

THE ASSESSMENT OF THE TROPHIC RELATIONSHIPS OF THE MIGRATORY-NESTING BIRDS POPULATIONS BELONGING TO THE FAMILY OF ARDEIDAE IN THE GIZILAGHAJ BAY

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Abstract. In 2013-2023, in the Gizilaghaj Bay located on the South-Western coast of the Caspian Sea, the trophic relationships of the migratory and nesting bird populations belonging to the Ardeidae family (*Botarus stellaris*, *Ixobrychus minutus*, *Nycticorax nycticorax*, *Ardeola ralloides*, *Bubulcus ibis*, *Egretta garzetta*, *Ardea alba*, *Ardea cinerea*, *Ardea purpurea*) were evaluated with 100 points. It was evaluated 40-60 (sufficient) in 36 species, the main food objects of which are plants, in 9 species 60-80 (good). It was evaluated 40-60 (sufficient) in 12 species of birds, the main food objects of which are invertebrates, 60-80 (good) in the populations of 114 species and 80-100 (very good) in 10 bird species. It was evaluated 0-20 (very bad) in 14 species, the main food objects of which are vertebrates, 20-40 (bad) in 18 species, 40-60 (sufficient) in 56 species and 60-80 (good) in 10 species.

Keywords: *Ardeidae*, *Gizilaghaj Bay*, *trophic relationships*, *migratory-nesting species*.

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1. Introduction

The Gizilaghaj Bay stretches from the North (39010/16//N 49013/52//E) to the South (38050/55//N 48051/44//E) on the South-Western coast of the Caspian Sea. The migratory-nesting bird populations belonging to the Ardeidae family came from South-East Asia and Africa countries, reproduce in this area. During the reproduction period of the migratory-nesting bird populations belonging to the Ardeidae family, the quantitative and qualitative indicators of the feed stock influence to their species composition, settlement character, trophic and biotope relationships in the changed ecological conditions of this area.

Although the numerous researches dedicated to the ornithofauna of the water-wetlands with the rich species diversity are carried out, there are few complex researches in this field (Grishanov, 2005). The location of the living conditions at the intersection of the water-wetland-dry areas creates a rich species diversity and allows to live the organisms belonging to the separate ecological groups in the neighborhood and together (Baldi, 1998). The richness and density of the species increase at the border of the

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ecosystems (border effect) (Nerekov, 2001). During the reproduction period, the trophic relationships of the birds influence the whole activity of the bird and determine its number, distribution, lifestyle, behavior, mutual relations with the other organisms, etc. (Taghiyev & Mammadli, 2019; Taghiyev & Karimova, 2023).

During the reproduction period, it is possible to know in advance where any species will be depending on the nature of the feed objects of the bird, the quality and quantity indicators of the feed.

The Gizilaghaj Bay is the main habitat area of the migratory-nesting species belonging to the Ardeidae family. The area of the Gizilaghaj Bay has been included in the list of the international important water-wetlands (Convention, 1991) since 2001 (Babayev *et al.*, 2006). The Gizilaghaj Bay consists of the Greater and Lesser Gizilaghaj Bays and connects through the channels of Fish Passing (38056/50//N 48055/31//E), Crash (38059/10//N 48055/25//E) and Spawning (39004/10//N 48054/09//E). The water of the Lesser Gizilaghaj Bay has sweetened and became the closed water pool due to the water brought by the Gumbashi and Vilash rivers from the Talish Mountains. In February-April, in the Greater Bay, the salinity of the water decreases from 10-12‰ to 2-7‰ as a result of the discharge of the fresh water from the Lesser Gizilaghaj Bay to the Greater Bay. At the end of May, the salinity rises gradually, in June-August, it drops again and in the autumn months, the salinity rises again (Vinogradov & Morozkin, 1979). This situation influences the quantitative and qualitative indicators of some aquatic invertebrates, which are food objects of the birds.

