HABITAT UTILIZATION AND WINTER TIME-ACTIVITY BUDGETS OF THE WHOOPER SWAN *CYGNUS CYGNUS* (LINNAEUS, 1758) POPULATION WINTERING AT THE VAN LAKE BASIN, TURKEY

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Abstract. In this study, daily behaviour patterns of whooper swans (*Cygnus cygnus*) were studied at the Van Lake Basin, which is one of the most important wintering areas of the species in Turkey. Winter-time activities of the swans were monitored from sunrise to sunset in 6 different categories: resting, feeding, preening, walking on land, swimming and flying. The most common daytime activity was resting (55%). Feeding (12.48%) and preening (10.98%) were the two other main diurnal activities of whooper swans during the present study. Resting peaked in midday period (08:30-13:30) while feeding was observed frequently in early morning hours (06:00-8:30) and late afternoon (13:30-17:00). At the beginning of severe winter period (December and January) whooper swans clearly reduced feeding time in all parts of the day, probably because they still met metabolic demands. A significant increase in feeding behaviour was observed in January and February when they were preparing to migrate. While open water surface was the most preferred area for resting, shallow coastal areas and reeds were the most utilized foraging habitats.
Keywords: *waterfowl, behaviour, diurnal period, movements, waterbirds, wetlands*

Introduction

Behaviour patterns of waterbirds vary with weather conditions, food availability, threat factors and the physiological status of the species (Weathers and Sullivan, 1993; Meissner and Markowska, 2009). These behaviours that birds show under different environmental conditions offer important tips in understanding their ecological requirements. Furthermore, changes in waterbird activity may provide an earlier indication of an impact than numbers of birds (Weathers and Sullivan, 1993; Hamilton et al., 2002).

Time-activity budget studies of wintering waterbirds give information about seasonal microhabitat selection and the influence of hunting pressure, habitat alteration and other threats on behaviour (Poulton et al., 2002; Michot et al., 2006; Crook et al., 2009). In this manner, such studies can be used to evaluate habitat quality and quantity, to compare activity patterns of populations in different geographic regions and contribute to wetland management or species conservation plans (Woodin and Michot, 2006).

Whooper swan (*Cygnus cygnus*) is mainly a winter visitor species to Europe and Turkey. Except reproduction period, they migrate in small flocks and congregating into flocks of up to 300-400 individuals in the winter (Johnsgard, 1978; Madge and Burn, 1988). The overall population trend is uncertain. Population size in Europe is estimated at between 25300-32800 pairs and the status is shown as "LC" in the IUCN category (Anonymous, 2015a). A limited number of studies about the Turkey population of the whooper swan indicate that the species has been wintering in the Van Lake Basin since the early 1990s. The species arrives to the basin from the beginning of the winter and stays at the basin until the beginning of spring and then leaves. Depending on the year,

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the population size of the species wintering at Van Lake Basin ranges between 50-240 individuals (Adızel, 1995; Adızel et al., 2010; Azizoğlu et al., 2016, 2017; Çelik et al., 2016). In recent years, the number of individuals wintering in the Basin has increased while there is a lack of data about behaviour pattern of the species. The aim of this study was to determine the daily behaviour of a colony of whooper swan wintering in the Van Lake Basin.

Materials and methods

Study area

This research was carried out at Göründü Delta (38.328637° N, 42.927174° E) in the southern part of Van Lake. Göründü Delta that located on the 58th km of Van-Bitlis highway, is a wetland with 124 ha (*Fig. 1*). The delta, 1648 m in altitude and 5 km^2 in width, is an internationally important wetland that hosts large numbers of migratory and the resident waterbirds (Anonymous, 2015b; Aşur, 2017). In recent years, one of the unique habitats where the whooper swans were wintering in the eastern of Turkey is the Göründü Delta.

