

Determination Of Ornithological Richness Of Erçek Lake, Dönemeç And Bendimahi Deltas (Van/Turkey) In Winter Season And Mapping With Geographic Information System

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Abstract: Basin of Lake Van is very rich in all seasons in terms of ornithology. Birds that find alternative habitats in the basin outside winter season, become dense in certain regions. Species and population sizes of water birds in Erçek lake, Dönemeç and Bendimahi Deltas in winter were researched in this study. Bird species and their population sizes were determined as a result of observations covering November-February months of 2013-2014 and 2014-2015. As a result of two-year winter counts, a total of 7563 individuals belonging to 20 species were counted in Dönemeç Delta, 2489 individuals were counted in Erçek Lake and Coot (*Fulica atra*) was determined as dominant species in both areas. A total of 1623 individuals belonging to 20 species were counted in Bendimahi Delta and Mallard (*Anas platyrhynchos*) was determined as dominant species. A total of 54 individuals from Common Pochard (*Aythya ferina*) species in VU (Vulnerable) category were counted in Bendimahi Delta according to International IUCN Red List criteria. Population densities of 5 different habitats in the area were determined and numerical thematic distribution maps were created by being processed in ArcMap 10.2.

Keywords: Water birds, Erçek Lake, Bendimahi Delta, Dönemeç Delta Geographic Information Systems

1 INTRODUCTION

Turkey's diverse geographical structure, climate range and habitat diversity also allow for increase in biodiversity. Number of species of birds that are part of this biological diversity in our country is 503 [1]. The most important one of the reasons why this number is so high is that one of the two important bird migration routes in West Palearctic enters our country through Artvin-Çoruh valley, passes through East Anatolian Region and leaves our country from Hatay-Belen pass [2]. The fact that Basin of Lake Van has a rich wetland potential attracts both migratory and resident bird species. Bird diversity of an area is determined by studies to be carried out during four seasons. Species that constitute ornithological diversity in an area, are evaluated in 4 different temporal categories consisting of Resident, Migratory, Wintering and Coincidental species. When these four categories were evaluated, number of bird species detected in the Basin of Lake Van was determined as 232 [3]. Gathering only around areas where fresh water flows into lake during winter season is one of the obligatory conditions to survive for birds that find different life alternatives in different habitats outside winter. In addition to this, Geographical Information Systems (GIS) are widely used in studies on monitoring and protection of species and habitats as well as in many areas. Recently, area protection strategies have begun to be evaluated together with GIS (Geographical Information Systems) [4,5].

Using Geographical Information Systems in our country and abroad, many studies have been carried out for protection, monitoring of wetlands and determination of biological diversity in wetlands [6,7]. In the studies carried out, habitat structures in the areas preferred by the birds were classified and it was determined for what purpose the birds in this habitat used the area [8]. Also, management plans related to the area were established according to density and vulnerability of water birds and borders of protected areas were drawn [9,10]. Use of numerical data in fauna and flora studies and formation of bases are important for identification of locations of endemic and vulnerable species easily and for creation of protection zones so that these areas are not affected by adverse factors. Because data used in digital maps are satellite-based geographic coordinates, these change depending on time. This prevents species from disappearing due to time and habitat loss.

2 MATERIAL AND METHOD

This study was carried out in Erçek Lake, Bendimahi and Dönemeç Deltas which are located at different positions from each other in Basin of Lake Van and which provide living areas for birds in the winter season with fresh water entries. (Figure 1). While determining population sizes and clustering areas of water birds, it was considered to perform these during periods when there was little or no activity of location change during the day. Study was carried out between November 15, 2013 - February 15, 2014 and November 15, 2014 - February 15, 2015. Field observations were performed from 07:30 to 12:00 in the morning and from 14:00 to 17:30 in the afternoon depending on region's climatic conditions and time zone. In order to determine population sizes of water birds in the study areas, Point Counts and Transect counting methods were used [11,12]. In 3 study areas, borders of habitats which are important for birds were determined and these were divided into 1 x 1 km UTM squares. 3 observation points were determined for each in such a way that they would represent habitat types in UTM squares and they would be at least 300 meters away from each other. While determining observation

