

# Studying the species diversity of the vertebrates in the southern part of the Ara Sea area

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**ABSTRACT:** We studied the contemporary species diversity of the vertebrate animals inhabiting the southern part of the Aral Sea area. The terrestrial vertebrates of the region comprise 33 reptilian, 317 avian and 67 mammalian species. We determined the influence of the Aral Sea's shrinkage on the local fauna and the long-term changes in the populations and life cycles of the animal species common for the region.

**Keywords:** vertebrates, reptiles, birds, mammals, Karakalpakstan.

## INTRODUCTION

Vertebrata is one of the most interesting animal groups, whose representatives have adapted themselves to life in all biological spheres, from water to air. The vertebrates' diversity is the result of the long evolution of the organic world. At a rough estimate, the total number of vertebrate species inhabiting our planet is 45.000, with about 20.000 fishes, 8.000 reptiles and 4.000 mammals. The global species diversity results from the diversity of environmental conditions in different regions of the Earth (Lopatin, 2002). The degradation of ecological systems and its consequences threaten the biological diversity of vertebrates in various regions, including Karakalpakstan. The ecological crisis caused by the shrinkage of the Aral Sea and the transformation of natural landscapes by humans have affected the environment all over the southern portion of the Aral Sea area, which led to a degradation of the natural environment, climate change, soil erosion and desertification. According to the first President of the Republic of Uzbekistan I.A. Karimov (1997), "... at the turn of the millennium the world faced problems and challenges it had never before dealt with, which threaten man, flora and fauna in different parts of our planet. The tragedy of the once unique and beautiful Aral Sea, which within a lifespan of one generation has turned into a small body of water threatening to disappear from the face of the earth, is a bright example of our negligent attitude to environmental issues". This resulted in the deterioration and shrinkage of animals' habitats, reduction of their populations, worsening of their gene pools, and change of reproduction phenology and decrease of fertility.

Thus, the terrestrial vertebrates of the southern part of the Aral Sea area are staying currently in extremely poor environmental conditions. Some species, such as the Caspian tiger, cheetah and Severtsov's sheep, which once inhabited the territory of Karakalpakstan, have become extinct in the last 60-70 years. Many others are critically endangered.

No one has yet estimated the scale of the environmental damage the region will suffer within some 50-100 years. It is very difficult to appraise the extent of the anthropogenic factor's impact, either on the humankind or on the global biodiversity and the animal world, in particular. We can never conceive the general mechanisms of this factor's impact upon wildlife, unless we carry out special research on local and regional levels.

In this respect, comprehensive research into the vertebrate animals of the southern part of the Aral Sea area, including the estimation of the population size and biodiversity situation, the studying of the human impact on the entire vertebrate fauna and the development of protection and conservation measures, is an important task in the current ecological crisis.

### MATERIALS AND METHODS

This research work is based on the results of field studies carried out in Karakalpakstan between 2007 and 2016. Most of the work, which included studying the species composition and monitoring all the terrestrial vertebrate animals (reptiles, birds and mammals) and their distribution and ecology, was carried out in three major ecosystems (northwestern Kyzylkum, Ustyurt Plateau and the area in the lower course of the Amudarya, including the dry bottom of the Aral Sea).

The research was carried out with the application of conventional methods and with the use of transect and point-transect surveys. Universal zoological and ecological methods were also used in the work (Novikov, 1953; Naumov, 1963; Stepanyan, 1990; Vaurie, 1959; Corbert, 1978).

The qualitative and quantitative composition of the vertebrate fauna was registered in all seasons of the year. Programme Biostat 3.8 (biostatsoft.com) was used for the statistical processing of the obtained data.

### RESULTS AND DISCUSSION

According to the analysis of the species composition, population size and distribution of the reptiles, birds and mammals in different types of terrain, the reptile fauna inhabiting the region consists of 33 species from two orders, Testudines и Squamata. The first order comprises only one species, steppe tortoise *Testudio horsfieldi* (Gray, 1844) (= *Agrionemys horsfieldi*), while the second one – the other 32 (fig. 1).

