

Global climate variability and critical problems of biodiversity of Nakhchivan Autonomous Republic

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The article describes the critical problems occurring in the biodiversity of the Nakhchivan Autonomous Republic due to global climate change. Specially protected natural areas created in the autonomous republic to eliminate essential problems in biodiversity and their importance are noted, the taxonomic composition and rare species of fauna and flora biodiversity are shown. In the fauna biodiversity, the following species are included: from reptiles, *Rhynchocalamus melanocephalus* Jan and from birds, *Chettusia gregaria* Pall have the status of *Critically Endangered* (CR). The species, such as Striped Hyena, Marbled polecat, and Manul are no longer found in the area. 27 species of flora biodiversity have *Critically Endangered* (CR) status, and their seed material is intended to be collected and stored in a genebank.

Keywords: *Global climate change, fauna, flora, biodiversity, category, rare species*

INTRODUCTION

Recently, global climate changes on Earth continue to cause serious consequences in nature. Factors such as the shrinking of distribution areas or biotopes, changes in the quality of habitat, degradation, and reduction of food objects indicate that the survival of species is at a critical level. Despite the expansion of special protection networks as a preventive measure by the state and the creation of an optimal environment for the protection of species, global climate change can still create critical problems for species in nature. First, the plant world, which is the beginning of the food chain, gets into a critical situation, and then, herbivores and, successively, carnivores suffer.

MATERIALS AND METHODS

The fauna and flora biodiversity of the Nakhchivan Autonomous Republic served as the research material. During the research, various

types of binoculars, such as a Swarovski telescope, photo traps, and GPS were used to determine the coordinates for species identification.

RESULTS AND DISCUSSION

One of the important factors in creating a favorable ecological environment in the territory of the Nakhchivan Autonomous Republic is the protection and restoration of the uniqueness of the natural environment, plant and animal resources, the basis of which is specially protected natural areas. In 1989, when the National Leader Heydar Aliyev came to power, the Ordubad State Nature Reserve with an area of 40,000 ha was established in the Nakhchivan Autonomous Republic. Then, on June 16, 2003, the President of the Republic of Azerbaijan Heydar Aliyev signed an order on the establishment of the Shahbuz State Nature Reserve (3,139 ha) and the Ordubad National Park named after Academician Hasan Aliyev (12,131 ha) with the aim of protecting the

environment, its efficient use, preserving rare and endangered plant and animal species, and developing the network of specially protected natural areas of the Republic. At that time, 27,869 ha of area was planned for the Ordubad reserve. On September 23, 2005, the Arazboyu State Nature Reserve with an area of 9,118 ha and on June 22, 2009, the Arpachay State Nature Reserve with an area of 68,911.18 ha were established. The establishment of the Zangezur National Park (ZNP) named after Academician Hasan Aliyev with an area of 42,787 ha by the decree of the President of the country dated November 25, 2009, created conditions for the development of ecotourism along with nature conservation. Specially protected natural areas in the autonomous republic have increased by more than 3.7 times compared to 1995, and currently, 148,695.18 ha of the autonomous republic, with an area of 550,275 ha, or in other words, up to 27.02%, are specially protected natural areas, which is an important ecological factor and even higher than in developed countries. It should be noted that in developed countries with a friendly attitude towards nature, this indicator is approximately 10-15% (Talibov, 1999; Talibov, 2003; Talibov, 2021).

In the field of nature protection, for the first time, in order to register and provide special protection to rare and endangered plant and animal species, according to the decree of the Chairman of the Supreme Assembly dated August 15, 2006, we prepared two-volume Red Books on the flora and fauna of the Nakhchivan Autonomous Republic, and at the same time, we published more than 30 books and monographs on the fauna and flora of the area. In general, based on our research on flora and fauna, 408 species of vertebrates belonging to 5 classes, 33 orders, 101 families, and 271 genera were recorded in the territory of the Nakhchivan Autonomous Republic (Table 1). At the same time, 3021 species of higher spore, gymnosperm and angiosperm plants belonging to 104 orders, 160 families and 910 genera were discovered in the area (Table 2).