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points, every UTM square was not used as base, UTM squares used intensively by water birds were into consideration only. It was gone to determined observation points to the extent that they could be reached, observation points on the surface of offshore water were reached by using boats or Zodiac boats. Point records obtained as a result of study were used by being assigned to UTM squares later. Thus, there are 3 pieces of point records for each UTM square and UTM square center point data to which records of 3 points were assigned. This process allows analysis on a grid basis besides point scale [13]. Hand counter, GPS, binoculars, telescope, 600 mm lens, cameras and Zodiac boat were used as equipment during observations

Armenian gull (*Larus armenicus*) and Eurasian coot (*Fulica atra*) are the most densely seen species in the area in winter season. Also, Flamingo (*Phoenicopterus roseus*) which uses the area for feeding in summer season, stays in the area until snowfall and leaves the area at the end of December when weather is quite cool. A total of 7563 individuals belonging to 20 species were determined in Dönemeç Delta as a result of counts performed in 5 different habitats. When it was looked at numerical differences between years, it was observed that number of population increased in marsh area and decreased in lake surface, sandy areas, river sides and reed fields (Table 1). When it is looked at the population numbers in habitat types, it is seen that populations in marsh areas, water surface, dune and river sides are statistically significant depending on years ($p < 0.05$). It is seen that there is no statistically significant difference in population numbers in the reed fields depending on years ($p > 0.05$) (Table 1). Distribution map of the birds determined in the area is shown in Figure 2.

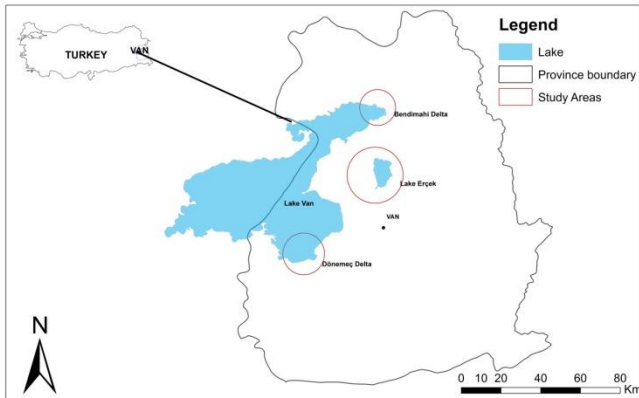


Figure 1. Position of study areas in Basin of Lake Van.

1/25.000 non-digital topographic maps were digitized in ArcMap 10.2 in order to process the data obtained during the study. Pro-Google Earth was used as satellite imagery. Colored thematic maps were created based on population density of birds on these digital maps created for 3 study areas.

3 RESULTS

3.1. Dönemeç Delta

The most active area in Basin of Lake Van in every period of the year is Dönemeç Delta. In addition to reed fields, abundance of sandy, marsh and meadowy areas enables birds to prefer this area densely. The fact that flow rate of Engil Creek forming the delta doesn't decrease even in winter, prevents delta from freezing. When compared to other areas where winter observations are made, population density of bird species is quite high. Bird species determined in the area and population numbers are given in Table 1.

Table 1. Total number of individuals determined in Dönemeç Delta in winter season based on habitat (n).

Habitats	Dönemeç D(n:20)		Mean±Std.Dev.	p-value
	2013	2015		
Swampy area	19	128	24.50±47.30	0,001
Lake surface, shore	991	945	138.2±27.90	0,001
Sandy area	1950	1032	372.7±137.7	0,001
River side	1278	1058	1168±110.0	0,005
Reeds area	83	79	40.5±0.860	0.131
Total Population	7563			

