in the Marzli pond. The total biomass of dragonfly larvae per season varies from 0.38 - 0.65 g/m² and the difference between 72-213 g/m². According to the results

of the study, the maximum development was in winter (213 ind/m², 0.65 g/m²) and the minimum development was in summer (72 ind/m², 0.38 g/m²). In the spring of the same research year, the number of organisms (108 ind/m², biomass 0.43 g/m²), and in the autumn, the number of individuals was 138 ind/m² and the biomass was 0.48 g/m². In winter, the main place is occupied by *Anax imperator* (29 ind/m², 0.08 g/m²) and *Orthetrum brunneum* (30 ind/m², 0.11 g/m²), and in the last place by *Erythromma sp.* (12 ind/m², 0.03 q/m²) type.

In 2020, 19 species of dragonfly larvae were recorded in the pond, of which 13 species were found in winter, 10 species in spring, 6 species in summer and 10 species in autumn. The maximum development of dragonfly larvae was in winter (number 156 ind/m², biomass 0.59 g/m²), the minimum was in summer (number 34 ind/m², biomass 0.20 g/m²). The main species is *S.vulgatum*, which has a number of 11-27 ind/m² and a biomass of 0.06-0.12 g/m². The average annual rate of caterpillar larvae was 102 ind/m², 0.45 g/m².

7 species - Calopteryx virgo, Lestes viridis, Coenagrion puella, C.scitulum, Erythromma viridulum, Anax imperator, Sympetrum vulgatum took part in the formation of the biological productivity of the Aynali pond. The biomass of dragonfly larvaes by seasons ranging from 0.12 - 0.26 g/m² and the difference between 34-72 g/m². Maximum growth was observed in winter and autumn, and minimal growth was observed in summer. Winter-autumn period - 6 species, summer - 4 species with the participation of species according to the seasons of the year. According to the number, the maximum growth was observed in the species Coenagrion scitulum (20/0.01), and the minimum development was observed in the species Anax imperator (6/0.01).

In 2020, 19 species of dragonfly larvae were recorded in the Aynali pond, of which 13 species were found in winter, 10 species in spring, 6 species in summer, and 10 species in autumn. 5 of the identified species still belong to the genus *Cooenagrion (C.puella, C.hastulatum, C.scitulum)*. In the research year, partial stability of the species was recorded, which is due to the improvement of hydrological and ecological conditions in the ditch.

According to the results of the quantitative analysis carried out

by seasons in 2020, the total number of dragonfly larvaes varies from 52 - 127 ind/m², and the biomass varies from 0.22 to 0.50 g/m². The maximum number of larvae was recorded in winter.

The 61 species of dragonflies recorded in the studied water basins consist of representatives of 2 subspecies of the Dragonfly family - 1. Zygoptera dragonflies and Anisoptera subfamilies. There are 29 species of caterpillar larvae belonging to 5 seasons, and 32 species of larvae of different caterpillars belonging to 5 clans. According to the biodiversity of the studied lakes and ditches, there are 15 species of Coenagrionidae (mainly members of the genus *Coenagrion*) and 21 species of Libellulidae (mainly members of the genus *Sympetrum*).

It should be noted that the dragonflies recorded in the lakes and ditches around the Kura make up $\approx 59\%$ of the total number of species. The next place is occupied by 9 species of Lestidae.

So, the basis of the existing dragonfly fauna in our country is the species belonging to 2 seasons. Other chapters are represented by 1-2 species, maximum 5 species.

We conducted a comparative analysis of the faunistic similarity of dragonfly larvae on the studied reservoirs (lakes and ponds). During the comparison, it was determined that the largest percentage of similarity (80.0%) was between Marzli and Aynali ponds. This is due to the fact that more and more similar species are recorded in both ponds. Thus, 22 species of dragonfly larvae were recorded in the Marzli pond and 17 species in the Aynali pond, 16 of which are common or similar species. Such a high degree of similarity between species can be attributed to the fact that both ponds are located in the same area, have similar vegetation and the corresponding parameters of water mass in them.^{12, 13}

¹² Aliyev, A.R., Tapdigova, K.A., Guliyeva, S.A. Lower Kura Lake and ponds dragonfly larvae - Odonata, larvae. Species composition, distribution, index of simularity and coefficient of generality // - Baku: Works of ANAS, Institute of Zoology, - 2018. volume 36, № 1, - pp. 35-42.