Reflecting more than half of the biodiversity of the Republic of Azerbaijan, the biodiversity of the Nakhchivan Autonomous Republic, according to our research and observations, has been significantly changing every year for the last 20-

25 years due to climatic factors and especially the radiation background, along with other factors, putting many of the existing species in a critical situation and at risk of extinction. The 3rd edition of the Red Book, which was published in 2023 with the care and support of the state head, reflects 241 rare and endangered fauna species (152 vertebrates, 89 invertebrates) and 460 flora species (423 plants: 383 higher, 15 higher spore plants, 6 mosses, 14 lichens, 5 algae; 37 mushrooms) (Taxonomic spectrum of the fauna of Azerbaijan (Vertebrates), 2020; Talibov et al., 2018; Talibov, Mammadov, 2016; Talibov et al., 2021).

Table 1. Species composition of vertebrates of the Nakhchivan AR

Classes	Order		Family		Genus		Species	
	Azerbaijan	Nakhchivan AR	Azerbaijan	Nakhchivan AR	Azerbaijan	Nakhchivan AR	Azerbaijan	Nakhchivan AR
Cyclostomata	1	-	1	-	1	-	1	-
Fish	12	6	17	9	53	28	107	33
Amphibians	2	1	5	4	7	5	9	6
Reptiles	2	2	13	13	37	32	63	39
Birds	19	18	64	54	210	160	409	260
Mammals	7	6	26	21	61	46	115	70
Total	43	33	126	101	369	271	704	408

Table 2. Higher spore, gymnosperm and angiosperm plants of the Nakhchivan AR

No	Phylum	Classes	Order	Family	Genus	Species
1.	<i>Bryophyta</i>	2	15	37	79	127
2.	<i>Equisetophyta</i>	1	1	1	1	7
3.	<i>Polypodiophyta</i>	1	2	6	11	15
4.	<i>Pinophyta</i>	1	2	4	14	22
5.	<i>Gnetophyta</i>	1	1	1	1	3
6.	<i>Magnoliophyta:</i>					
	- <i>Monocotyledoneae</i>	1	20	24	159	578
	- <i>Dicotyledoneae</i>	1	63	87	645	2269
	Total:	8	104	160	910	3021

The Red Books play an important role as a guiding document for the protection of the biodiversity of the Republic, the identification of endangered species of fauna and flora and the

further strengthening of protection measures. The decrease, rather than the increase, of the numbers in the Red Books is considered a victory of humanity over nature. Therefore, these books are prepared and published for this very purpose. The Red Books are the red borders of the path of living nature towards extinction and a call not to cross the red borders between man and nature. If we consider the dynamics of the numbers of species included in all volumes of the Red Books from the territory of the Nakhchivan Autonomous Republic, then we will see that there are indeed critical problems in the problem of protecting our nature. The following data for vertebrates confirms this idea more fully (Table 3).

Of the 704 species found in the Republic of Azerbaijan, 408 were discovered in the territory of the Nakhchivan Autonomous Republic. If we examine them in order, the picture is as follows:

One species of Cyclostomata is listed in the Red Book and is not found in the territory of the Nakhchivan Autonomous Republic.

Out of 107 species of fish, 33 are distributed in the territory of the Nakhchivan Autonomous Republic, the low number of these species can be attributed to the absence of large mammals in the area and due to critical climate change in the last decade, almost none of the rivers can normally connect with the Araz River. Therefore, it is likely that serious reductions in the number of species of fish fauna will be observed in the future (Red Book of the Republic of Azerbaijan. Second edition. Fauna, 2013; Red Book of the Republic of Azerbaijan Third edition. Fauna, 2023).

Table 3. Number dynamics of vertebrates included in the Red Books of the Nakhchivan Autonomous Republic

Classes	Total species number		Azerbaijan			Nakhchivan		
	Azerb.	Nakhch.	1989	2013	2023	2006	2013	2023
Cyclostomata	1	-	-	1	1	-	-	-
Fish	107	33	4	9	11	1	1	2
Amphibians	9	6	3	4	6	1	1	1
Reptiles	63	39	8	14	18	10	12	9
Birds	409	260	36	71	88	39	64	47
Mammals	115	70	14	41	40	20	26	22
Total	704	408	65	140	164	71	104	81

Amphibians are represented in Azerbaijan by a small number - 9 species, and 6 species were discovered in the autonomous republic. Of these species, 3 were included in the Red Book in the

Republic of Azerbaijan in 1989, 4 in 2013, and 6 in 2023, of which, in the territory of the Nakhchivan Autonomous Republic, only Syrian spadefoot was included in the Red Book.