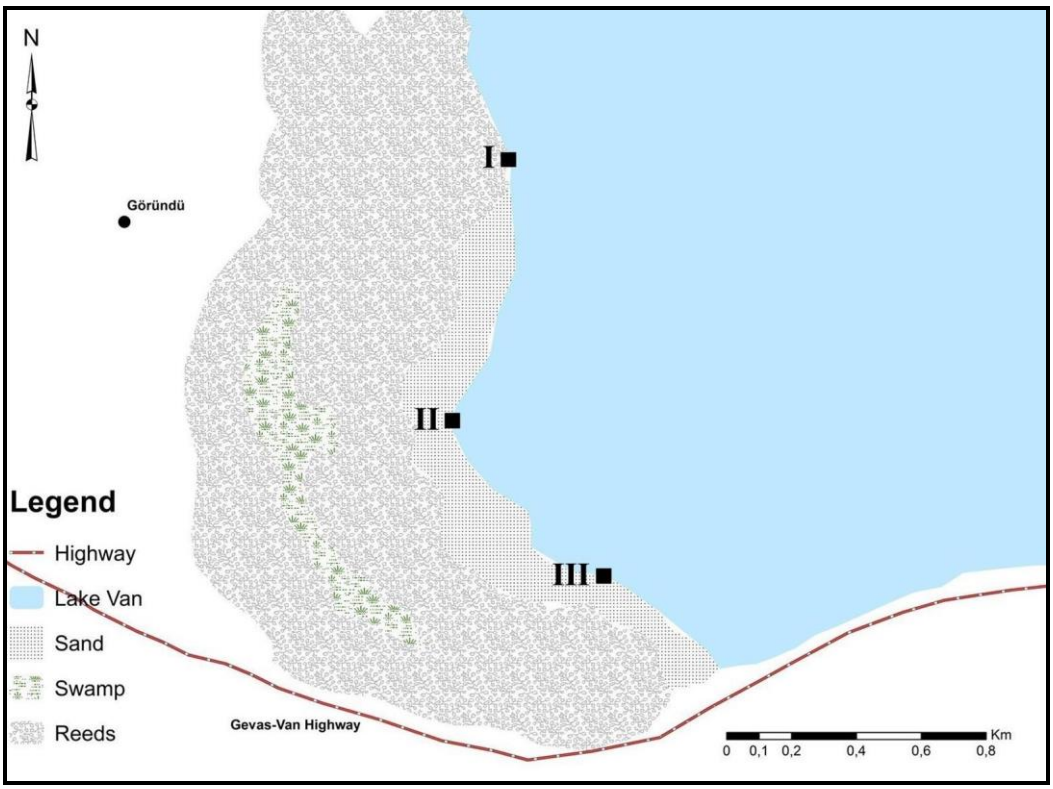

Figure 1. *Observation points at Göründü Delta*

Behavioural observations

In order to identify the wintering behaviour of whooper swan, observations were conducted between November 2015 and March 2016 on days without precipitation or strong wind. During this study period, a total of 70 days between November and March were used for diurnal observations.

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Scan sampling and focal sampling methods were used to evaluate different daily wintering behaviour of adults and juveniles (Altmann, 1974). The observations started in the morning before sunrise (06:00) and continued until sunset (17:00). This period was divided into 3 equal parts as morning (06:00-08:30), midday (08:30-13:30) and late day (13:30-17:00) with equal numbers of focal sample observations within them. Scan samplings were made at the beginning of each period to assess the total number of birds. When using this method, the behaviour of all individuals in a flock were recorded at predetermined time intervals during the daytime hours. In total 1540 observation sessions and 192.2 h of scanning were performed. Six main activities of whooper swan were evaluated in this study: resting, feeding, preening, swimming, flying and moving on land. In the determination of the behaviours, random focus observation method was used. The instantaneous behaviour of each individual in a flock with 90 individuals was recorded with a telescope in half-hour intervals. After scanning maximum 30 individuals, other individuals were evaluated as second and third groups. The scanning started from the first individual and continued towards left until the last individual. We quantified time-activity budgets by calculating the proportion of time spent in each behaviour for each focal sample.

Statistical analysis

The statistical software SPSS 20 was used to perform all statistical analyses. We identified diurnal period and winter period differences with ANOVA.