¹³ Guliyeva, S.A. Generalized condition of dragonfly (Odonata) larvae of lakes around Kura // Advances in Biology Earth Sciences - Baku, 2021, vol.6, № 2, pp.184 - 190.



Graph 3. Faunistic similarity of dragonfly larvae (Odonata) in the Kura region reservoirs in 2012 - 2020

CHAPTER V. BİO – ECOLOGİCAL FEATURES OF DRAGONFLY LARVAE

Chapter 5 of the thesis is devoted to the bioecological characteristics of dragonfly larvae. This chapter reports on the structure of the body, nutrition, reproduction, development of dragonfly larvae, their relationship with the biotope, water depth, O₂ regime, pH, etc.

It is known that dragonflies lead a dual lifestyle. The first events take place in the aquatic environment. The aquatic environment is the longest life cycle of dragonflies: 2-3 years. They grow mainly in shallow, stagnant and birch water bodies. Dragonfly larvae are also found in low-flow rivers (mainly in river bays) and mountain rivers (mainly between rocks and below them).

Imago forms of fully formed dragonflies are mainly animals with an active rhythm of life during the day. They fly, feed, spread and multiply only in the warmer months of the year (from April to October in our conditions) in cloudless and calm weather.

As a result of literature data and some phenological observations in field studies, it was found that the life span of adult dragonflies is 2 to 3 months (*Sympecma fusca, Coenagrion scitulum, C.pulchellum, C.puella, Anax imperator, Sympetrum sanguineum*), 4 – 5 up to a month (*Lestes sponsa, İschnura elegans, Enallagma cyathigerum*). In this short time, they feed intensively, develop sexual products and start a new generation. Fully formed adult dragonflies fly over rivers, lakes and streams and on their shores, laying eggs on the leaves and stems of aquatic plants in water bodies and their tissues, and eventually perishing.

CHAPTER VI. THE ROLE OF GRAGONFLY LARVAE İN FİSH FOOD

Research has shown that there is a difference in the diet of carp living in lakes (Ağgöl, Mehman, Nakhalikhchala (Sarisu), Hajigabul etc.) around the Kura and in the ponds. Thus, in the younger age group they prefer plant foods, and in the older age group they prefer plant and animal foods.

In summer (july-august), algae occupied the main place (66.7%) in the food spectrum of carp cubs caught in lake Nakhalikhchala, while chironomid larvae (58.3%), eggs and larvae of dragonflies (41.7%) occupied the main part of the food for adult hunters.) is organized. The coefficient of intestinal filling of the studied fish averaged 201.7‱. A similar incident took place at lake Aggol. So, if the first place in the diet of fish weighing 12-17 cm is occupied by the larvae of chironomids (72.7%) and the second place is the larvae of dragonflies (36.4%), the bulk of food in the stomach of elderly individuals was chironomids (77.7-80.0%) and dragonfly larvae (30.0-55.5%). The intestinal fullness ratio ranges from 168.3 to 335.6. In lake Mehman, the main food item for weight fish of the age group 1+ caught in summer (june) was food of animal origin - chironomids (66.7%) and dragonfly larvae (33.3%).

Table 4

	- 3						
Food facility		Length of fish, cm					
		3-7	8-14	15-21	22-28	30-36	
1.	Algae	66,7	35,7	25,0	11,1	-	
2.	Higher plants	-	42,9	50,0	55,5	63,6	
3.	Zooplankton	33,3	28,6	33,3	16,7	9,1	
4.	Chironomid larvae	22,2	57,1	58,3	61,1	72,7	
5.	Oligochaetes	-	35,7	33,3	38,9	45,5	
6.	Dragonfly larvae	-	28,6	41,7	38,9	45,5	
	Number of stomachs examined	9	14	12	18	11	

Changes in the nutrient content of carp in lake Nakhalikhchala depending on the size of the fish (occurrence, in%)

The Caspian roach is also a fish that eats a variety of foods. So, according to the percentage of annual (1+) Caspian roach (6.3-9.7 cm) caught in the lake in April, the number of larvae in the diet is 83.3%, and the second place is occupied by the remains of higher plants (58.3%). The coefficient of intestinal filling of the studied fish ranged from 94 to 239 ‱. At the end of May, diatoms (*Navicula*) - 66.7% and crustaceans - 46.7% were the main food of the Caspian region under one year old (0+), obtained from lake Aggol. The role of dragonf-lies - 40.0% and chironomid larvae in the diet was secondary.

