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NEST SITE SELECTION AND REPRODUCTIVE SUCCESS OF WHITE-HEADED DUCK (*Oxyura leucocephala* Scopoli, 1769) IN THE VAN LAKE BASIN (TURKEY)

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ABSTRACT

In this study we investigated the factors effecting nest-site choice of white-headed ducks (*Oxyura leucocephala)* at three wetlands (Lake Erçek, Lake Arin and Lake Norşin) in the Van Lake Basin, during 2007-2010. Selecting a nest site is an important decision in the annual cycle of ducks. This species preferred to breed in the habitats having tall and dense reeds (*Phragmites spp.)* and cattails *(Typha spp.),* far from the shore and human effects which are sheltered from wind and precipitation. It was observed that 19 old nests of coots *(Fulica atra)* were repaired by male and female ducks throughout the study period. The most important factors found in the nest site selection by white-headed duck were reed height, elevation of nest from water, distance from shore and open lake. Nest preference was 51% affected by reed height, 48% by elevation from water, 55% by distance from shore and 42% by distance from open lake. Norşin Lake, where breeding success of white-headed duck was greatest, was determined as most favourable nesting site in Van Lake Basin because of the fact that nests were far away from human activity. Such informations can be effectively used for the management and conservation of white-headed duck and other waterfowls breeding in the area.

Key words: white-headed duck, nest site selection, breeding habitat, hatching success, Van Lake Basin, Turkey.

INTRODUCTION

Habitat selection is choice of a particular area having special biotic and abiotic features among available habitats. This special choice is made by individuals of a species from an area where they spend their time (Patridge, 1978). Nest-site selection itself is the final step in habitat selection and follows in time after general habitat selection and territory acquisition (Donehower and Bird, 2009). Birds selecting nest-site must maximize the potential for finding cover and protection from sun, flood, predators, etc (Burger, 1985; Clark and Shutler,1999). Nest site choice can influence whether the female survives the nesting season and her eggs survive to hatch. A poor choice might expose the nesting female and her eggs to predators, destruction by machinery, or flooding and can influence its reproductive success by affecting acquisition of resources such as food, shelter, mates, nest materials and protection of eggs and young from predators and inclement weather (Schoener, 1974; Johansson and Blomqvist, 1996). This aspect of nesting behavior is shaped over time by natural selection, reflecting strategies that have been effective for the species.

White-headed duck (*Oxyura leucocephala*) typically choose breeding sites having dense emergent vegetation around the lakes and small or enclosed areas within larger wetland systems. During the breeding season, the favorite habitats of this species consist of brackish lakes and lagoons that are fringed with emergent herbaceous vegetation, such as reeds (*Phragmites sp.*) and cattails (*Typha sp.*) and have a good growth of pondweeds (Potamogetonaceae) (Johnsgard and Carbonell, 1996). They are best adapted to living in dense marsh vegetation having small open pools of 0.5-3 m depth. But little is known about white-heade duck' nesting habitats, avoidance of predators and reproductive success. In this study, we investigated the habitat and nest-site selection, reproductive success and causes of nest failure of white-headed duck nesting on wetlands in Van Lake Basin.

MATERIALS AND METHODS

The study on white-headed ducks was conducted at three wetlands (Lake Erçek, Lake Arin and Lake Norşin) in Van Lake Basin that is on the east of Turkey (38^o 24' N, 42^o 55' E), during 2007-2010 (Figure1).

These lakes that are known to be the breeding sites of white-headed duck, population size, breeding biology and reproductive success of this species were investigated. Prior to the study, we searched all reed beds in the study areas in 2007 where white-headed duck nests. Based on this preliminary study, we considered wetland basins as available habitat for nesting white-headed ducks. Because of the reasons such as reed density and distances between study sites it was not possible to reach and examine all of the nests in terms of time and facilities. Hence, for studying the breeding biology, sample nests in each site were selected

according to the accessibility of sites. Nineteen nests (5 in Erçek Lake, 8 in Norşin Lake and 6 in Arin Lake) were observed throughout the study. Latitude and longitude of white-headed duck nests was recorded using a handheld Global Positioning System unit and marked their exact locations.