Results and discussion

During the five months of survey, daily activities of a whooper swan showed a major variation which occurred majorly due to the hydrobiological condition and ecological status of the coastal area. We detected that in winter season the whooper swans spent most of the time by resting (55%) and the rest by feeding (12.48%), preening (10.98%), walking on land (8.94%), swimming (7.73%) and flying (4.87%) (*Fig. 2*).

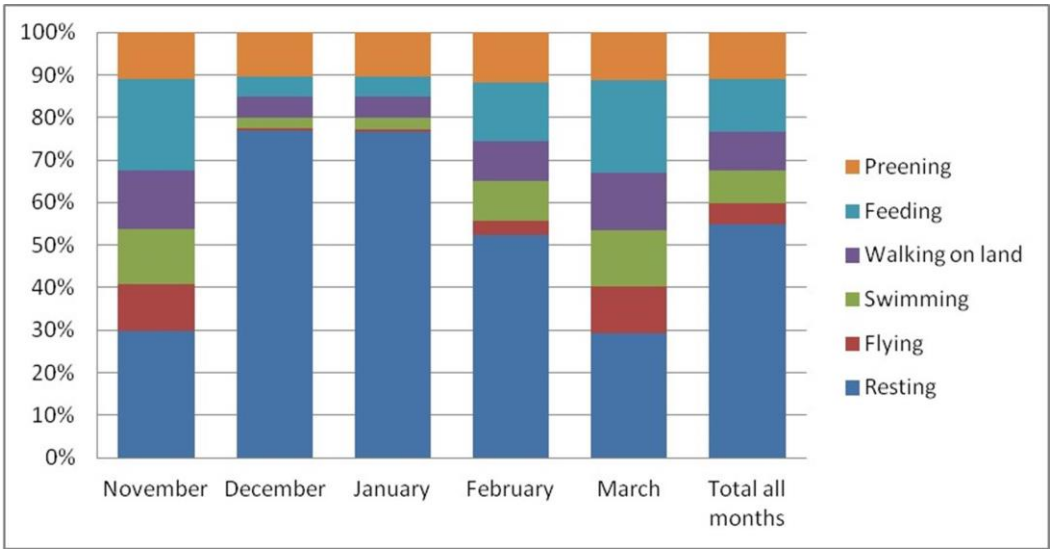

Figure 2. *The percentage of time spent to the activities by whooper swan at different parts of winter time (monthly and in total)*

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Resting, feeding and preening were the main diurnal activities. Resting peaked in midday while feeding was observed frequently in morning and late afternoon (*Table 1*). The feeding pattern recorded was similar to patterns recorded earlier studies of swans (Tatu et al., 2007; Peihao et al., 2011).

Table 1. *Mean percentage of winter-time diurnal activities of the whooper swan in different time periods of the day*

Behaviour	**Morning (06:00-8:30) n: 43.45h**	**Midday (08:30-13:30) n: 87.5h**	**Late day (13:30-17:00) n: 61.25h**	**Overall**
Resting	41.8	62.9	60.3	55
Feeding	27.1	7.8	2.54	12.48
Preening	11.39	10.6	10.95	10.98
Walking on land	8.82	6.2	11.8	8.94
Swimming	7.25	6.74	9.2	7.73
Flying	3.64	5.76	5.21	4.87

n: observed hour

Temperature at a wintering site is an important determinant of the waterbirds' time budgets (Guillemain et al., 2002). The temperature averages according to the months were; November (4.4 °C ± 0.2), December (-2 °C ± 0.3), January (-3 °C ± 0.3), February (-4 °C ± 0.2) and March (-1 °C ± 0.4). The higher average temperature in November and March compared to the temperature average of December, January and February, affected the activities of the species. Resting activity in December, January and February was significantly higher whereas more time was spent on feeding activity in November and March ($P < 0.05$) (*Fig. 2*).

In this study, we detected that mean percentage of time spent to feeding activity was similar in November and March and the resting was similar in December and January. It was identified that all the activities in February shows temporal differences with the activities in the other months (*Table 2*).