Table 5

Food facility		Length of fish, cm				
		4-6	7-9	10 - 12	14-16	
1.	Algae	66,7	27,3	14,3	15,4	
2.	Higher plants	26,7	54,5	71,4	84,6	
3.	Zooplankton	46,7	27,3	28,6	15,4	
4.	Chironomid larvae	26,7	63,7	85,4	76,9	
5.	Oligochaetes	13,3	18,2	14,3	23,1	
6.	Dragonfly larvae	40,0	54,5	42,9	46,2	
	Number of stomachs examined	15	11	7	13	

Changes in the nutrient content of the Caspian roach in Aggol lake depending on the size of the fish (occurrence, in%)

The diet of one-year-old (1+) Caspian roach (7.0 - 10.0 cm) hunted in May consisted of plant and animal foods, as in lake Nakhalikhchala. In terms of the percentage of occurrence in food content, chironomid (63.7%) and dragonfly larvae - 54.5%, and plant residues (54.5%) higher than plant foods. Intestinal filling coefficient ranged from 74.1 to 329 ‰.

It is known that common pike perch is a predatory fish. The analysis showed that crabs (70.0%), chironomid (40.0%) and dragonfly (30.0%) larvae play a major role in the diet of infants with a length of 3.0 - 3.5 cm in lake Nakhalikhchala. Fish fry (10.0%) can be found, albeit in small quantities. Analysis of the stomach showed that with an increase in the length of pike perch pups (5.5-6.5 cm), the amount of zooplankton in their diet decreases to 28.6%, while fish pups predominate in the stomach in terms of occurrence and weight. In the spring, the average rate of filling the cocoon was 132.6 ‱. Crabs (77.7%), chironomids (44.4%) and dragonflies (33.3%), caught in May in lake Aggol and whose growth was 2.5-3%, played a key role in the nutrition of infants under one year of age., 5 cm). Larvae of crustaceans (57.9%), horned crustaceans (36.8%), chironomids (31.6%) and dragonflies (26.5%) were the main food for fresh fish taken from lake Mehman¹⁴. Along with juveniles of fish in the food spectrum of pure pups with a body length of 16.0 cm, larvae of mysids, chironomids and dragonflies are found. The coefficient of intestinal filling of the studied fish was 174.2 ‱.

CONCLUSION

The results of seasonal studies in 2012-2020 on the species composition of dragonfly larvae, the number, distribution of species in lakes and streams, the intensity of encounters, bioecological features, their role in the diet of fish formed in 4 large lakes (Aggol, Mehman, Nahalikhchala, Hajigabul lakes) and 5 ponds (Yetim Kur, Garaoghlan, Garkhun, Marzli, Aynali) in the lower sides of Kura:

1. 61 species of dragonfly larvae belonging to 2 subspecies (Zygoptera and Anisoptera), 10 families and 23 genera of the Insect class of dragonflies were recorded in the studied water basins, most of which coincide with the species recorded so far in hydrobiological studies. 5 species registered by us (*Lestes viridis, Sympecma fusca, Sympetrum striolatum, Sympetrum sanguineum və Sympetrum meridionale*) which are new for Azerbaijan [1, 6, 8, 9, 11, 12].

2. According to the biodiversity of dragonfly larvae recorded in lakes and ponds around the Kura, the genus *Coenagrion* includes 9 – species (*C.puella, C.hastulatum, Coenagrion sp., C.lunulatum, C.pulchellum, C.mercuriale, C.ornatum, C.ponticum*) first place, *Sympetrum* genus of 8 species (*Sympetrum sp., S.flaveolum, S.fonscolombii, S.depressiusculum,*

¹⁴ Guliyeva, S.A. On the ichthyofauna of the Kura lakes (Aggol and Mehman lakes) // Republican scientific and practical conference Fundamental and applied scientific research in zoology: topical issues, achievements and innovations materials // ANAS, Institute of Zoology, 2021. pp. 259 - 262.

S.vulgatum, S.striolatum, S.sanguineum, S.meridionale) the second place, the *Lestes* and *Aeschna* breeds share the third place with 6 species each [12].

