Symbiosis

www.symbiosisonlinepublishing.com
ISSN Online: 2475-4706

Research Article | International Journal of Marine Biology and Research | Open Access

The Effect of Drying of Urmia Lake on Community Structure and Species Diversity of Waterbirds in Kaniborazan Wetland, 1995, 2005, and 2015

Behrouz Behrouzi-Rad*

*Department of Environment, Wildlife Ecology specialist and ornithologist, College of Agriculture and Natural Resources, Islamic Azad University, Ahvaz Branch, Tehran, Iran.

Received: April 29, 2019; Accepted: May 08, 2019; Published: May 13, 2019

***Corresponding author:** Behrouz Behrouzi-Rad, Department of Environment, Wildlife Ecology specialist and ornithologist, College of Agriculture and Natural Resources, Islamic Azad University, Ahvaz Branch, Tehran, Iran, E-mail: bbehrouzirad@yahoo.com*

Abstract

Dryness effects of Lake Urmia on water birds population and species diversity changes carried out by total count method in 1995, 2005 and 2015. Thirty three water birds species with a population 5576 individuals counted in 1995(water level of Lake Uromia was 1277.96 masl and the area of wetland was 907 hectare, 23 water birds species with a population 2363 individuals counted in 2005, (water level of Lake Urmia was 1273.41masl, area of Kaniborazan was 600 hectare, 17 water birds species (11species were swimmer waterbirds and 6 species were waders and wading birds) with a population 660 individuals counted in 2015,(south part of lake Urmia was dried completely and depth of north part of the lake was less than one meter, water level of lake Urmia was 1270.1 masl and area of the Kaniborazan was 200 hectare). Comparison of number of water birds and number of species in three years showed the water bird's population and number of species declined. The species reduction was 41%, and population reduction was 88%. β diversity was 0.24, 0.38, and 0.43 in 1995, 2005 and 2015 respectively. Species diversity was 28, 23, and 17 in 1995, 2005 and 2015 respectively, and γ diversity was 33. Margalef's index were 3.36, 3.09 and 2.47, Fisher-Alpha index were 4.16, 3.90 , 0.19 and Simpsons evenness were 0.31,0.47 and 0.49 in 1995,2005 and 2015 respectively. Comparison of diversity indices showed that they reduced, and dominance and evenness indices decreased in three years. The main reason was drying effects of Lake Urmia on the Kaniborazan Wetlands Ecosystem.

Keywords: Lake Urmia; water birds Population changes; Species diversity; Kaniborazan; Iran;

Introduction

Water birds are one of the most important indicators of the suitability and management of changes in wetland habitats [15]. Diversity variations, populations, biodiversity indices and waterbird density, are an appropriate index in determining the health status of the ecosystems of the wetlands, [10,14]. Therefore, the study of changes in the diversity and density of waterbirds in different years can serve as an indicator of the health status or threats in the ecosystems of the wetlands [23]. On the other hand, Iranian wetlands in West Asia are very important for the survival of waterbirds [27]. The wetlands of southern Lake Urmia in Iran are more important in spring and summer [2,7]. Because other wetlands of Iran are hotter in spring and summer than wetlands at south of Lake Urmia, while wetlands of south of Lake Urmia are more suitable habitat for the presence of waterbirds [7]. Therefore, they are of more importance to maintain the populations of migratory water birds, chicks, and resident water birds [27]. Due to this, the wetlands of the southern Urmia Lake are considered as sensitive habitats [7], especially the Kaniborazan wetland, which globally threatened species such as White-headed Duck *Oxyura leucocephala* and Marbled Duck *Marmaroneta angostirostris* (IUCN, 2010). They were reproducing in these wetlands [1,2,4]. Also, they are a sensitive habitat for protected water birds species in Iran such as White Stork *Ciconia ciconia* and Herons, which are located on the outskirts of Lake Urmia [7]. After drying of Lake Urmia, wetlands in south of Lake Urmia have played a greater role in protecting waterbirds dependent on the ecosystems of Lake Urmia, and the only sources of nutrition of these species are wetlands at south of the lake such as the Kaniborazan wetland. The Kaniborazan wetland with the Lake Urmia has a hydrological and ecological relationship [11]. The Mahabad River first pours into the Kaniborazan wetland. In the wet years, the wetland flows into Lake Urmia [3,4]. Regarding the habitat values due to the nature of the Lake Urmia with the Kaniborazan, the breeding species of waterbirds in Urmia Lake such as Grater Flamingo *Pheonicopterus ruber* and White Pelican *Pelecanus onocratolus* with their newly-hatched chicks come to Kaniborazan for feeding and use security [1,2,3,6]. After the chicks fledged, they leave the area to wintering habitats [7]. At the time of the presence in the Kaniborazan wetland, if they threaten by natural or human factors, they will take refuge in Lake Urmia. In fact, the survival of waterbirds depends on the survival of the Kaniborazan wetland and Lake Urmia. Survival of the wetland and Lake Urmia is also tied to the amount of water

received. A review of the published articles showed that so far no study has been performed on the water birds of the Kaniborazan wetland due to the drying of Lake Urmia, only its waterbirds are counted in the winter along with other wetlands in the West Azarbaijan province [11,12]. Due to the drying of Urmia lake in recent years [1,2,4,6,7,16,25,26,27]., its ecological functions have been changed and caused the collapse of the colony of breeding water birds of Urmia Lake [7] and the waterbirds of the southern wetlands of lake Urmia, including the Kaniborazan wetland. These changes and population fluctuations of the waterbirds of the Kaniboarazan wetland are, as an indicator of the quality and ecological function of the Kaniborazan wetland. The purpose of this study was to investigate the effect of drying of Urmia Lake on Kaniborazan wetland by comparing the biodiversity indicators of water birds in the wetland in 1995 wet year, 2005 low water and in 2015, the dry year (South of Lake Urmia was quite dry and the Kaniborazan wetland has very low water in 2015).