The reptile class is represented by 63 species, of which 39 species were found in the territory of the Nakhchivan Autonomous Republic. In 1989 – 8, in 2013 – 14 and in 2023 – 18 species were included in the Red Book for the Republic of Azerbaijan, of which 10, 12 and 9 species were included in the Red Book in the territory of the Nakhchivan Autonomous Republic, respectively. The decrease in data in 2023 is only due to the fact that some of these species, although they are present in the territory, were not marked on the maps due to a technical error.

The class of birds is represented by 408 species, of which 260 species were found in the territory of the Nakhchivan Autonomous Republic. In the Republic of Azerbaijan, 36 species were included in the Red Book in 1989, 71 in 2013, and 88 in 2023, of which 39, 64, and 47 species were included in the Red Book in the territory of the Nakhchivan Autonomous Republic, respectively. The decrease in data in 2023 is only due to the fact that some of these species were not recorded in the territory due to a technical error.

The class of mammals is represented by 115 species, of which 70 species were discovered in the territory of the Nakhchivan Autonomous Republic. In 1989 - 14, in 2013 - 41 and in 2023 - 40 species were included in the Red Book of the Republic of Azerbaijan, of which in the territory of the Nakhchivan Autonomous Republic, respectively, 20, 26 and 22 species were included in the Red Book. The decrease in the information in 2023 is only due to the fact that some of these species were not recorded in the territory due to a technical error. In the monograph we present, you can also see the works of H.S.Rasulzade (Talibov, Rasulzade, 2021). Rare waterfowl of the Nakhchivan Autonomous Republic), who also defended his dissertation on ornithology. Most of the newly discovered species are confirmed by original photographs.

Thus, out of 164 rare and endangered vertebrate species listed in the latest edition of the Red Book of the Republic of Azerbaijan, 81 species are distributed in the territory of the

Nakhchivan Autonomous Republic. Thus, approximately half of the rare species are also found in the territory of the Nakhchivan Autonomous Republic, and the distribution of some species is limited only to the territory of the Nakhchivan Autonomous Republic. If a species has not been found in nature for several years and has probably remained in natural landscapes inaccessible to humans, and is also under threat of extinction in the future, then the species is included in the CR status. In the fauna biodiversity, from the reptiles, *Rhynchocalamus melanocephalus* Jan, and from the birds, *Chettusia gregaria* Pall. have been classified as CR, but the vast majority of rare species are Endangered - EN and Vulnerable - VU. With the research and observations we conducted, as well as the camera traps we set, none of the mammal species *Hyaena hyaena* L.; *Vormela peregusna* Guldenstaedti, and *Otocolobus manul* Pall. have been observed in the area.

Global climate changes occurring on Earth have had a more serious impact on the plant world since plants, unlike animals, are deprived of the ability to move and therefore, suffer more damage during sharp climate changes, remaining in the place where they grow. Studies show that the number of plant species listed in the Red Book has also increased over the years. In the last volume of the Red Book, the number of such species that are critically endangered in the territory of the Nakhchivan Autonomous Republic alone was 27. When it is assumed that the populations of the studied species may be severely damaged during floristic studies, it can be attributed to the Critically Endangered category. Thus, out of 3021 higher spore, gymnosperm and angiosperm plant species of the Nakhchivan Autonomous Republic flora, 27 species whose current state in nature is at a critical level or whose descendants are presumed to be extinct belong to the CR status (Red Book of the Republic of Azerbaijan. Second edition, 2013; Red Book of the Republic of Azerbaijan. Third edition, 2023; Talibov, 2009).

1. *Epipactis veratrifolia* Boiss.et Hohen. – It was considered to have VU C2 status in the Red Book of the Nakhchivan Autonomous Republic (NAR), but due to the drastic changes in nature over the past 13 years, the

species' survival opportunities have also decreased. Therefore, in the III edition of the Red Book of the Republic of Azerbaijan, it has CR B1ab(ii) status.