3. Lakes and ponds studied in the species listed below were found only once, once or twice during the study period and in one or two individuals, and we recommend that these species be listed as rare species in the region. These include *E.fatime* (found in lake Mehman in spring, 1-3 individuals) and *Lestes dryas, Platycnemis pennipes, Coenagrion ornatum, Orthetrum cancellatum, Libellula quadrimaculata* (also found in small numbers in the same lake in winter and early spring) [7, 10].

4. 28 species of dragonflies were recorded from the hydrofauna of Aggol during the research period. Three of the identified species (*Sympetrum striolatum, S.sanguineum, S.meridionale*) were recorded for the first time for the fauna of the lake. Five of the species found in the lake belong to the genus *Coenagrion (Coenagrion puella, Coenagrion sp., C.pulchellum, C.mercuriale* və *C.scitulum*). Species such as *C.scitulum, C.pulchellum, Anax imperator, Sympetrum flaveolum* differ in the intensity of occurrence. The total number of dragonfly larvae in the lake varies from 37 - 113 ind/m², and the biomass varies from 0.16 to 0.75 g/m². Maximum growth was recorded in winter and autumn, and minimal growth in summer [3, 4, 8].

5. 26 species of dragonflies were recorded in Mehman lake. 5 of these species belong to the genus *Coenagrion (Coenagrion hastula-tum, C.mercuriale, C.ornatum, C.scitulum, C.puella)*. The biomass of dragonfly larvae varies between 0.21 - 0.50 g/m² and the number between 22 - 80 ind/m². Maximum growth was recorded in winter and autumn, and minimal growth in summer [7, 8, 10].

6. 28 species of dragonfly larvae were found in lake Nahalikhchala. Two of them (*Lestes viridis, Sympecma fusca*) are first mentioned for the fauna of the lake. 7 of the species mentioned in the lake belong to the genus *Coenagrion* (*C.puella, C.hastulatum, Coenagrion sp., C.pulchellum, C.mercuriale, C.ponticum, C.scitulum*). Species such as *Lestes virens, İschnura pumilio, Coenagrion hastulatum, C.scitulum* differ in the intensity of occurrence. The total biomass of dragonfly larvae in the lake varies between 0.17 – 0.51 g/m² and the number between 19 – 71 ind /m². Maximum growth was recorded in winter and autumn, and minimal growth in spring and summer [2, 8, 9, 11].

7. In lake Hajigabul, 17 species of Zygoptera larvae and 19 species of 36 species of dragonflies belonging to the Anisoptera subfamily have been recorded. The biodiversity differs from the genus *Coenagrion* (7 species), belonging to the Coenagrionidae family, and the genus *Sympetrum* (8 species), belonging to the Libellulidae family. In the lake, *Sympecma fusca, S.paedisca, Coenagrion pulchellum, C.scitulum, Lindenia tetraphylla, Aeschna affinis, Anax imperator, Sympetrum depressiusculum və Sympetrum sp. - often occurring species.* The values of their biomass in the lake range from 0.18 to 0.50 g/m² [1, 5, 6, 11, 12].

8. Studies of ponds have shown that although ponds are small aquifers in the field, the biodiversity of the larvae of conifers formed in their benthos is almost identical to that observed in lakes. Thus, the number of species belonging to the genus *Coenagrion* in ponds is significantly higher than in other genera. The number of species of this genus varies between 3 species (Yetim Kur) and 5 species (Qarkhun). The leading dragonfly larvae of ponds are also due to the species of this genus. Thus, 3 out of 16 species registered in Yetim Kur akhmaz, 4 out of 25 species in Garaoghlan, 5 out of 21 species identified in Garkhun, 4 out of 23 species in Marzli, 2 out of 18 species registered in Aynali akhmaz belong to the *Coenagrion* genus and has been widely known [6, 8, 9, 11, 12].

9. In the studied lakes, using the example of 2 benthophages and one predatory fish, it was found that dragonfly larvae make up 36.4% of the total diet of benthophages and 30.0% of predatory fish [13].

PRACTICAL RECOMMENDATIONS

1. According to the studies carried out by hydrobiologists in the water bodies around the Kura, and calculations obtained on the basis of the average quantities obtained by the larvae of our dragonfly in the lakes Aggol and Nakhalikhchala, as well as in Garaoghlan (biomass 0.16-0.64 g/m²) and ponds Marzli (0.38-0.65 g/m²). It was found that the unused indicators of bottom food items are very high. It is said that benthophagous fry are released in addition to these lakes and ponds.