Suborder	Family	Number of species
Squamata	Agamidae	8
	Gekonidae	5
	Lassertidae	6
	Scincidae	1
	Varanidae	1
Serpentes	Colubridae	7
	Boidae	2
	Grotalidae	1
	Viperidae	1

Figure 1. Species and taxonomic diversity of reptiles from suborders Squamata and Serpentes in the southern part of the Aral Sea area

The number of reptile species of a standard population size varies according to an ecosystem. In the northwestern Kyzylkum they number 11, on the Ustyurt Plateau - 8 and in the lower course of the Amudarya River - 6, which depends on the ability of these species to adopt to different environment. The studied ecosystems vary considerably in natural and climatic conditions, which are highly important for the life of terrestrial vertebrates. This is confirmed by figures representing the quantitative aspect of the reptiles' species composition (Table 1).

Table 1. Figures of the species composition of the reptiles in the ecosystems of the southern part of the Aral Sea area

	absolute quantity	in %
Common species: for all ecosystems	18	54.5
In Kyzylkum and on the Ustyurt Plateau	19	57.6
In Kyzylkum and the lower course of the Amudarya	22	66.7
On the Ustyurt and in the lower course of the Amudarya	21	63.6

The commonality of the reptile faunas of the three regions (Kyzylkum, Ustyurt and the lower Amudarya) is expressed in the number of common species (18, according to our analysis, or 54.5% of the total number of species found in the area), which testifies to close phylogenetic relation between these faunas and to their wide distribution.

The Kyzylkum desert and Ustyurt Plateau have 19 species in common (57.6%), Kyzylkum and the lower course of the Amudarya – 22 species (66.7%) and Ustyurt and the lower course of the Amudarya – 21 species (63.6%). Thus, with respect to the quantity of common species, the combined area of Kyzylkum and the lower course of the Amudarya is close to that of Ustyurt and the lower course of the Amudarya, while the Kyzylkum-Ustyurt area features fewer common species. This, probably, results from a wide belt of oases in the lower Amudarya region, which separates the Kyzylkum desert from the Ustyurt Plateau. At the same time, the lower section of the Amudarya River borders on Kyzylkum in the east and Ustyurt in the west, which facilitates the interpenetration of species from the adjacent territories.

Birds occupy a special place among the vertebrate animals inhabiting the territory of Karakalpakstan. We recorded a great number of avian species belonging to 54 families and 19 orders. The widest range of species was registered in the lower course of the Amudarya River (295), followed by northwestern Kyzylkum (156) and the Ustyurt Plateau (130).

The number of species found in all the three regions (Kyzylkum, Ustyurt and the lower Amudarya), which we refer to as 'common species,' is 83 (26.2%). This figure indicates the polygenetic relations between the territories, their faunistic affinity or remoteness. Here, again, Kyzylkum and Ustyurt have 93 common species, which is 29.3%, while Kyzylkum and the lower Amudarya feature 141 common species, or 44.5%, which indicates that, historically, Kyzylkum and the lower Amudarya have had closer faunistic contacts than Kyzylkum and the Ustyurt Plateau. The lives of most of the avian species recorded in the area are associated with bodies of water. Therefore, the shrinkage of the Aral Sea and lakes within the Amudarya delta has impacted heavily the birds' populations in the southern part of the Aral Sea area. The drying of all lacustrine systems led to the disappearance of reed and bullrush beds over large areas, where birds had used to build their nests. All this had an impact on the size of avian population, which began to decrease, with a number of species abandoning their habitats for good.

The analysis of the birds' species diversity and the character of their use of the natural complexes of the southern portion of the Aral Sea area showed that passing birds (76.0%) prevail over nesting (39.7%), wintering (33.7%) and resident (9.1%) species (Table 2).

Table 2. Number of species and character of their use of the southern part of the Aral Sea area

Order	Number of species	Resident		Nesting		Passing		Wintering	
		abs.	%	abs.	%	abs.	%	abs.	%
Gaviiformes	2	-	-	-	-	2	0.8	-	-
Podicipediformes	5	-	-	4	3.2	5	2.1	-	-
Pelecaniformes	4	-	-	4	3.2	3	1.2	-	-
Ciconiformes	10	-	-	10	7.9	3	1.2	3	4.3
Phoenicopteriformes	1	-	-	1	0.8	1	0.4	-	-
Anseriformes	28	-	-	9	7.1	28	11.6	11	15.7
Falconiformes	31	3	10.3	13	10.3	25	10.4	14	20.0
Galliformes	4	2	6.9	1	0.8	1	0.4	2	2.8
Gruiformes	12	-	-	4	3.2	12	5.0	1	1.4
Charadriiformes	60	-	-	19	15.1	56	23.2	5	7.1
Columbiformes	10	3	10.3	5	3.9	4	1.6	1	1.4
Cuculiformes	1	-	-	1	0.8	1	0.4	-	-
Strigiformes	5	3	10.3	2	1.6	1	0.4	1	1.4
Caprimulgiformes	2	-	-	2	1.6	1	0.4	-	-
Apodiformes	2	-	-	2	1.6	1	0.4	-	-
Coraciiformes	4	-	-	4	3.2	2	0.8	-	-
Upupiformes	1	-	-	1	0.8	1	0.4	-	-
Piciformes	3	1	3.4	-	-	2	0.8	-	-
Passeriformes	132	17	58.6	44	34.9	92	38.1	32	45.7
Bcero	317	29	9.1	126	39.7	241	76.0	70	22.1

