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THE CHANGES OCCURRED IN THE WINTERING BEHAVIOR OF THE MIGRATORY-WINTERING RED BOOK SPECIES OF THE ANSERIFORMES IN THE GIZILAGHAJ BAY

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Abstract. In 2018-2024, the effect of the lowering of the water level in the Caspian Sea on the wintering behavior of the migratory-wintering species from the order of Anseriformes included in the 3rd edition of the Red Book of the Republic of Azerbaijan (2023) was studied in the Gizilaghaj Bay which is one of the largest wintering places of the birds in Eurasia. 10 migratory-wintering species (*Branta ruficollis, Anser erythropus, Cygnus olor, Cygnus bewickii, Marmaronetta angustirostris, Aythya ferina, Aythya nyroca, Clangula hyemalis, Melanitta fusca, Oxyura leucocephala*) from the Anseriformes order were included in the Red Book of Azerbaijan. 9 of them are the migratory-wintering species. Only *Aythya nyroca* has a migratory-wintering population as well as a sedentary one. The migratory-wintering species included in the Red Book come to the research area from the Northern European countries, Russia and the North of Kazakhstan. The lowering of the water level in the Caspian Sea caused a change in the wintering behavior of the migratory-wintering species in the Gizilaghaj Bay.

Keywords: *Anseriformes, Gizilaghaj Bay, migratory-wintering species, behavior.*

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1. Introduction

An ornithological reserve is operates since 1929 near the Gizilaghaj Bay, located on the South-Western coast of the Caspian Sea and a National Park with the same name is operates since 2018. The area of the Gizilaghaj Bay was included in the list of the internationally important wetlands (Ramsar Convention) since 2001 (Babayev *et al*., 2006). The Gizilaghaj Bay consists of the Greater and Lesser Gizilaghaj Bays. The Greater Gizilaghaj Bay connects with the Lesser Gizilaghaj Bay and through three channels (Fish Passing (38056′50″N 48055′31″E), Crash (38059′10″N 48055′25″E), Spawning (39004′10″N 48054′09″E)). 1/5 part of the area of the Gizilaghaj Bay, which was in the 20s of the last century, remains (Eyvazov *et al*., 2023). Until the 1990s, numerous small lakes near the coast of the Caspian Sea's Gizilaghaj Bay were completely

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dried up and out of order as a result of the human agricultural activity. In this regard, the importance of the Gizilaghaj Bay as the main wintering place for the migratory-wintering birds has increased. Due to the decrease of the water level in the Caspian Sea, the changes in the biotopes and the quantitative and qualitative indicators of food reserves in the Northern and Southern parts of the Gizilaghaj Bay changes the wintering behavior of the Red Book species of the migratory-wintering bird populations (Taghiyev, 2014; 2024). The main food of the migratory-wintering Red Book species in the research area is vegetable and mixed feed.

In the early 1980s, the water pools with an area of more than 7,000 ha were created in the Gizilaghaj Bay for the purpose of the raising fish babies. This farm operated until the end of 1993. The water level has been high in the water pools and in the channels connected this basin with the other water pools of the farm, which have been operated for more than 10 years. In this regard, the area was the main wintering place of the migratory-wintering birds. In 1993, due to the problems in the fish breeding farm, this area was left neglected and covered with the marshy reeds and reeds (Kuliev, 1989). Due to the lowering of the water level in the Caspian Sea, currently these areas have become completely dry and in some channels connected the water pools, tamarisk and reedy weak marshy areas have become unsuitable for the use of the migratory-wintering birds.

Table 1. Water level change in the Caspian Sea (1995-2022)