2. We propose to provide water to lake Hajigabul, which was once of great fishing importance, and to enrich the lake with fry of plankton - feeders and benthophages, as well as to restore a fish factory that once operated in this region!

TRE LİST OF PUBLISHED SCIENTIFIC WORKS ON THE TOPIC OF THE DISSERTATION

- Aliyev, A.R., Aliyev, R.A., Guliyeva, S.A. Odonata larvae (species composition) of freshwater basins of Azerbaijan // Baku; Works of Azerbaijan National Academy of Sciences, Institute of Zoology, 2013. vol. 31, № 1, pp. 56-68.
- Aliyev, A.R., Aliyev, R.A., Guliyeva, S.A. Species composition and quantitative development of dragonfly larvae (Odonata) of lake Nakhalikhchala // – Baku; Azerbaijan National Academy of Sciences, Works of the Society of Zoologists, – 2014. vol. 6, № 2, – pp. 32-37.
- 3. Guliyeva, S.A. Species composition of Aggol lake dragonfly larvae (Odonata) // Republican Scientific Conference on "Prospects for the development of experimental biology", dedicated to the 80th anniversary of the Faculty of Biology of BSU, Baku: "CBS polygraph production", December 19-20, 2014, pp. 64-67.
- 4. Guliyeva, S.A., Aliyev, P.A. Specied composition and quantitative distribution of larvae of dragonflies (Odonata) in the new ecological conditions of the lake Aggol // Ukraine, Zaporozhye: "Vesnik" journal, 2015. № 2, pp. 93-99.
- 5. Aliyev, A.R., Guliyeva, S.A. The first information on the study of larvae of dragonfly (Odanata) of lake Hajigabul // – Baku: Dedicated to the 80th anniversary of the Institute of Zoology of Azerbaijan National Academy of Sciences, Works of the Institute of Zoology of ANAS, – 2016. vol. 34, № 2, – pp. 90 - 98.
- 6. Aliyev, A.R., Guliyeva, S.A. Fauna of dragonfly larvae (Odonata larvae) of Azerbaijan (species composition and distribution) // Baku: Works of the Institute of Zoology of ANAS, 2017. vol. 35, № 1, pp. 26-33.
- 7. Guliyeva, S.A. Dragonfly larvae of Mehman lake (Odonata larva) //

Materials of the Republican scientific-practical conference on "Modern problems of economic science", - Zagatala: - UNEC - "University of Economics" publishing house, - May 31, - 2018, - pp. 209-213.

- Guliyeva, S.A. Species composition and distribution of dragonfly larvae (Odonata larvae) in lakes and reservoirs around Kura // – Lankaran: Journal of Scientific News, Department of Natural Sciences, – 2018. № 1, – pp.133-136.
- Aliyev, A.R., Tapdigova, K.A., Guliyeva, S.A. Lower Kura lake and ponds dragonfly larvae – Odonata larvae. Species composition, distribution, index of simularity and coefficient of generality // – Baku: Works of ANAS, Institute of Zoology, – 2018. vol. 36, № 1, – pp. 35-42.
- Guliyeva, S.A. Species composition and quantitative distribution of larvae of dragonelies (Odonata) in the new ecological conditions of the lake Mehman // Economic and Social Development, 37th International Scientific Conference on Economic and Social Development –"Socio Economic Problems of Sustainable Development" Warsaw: Varazdin Development and Entrepreneurship Agency, – 14-15 February, – 2019, – pp. 985-989.
- Guliyeva, S.A. Composition and distribution of insecta larvae (Odonata larvae) in lakes and waterfalls// Economic and Social Development 56th International Scientific Conference on Economic and Social Development, Aveiro, – Portugal: Varazdin Development and Entrepreneurship Agency, – 02 – 03 July, – 2020, – pp. 144-148.
- 12. Guliyeva, S.A. Generalized condition of dragonfly (Odonata) larvae of lakes around Kura // – Bakı: Advances in Biology & Earth Sciences, – 2021. vol. 6, № 2, – pp. 184-190.
- Guliyeva, S.A. On the ichthyofauna of the Kura lakes (Aggol and Mehman lakes) // Republican scientific and practical conference Fundamental and applied scientific research in zoology: topical issues, achievements and innovations materials // ANAS, Institute of Zoology, 2021. pp. 259 – 262.

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