Figure 1. Geographic location of study area

Starting from pre-breeding period and up to April and July, data on nests and breeding biology were recorded. The nests were checked daily to determine clutch initiation date, the number of breeding attempts, clutch size (number of eggs in the clutch) and breeding parameters (unhatched and hatched eggs, dead nestlings and fledglings). Concerning the nest; information about the structure of nesting area, nest locations, materials, reed height, elevation of nest from water, distance from open lake and distance from shore were determined. Concerning breeding; information about mating behavior, egg-laying and incubation period was collected. The structure of nesting grounds, their positions and nests within reeds were pinpointed through direct observation. Nest's elevation from water, reed height in nest ground and nest distance from shore and open lake were measured in metres. Also, satellite images of areas were used in these estimations. Identification of nest materials were performed by experts and by using reference books (Davis, 1984; Baytop, 1994).

Data Analysis: Statistical analysis was conducted in order to assess and compare triennial landscape data. Principle Component Analysis (PCA) was utilized to compare criteria which have an effect on the species' nest site selection for different breeding areas (nest's elevation from water, reed height in nest ground, nest distance from shore and open lake). To determine if there is a difference between areas and years pertaining nest measurements ANOVA method and Tukey test were used. PCA analysis concerning nest site selection was conducted with MVSP program version 3.13q. Valid importance level used for statistical analysis was $p<0.05$.

Breeding success rates was estimated with two different methods. In the first method; breeding success was defined as the ratio between number of fledgling and number of total eggs (BS_1: number of fledgling X 100/number of eggs). In the second method; breeding success was defined as the ratio between number of ducklings hatched and number of fledgling (BS_2: number of fledgling X 100/number of ducklings hatched).

RESULTS AND DISCUSSION

In the Van Lake Basin, most important breeding grounds of the white-headed duck are Lakes Arin, Norşin and Erçek having dense reed beds. Common aquatic plants include *Phragmites australis* and *Typha latifolia.* Norşin Lake, while being a significantly small lake in terms of surface area (250 ha), is a very convenient area for breeding in terms of structure and location of the reeds. Reed beds are enclosed with water that is in the middle of the lake are preferred frequently by the species as a nesting area. Due to their location, human impact and predation risk on these nests in this lake area are at low levels. Reeds in which the species build their nests in Arin Lake are located very close to the residential area. The nesting area in Erçek Lake is located very close to the highway and railway. What those three areas have in common is that there are waterways facilitating hiding and escape routes. Therefore, individuals can easily evade trouble.

Nests by white-headed duck in all three lakes (Arin, Erçek and Norşin) were built by reed and rush branches and leaves composing the emergent vegetation of the region. It was detected that individuals usually repair old nests of coots (*Fulica atra)* with new leaves and branches and then use those. Other materials such as feather, etc. were not found in the nests. In the previous studies conducted about this species, it was also stated that the species use old nests of other waterfowls such as coot (*Fulica atra)* and tufted duck (*Aythya fuligula)* (Amat and Sanchez, 1982; Johngard and Carbonell, 1996). During our study, it was observed that individuals use old nests by repairing them with branches and leaves of *P. australlis* and *T. latifolia*. The reason why the old nests are used probably is that a nest that was used formerly and did not face any trouble is considered to be safer by the individuals. Intraspecific competition concerning the nest site selection between individuals was not observed frequently. However, nests relatively higher from water and far from open lake and shore where vegetation structure is dense were preferred more commonly (Table 1).

Carbonell (1983) reported that some individuals cover their nests with leaves and some cover their eggs with feathers. We observed only one nest that was very close to shore in Arin Lake had been covered and tried to be hidden with leaves. Eggs were not observed to be

covered to protect them against heat loss and to hide them.

Table 1. Rates about nest site selection of White-headed duck

	PC1	PC2
Reed height (cm)	0.519	-0.303
Elevation from water (cm)	0.487	-0.519
Distance from open lake (cm)	0.426	0.788
Distance from shore (cm)	-0.558	-0.133

PC1: Axis 1, PC2: Axis 2

It was observed that white-headed duck's nest site preference is affected by reed height, elevation of nest from water, distance from shore and open lake. Areas far from shore and with tall reeds were preferred by the species for nesting. According to PCA results, distance from shore and open lake, elevation from surface and reed height are 96% effective factors for white-headed duck to choose a nesting site. Statistically, (according to Axis 1) nest preference is 51% affected by reed height, 48% by elevation from water and 55% by distance from shore (Table 1).

According to Axis 1, in Lake Norşin, distance from shore, reed height, elevation from water and distance from open lake were determinants in nest preference while for Lakes Erçek and Arin, distance from open lake, reed height and elevation from water were the determinants (Figure 1).