Years	Months													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual average, cm**	**Baltic system**
1995	149	153	158	163	165	175	179	169	155	151	150	149	160	- 26.40
1996	148	147	149	152	150	154	147	133	124	119	118	115	138	- 26.62
1997	116	118	115	120	123	135	142	132	119	117	120	123	123	- 26.77
1998	110	110	102	102	124	139	141	132	124	118	115	118	120	-26.80
1999	112	110	114	114	119	124	127	128	123	124	109	105	117	- 26.83
2000	109	108	109	105	112	122	124	120	111	105	105	101	111	- 26.89
2001	90	89	92	98	107	116	121	114	108	94	84	93	101	- 26.99
2002	92	90	95	99	105	118	124	120	107	99	97	98	104	- 26.96
2003	95	91	94	103	109	121	125	123	115	105	108	105	108	- 26.92
2004	99	105	108	109	116	122	131	130	124	115	109	110	115	- 26.85
2005	103	113	115	117	124	139	145	143	129	125	122	120	125	- 26.75
2006	117	115	115	117	126	131	134	123	113	102	103	101	116	- 26.84
2007	98	103	102	107	117	129	129	124	114	101	104	101	111	- 26.89
2008	107	105	108	113	119	130	128	123	114	106	100	104	113	- 26.87
2009	101	98	103	111	114	122	124	120	107	107	107	102	110	- 26.90
2010	100	99	99	105	113	122	122	112	98	90	85	80	102	- 26.98
2011	80	80	77	79	87	95	96	91	76	70	72	67	81	-27.19
2012	66	71	71	73	81	89	93	73	67	72	74	64	75	- 27.25
2013	58	62	62	68	75	89	92	90	76	69	58	60	72	-27.28
2014	57	57	56	62	68	75	75	62	53	71	75	33	62	-27.38
2015	31	33	33	42	44	50	52	42	31	16	9	12	33	- 27.67
2016	14	9	21	31	37	49	57	51	43	32	29	25	33	- 27.67
2017	23	23	23	27	37	46	47	47	39	37	25	21	33	- 27.67
2018	25	21	22	28	32	43	50	41	28	16	15	6	27	- 27.73
2019	9	7	7	13	18	26	29	19	6	-4	-8	-6	10	- 27.90
2020	-6	-1	1	5	13	28	28	21	12	-5	-9	-11	6	- 27.94
2021	-15	-9	-13	-10	-3	5	6	-3	-12	-30	-38	-45	-14	- 28.14
2022	-41	-42	-39	-39	-32	-23	-24	-34	-47	-57	-63	-67	-42	- 28.42

The biggest change in the water level of the Caspian Sea was in 1862 (-24.0 m) and in 1976 (-29.0 m). Since 1976, the water level of the Caspian Sea began to rise and in

1978-1995, the water level rose by ~2.5 meters. Since 1996, the water level in the Caspian Sea has started to decrease. In the years 1996-2022, the water level in the sea has decreased by more than ~1.33 meters (Table 1). In the years of 1996-2022, the water level in the sea has decreased by more than ~1.33 meters. At present, the level of the sea water continues to decrease.

As a result of the lowering of the water level in the Caspian Sea, the studying of the changes in the wintering behavior of the Red Book species that migrate and winter in the Gizilaghaj Bay is important for the solving the problem of the preserving the natural biological diversity and gene pool (Sultanov & Karimov, 2007).

2. Material and methods

The researches were conducted in 2018-2024, on foot, by car, using motorized and non-motorized boats, every year mainly in the months of November, December, January, February at 900-1700 hours, sometimes at night hours. The binoculars and a Carl Zeiss telescope were used. The changes occurred in the wintering behavior of the migratory-wintering Red Book species are carried out in their feeding, resting areas, in the areas where they spend the night, etc.

3. Results and discussion

The lowering of the water level in the Caspian Sea creates a difference in the water level of the Northern and Southern parts of the Gizilaghaj Bay. Since the Greater Gizilaghaj Bay is connected directly to the Caspian Sea, the lowering of the water level in the Caspian Sea also causes the lowering of the water level in the Greater Gizilaghaj Bay. There is no connection directly of the Lesser Gizilaghaj Bay with the Caspian Sea. The Lesser Gizilaghaj Bay is connected with the Greater Gizilaghaj Bay by three canals and pipes, so it has become a closed water pool. The lowering of the water level in the Caspian Sea causes a difference in the water level in the Northern and Southern parts of the Spawning channel of the Gizilaghaj Bay. The Kura River flows to the Northern part of the Gizilaghaj Bay from its Spawning channel, through the rivers of Vilash, Orman and Akkusha which started from the Talish Mountains. Therefore, the water level is high in this area and the area is connected with the Greater Gizilaghaj Bay through the pipes. And in the Southern part of the Lesser Gizilaghaj Bay from the Spawning Channel, the water flows to the Greater Gizilaghaj Bay and from there to the Caspian Sea through the Fish Passing Channel as and the water level is falling. The reason is that the Lesser Gizilaghaj Bay is located relatively higher than the Greater Gizilaghaj Bay and the Caspian Sea. The occurred changes cause the decreasing of the trophic and biotope relations and wintering places of the migratory-wintering Red Book species during the wintering period.