2. *Allium tripedale* Trautv. (*Nectaroscordum tripedale* (Trautv.) Grossh.) – This species has been given the status CR B2ab(ii) in the publications of the NaxQK and AzQK. In the area, it is found only in small groups in the areas at the foot of Demirlidagh in the Julfa region and Soyugdagh in the Ordubad region. We only discovered a pure formation of this species at the foot of Gaplan Rock in the Nus-Nus village of the Ordubad region. In that area, we discovered and described a white-flowered variation of the species - *Allium tripedale* Trautv. var. *alba* Talibov. It is cultivated in the Botanical Garden of the Institute of Bioresources. It was introduced by us to the Institute of Dendrology (Figure 1).
3. *Triticum boeoticum* Boiss. This species has not been discovered for a long time, despite serious searches, in the area of the Garagush mountain of the Deralayaz range. According to the literature, the NaxQK is currently maintained with the status of CR A1c; B2ab(I,II)+C2a(i), and the AzQK is maintained with the status of CR A1c+C2a(i).
4. *Triticum timopheevii* (Zhuk.) Zhuk. – Timofeyev wheat (*T.araraticum* Jakubz.). NaxQK CR A1c;B2ab(i,ii)+C2a(i), AzQK CR A1c+C2a(i). This variety has not been found in the wild either. It was preserved based on literature materials.
5. *Aristolochia bottae* Jaub. & Spach. It is a monotypic representative of the genus, found in a narrow areal, NaxQK CR B2a. It is found singly in zones adjacent to cultivated fields. Unfortunately, it is found only in a small area near the village of Nursu in the Shahbuuz region and has not been found in other zones. Attempts are being made to cultivate it using seeds collected in the Botanical Garden of the Institute of Bioresources (Figure 2).
6. *Dianthus libanotis* Labill. – Status-AzQK CRB2b(iii). It grows in the Ashabi-Kahf and Nahajir mountain areas in the Nakhchivan Autonomous Republic. It will be protected within the ZNP area.
7. *Quercus infectoria* subsp. *veneris* (A.Kern.)

- Meikle (*Q. araxina* (Taurtv.) Grossh.) - Status-AzQK CR A1ab;B1bc(iii,iv). According to literature, it is found in the Babek and Ordubad regions, but currently, only in the area where the Kilit village of Ordubad region joins the Araz River, there is a small grove.
8. *Iberidella trinervia* Boiss. (*Aethionema trinervium* (DC.) Boiss.) – Status-AzQK CR B2a. Found only in the territory of Nakhchivan Autonomous Republic, the QK has been newly added.
 9. *Physoptychis caspica* (Habi.) V.Boczantzeva – It is a unique-looking, specific plant, and is included in the NaxQK and AzQK CR B2ac(i);C2a(i) status. It is distributed in small groups on the high peaks of the Ordubad Mountain area of the Zangezur Range.
 10. *Sorbus roopiana* Bordz. (*Hedlundia roopiana* (Bordz.) Sennikov et Kurtto) - Status-Az.QK CR B2b(ii,iii). It is found in the Bichenak and Derebogaz areas of the Shahbuz district. It is planned to collect seed material of this species and propagate it in the Botanical Garden.
 11. *Colutea komarovii* Takht. It is an ornamental shrub. This species has been given the status CR B1ac(ii,iv);C2a(i) in the publications of the NaxGK and AzGK. It grows in small groups on the rocks in the area of Kotam village, Ordubad district of the Zangezur range. So far, it has only been found in small groups in the area called Sari Gaya of Kotam village and the plane grove of Kotamchay. It was introduced by us to the Institute of Dendrology.
 12. *Astragalus caraganae* Fisch. & C.A.Mey. (*A.nachitschevanicus* Rzazade) – Status-NaxQK CRB1ac(i), AzQK CR B1ab(i,ii,iii)c(i)+2ab(i,ii,iii)c(i). It is a species with a decorative appearance and is of importance as a food. Its typical distribution area is around the village of Turkesh in the Shahbuz region.
 13. *Astragalus montis-aquilis* Grossh. – Status-AzQK CR B2c(ii,iv). It is found singly around the village of Chalkhangala in Kangarli district and in the area of the Garagush Mount. It will be protected within the ZNP area.
 14. *Astragalus ordubadensis* Grossh. – It grows singly in the Ordubad region on the territories of Soyug Dag and Ajnovur Dag. Status-AzQK CRB2a.
 15. *Astragalus paradoxus* Bunge – Status-NaxQK CR B1ac(i), AzQK CR A2c+3c; B1ac(i)+2ab(i,ii,iii). It grows in small groups around the village of Nehram in the Babek region, the Alinjachay Valley in the Julfa region, and the village of Chennab in the Ordubad region. It is a beautiful ornamental plant and is protected within the ZNP area.
 16. *Astragalus pinetorum* Boiss. (*A.badamliensis* Chalilov) – *Astragalus badamliensis* Chalilov. Status-NaxQK CRB1ac(ii,iv)+C2a(i) və AzQK CR A2c+3c;B1ac(i)+2ab(i,ii,iii). It is spread in small groups around the villages of Turkesh, Badamli and Kukudagg in the Shahbuz region.
 17. *Oxytropis savellanica* Bunge ex Boiss. – Status-AzQK CR B2a. It grows in small groups in the villages of Tivi and Bist, in the Soyuzdag area of the Zangezur range in the Ordubad district. It will be protected within the ZNP area.
 18. *Trifolium bordsilovskyi* Grossh. – Status-AzQK CR B2a. It grows in small groups in the Batabat area of the Shahbuz district.
 19. *Apium nodiflorum* (L.) Lag. (*Helosciadium nodiflorum* (L.) W.D.J.Koch) – Status-AzQK CR B2a. Found singly in the low hills around the villages of Hamzali and Akhura in the Sharur region. It will be protected within the ZNP area.
 20. *Ferula oopoda* (Boiss. & Buhse) Boiss. – Status-NaxQK CR C2a(ii), AzQK CR B2ab(ii,iii);C2a(ii). It is distributed singly in a limited area, in a small group around Duzdag in the Babek district. Seed material will be collected and cultivated in the Botanical Garden. It is protected within the ZNP area.
 21. *Jurinea spectabilis* Fisch. & C.A.Mey. – Status-NaxQK və AzQK CR A2cd. It grows singly under rocks in the Ordubad region, around Soyugdag. It is decorative.
 22. *Podospermum grossheimii* (Lipsch. & Vassilcz.)Kuth. (*Scorzonera grossheimii* Lipsch. et Vassilcz.) – Status-NaxQK CRB1ac(i), AzQK CR B2ab(ii,iii,iv,v). It is found on rocks in the Kapticig and Soyugdagh areas of the Zangezur range in the Ordubad district. It is protected within the ZNP area.
 23. *Nonea cyanocalyx* M.Pop. ex V.N.Karimov – Status-AzQK CR B2b(v). It grows in small