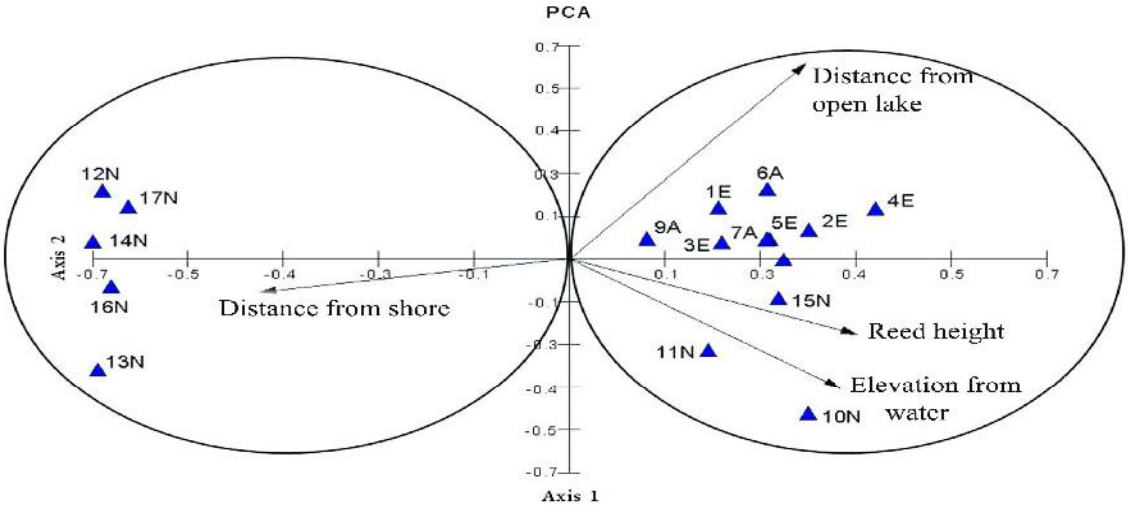

Figure 1. Nest site selection of White-headed duck within the study areas according to Axis 1

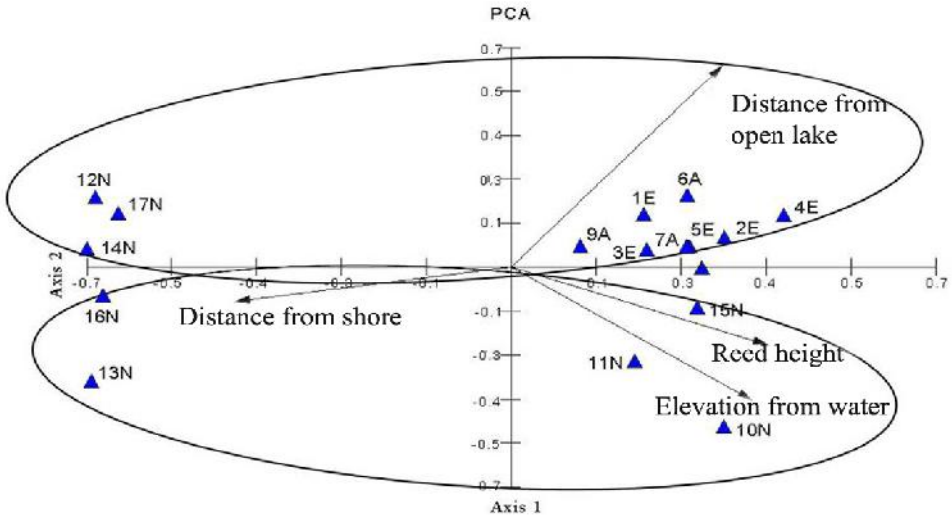

Figure 2. Nest site selection of White-headed duck within the study areas according to Axis 2

Assessment of both axises shows that distance from open lake is more effective in Arin and Erçek Lakes where anthropological pressure is more dominant while distance from shore is more efficient in Norşin Lake. (Figure 3).

It was determined that the nest area of white-headed duck features heavy vegetation consisting of reeds and had a low risk of anthropological pressure and predation. Distance of nests from shore was meanly 275 cm for Arin Lake where anthropological pressure is high and 160 cm in Erçek Lake. For Norşin Lake where nests were more protected from anthropological impact, the average distance of nests from shore was 80 m. In addition, accessibility of aquatic predators to nests is also effective on height of the nest from water level. Elevation from water of the nests in Norşin Lake was recorded to be greatest, 20.75±3.05 cm and in Erçek Lake to be the smallest, 10.6±2.40 cm. The difference between the height of the nests from water level in the lakes was found to be statistically significant ($p<0.05$).