Starting from 2008, the reeds (Phragmites australis), which are one of the main biotopes of the migrant-wintering species in the Gizilaghaj Bay, has started to rot and fail in a massive way. In 1995, when the water level in the Caspian Sea was high, the length of the “mirror” area of the Lesser Gizilaghaj Bay was ~14,598 m and the width was ~5,903 meters. In 2024, during the period of low water level in the Caspian Sea, the length of the “mirror” part of the Lesser Gizilaghaj Bay increased to ~16,087 meters and its width to ~7,537 meters (due to the massive decay of the reeds). In 2018-2024, as a result of the lowering of the water level, the reeds (Phragmites sp.), tamarisk (Tamariks sp.) and the plants belonging to the Cyperaceae family remained dry and in some places were

destroyed completely. Due to the lowering of the water level, in 2024, in the Bay, in the direction of the sea from the Fish Passing channel (over the bridge) 38º56′50″N 48º55′31″E, the length of the dry area between the water area of the Greater Gizilaghaj Bay (38056′45″N 48056′21″E) was ~1,241 meters, the area was 219 ha, from the post 1 (38057′35″N 48055′22″E) from the road to the Crash channel (38059′10″N 48055′25″E the cement road with the sluices) (38058′15″N 48055′20″E) the length of the dry area between the water area of the Lesser Gizilaghaj Bay (38057′39″N 48054′42″E) was ~960.0 meters, and the area was ~116.0 ha. The land-air distance from the 1st post to the Crash channel is ~2,932 meters. The length of the dry area between the 1st post and the water area of the Greater Gizilaghaj bay (38059′28″N 48057′20″E) between the post 1 and the Crash channel is ~2,822 meters and the area is ~794.0 ha. The land-air distance from the Crash channel to the Spawning Channel (39004′10″N 48054′09″E) is ~9,460 meters. The length of the area which became the dry area is ~4,029 meters, the distance from the Spawning channel to the water area of the Greater Gizilaghaj Bay (39003′32″N 48056′48″E). The area of the place which became the dry area is ~2,786 ha in the direction of the Greater Gizilaghaj Bay between the Crash channel (38059′10″N 48055′25″E) and the Spawning channel (39004′10″N 48054′09″E).

Despite the lowering of the water level in the Caspian Sea, the water level does not decrease in the area of Pirman, which is located in the Northern part of the Fish Passing channel. The reason why the water level does not go down is that the water of the Vilash and Akkusha rivers flows into Pirman. The area of the water part of Pirman is ~3,950 ha. From the entrance gate of the Pirman channel (39004′21″N 48053′27″E) to the watery shore of the Greater Gizilaghaj Bay (39003′32″N 48056′48″E), the length of the area which became the dry area is ~5,076 meters, the distance to the dry area in the direction of the Gizilaghaj village (39005 ′37″N 48048′49″E) is ~7,090 meters (Figure 1).