Materials and Methods

Study Area

The Kaniborazan wetland is located 30 kilometers north of Mahabad City, south of Lake Urmia, in the geographical position 36°59'32"N450°46'39"E [3] figure 1. Its area was 907 hectares in the wet years, decreases to about 200 hectares during dryness, or sometimes it is completely dry [21] figure 2. The altitude is 1375 meters from sea level. Depth of water has been decreased from 120 centimeters to 40 centimeters in 2015 [3]. The Kaniborazan wetland is managed by the Department of Environment of Iran as the protected area, and is the first place for bird watching in West Azarbaijan Province [3,12]. It has been registered in Ramsar sites as an international importance wetland. Based on the classification of the Ramsar Convention, it is in the Palustrine fresh water wetlands group, [24]. From the springs of Ghareh-Dagh, Khor-Khore villages, the surface waters, and part of Mahabad River receive water. There is an ecological and hydrological relationship with Lake Urmia. Drying of Urmia Lake is effective on the environment of Kaniborazan wetland. In the rainy time of Urmia Lake, its water entered the wetland, and in the rainy days of the wetland, the water overflowed into the lake [12]. There are 45 plant species of 35 genera and 17 families in the Kaniborazan wetland, which make up 21 plant communities. Important plants around the wetland include the Chenopodiaceae and Graminae grasses. Plants exited from water such as *Typha sp, phragmites sp, cerax sp, scirpus* sp and *immersion such as Ceratophyllum* sp and halophyte and dominant species between wetland and lake of Urmia, are *Tamarix sp, Alhaji camelus, Salicornia sp, Suaeda sp* [21].

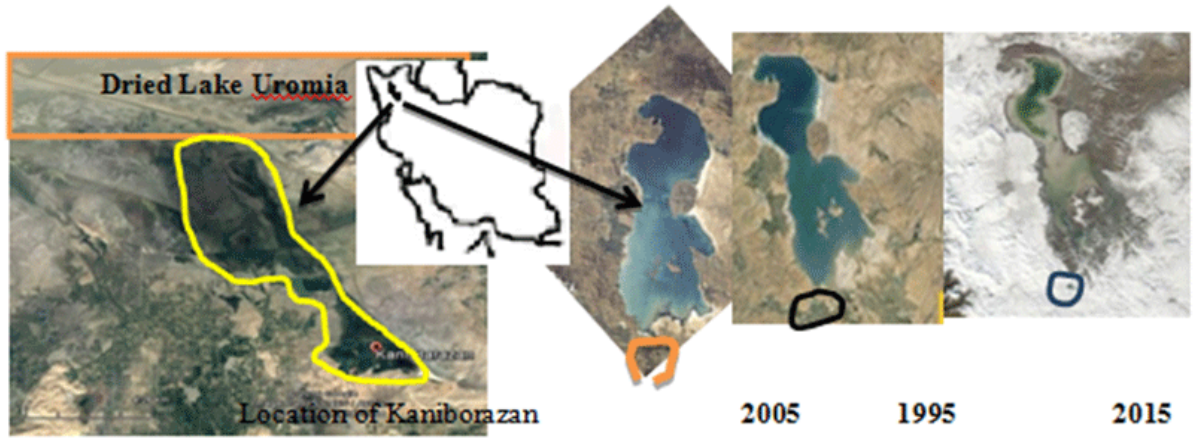

Figure 1: Location of Kaniborazan at south of Lake Urmia (Google earth 2015)