In 1996-2023, in the Caspian Sea, the water level has dropped more than ~1.0 meters. It is probable that the falling of the water level will continue to ~9.0-18.0 meters as of the end of the century (2100) (<https://centralasia.media/news:1670800>) according to the international forecasts. If it happens, the Caspian Sea will lose 1/3 of its total area and it will cause the serious damage to the biodiversity of the Caspian Sea and the economy of the Caspian countries. In the Caspian Sea, the dropping of the water level is most felt in the area of Gizilaghaj Bay on the South-Western coast of the Caspian Sea. The studying of the influence of the changes occurred in the Caspian sea level on the biodiversity, is important for solving the problem of the preserving the genetic fund and natural biological diversity (Krivenko, 1991; Nerekov, 2001).

2. Material and methods

The researches were conducted in 2013-2023 by using foot, horse, car, motorized and non-motorized boats. The main purpose was to evaluate the trophic relations of the migratory-nesting birds belonging to the Ardeidae family with 100 points under the changed environmental conditions in the research area. The researches were conducted every year in April, May, June, July, August at different times, mostly from 09:00 to 19:00, sometimes at night hours. The binoculars and a Carl Zeiss telescope were used. The assessment of the trophic relations of the migratory-nesting birds belonging to the Ardeidae family with 100 points was carried out in their feeding, nesting, resting and nighting areas. The birds carry out feed their chicks more intensively during the reproduction period, that's why it is possible to assess more accurately their trophic relationships.

The evaluation of the trophic relationships of the migratory-nesting species belonging to the Ardeidae family with 100 points (0-20 very bad, 20-40 bad, 40-60

sufficient, 60-80 good, 80-100 very good) was carried out taking into account the following main complex factors.

1. The natural-geographic conditions of the concrete area;
2. The settling possibility of the species in the area;
3. The quantitative indicators of the individuals of the species;
4. The quantitative and qualitative indicators of the feed base in the area;
5. The meeting intensity of the feed object in the concrete area;
6. The intraspecific food competition for food;
7. The interspecies food competition for food;
8. The bioecological characteristics of the species for hunting the food object;
9. The influence of the natural factors on the hunting of the food object;
10. The influence of the anthropogenic factors on the hunting of the food object, etc.

3. Results and discussion

The main food of the migratory-nesting birds belonging to the Ardeidae family (*Botarus stellaris*, *Ixobrychus minutus*, *Nycticorax nycticorax*, *Ardeola ralloides*, *Bubulcus ibis*, *Egretta garzetta*, *Ardea Alba*, *Ardea cinerea*, *Ardea purpurea*) is the foods of animal origin. At the intersection of the water-swamp-land ecosystems of the Gizilaghaj Bay, the biomass of the aquatic and terrestrial invertebrates is much higher than that of the other organisms (border effect). In the Gizilaghaj Bay, the quantity and quality indicators of the aquatic, terrestrial invertebrates and vertebrates vary depending on the concrete area of the territory. As a result of the lowering of the water level in the Caspian Sea, the changes occurred in the Greater and Lesser Gizilaghaj Bays cause to the diversity in the assessment of the trophic relationships of the migratory-nesting species belonging to the Ardeidae family. As a result of the lowering of the water level in the Caspian Sea, several hundreds of hectares of the land between the Greater and Lesser Gizilaghaj Bays and in various areas of the Lesser Gizilaghaj Bay have become a dry area. The occurred changes influence to the evaluation of the trophic relationships of the migratory-nesting birds in the Southern, Northern and Pirman areas of the Lesser Bay.

Table 1. The evaluation of the trophic relationships of the migratory-nesting bird populations belonging to the Ardeidae family with 100 points in the Greater Gizilaghaj Bay

No	Species	Greater Gizilaghaj Bay						
		The evaluation of the trophic relationships with 100 points						
		Aquatic invertebrates	Terrestrial invertebrates	Fishes	Amphibians	Reptiles	Birds	Mammals
1.	<i>Botarus stellaris</i>	20-40	0-20	20-40	0-20	0-20	0-20	20-40
2.	<i>Ixobrychus minutus</i>	20-40	0-20	20-40	0-20	0-20	0-20	20-40
3.	<i>N.nycticorax</i>	40-60	0-20	40-60	0-20	0-20	0-20	0-20
4.	<i>Ardeola ralloides</i>	20-40	0-20	20-40	0-20	0-20	0-20	0-20
5.	<i>Bubulcus ibis</i>	20-40	0-20	20-40	0-20	0-20	0-20	0-20
6.	<i>Ardea alba</i>	60-80	20-40	60-80	0-20	60-80	0-20	40-60
7.	<i>Egretta garzetta</i>	40-60	20-40	40-60	0-20	0-20	0-20	0-20