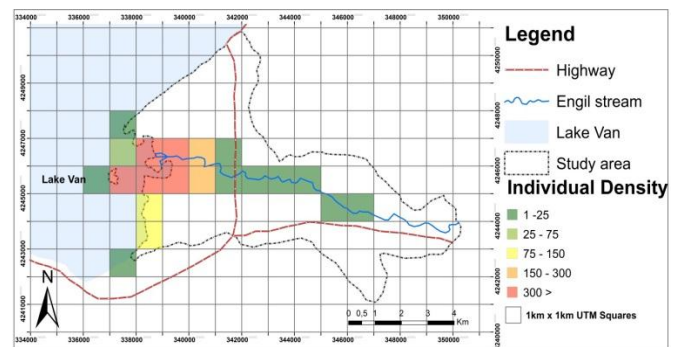


Figure 2. Numerical distribution of birds in Dönemeç Delta.

3.2. Erçek Lake

Erçek Lake is the largest area in the study areas. Although it is large in terms of area, it freezes completely in winter. Because a part of Memedik creek which is located in the eastern part of the lake, which flows into lake is narrow and only this area is not frozen, this situation causes water birds to become dense in this region in winter season (Figure 3). Species and population densities determined in the area in winter season of 2014 and 2015 are given in Table 2 below.

Table 2. Total number of individuals determined in Erçek Lake in winter season based on habitat (n).

Habitats	Erçek G(n:20)		Mean±Std.Dev.	p-value
	2013	2015		
Swampy area	1	26	24.5±47.3	0,001
Lake surface, shore	824	526	75.0±37.3	0,001
Sandy area	550	414	160.6±56.3	0.774
River side	0	0	0	0
Reeds area	54	94	29.6±7.90	0,001
Total Population	2489			

A difference is also seen between populations of 20 species determined in 5 different habitats in Erçek Lake in two years. While total number of individuals between the years 2013-2014 was higher, total number of individuals in the winter season of 2014-2015 decreased (Table 2). Despite the changes in number, areas used by species in the region didn't change and areas where fresh water flows into lake were

highly preferred. Density of bird species increases in sandy areas between lake and coastal area (Figure 3). When distribution of populations among habitats is considered, there is a statistically significant difference in marsh area, lake surface and reed field depending on years ($p < 0.05$) and statistical difference is not seen in sandy area ($p > 0.05$) (Table 2).

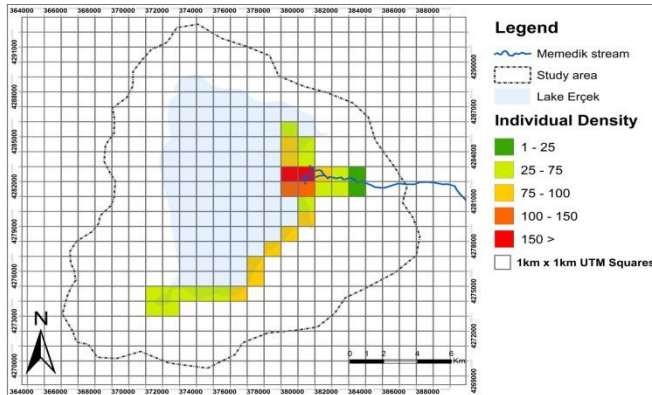


Figure 3. Numerical distribution of birds in Erçek Lake.

3.3. Bendimahi Delta

Bendimahi Delta is one of the areas that hosts birds during four seasons just like Dönemeç Delta. Because of density of reeds in the area and abundance of areas not freezing, bird population becomes dense in winter (Figure 3). Expansion of Muradiye creek in these reeds constitutes both feeding and protection areas for birds coming to the area in winter. Although number of population is low compared to other areas, it is an important wintering area for birds (Table 3). In addition, Common Pochard (*Aythya ferina*) species which is in Vulnerable category according to International IUCN criteria, is available in the field in both years.

Table 3. Total number of individuals determined in Bendimahi Delta in winter season based on habitat (n).