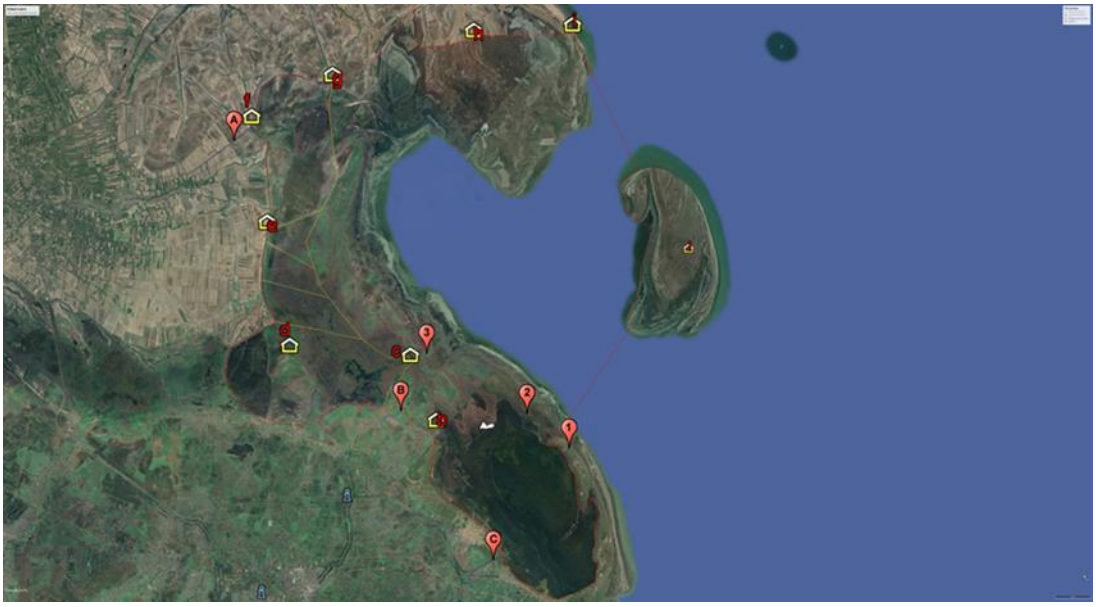

Figure 1. 1 - Fish Passing channel, 2 - Crash channel, 3 - Spawning channel, A - Akkusha river, B - Vilash river, C - Gumbashi river, i - Mikayilli post, h - Garagush post, g - Akkusha post, f - Khazar post, e - Itdishi post, d - Gizilaghaj post, c - Haji post, b - 2nd post, a - 1st post

One of the main wintering areas of the Red Book species is Kurdili Island and nearby wetlands of its. Taking into account that the water level has lowered by more than 2 meters in the last 20 years, during the period of its high level in 1995, the water distance from the administrative building of the 1st post to the Kurdili Island was ~11,804 m and in 2023, this distance has decreased to ~10,400 m. In 1995, the length of the island was 12,758 meters, the width was 5,197 meters, the area was 4,894 ha and in 2023, it increased to ~15,026 meters, the width was ~7,720 meters and the area was ~9,048 ha. All these occurred changes have caused to the reduction of the wintering places, to the changing habitats and behavior of the migratory-wintering Red Book species.

Branta ruficollis, included in the Red Book (2023) from the *Anseriformes* order, is met rarely in the flocks of *Anser erythropus* in the Gizilaghaj Bay. In the harsh winter months, the number does not exceed 50 individuals (Agaeva *et al*., 2020). The changes in wintering behavior are related to the lowering of the water level. *Cygnus olor,* included in the Red Book (2023), winters mainly on the South-Western coast of the Caspian Sea. The arrival of the species to the Gizilaghaj Bay for the wintering is connected with the fall of cold in the Northern countries and lasts mainly from the 2nd decade of November to the end of February. On the South-Western coast of the Caspian Sea, 26,445 individuals were noted in the harsh winter months of 2010 and only 163 individuals were noted in the mild winter of 2022 in Azerbaijan (Taghiyev, 2024). The largest wintering place of this species in Azerbaijan is Gizilaghaj Bay. In the Gizilaghaj Bay, its main food consists of the aquatic plants, aquatic insects and fish. Years ago, *Cygnus olor* wintered more in the Greater Gizilaghaj Bay than in the Lesser Gizilaghaj Bay. During the wintering period, it settled in ~11,869 meters of the open water areas between Garagush post (39014′45″N 49002′15″E) and Mikayilli post (39011′19″N 49009′13″E) near the coast of the Greater Gizilaghaj Bay. This area is famous as the main wintering area of swans (Gughlug). As the main wintering area of swans, this place is called Gughlug. As a result of the lowering of the water in the Caspian Sea, most of the wintering areas of this species became dry, which caused to a decrease in the wintering places and a change in their behavior. Although it is a Red book species, the number of the wintering individuals of *Cygnus olor* in the Gizilaghaj Bay is more than the combined number of the wintering individuals of the *Cygnus cygnus, Cygnus bewickii* species. *Cygnus olor* does not enter into food competition with the other Red book species, which migrate and wintering in their wintering areas, because they take their food relatively deeper.