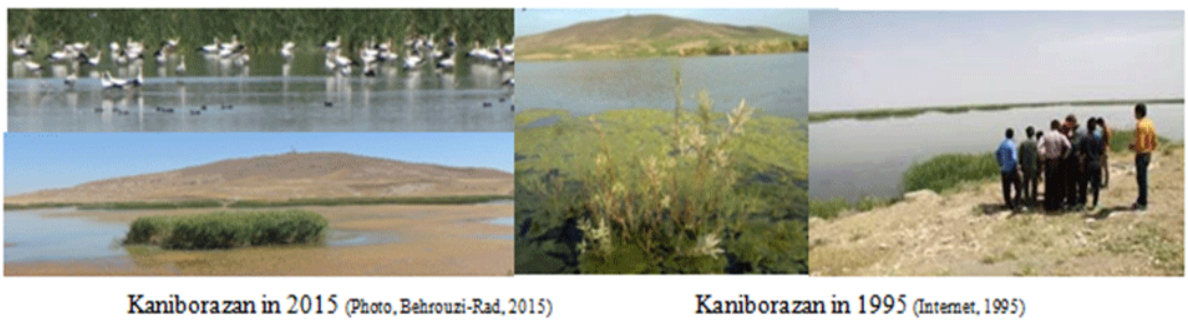

Figure 2: Natural features of the Kaniborazan wetland in December 2015

Data collection

The count of water birds was done according to the advice of Wetland International using the Total Count method [28]. The (WI) has been using this method since 1968 in the world's wetlands for the census of water birds. In Iran, the Department of Environment has been using this method since 1969 for counting water birds in wetlands. For these reason water birds of the Kaniboarazan wetland were counted on September 10, 1995, September 13, 2005, and September 12, 2015 by direct counting of total count method with 40×10 Zeiss binocular and 15×60 telescopes. The counts lasted from 7 am to 12 noon. Water birds were identified using the Field Guide to the Asian Water birds [9] Biodiversity indices, alpha, beta and gamma diversity [29]; waterbirds of the Kaniborazan wetland using Past software [18] and Ecological Methodology [19] are calculated with the following Formulas. The biodiversity indicators calculated in this study were Shanon-Winnier $H' = -\sum_{i=1}^{s} PiLn(Pi)$, Simpson

Dominance $1-D = 1-\sum_{i=1}^{s}\left[\frac{ni(ni-1)}{N(N+1)}\right]$, Margalef and Menhinick richness $R = \frac{S-1}{LnN}$, $D_{mn} = \frac{S}{\sqrt{N}}$, Species evenness $E = \frac{H'}{Ln(S)}$ Berger-Parker evenness $d = \frac{Nmax}{N}$, Brillouin $Hg = \frac{1}{N}\log\left(\frac{N!}{n1!n2!n3!.....}\right)$, Equitability $E = \frac{H'}{Ln(S)}$ Fisher-alpha S= αln(1+n/α), alpha, beta, and gamma diversity have been used by [29], α Diversity is the variety of species found in a community, habitat, or specific ecosystem, β diversity $\beta = \frac{G+L}{2a}$ and γ diversity is the richness of a range of habitats in a geographic region and percentage similarity coefficient and Euclidean difference measured with Past Software [18] Globally threatened species distinguished by the IUCN 2015 criteria's, and protected species in Iran are distinguished by rules of Department of Environment of Iran [10]. The meteorological information of the area has been extracted from the site of the West Azerbaijani Meteorological Office [13].

Result

In the Kaniborazan wetland in 1995 (wet year), 5576 birds were counted belong to 28 species. In 2015, 660 waterbirds were counted from 17 species. The population declined by 88% and the number of species decreased by 39%. The south of Lake Urmia was completely dry in 2015, and the wetland was very small. The trend of waterbirds populations of the Kaniborazan wetland has been decreased from 1995 to 2015. (The number of waterbirds in three years was: (5576>2363>660) respectively. The decrease in the number of waterbirds in 2005 in comparison with 1995 was 57% and in 2015 compared to 1995 was 88%. The number of species of waterbirds in 1995 was 28; in 2015 it decreased to 17 species. Reduction was 39% (28>23>17). The total density of waterbirds decreased by 89% in 2015 compared to 1995. The decrease in shore birds in 2015 compared to the 1995 was less than the decrease in swimmer waterbirds. Reduction of shore birds was 50%. Changes in population and number of species of waterbirds in three years in table 1, biodiversity indices of waterbirds in the kaniborazan in table 2, variation of alpha , beta, and gama diversity has been showed in table 3, and the number of each counted species has been showed in three years in table 4.

Table 1: Changes in the number and density of water birds in 1995, 2005, and 2015 in Kaniborazan wetland Area of the wetland was 907 hectare and depth of it was 120 Centimeter in 1995. Area of the wetland was 300 hectare and depth of it was 60 Centimeter in 2005. Area of the wetland was 200 hectare and depth of it was 40 centimeter in 2015.

Birds Group	1995	2005	2015	Reduction Percent
Species number of swimmer waterbirds	20	15	11	Reduction:25% and 45%
Population of swimmer waterbirds	4929	1736	334	Reduction: 65% and 93%
Density per hectare of swimmer waterbirds	5.43	1.91	0.36	Reduction: 65% and 93%
Number of shore birds	8	8	6	Stable and reduction: 25%
Population of shore birds	647	627	326	Reduction: 3% and 50%
Density per hectare of shore birds	0.71	0.69	0.24	Reduction: 3% and 66%
Total number of waterbirds	5576	2363	660	Reduction: 41% and 88%
Density per hectare of all waterbirds	6.12	2.60	0.71	Reduction: 57% and 89 %
Species number of all waterbirds	28	23	17	Reduction : 18% and 39%

Table 2: Biodiversity indicators of water birds in Kaniborazan, 1995, 2005, and 2015

Biodiversity indices	1995	2005	2015	Status
Taxa-S	28	23	17	Reduced
Individuals	5576	2363	660	Reduced
Dominance-D	0.15	0.16	0.18	Increased
Simpson-1-D	0.85	0.83	0.82	Reduced
Shannon-H	2.23	2.17	2	Reduced

Evenness-e^H/S	0.31	0.47	0.48	Increased
Brillouin	2.21	2.44	1.95	Reduced
Menhinick	0.66	0.51	0.41	Increased
Margalef	3.36	3.09	2.47	Reduced
Equitability	0.65	0.76	0.77	Increased
Fisher-alpha	4.16	3.9	0.19	Reduced
Berger-Parker	0.29	0.28	0.22	Reduced
Chao-1	28	23	17	Reduced