8.	<i>Ardea cinerea</i>	60-80	20-40	60-80	0-20	40-60	0-20	40-60
9.	<i>Ardea purpurea</i>	60-80	20-40	60-80	0-20	40-60	0-20	40-60

Due to the lowering of the water level in the Caspian Sea, under the changed ecological conditions of the Greater Gizilaghaj Bay, the natural-geographical conditions of the area, the quantity and quality of the feed base, the meeting intensity of the feed objects, the settling possibility of the species in the area, the quantitative indicators of the individuals of the species and the interspecific competition more impact to the assessment of the trophic relations of the migratory-nesting species belonging to the Ardeidae family. In the area of the Greater Gizilaghaj Bay, the trophic relationships of the migratory-nesting bird populations belonging to the species of *A.alba*, *A.cinerea* and *A.purpurea* with the aquatic invertebrates suitable to 60-80 points, in *N.nycticorax*, *E.garzetta* to 40-60 and in the other species to 20-40 (Table 1). The evaluation of the trophic relationships with the terrestrial invertebrates suitable to 20-40 points in the species of *A.alba*, *E.garzetta*, *A.cinerea*, *A.purpurea* and 0-20 points in the other species. The trophic assessment with the fish suitable to 60-80 points in populations of *A.alba*, *A.cinerea*, *A.purpurea*, 40-60 points in the individuals of *N.nycticorax* and *E.garzetta* and 20-40 points in the other species. The trophic relations with the amphibians are evaluated with 0-20 points in all the species. The trophic relationships with the reptiles suitable to 60-80 points in the population of *A.alba*, 40-60 points in the populations of *A.cinerea* and *A.purpurea* and 0-20 points in the other species. The trophic relationships with the birds suitable to 0-20 points in all the species. The trophic relationships with the mammals suitable to 40-60 points in the populations of *A.alba*, *A.cinerea*, *A.purpurea* and to 0-20 points in the populations of *B.stellaris* and *I.minutus*. In the other species, it suitable to 0-20 points (Table 2).

Table 2. The evaluation of the trophic relationships of the migratory-nesting birds belonging to the Ardeidae family with 100 points in the Southern part of the Lesser Gizilaghaj Bay

No	Species	Lesser Gizilaghaj Bay (Southern part)						
		The evaluation of the trophic relationships with 100 points						
		Aquatic invertebrates	Terrestrial invertebrates	Fishes	Amphibians	Reptiles	Birds	Mammals
1.	<i>Botarus stellaris</i>	60-80	40-60	20-40	60-80	40-60	0-20	20-40
2.	<i>Ixobrychus minutus</i>	60-80	40-60	20-40	60-80	20-40	0-20	20-40
3.	<i>N.nycticorax</i>	60-80	20-40	60-80	60-80	20-40	0-20	20-40
4.	<i>Ardeola ralloides</i>	40-60	60-80	20-40	60-80	20-40	0-20	0-20
5.	<i>Bubulcus ibis</i>	40-60	60-80	20-40	60-80	20-40	0-20	0-20
6.	<i>Ardea alba</i>	60-80	20-40	60-80	60-80	40-60	20-40	20-40
7.	<i>Egretta garzetta</i>	60-80	60-80	60-80	60-80	20-40	0-20	0-20
8.	<i>Ardea cinerea</i>	60-80	20-40	60-80	60-80	40-60	20-40	20-40
9.	<i>Ardea purpurea</i>	60-80	20-40	60-80	60-80	40-60	20-40	20-40