Cygnus bewickii, a migrant-wintering Red Book (2023) species, is a small occasional migrant and passerby in the open, relatively shallow waters of the Bay. The migration and settlement takes place from the end of October to the middle of November. They leave the area in the first decade of March. They spend their nights in the open water areas of the Bay and the sea near the coast when there are disturbing factors. In the harsh winter months, the number does not exceed 50 individuals (Patrikeev, 2004; Sultanov *et al*., 2010). In the Gizilaghaj Bay, it is met sometimes in the flocks of *Anser erythropus* and the other geese. During the wintering period, it is met with the other swan species in the open water areas called Gughlug in the area of ~11,869 meters between Garagush Post (39014′45″N 49002′15″E) and Mikayilli Post (39011′19″N 49009′13″E) near the coast of the Greater Gizilaghaj Bay.

In 2010, 25.0 individuals of *Anser erythropus*, a species of the Red Book (2023), were noted near the Garagush post of the Gizilaghaj National Park. In 2011-2014, 1000 individuals wintered in the Gizilaghaj National Park (Taghiyev, 2024). The main wintering place is the Gizilaghaj Bay. It is met together with *Anser anser* in the Gizilaghaj

Bay, but nighting and feeding biotopes are separate or they separate during the nighting and feeding. Along the South-Western coast of the Caspian Sea, it is more met in the open water areas near the shore in the Lankaran Plain. When it feels threatened, it spends the night in the open water area in the Gizilaghaj Bay. As a result of the lowering of the water level in the Caspian Sea, there have occurred a decrease in the water areas where this species spend its nights, rests and shelters, but there have been no changes in its feeding places on dry area.

Marmoronetta angustriostris, which is included in the Red Book, settles mainly in the open water areas of the Lesser Gizilaghaj Bay with a lot of aquatic plants and in the shallow water areas near the shore of the Greater Gizilaghaj Bay, due to the lowering of the water level in the Caspian Sea. It is a species few in number which winters irregularly. In the harsh winter of 2010, up to 600 individuals were noted in the Gizilaghaj Bay (Sultanov *et al*., 2010). The lowering of the water level in the Caspian Sea, has reduced significantly the area of the places where it feeds and settles during the wintering period in the Gizilaghaj Bay.

Aythya ferina, included in the Red Book, is a wintering and passing species in the area. As a result of the lowering of the water level in the Caspian Sea, the area of the placess where it feeds and winters has decreased significantly. Compared to the other migratory-wintering Red Book species, the number is relatively high in the wintering period of the research area. In the open water areas of the Lesser Gizilaghaj Bay, which are rich with the aquatic plants and in the shallow water areas near the coast of the Greater Gizilaghaj Bay, a certain part of the areas where it is fed and inhabited has become to he dry area or unusable swamp.

Aythya nyroca, included in the Red Book of the Republic of Azerbaijan, has a wintering population as well as a sedentary population in the research area. The sedentary popuplyation is mainly settled in the Pirman area. Up to 40-60 pairs are met in the open water areas and wetlands rich with the aquatic plants of Pirman (Taghiyev, 2024). The lowering of the water level caused the failure of large areas in the Southern part of the Spawning Channel of the Bay and in the Northern part of Pirman. Due to the small number of the species, the changes that occurred did not affect significantly to the feeding and settlement areas. *Clangula hyemalis,* included in the Red Book of the Republic of Azerbaijan, is an irregular wintering species in the area. It is mainly met in the open coastal waters of the Bay. The number is very small. In some years it was noted singly. *Melanita fusca,* included in the Red Book of the Republic of Azerbaijan, inhabits in the shallow waters of the coast of the Greater Gizilaghaj Bay, sparse reedy areas and in the open water areas of the sea. In 2008, 4 individuals were noted in Gizilaghaj Bay (Sultanov *et al*., 2011). It is an occasional and migratory bird. Its food is mainly aquatic plants in the Lesser Gizilaghaj Bay, small fish, molluscs and larvae of the aquatic insects in the shallow water areas of the Greater Gizilaghaj Bay. Due to its small number, the changes in the wintering areas have a weak effect on this species.

Oxyura leucocephala, which is included in the Red Book of the Republic of Azerbaijan, is a wintering species in a rare number which winters in the shallow part of the Gizilaghaj Bay and in the small lakes near the coast. The lowering of the water levels have caused to the reduction of the wintering places and as a result, have changed their wintering behavior to less vegetated deep water areas of the Caspian Sea. Since the number is rare, the changes in feeding and biotope habitats associated with the lowering of the water level do not affect significantly to the species.

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