Table 3: Alpha, beta, and gamma diversity of waterbirds in Kaniborazan three years, 1995.2005 1nd 2015

Beta Diversity	**1995-2005**	**2005-2015**	**1995-2015**	**Status**
Wittaker	0.24	0.38	0.43	Increased
Harison	0.007	0.02	0.018	Increased
Wilson-Shimda	4.64	3.61	3.57	Reduced
Alpha Diversity	28	25	17	Reduced
Gama Diversity		34		

Table 4: Changes in the number of waterbirds counted in the Kaniborazan wetland in September, 1995, 2005, and 2015 the percent reduction or increase is compared to 1995, because in 1995, Lake Urmia and the Kaniboarazan wetland were in normal condition**.** The numbers inside the Parentheses are the number of species

Species	**1995**	**2055**	**2015**	**Status %**
Little Grebe Tachibaptus ruficollis	12	8	5	Reduced 43% and 59**%**
Great Crested Grebe Podiceps cristatus	170	0	0	Reduced 100%
Pygmy Cormorant Phalacocrocax pygmeus	0	0	1	Increased 100%
Great White Pelican Pelecanus onocrotalus	6	0	0	Reduced 100%
Graylag Goose Anser anser	21	0	0	Reduced 100%
Greater Flamingo Phoenicopterus ruber	6	0	0	Reduced 100%
Marbled Teal Marmaroneta angustirostris	12	8	6	Reduced 43% and 50%
White-headed Duck Oxyura leucocephala	6	6	0	Stable and reduced 100%
Mallard Anas platyrhynchos	180	110	14	Reduced 39% and 92%
Common Pochard Aythya ferina	234	124	0	Reduced 47% and 100%
Gadwall Anas strepera	12	3	0	Reduced 75% and 100%
Ruddy Shelduck Tadorna ferruginea	6	0	0	Reduced 100%
Teal Anas crecca	1234	120	15	Reduced 90% and 98%
European Wigeon Anas penelope	45	150	0	Increased 70% and reduced 100%
Common Shelduck Tadorna tadorna	45	11	0	Reduced75% and 100%
Duck sp	1000	230	0	Reduced 77% and 100%
Coot Fulica atra	1211	662	72	Reduced 45% and 94%
Moorhen Gallinula chloropus	34	8	2	Reduced 76% and 94%
Black-headed Gull Larus ridibundus	85	35	24	Reduced 59% and 72%
Slender-billed Gull Larus genei	11	7	4	Reduced 26% and 63%
Herring Gull Larus argentatus	56	43	6	Reduced 23% and 89%
White-winged Black Tern Childonias Leucopterus	543	211	185	Reduced 61% and 66%

21 species Swimmer waterbirds	(20)4939	(915)1736	(11)334	Reduced 65% and 94%
Little Egret Egrta garzetta	12	34	134	Increased 65% and 91%
Grey Heron Ardea cinerea	21	18	43	Reduced 14%,Increased51%
Squcca Heron Ardeola raloides	13	14	0	Increased 7% Reduced100%
White Stork Ciconia ciconia	6	145	123	Increased 96% and 95%
Lapwing Vanellus vanellus	500	145	2	Reduced 71 and 99%
Spur-winged Plover Vanellus duvaucelli	0	0	2	Increased 100%
Black-winged Stilt Himantopus himantopus	34	18	12	Reduced 47% and 65%
Pied Avocet ricurvirostera avocetta	4	0	0	Reduced 100%
Sandpiper Tringa sp	45	227	0	Increased 80% and Reduced 100%
Redshank Tringa tetanus	0	14	0	Increased 100% and Reduced 100%
Green Sandpiper Tringa ocropus	0	12	0	Increased 100% and Reduced 100%
Little Stint Caldris minuta	12	0	0	Reduced 100%
Total of shore birds		**(8)627**	**(8)647**	**Reduced 3% and 50%**
Total of all waterbirds		**(23)2363**	**(28)5576**	**Reduced 41% and 88%**

Similarity and Euclidean difference coefficient for waterbirds of the Kanioerazan wetland

Table 5 shows the similarity and Euclidean difference coefficients of waterbirds of the Kaniborazan wetland in three years, 1995, 2005, and 2015. Table 5 shows that the most similarity between waterbirds in the Kaniborazan wetland was between 2005 and 1995 (66%) and the lowest similarity between 2015 and 1995 (30%). For this reason, Euclidean's greatest difference (356) was between 2015 and 1995.