Habitats	Bendimahi D(n:20)			p-value
	2013	2015	Mean±Std.Dev.	
Swampy area	0	55	27.5±27.5	0,001
Lake surface, shore	511	516	79.0±21.9	0,283
Sandy area	109	51	53.3±14.1	0,001
River side	190	173	90.7±37.7	0,497
Reeds area	14	4	9.00±5.00	0,03
Total Population	1623			

One of the remarkable birds of the delta is swan (*Cygnus cygnus*). This species coming to the basin as a winter guest leaves the area when weather begins to warm up. The most densely populated species in the area is Mallard (*Anas platyrhynchos*). Areas in Bendimahi Delta where birds become dense are fresh water sides, coastal areas and dunes due to formation of protection barriers by reeds (Figure 3). When it is looked at statistical distribution of populations among habitats in two winter seasons, there is a significant difference between marsh, sandy areas and reed fields ($p < 0.05$) but, there is no statistical difference between lake surface and river side populations ($p > 0.05$) (Table 3).

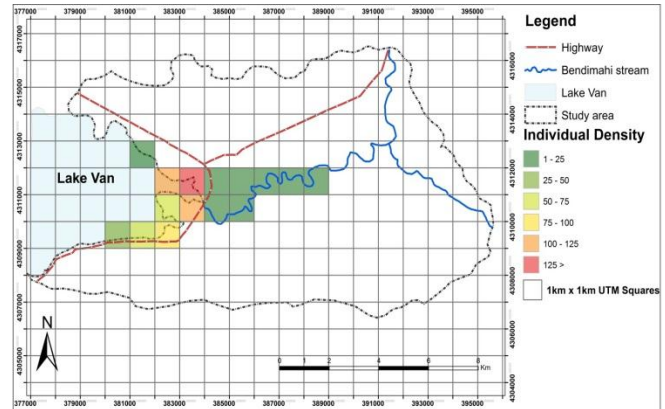


Figure 4. Numerical distribution of birds in Bendimahi D.

4 CONCLUSION

Basin of Lake Van is ornithologically rich and also important in every period of the year. Birds which have alternative areas in spring and summer seasons, need to go areas which are not frozen with the arrival of autumn and cold weather because number of their alternatives decreases. The most important areas for especially water birds in winter are Dönemeç and Bendimahi Deltas and Erçek Lake [8]. Species became dense in shallow localities where water is not frozen, fresh water entry is seen and feed is abundant in each 3 study areas for feeding. They spread towards frozen parts of the lake in order to rest and protect themselves. As a result of the counts performed, the area with the highest total population (7563) among 3 areas is Dönemeç Delta. While total bird population of delta in winter season of 2013-2014 was 4321 individuals, winter population of 2014-2015 was determined as 3242. Erçek Lake is in the second place in terms of population density (2489). In Erçek Lake, there is not difference in total population depending on years. When it is looked at total population number, the area with the least difference from other two areas depending on years is Bendimahi Delta. Total number of individuals determined in Bendimahi Delta is 1623 (Table 3). When it is looked at annual population numbers of species in all three areas, the number in 2013-2014 is more than population number in winter season of 2014-2015. The reason for decrease in population number in the second winter season is the fact that average temperature in November 2013-February 2014 was -6°C and average temperature in November and February period of 2014-2015 was -11°C [14]. Because of this average temperature difference, certain parts of each three areas froze and number of individuals in the area decreased. When distribution of bird population in each three study areas is considered, it is thought that there are differences among habitats and environmental factors and possibility of finding feed cause these differences. Environmental factors attracting attention in the areas are the amount of water supply that feeds the areas, distance to the settlements, density of reeds and anthropogenic effects. Observation methods and transfer of species whose regions are determined with coordinates obtained to numerical environment and creation of distribution maps enable areas to be used and protected. With these distribution maps, mapping can be made and protection limits can be drawn either in the size of population or for each species. It is especially advantageous in terms of time and labor for protection of endangered species in the area. Van-Erciş highway and

settlements passing through the center of the delta cause birds to spread towards the parts towards the lake in other seasons. Population number decreases in regions where human activities are dense.

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