The Southern part of the Lesser Gizilaghaj Bay stretches from the North ($39^{\circ}03'31''\text{N}$ $48^{\circ}49'01''\text{E}$) to the South ($38^{\circ}52'32''\text{N}$ $48^{\circ}49'43''\text{E}$). In this part of the research area, the natural-geographical conditions of the area, the settling possibility of the species in the area, the quantitative indicators of the individuals of the species, the quantity and quality of the feed base, the meeting intensity of the feed objects, the intraspecific and interspecific food competition, natural and anthropogenic factors more impact to the assessment of the trophic relations of the birds belonging to the *Ardeidae* family. In the Southern part of the Lesser Gizilaghaj Bay, the assessment of the trophic relationships with the aquatic invertebrates suitable to 40-60 points in the populations of *A.ralloides*, *B.ibis* and 60-80 points in the other species. The assessment of the trophic relationships with the terrestrial invertebrates suitable to 60-80 points in the populations of *A.ralloides*, *B.ibis* and *E.garzetta*, 40-60 points in the populations of *B.stellaris*, *I.minutus* and 20-40 points in the other species. The trophic relationships with the fish suitable to 20-40 points in the species of *B.stellaris*, *I.minutus*, *A.ralloides*, *B.ibis* and 60-80 points in the other species. In the Southern part of the Lesser Bay, the trophic relationships with the amphibians are estimated with 60-80 points in all the species. The trophic relationships with the reptiles suitable to 40-60 points in the species of *B.stellaris*, *A.alba*, *A.cinerea*, *A.purpurea* and 20-40 points in the other species. The trophic relations with the mammals are evaluated with 0-20 points in the populations of *A.ralloides*, *B.ibis*, *E.garzetta* and 20-40 points in the other species (Table 3).

Table 3. The evaluation of the trophic relationships birds belonging to the Ardeidae family with 100 points in the Pirman area of the Lesser Gizilaghaj Bay

No	Species	Lesser Gizilaghaj Bay (Pirman area)						
		The evaluation of the trophic relationships with 100 points						
		Aquatic invertebrates	Terrestrial invertebrates	Fishes	Amphibians	Reptiles	Birds	Mammals
1.	<i>Botarus stellaris</i>	40-60	40-60	0-20	40-60	20-40	0-20	0-20
2.	<i>Ixobrychus minutus</i>	40-60	40-60	0-20	40-60	20-40	0-20	0-20
3.	<i>N.nycticorax</i>	20-40	20-40	20-40	40-60	0-20	0-20	0-20
4.	<i>Ardeola ralloides</i>	20-40	20-40	20-40	40-60	0-20	0-20	0-20
5.	<i>Bubulcus ibis</i>	20-40	20-40	20-40	40-60	0-20	0-20	0-20
6.	<i>Ardea alba</i>	20-40	0-20	20-40	20-40	40-60	0-20	20-40
7.	<i>Egretta garzetta</i>	20-40	20-40	20-40	60-80	20-40	0-20	20-40
8.	<i>Ardea cinerea</i>	40-60	20-40	40-60	40-60	40-60	0-20	20-40
9.	<i>Ardea purpurea</i>	60-80	0-20	40-60	60-80	40-60	0-20	20-40

The Pirman area of the Lesser Gizilaghaj Bay consists of 3,950 ha of the water area from the entrance gate ($39^{\circ}04'21''\text{N}$ $48^{\circ}53'27''\text{E}$) of the Pirman channel to the land area ($39^{\circ}05'37''\text{N}$ $48^{\circ}48'49''\text{E}$). The main factors influenced to the evaluation of the trophic relationships of the migratory-nesting bird populations are: the natural-geographical conditions of the area, the settling possibility of the species in the area, the quantity and quality indicators of the feed base and the meeting intensity of the feed objects, etc. In the Pirman area of the Lesser Gizilaghaj Bay, the natural-geographical conditions of the

area, the settling possibility of the species in the area, the quantity and quality indicators of the feed base and the meeting frequency of the feed objects more impact to the assessment of the trophic relations with the aquatic invertebrates. The trophic relationship with the aquatic invertebrates is estimated with 60-80 in the population of *A.purpurea*, 40-60 in the populations of *A.cinerea*, *I.minutus*, *B.stellaris* and 20-40 in the other species. The trophic relationships with the terrestrial invertebrates suitable to 0-20 points in the populations of *A.purpurea*, *A.alba*, 40-60 points in the populations of *B.stellaris*, *I.minutus* and 20-40 points in the other species. The trophic relationships with the fish are estimated with 40-60 points in the populations of *A.cinerea*, *A.purpurea*, 0-20 points in the populations of *B.stellaris*, *I.minutus* and 20-40 points in the other species. The trophic relationships with the amphibians are estimated with 60-80 in the populations of *E.garzetta* and *A.purpurea*, 20-40 in *A.alba* and 40-60 in the other species. The trophic relationships with the reptiles suitable to 0-20 points in the populations of *A.ralloides*, *B.ibis*, *N.nycticorax*, 40-60 points in the populations of *A.alba*, *A.cinerea*, *A.purpurea*, 20-40 points in the populations of *B.stellaris*, *I.minutus*. The assessment of the trophic relationships with the birds suitable to 0-20 points for all the species. The trophic relations with the mammals are evaluated with 0-20 points in the populations of *N.nycticorax*, *A.ralloides*, *B.ibis* and 20-40 points in the other species.