Table 5: Similarity and Euclidean difference coefficients of water birds of the Kaniborazan wetland in 1995, 2005, and 2015

Year	1995	2005	2015
Euclidean distance			
1995	000		
2005	270	000	
2015	356	126	000
Similarity			
1995	000		
2005	66	000	
2015	30	37	000

Hydrology of the Kaniborazan Wetland

The rainfall data from the Pole Sorkh Abad Station of Mahabad city has been received. This station is located after the dam of Mahabad. Water flows from the dam to the Kaniborazan wetland. This station is located after Mahabad Dam. Water flows by Mahabad River from the dam to the Kaniborazan wetland. The rainfall was 317 mm in 1995, the area of the wetland in that year was 907 hectares, its depth was about 150 cm, and the average depth of the wetland was 1 meter. Therefore, under wet conditions in the wetland, its volume is estimated at 907 million cubic meters. The rainfall was 164 mm in 2005, the maximum depth of the wetland was 1 m, the average depth was 50 cm, and the volume of water in the wetland in that year was 450 million cubic meters. The rainfall was 302 mm in 1394, but the maximum depth of water in 2015 was about 40 cm and the average depth was about 40 cm table 6. Despite rising rainfall in 2015, the depth of the wetland has decreased, which results from water harvesting upstream of the wetland. So the volume of water in the wetland in this year was 181 million cubic meters. Correlation coefficients between wet and dry years with the number and diversity of waterbirds indicate that the diversity and number of waterbirds has a significant relationship with water content, area, and depth of the wetland. Variation and the density and number of birds show a significant difference among 1995, 2005 and 2015, table 7.

Table 7 shows there is a correlation of 0.507 between the depth and area of the wetland with the number of swimmer waterbirds and shore birds, and correlation is 0.44 with a total population of waterbirds and depth and area of the wetland. Also, the area and depth of the wetland with the number of species,

and the population of swimmer waterbirds, and the number of species and populations of shore birds were in the range of (-0.125), (-166.0), (-0.12) , (-0.37) and (-0.24) have a negative relationship. These numbers indicate that the depth and the area of the wetland has decreased, the number and population of birds has also decreased. Figures 3 and 4 also confirm this mater. By decreasing the area of the Kaniborazan wetland, the number of waterbirds has decreased, and with the decrease in the depth of the wetland, the number of species of waterbirds has also decreased

Table 6: Area, depth and number of waterbirds in the Kaniborazan wetland in 1995, 2005, and 2015

Year	Wetland area	Average depth	Rainfall	Species number of swimmer birds	Number of swimmer waterbirds	Species number of shore birds	Number of shore birds	Total Species Number	Total Number of waterbirds
1995	907	100cm	317mm	20	4929	9	647	28	5576
2005	400	50cm	164mm	15	1736	8	627	23	2363
2015	200	40cm	302mm	11	334	6	326	17	660

Table 7: Pearson correlation coefficient for determining the relationship between area, depth, populations, and bird diversity of Kaniboarazan Wetland in 1995, 2005 and 2015

Factors	Pearson correlation	Area and depth
Area and depth of wetland	Pearson correlation	1
	Sig. (2-tailed)	
	Number	12
Total species of waterbirds	Pearson correlation	0.507
	Sig. (2-tailed)	0.093
	Number	12
Total population of waterbirds	Pearson correlation	0.44
	Sig. (2-tailed)	0.15
	Number	12
Species number of swimmer waterbirds	Pearson correlation	-0.125
	Sig. (2-tailed)	0.7
	Number	12
Population of swimmer waterbirds	Pearson correlation	-0.166
	Sig. (2-tailed)	0.6
	Number	12
Number of species of shore birds	Pearson correlation	-0.12
	Sig. (2-tailed)	0.7
	Number	12
Population of shore birds	Pearson correlation	-0.37
	Sig. (2-tailed)	0.24
	Number	12

Discussion

Before the drying of Lake Urmia, the Kaniborazan wetland was connected to it. Its water was from direct precipitation, surface runoff of the adjacent hills, Khor-Khore and Qaradagh springs, and the Mahabad River. During wet years it's splashed into Lake Urmia. During the wet years of Lake Urmia, the water returned to the Kaniborazan wetland. Increase or decrease of amount of water of Urmia Lake influences in depth, area, and amount of water and wetland area. Among the most important impacts of Urmia Lake's water advent and retreat towards the Kaniborazan wetland is the drying of the surrounding areas of the Gharedagh canal, the northern, northwest, and eastern parts of the wetland. The lands left for the advancement and retreat of Lake Urmia waters have been transformed into salt lands, and

Plants that grow in salty lands have quickly been replaced in these lands. The advent of the salty water into the Kaniborazan caused the intersection of freshwater mixture with different gravity and two separate layer of water in the opposite flow. Because fresh water of wetland is lighter, it flows from the surface layer to the Urmia Lake, and the Salty water of Lake Urmia, which are heavier, moves from bottom of the lake to the wetland. The fresh and salty water contributed greatly to the entire ecosystem of the wetland, especially the superiority and type of the Fauna and flora of the wetland. These Since 1995, which was a wet year, and Lake Urmia, were connected to the Kaniborazan wetland, when the south of the lake Urmia was completely dry in 2015, depth and area of the wetland decreased by less than 30%, it was negative affected on the number, diversity, density, and abandoned of waterbirds and species diversity reduced from 28 to 17 species and population of waterbirds decreased from 5576 to 660 individuals figures 3 and 4. In a similar study in 2013 Behrouzi-