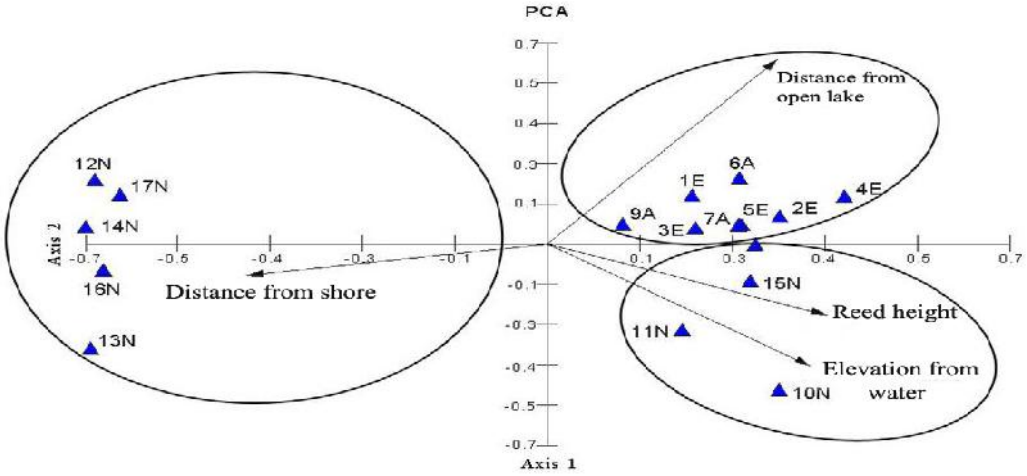

Figure 3. Nest site selection of White-headed duck within the study areas according to Axis 1 and Axis 2

Table 2. Nest site measurements of white-headed duck within the study areas

Location	Statistical Value	Reed height (cm)	Elevation from water (cm)	Distance from open lake (cm)	Distance from shore (cm)
	n	5	5	5	5
Lake Erçek	Min.	150	8	200	100
	Max.	180	14	350	200
	Mean±SD	165±12.24	10.6±2.40	260±65.19	160±41.83
	n	4	4	4	4
Lake Arin	Min.	200	8	200	200
	Max.	350	16	500	350
	Mean±SD	275±64.55	13±3.55	331.25±134.43	275±64.55
	n	8	8	8	8
Lake Norşin	Min.	250	16	0	300
	Max.	350	26	500	13000
	Mean±SD	303.75±33.354	20.75±3.05	243.75±180.15	8075±6415.27
TOTAL	n	17	17	17	17
	Min.	150	8	0	100
	Max.	350	26	500	13000
	Mean±SD	256.176±71.57	15.9412±5.528	269.11±141.29	3911.76±5863.3
Statistical Significance		p:0.001	p:0.001	p>0.05	p<0.05

n: number of nest, Mean±SD: Average ± Standart Deviation.

Comparing with the nest measurement values in Erçek, Arin and Norşin Lakes, it was found that reed height in Norşin Lake was the greatest, 303.75±33.354 cm, while at Erçek Lake was the smallest, 165±12.24 cm.

There was a significant statistical difference between lakes in terms of reed height ($p<0.05$). Distances of the nests from shore in Norşin was the greatest 8075±6415.27 cm and in Erçek Lake was the smallest, 160±41.83 cm. The difference between the distances of the nests from shore in the lakes was found to be statistically significant ($p<0.05$). No significant difference had been detected between the lakes in terms of the distances of the nests from open lake ($p>0.05$).

Throughout the study period, 247 ducklings hatched out of 273 eggs laid at three lakes. It was determined that 90 % of the laid eggs were hatched and a loss of 9 % had been detected. Twenty-six out of 247 ducklings died before migrating from breeding sites because of reasons such as increasing anthropological pressure, lack of food and cold weather conditions. Breeding success values of *Oxyura leucocephala* according to breeding sites are given in Table 3.

Table 3. Breeding Success Rates of white-headed duck

Location	Year	Breeding success by number of eggs laid (BS_1)		Breeding success rates by number of ducklings hatched (BS_2)		Number of fledgling
Erçek	2008	n: 11	% 81.81	N: 11	% 81.81	9
Lake	2009	n: 31	% 80.64	N: 29	% 86.20	21
	2010	n: 33	% 72.72	N:30	% 79.99	24
Arin	2008	n: 12	% 66.66	N: 11	% 72.72	8
Lake	2009	n: 25	% 64.00	N: 22	%72.65	16
	2010	n: 36	% 72.22	N: 31	% 83.87	26
Norşin	2008	n: 34	% 76.47	N: 30	% 86.66	26
Lake	2009	n:53	% 79.24	N: 48	% 87.50	33
	2010	n: 38	% 84.21	N: 35	% 91.42	32
	2008	n: 57	% 75.43	N: 52	% 82.69	43
Total	2009	n:109	% 76.14	N: 99	% 83.83	70
	2010	n:107	% 76.63	N: 96	% 85.41	82
	2008-2009-2010	**n: 273**	**% 71.42**	**N: 247**	**% 78.94**	**195**

n: number of eggs; N: number of eggs laid, BS_1: Number of fledgling X 100/n,
BS_2: Number of fledgling X 100/ number of ducklings hatched.