Among the orders recorded in the territory of Karakalpakstan the largest is Passeriformes comprising 132 species (41.6%). This is followed by Charadriiformes (60 species, 18.9%), Falconiformes (31, 9.8%), Anseriformes (28, 8.8%), Gruiformes (12, 3.8%), Ciconiformes and Columbiformes (10 species each, 3.1%). In total, these 7 orders comprise 89.1% of all the avian species inhabiting the region.

Similar proportions were recorded in nesting birds: Passeriformes comprise 34.9%, Charadriiformes – 15.1%, Falconiformes – 10.3% and Ciconiformes – 7.9%. Other noticeable orders are Anseriformes (7.1%), Columbiformes (3.9%), Podicipediformes, Pelecaniformes, Gruiformes and Coraciiformes (all 3.2%). The same situation is observed in the passing birds' community, with the prevalence of Passeriformes (38.1%), Charadriiformes (23.2%),

Anseriformes (11.6%) and Falconiformes (10.4%). Among the wintering species Passeriformes comprise 45.7%, Falconiformes – 20.0% and Anseriformes (15.7%).

The relative diversity of the avian fauna in the Amudarya River delta results from the existence in the area of basic anthropogenic biotopes, such as lakes and forests, on the one hand, and, on the other hand, from the territory's situation on the point where three deserts meet – Karakum and the Ustyurt Plateau from the northwest, Kyzylkum from the northeast and Aralkum connecting the gypsum desert of Ustyurt with northwestern Kyzylkum, from the north. The current structure and heterogeneity of the avian fauna depends on both the origin and the geological age of the regional fauna.

The comparative analysis of the mammalian fauna inhabiting different ecosystems of the southern part of the Aral Sea area revealed the commonality of species composition. Of the 67 mammalian species recorded in the area, 46 species were registered in each of the northwestern Kyzylkum and lower Amudarya areas and 44 – on the Ustyurt Plateau (Fig. 2).

Suborder	Family	Number of species
Insectivora	Erinaceidae	2
	Soricidae	2
Chiroptera	Rhinopophidae	6
	Vespertilionidae	1
Lagomorpha	Leporidae	1
Rodentia	Sciuridae	3
	Hystriidae	1
	Myocastoridae	1
	Dipodidae	13
	Cricodidae	4
	Gerbillidae	4
	Muridae	2
Carnivora	Canidae	4
	Mustelidae	6
	Felidae	7
	Hyaenidae	1
Perissodactyla	Equidae	1
Artiodactyla	Suidae	1
	Cervidae	1
	Bovidae	4

Figure 2. Species and taxonomic diversity in the mammals of the southern part of the Aral Sea area

The distribution of mammals in the studied ecosystems is almost identical to that of rare species (fig. 3), which testifies to the instability of the species diversity (50-60%) in the animals inhabiting the southern portion of the Aral Sea area.

Most specialists agree that these processes were triggered by the increasing desertification, climate change, anthropogenic impact and industrial and agricultural development. The situation in the region is aggravated by the shrinkage of the Aral Sea, whose shoreline retreated to a distance of over 100 km. All this combination of factors contribute to the degradation of the soil leading to highly negative consequences, the worst of which can be observed in the southern part of the Aral Sea area.

Indications of perpetual desertification can be observed in all forming biocomplexes, on the dry bottom of the lake and in the river delta, which change depending on edaphic factors and their age. This desertification leads to the formation of areas with specific terrain, which vary in soil type, flora and fauna or prevalence of edificatory groups.