Table 4. The evaluation of the migratory-nesting populations with 100 points in the Northern part of the Lesser Gizilaghaj Bay (except for the Pirman area)

No	Species	The Northern part of the Lesser Gizilaghaj Bay (except for the Pirman area)						
		The evaluation of the trophic relationships with 100 points						
		Aquatic invertebrates	Terrestrial invertebrates	Fishes	Amphibians	Reptiles	Birds	Mammals
1.	<i>Botarus stellaris</i>	20-40	40-60	0-20	20-40	20-40	0-20	20-40
2.	<i>Ixobrychus minutus</i>	20-40	40-60	0-20	20-40	20-40	0-20	20-40
3.	<i>N.nycticorax</i>	20-40	0-20	20-40	0-20	0-20	0-20	0-20
4.	<i>Ardeola ralloides</i>	40-60	40-60	0-20	20-40	20-40	0-20	0-20
5.	<i>Bubulcus ibis</i>	40-60	40-60	0-20	20-40	20-40	0-20	0-20
6.	<i>Ardea alba</i>	20-40	20-40	20-40	0-20	20-40	0-20	20-40
7.	<i>Egretta garzetta</i>	40-60	40-60	20-40	20-40	20-40	0-20	20-40
8.	<i>Ardea cinerea</i>	20-40	20-40	20-40	0-20	20-40	0-20	20-40
9.	<i>Ardea purpurea</i>	20-40	0-20	20-40	0-20	20-40	0-20	20-40

In the Northern part of the Lesser Gizilaghaj Bay (except for the Pirman area), the water-wetland areas where the species belonging to the *Ardeidae* family feed there, have become a dry area. The natural-geographical conditions of the area, the quantitative, qualitative and meeting indicators of the feed base, the natural factors more impact to the assessment of the trophic relations of the migratory-nesting birds settled in the area. The estimation of the trophic relationships with the aquatic invertebrates suitable to 40-60 points in the populations of *A.ralloides*, *B.ibis*, *E.garzetta*, 20-40 points in the other

species, with the terrestrial invertebrates to 40-60 in the populations of *B.stellaris*, *I.minutus*, *A.ralloides*, *B.ibis*, *E.garzetta*, 20-40 in the populations of *A.alba*, *A.cinerea*, 0-20 in the populations of *N.nycticorax*, *A.purpurea*. The trophic relationships with the fish are evaluated with 0-20 points in the populations of *B.stellaris*, *I.minutus*, *B.ibis*, *A.ralloides* and 20-40 points in the other species. The trophic relationships with the amphibians are evaluated with 20-40 points in the populations of *B.stellaris*, *I.minutus*, *A.ralloides*, *B.ibis*, *E.garzetta* and 0-20 points in the populations of *N.nycticorax*, *A.alba*, *A.cinerea*, *A.purpurea*. The trophic relationships with the reptiles suitable to 0-20 points in the population of *N.nycticorax* and 20-40 points in the other populations. The trophic relations with the mammals suitable to 0-20 points in the populations of *N.nycticorax*, *A.ralloides*, *B.ibis* and 20-40 points in the other populations (Table 4).

As a result of the direct and indirect impacts of the changes occurred due to the lowering of the water level in the Caspian Sea, in the Gizilaghaj Bay, the area of the feeding places with the aquatic invertebrates, fishes and amphibians has decreased significantly in the trophic relations of the migratory-nesting species belonging to the Ardeidae family.

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