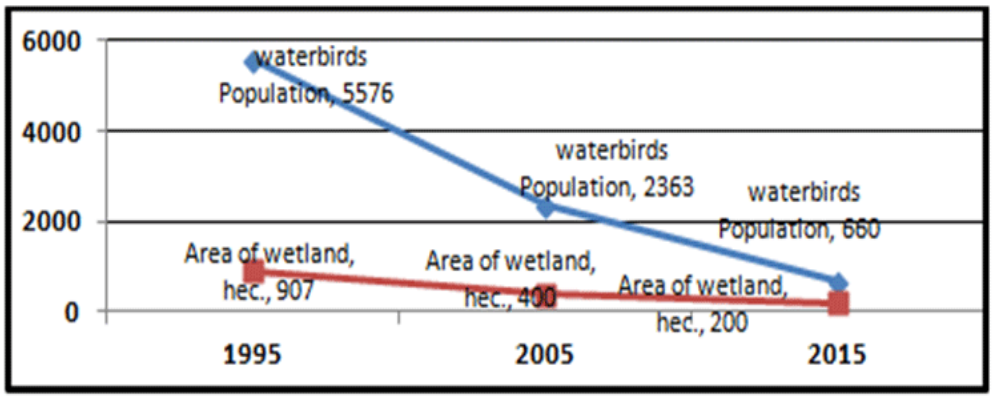

Figure 3: Relationship between trend of waterbirds population and area of kaniborazan in three years

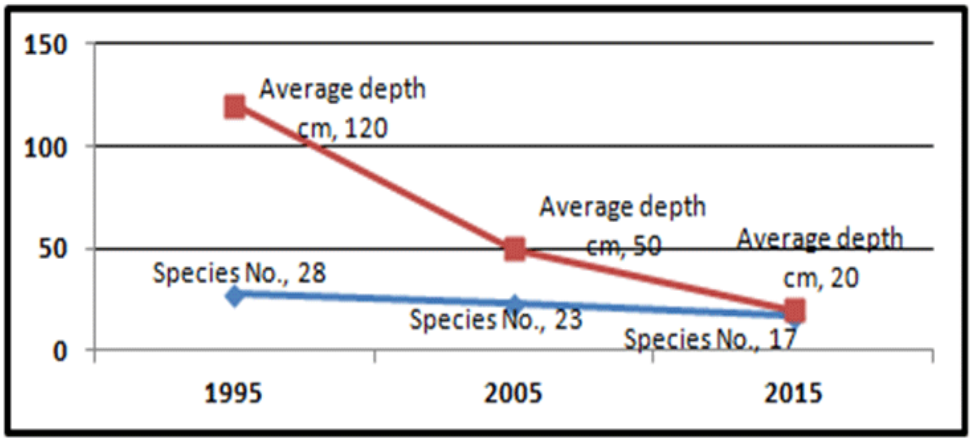

Figure 4: Relationship between average depth of wetland and species number of waterbirds in three years

Rad reported the Urmia Lake drying affected on the populations of breeding waterbirds in Urmia Lake and breeding population of waterbirds has reduced 98 percent in 2001 [7]. His findings confirm the results of this study. Therefore, drying of Lake Urmia and decreasing the Area and depth of the Kaniborazan wetland have had a negative effect on the diversity and density of waterbirds table 1. Reducing the depth of the wetland has not only had a negative impact on diversity and density, but has also changed the species composition of the waterbirds in the wetland. The wetland was dominated by swimmer waterbirds in 1995; Species such as Pochard with population 234 individuals, Coot with 1211 individuals were dominant. These two species are the diving waterbirds that perform the water bodies with a depth of more than 1 meter [26]. But, the population of the two species is decreased to 120 and 622 in 2005 respectively, and it is decreased to zero and 72 individuals in 2015 respectively. A 100% reduction was in pochard population and a 94% reduction in Coot table 4. The reason for this is to reduce the depth of the water in the wetland, which allows dive into the water and reach for food at the bed of wetland. Because the depth of water has been reduced, this is not possible as a result populations of these species reduced. But White Stork, the Little Egret and the Grey Heron are