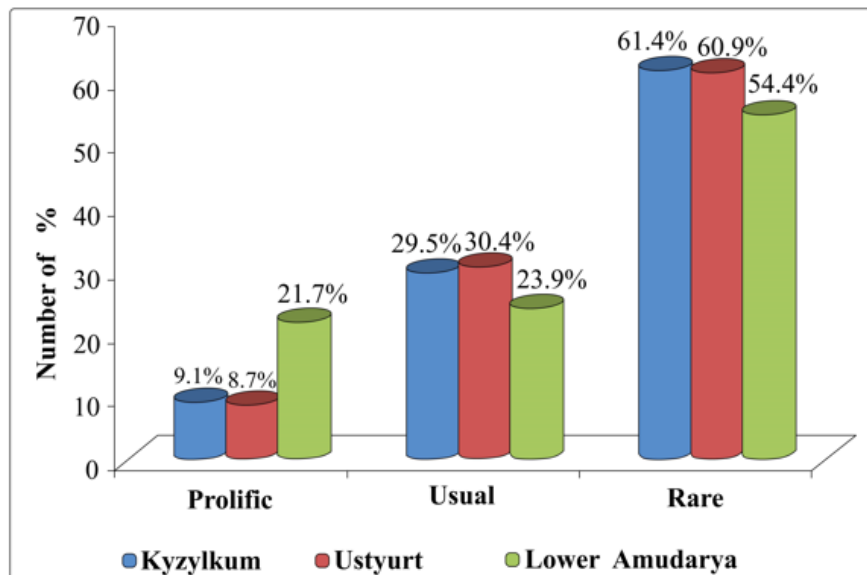


Figure 3. Size of mammalian populations in the ecosystems of the southern part of the Aral Sea area

The ecological situation in the lower course of the Amudarya River changed greatly, which led to the decrease of habitats for some species (Transcaspian vole, muskrat, wild boar, pest rat and others) and the increase for other ones (over the territories abandoned by the former). As was expected, rodents are moving in increasingly large numbers to the drying littoral, with 7 rodent species found in the territory – great, midday, tamarisk and red-tailed gerbils, hairy-footed jerboa, house mouse and Tolai hare.

We also noted changes in the habitats of some avian and mammalian species, most of which corresponded with the data provided by O. Mitropolsky (2008).

**Species with increasing habitats.** Some species of birds – greater flamingo (*Phoenicopterus roseus*), courser (*Cursorius cursor*), common myna (*Acridoteres tristis*), Eurasian collared dove (*Streptopelia decaocto*) and house sparrow (*Passer indicus*) – and mammals – yellow ground squirrel (*Spermophilus fulvus*), red-tailed gerbil (*Meriones erythrourus*) and midday gerbil (*Meriones meridianus*) – can be referred to this group.

**Species with decreasing habitats.** This group includes some mammalian species – short-tailed bandicoot rat (*Nesokia indica*), Transcaspian vole (*Microtus transcaspicus*), muskrat (*Ondatra zibethica*) and wild boar (*Sus scrofa*) and birds – northern goshawk (*Accipiter gentilis*), white-winged woodpecker (*Dendrocopos leucopterus*), common kingfisher (*Alcedo atthis*) and black-headed penduline tit (*Remiz macronyx*). The habitats of all these animals are decreasing with the change of the regime of the Amudarya River, shrinkage of the Aral Sea and accelerating aridisation of the southern portion of the lake’s area, as a result of which most of the habitats, such as lakes, canals and other bodies of water with reeds and surrounded with *tugay*, have either disappeared or heavily decreased in area. The climate change and warming is speeding up the process. All these factors could not but impact some of the birds inhabiting the area. The shrinkage of the *tugay* areas by 90% has led to the decrease of the habitats of the animals inhabiting them. For example, the white-winged woodpecker and northern goshawk, which earlier were quite common for the region, have become rare.

During the last century many vertebrates in the southern part of the Aral Sea area have suffered the shrinkage of their habitats. This is not only due to the change of the Amudarya’s regime, the Aral Sea’s shrinkage, poaching and extension of agricultural lands, but also because of the acceleration of the climate warming and the aridisation that results from it. The abovementioned mammals and birds in the southern portion of the Aral Sea area are indicator species, which can be used for long-term monitoring of the changes in the environment.

Our government pays closest attention to the issues of conservation and rational use of natural resources. The conservation of nature and the animal world in particular has become a matter of paramount importance for the country and nation. The network of reserves is growing year after year in Uzbekistan, while hunting is getting more and more under control. By now a number of special laws have been adopted to conserve all species of terrestrial vertebrate animals. Each person’s duty is to help their enforcement.

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