groups around Lake Batabat in the Shahbuz region and in the Bichenak Pass. It will be protected within the ZNP area.

24. *Onosma gracilis* Trautv. – Status-AzQK CR B1b(i,iii)+ 2b(ii,iii,v). It is found in the villages of Bilev and Tivi in the Ordubad district. It will be protected within the ZNP area.

25. *Onosma zangezura* T.N.Pop. – Status-AzQK CR B2b(ii,iii). It is found in the villages of Leketagh and Bayahmed in the Julfa district.

26. *Veronica multifida* L. (*V.arceuthobia* Woronow) – Status-AzQK CR B2a. It will be protected within the ZNP area.

27. *Ajuga chamaecistus* Ging. ex Benth. – Status-AzQK CR B2a. It will be protected within the ZNP area.

Monitoring of the listed species has already begun with the participation of employees of the

Ministry of Ecology and Natural Resources of the Nakhchivan Autonomous Republic. Efforts will be made to include the collected materials and research results in the second edition of the Red Book of the Nakhchivan Autonomous Republic. In addition, along with the introduction of rare species of the autonomous republic in the Botanical Garden, it was decided to collect their seed materials in nature and store them in gene banks.

At this time, the most attention will be paid to *Critically endangered* – species whose condition in nature is at a critical level or is likely to be extinct, *Endangered* – species whose number dynamics in nature continue to decrease consistently and are close to extinction, and *Vulnerable* – species with a sensitive status that are distributed in limited areals or areas and are subject to negative impacts.



Fig. 1. 1,2 - *Allium tripedale* Trautv., 3 - *Allium tripedale* Trautv. var. *alba* Talibov T.



Fig. 2. *Aristolochia bottae* Jaub. & Spach - Botta zarəvəndi

More attention will be paid to annual plants because the most damage due to global climate change affects annual plants that are deprived of

the opportunity to set seeds due to low rainfall, and their areal is reduced year by year.

CONCLUSION

Thus, to eliminate critical problems in the biodiversity of the Nakhchivan Autonomous Republic due to global climate change, the importance of specially protected natural areas created in the autonomous republic, which account for more than 27%, was noted, and the taxonomic composition and rare species of fauna and flora biodiversity were shown. In the fauna biodiversity, from the reptiles, *Rhynchocalamus melanocephalus* Jan, and from the birds, *Chettusia gregaria* Pall. have been classified as CR, and 3 species: Striped Hyena, Marbled polecat, and Manul are no longer found in the area. 27 species of flora biodiversity have CR status. Along with the introduction of rare species in the Botanical Garden of the Autonomous Republic, it was decided to collect their seed materials and store them in genebanks.

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