the shallow water index (water index with a depth of less than 40 centimeters), and by walking in the shallow waters or standing together in shallow places, they feed on the aquatic animals [9], from 6 to 123 individuals (95% increase), from 12 to 134 individuals (91% increase) and from 21 to 43 individuals (51% increase), respectively. Reducing the diving species and increasing the shore birds species indicates a decrease in the volume and depth of the water, confirming the decline in the size of the wetland figures 3 and 4. The drying of the Urmia Lake has not only lost the breeding bird's colony in the lake [7], but also negatively affected the southern wetlands of the lake, and the diversity and composition of the species of shore birds and swimmer waterbirds in the Kaniborazan wetland has been reduced and the composition of their species has changed. The population of the White-winged Black Tern Chelidonias leucopterus population, which catches the fish or other water animals from surface of water [9], has decreased from 543 in 1995 to 185 in 2015 (66%), indicating that the Kaniborazan wetland habitat changed in 2015 for the food of this species and caused to reduced its population table 4. The population of shore birds such as lapwing and Black-winged Stilt reduced 99.5% and 65%, respectively table 4. These species feed on benthoses at around of wetlands [9]. Due to the drying of moisture lands around the wetland, due to reduction of its depth and area, it is impossible to feed to benthos eaters such as Waders and shore birds, as a result, their populations have declined. Of the three fish-eating species, the White Pelican population, from 6 to zero, population of Little Grebe from 12 to 5, and the population of Great Crested Grebe, declined from 170 to zero individuals in 2015 table 4. This indicates the deterioration of the aquatic environment in the wetland and its impact on the populations of waterbirds. Changes in population and number of species have a negative effect on biological indices, species diversity, such as Margalef, Shannon-Weiner, Fisher-alpha, Menhinick, Brillouin and Alpha diversity reduction, evenness and dominance of Simpson and Wittaker and Harison beta have increased tables 1 and 2. Also, the similarity of the population of waterbirds in the years 1995 and 2015 was reduced, and the Euclidean difference coefficient was increased table 5. The Euclidean difference coefficients of the Kaniborazan wetland between 1995, 2005, and 2015 were 126, 356 and 270 respectively, and their similarity was 66, 30, and 37 percent, respectively table 5. The difference in Wittaker's beta diversity were 0.24, 0.38, and 0.43, and the Harison beta diversity were 0.007, 0.020 and 0.018 respectively in these three years, indicating a significant difference between the waterbirds community in 1995 with the 2015 waterbirds community. Biodiversity indicators of waterbirds have decreased, such as Margalf species diversity index from 3.36 to 2.47, Fisher-Alpha diversity from 4.16 to 0.19, but Simpson's evenness increased from 0.31 to 0.48 finding that changes in the community of waterbirds, because with the reduction of diversity, evenness means the distribution of species within the population has become more uniform. Reducing diversity and increasing uniformity is a reason for the decline in the quality of the habitat of the wetland. The percentage of similarity of waterbirds in three years was 66, 30 and 37 percent, respectively, and Euclidean difference of waterbirds in the three years was 126, 256 and 370, respectively, which indicates the difference in the population of waterbirds between 1995, 2005 and 1394, tables (1 and 3). Reducing species diversity, increasing uniformity, reducing the biodiversity index of waterbirds is in relation to wetland water status tables (3 and 7), it was wet year in 1995 and connected to the Lake Urmia, but in 2015 (dry year) it was separated from the lake and its water depth decreased, resulting in a decrease in its area by 30%. These findings are confirming the results of the study of the effects of drying Lake Urmia on the breeding waterbirds of the lake of Urmia in 1981 and 2011 [7]. In a similar study, Khalilipour and Behroozi Rad (2007) investigate the relationship between the species diversity and number of waterbirds in the southern wetlands of the Caspian Sea, and concluded that in larger wetlands, species diversity and number of waterbirds were higher than small one [8]. The current study confirms the results of that study. Golshahi et al., In (2009), have achieved the same result, in the study of the population and species diversity of waterbirds in the Alagol, Almagol and Ajigolag wetlands at south of Caspian sea coasts, and reported that in wetlands with greater depth and Area, the number of waterbirds and species diversity are higher. Nabavi and colleagues (2005), in a similar study, reported that in deep parts of Shadegan wetland, diving species of waterbirds were more than shallow parts of wetland, and waterbirds were more in the shore and shallow parts of the Shadegan wetland, which is similar to the results of current research and confirms it. [30], studied changes in the diversity and abundance of waterbirds in water ecosystems in Khorasan Razavi province and reported that in larger wetlands, the number of species and the population of birds is higher. His findings are similar to the results of the current study, and confirm it. [14], in a study titled waterbirds as an indicator of the environmental condition, has reported that population changes and species diversity are influenced by the environmental quality of the wetland, its water content and its depth. The results obtained by Green are similar to this study, and confirm it. The results of past and current researches indicate that the water level, depth, and Area of the wetlands in the amount of Alpha, Beta and Gamma diversity, Margalf, Berger-Parker, Brillouin, Shannon-Weiner, and Menhinik diversity in water ecosystems biodiversity indicators are effective, and the alpha diversity, which expresses the number of species in each ecosystem, is higher in larger wetlands. Beta diversity, which indicates the difference between two times in one ecosystem, or in two ecosystems, shows that the difference in the number of species in the kaniborazan has increased from 1995 to 2015 table 3. The final result is that one of the most important values of this wetland is the protection of waterbirds, which provides an attraction for birdwatchers figure 2. According to the latest survey, 32 species of waterbirds belonging to 11 families were identified and reported in this wetland. With Terrestrial bird's species, this number reaches more than 100 species. The diversity of

waterbirds and terrestrial reveals the importance of the Kaniborazan wetland. The presence of endangered species, such as Pygmy Cormorant, Farraginous Duck, White-headed Duck, Marbled Duck, and Protected species in Iran such as White Pelican and White Stork [10] adds value to the wetland value. For this reason, the Kaniborazan wetland has been added to the list of important international wetlands in 2011 and has been registered at the Ramsar Convention as an important international wetland [12]. Drying the Lake Urmia and disconnecting water between the wetland and the lake, dividing the wetland due to the construction of a drainage channel, which completely dries the majority of the Kaniborazan wetland during the summer. Reduced area of the wetland due to drying, failure to comply strictly with the environmental protection regulations,(the existence of illegal hunting and fishing), construction of small hunter room in the wetland, grazing on the inside of the wetland in the spring, easy access to the wetland, lack of tourists management in the wetland, water drainage of the Kaniborazan wetland, the entry of pesticides into the wetland, Harvest of water plants such as Typha and Phragmites and finally drought are the most important threat factors in the wetland. In the absence of attention and planning to protect and manage its ecosystems, the remaining small population of waterbird will also be destroyed. Most importantly, the lack of management program, failure to restoration the Lake Urmia timely will lead to a crisis of salt storm. Because ecosystems of Lake Urmia, along with its marginal wetlands, play an essential role in protecting waterbirds, agriculture and ecotourism in the region. For this reasons, it is suggested to study the changes in the population of reproductive waterbirds in a long time, management and planning to attract birdwatchers and organizing current ecologists and study of terrestrial birds in the Kaniboarazan wetland and other wetlands in the south of Lake Urmia.