BS_1 rates were 81.81 % in Erçek Lake, 66.66 % in Arin Lake and 76.47 % in Norşin Lake in 2008, 80.64 % in Erçek Lake, 64 % in Arin Lake and 79.24 % in Norşin Lake in 2009 and 72.72% in Erçek Lake, 72.22% in Arin Lake, 84.21% in Norşin Lake in 2010. BS_2 rates were as follows; 81.81 % in Erçek Lake, 72.72 % in Arin Lake and 86.66 % in Norşin Lake in 2008, 86.20 % in Erçek Lake, 72.65 % in Arin Lake and 87.50 in Norşin Lake in 2009 and 79.99% in Erçek Lake, 83.87% in Arin Lake, 91.42% in Norşin Lake in 2010.

In Norşin Lake where breeding success of the species was the greatest, average distance of nests from shore was measured to be 80.75±64.1527 m and average reed height was 3.0375±3.3354 m. Appropriately, the reason why Norşin Lake was more preferable by the duck was thought to be the distance of nests from the shore away from the potential human impact. Yerkes (2000) observed that in order to reduce the predation risk, *Aythya americana* nests in places that are quite far from shore and have reed beds taller than two metres. Phillips et al. (2004) suggested that hatching success should be low near wetlands because activity level was high within 50 m of wetland edges. Similarly, the selection of Lake Norşin as most favourable nesting site could be attributed to the fact that nests are safer being far away from predator and human activity.

Consequently, it was determined that breeding success of white-headed duck in Van Lake Basin is quite high. One of the most important reasons of high reproduction success is that nests are hidden inside the reeds on water very well and thus predators are not able to reach the nests. During our studies it was observed that yellow-legged gull (*Larus michahellis)*, rook (*Corvus frugilegus)* and marsh harrier (*Circus aeruginosus)* pose threat against the eggs and ducklings but any damage caused by these species had not been observed. Also, ducklings of this species are precocial at the time of hatching and they are able to increase their chances of survival by adapting to environmental condition is a short time. Even in dangerous conditions, they can survive with the ability to dive. As they become independent of their parents in a short time, that may cause some problems at times. However, as they can dive into water, that enables them to live and survive under dangerous conditions.

In addition, another factor that increases the reproductive success is that incubation of the species occurs during the months June and July in which temperature is at its highest values (19-23^{0}C). Several other factors such as drought and flooding resulting from climatic factors during incubation periods of the species in the study period did not occur, that also increased the incubation success. Duckling losses were observed after

the first 20 days when the ducklings started to become independent of their mothers.

Loman (1982) stated that several factors such as lack of food at the end of breeding season, deterioration of climate conditions and increase in predation rate cause increase in duckling mortalities. The lowest reproduction success was determined in Arin Lake. One of the reasons of that was that nest areas of individuals of this species were close to Göldüzü Village. Especially the children in the village and the shepherds who pasture their animals disturb females during the clutch and then ducklings. In addition, the weather becomes cold relatively earlier in autumn at Arin Lake at the north of the Basin. Thus, climatic factors are also thought to affect the incubation success at this lake.

Johnsgard and Carbonell (1996) determined that in Spain eggs of this species are damaged by *Arvicola sapidus* and *Circus aeruginosus*. Fox *et al*., (1994) observed that the individuals exhibit irritated behaviors and move quickly when gulls are present in their regions. In this study no certain predator was observed that threatened the individuals and ducklings. However, they were observed to become alert especially when marsh harriers come closer and they tried to keep themselves as far away from them as possible.

Breeding grounds of the white-headed duck in the Van Lake Basin urgently need legal protection status and to prepare habitat management plan for this species. To mitigate anthropological effects on white-headed duck population, it is recommended that attempt should be made to maintain nesting habitat in wetland basins with reed beds thereby maximizing potential nest sites. Additionally, chances in breeding habitat such as chances in climate, vegetation and wetland hydrology may impact nest-site choice of the species. So, we suggest that further studies focusing on future nest site selection strategies of the species and managing the nesting habitats.

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