References

1. Behrouzi-Rad B. Identification of migrate rout of Greater Flamingo in Iran. Journal of Environment Spring. 1993;1:16-24.
2. Behrouzi-Rad B. White-headed Duck as an endangered species. Journal of Environment Summer. 1994;2:42-56.
3. Behrouzi-Rad B. wetlands of Iran. Published by Geographic Organization of the Army of the Islamic Republic of Iran. 2008:39-93.
4. Behrouzi-Rad B. Identification of migrate rout of White Pelican in Iran. Journal of Natural Resources of Iran. 2009;42:12-18.
5. Behrouzi-Rad B. Changes of migrating rout of Red-breasted Goose in Iran as an indicator of deep wetlands ecosystems. Journal of Environment. 2010;32:14-19.
6. Behrouzi-Rad B. Identification and Importance of Bird communities as bio-indicators in Urmia Lake ecosystems. Proceeding of the Urmia Lake Challenges Conference. Urmia University, Urmia. 2012.
7. Behrouzi-Rad B. Comparison of changes in the number of species and populations of breeding water birds in the Lake Urmia in 1981 and 2011. Journal of Environment Research. 2013;8:195-204.
8. Khalilipour A, Behrouzi-Rad B. Investigating changes in the diversity and density of water birds in the southern wetlands of the Caspian Sea. Journal of Environmental Science. 2007;44:20-26.
9. Bhushan B. A Field Guide to the Water birds of Asia. Published by Wild Bird Society of Japan. 1993:223.
10. Department of Environment of Iran. Laws and Regulations of Environmental Protection of Iran, Establishment of the Office of Legal and Parliamentary Affairs, February. 2000;1:198-209.
11. Department of Environment of West Azarbayjan. National Park of Lake Urmia. 1996:98.
12. Department of Environment west Azarbayjan. Birdwatchers reports in Kaniborazan wetland, unpublished reports. 2011.
13. Department of meteorological of West Azarbaijan. Rainfall in West Azarbaijan province. 2015.
14. Amat JA, Green AJ. Water birds as Bio indicators of environmental conditions. Conservation monitoring in freshwater habitat, a practical guide and case studies, Edited by Hurford C, Schneider M, and Cown L. Springer Dordrecht Heidelberg London New York. 2010: 45-52.
15. Baldi A, Kisbendek T. Species-specific distribution of reed-nesting passerine across reed-bed edges: Effects of spatial scale and edge type. Acta Zoological Academica Scientiarum Hungaricae. 1999;45(2):97-114.
16. Evans MI. Important bird Areas in the Middle East. Published by UK. 1994:31-156.
17. Golshahi A, Homami M, Khalilipour O. Study of species diversity of water birds in Alla Gol, Almagol, Aji Gol and Gomishan wetlands. Journal of Wetland Eco-biology. 2009;1(1):18-32.
18. Hammer Ø, Harper DAT, Ryan PD. Paleontological Statistics Software (PAST) Package for Education and Data Analysis. Palaeontologia Electronica. 2001;4(1):9.
19. Krebs JCh. Ecological Methodology. Published by Harper & Row publishers, London. 2001:93-370.
20. IUCN. Red List of Threatened Animals IUCN Switzerland. 2015.
21. Masoumi A, Ghahremaninejad F, Abbaspour ND. Flora of the Kaniborazan Wetland. Proceeding of the 2nd National Conference on Climate Change and its Impact on Agriculture and the Environment. 2013.
22. Nabavi SMB, Behrouzi-Rad B, Yusufyan S. Determination of density, distribution, and species diversity of water birds in Shadegan wetland. Journal of Environment. 2005;38:109-116.
23. Paul A, Thomas JD, Alex G. Indicators for Monitoring Biological Integrity of Inland, Freshwater Wetlands. Office of Wetlands, Oceans, and Watersheds, Washington DC USA. 2001:219.
24. Ramsar Convention Bureau. Ramsar information Sheet. 2015.
25. Scott DA. A Directory of Wetlands in the Middle East. Published by IUCN, Switzerland. 1995:43-221.
26. Scott DA. A Review of the Status of the Breeding Water birds in Iran in the 1970s. Podoces. 2007;2(1):1-21.
27. Scott DA. Rare birds in Iran in the late 1960s and 1970s. Podoces. 2008;3(1/2):1-30.
28. Wetlands International. Water bird Population Estimates, 4th Edition. Wetlands International, Wageningen. 2006:320.
29. Whittaker RH. Evolution and Measurement of Species Diversity. Taxon. 1972;21(2/3):213-251.
30. Yazdandad H. Investigation of variation and frequency of water birds in aquatic ecosystems of Khorasan Razavi province. Journal of animal Environmet. 2011;3(1):45-58.