Table 2. *Statistical analysis of the monthly activity budgets of whooper swan*

ANOVA		**Subset for alpha = 0.05**				
Behaviour	**n**	**November**	**December**	**January**	**February**	**March**
Resting	90	0.890667^{c}	2.145259^{a}	2.128333^{a}	1.448571^{b}	0.873056^{c}
Feeding	90	1.178^{c}	0.246^{a}	0.26^{a}	0.7608^{b}	1.1853^{c}
Preening	90	$0.6107^{a,b}$	0.5789^{b}	0.575^{b}	0.6405^{a}	$0.6226^{a,b}$
Moving on land	90	0.7457^{a}	0.2723^{c}	0.269^{c}	0.5233^{b}	0.7478^{a}
Swimming	90	0.7187^{a}	0.1409^{c}	0.149^{c}	0.5154^{b}	0.7238^{a}
Flying	90	0.6077^{a}	0.0375^{c}	0.0303^{c}	0.1796^{b}	0.6124^{a}

*$P < 0.05$, n: individual number

When the activities of the species in November and March were considered, we revealed that diurnal activities as flying, swimming and moving on land were similar within themselves (^{a}) ($P < 0.05$), feeding and resting were homogeneous within

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themselves (^{c}) ($P < 0.05$). Preening was totally different from feeding and resting. However it was similar with the other activities (^{a,b}) ($P < 0.05$). When daily activities in December and January were considered, feeding and resting were similar with themselves (^{a}), while flying, swimming and on land movement were showing similarities within themselves (^{c}). The preening activity was independent from both groups (^{b}) ($P < 0.05$). In February all diurnal activities were similar with each other except preening (*Table 2*).

Results of our work confirm the findings by Squires and Anderson (1997) that swans spent more time resting as winter temperatures decreased. Percent of time spent on different daily activities differed significantly between day periods in mild and severe winter (*Fig. 2*). They spent the most of severe winter period inactive, apparently relaying on accumulated energetic reserves. Increasing energetic expenditure in the period of low temperatures is often compensated through more intensive and longer foraging (Guillemain et al., 2002; Meissner and Ciopcinska, 2007). However, during the harshest winter weather observation period in the Göründü Delta whooper swans reduced all daily activities primarily foraging and feeding. They spend less time on locomotion, but the most striking difference concerned feeding time. In December, January and February where the air temperature is the lowest -17 (average -4), the resting ratio is about 76%, and this ratio decreases 29% in November and March.

Despite lower air temperature in late winter period (in February), whooper swans had increased the total feeding time and they were more active. Because they had to store energy and increase fat reserves before the long migration period. At the same time they begin getting the nutrient reserves required for reproduction.

Black et al. (2010) indicated that 44.9% of the daily activities of the Tundra swan (*Cygnus columbianus*) in the Eel River Delta were related to the foraging activities. Rees and Bowler (1991) reported a similar proportion of 48.4% feeding in swan flocks in England in late winter/spring period. According to our results, daily foraging activities of whooper swans were decreased in the late winter period but lower than these rates. We think that the most important reason for this situation is low nutrient density, food availability and different climatic conditions in Göründü Delta.

Laubek et al. (1999) pointed out that the whooper swans use open water surface while performing their daily activities during the winter months. Similarly, we observed that the whooper swans were performed almost all their daily activity in water.

Conclusion

In the Göründü Delta where ducks winter in high density, whooper swans spent most of the brief severe winter period almost inactive, probably relying on accumulated energetic reserves. Diet of whooper swans mostly consist of aquatic plants such as *Algae* sp., *Chara* sp. and *Zostera* sp (Brazil, 1981; Del Hoyo, 1992; Kantrud, 1990; Squires and Anderson, 1995). Since the study area is associated with Van Lake and has soda-water, it is poor in terms of water plants. This factor reduces the feeding time of the species. The whooper swans were feeding in shallow water line and reeds. The caloric value in aquatic plants is lower than in terrestrial plants (Dourado et al., 2004). During the winter the species is known also to feed on agricultural land and takes agricultural grain (Brazil, 2003). Nevertheless, grazing on land was observed just a few times only in March. Intensive hunting pressure in the field is the most important reason for this situation. More comprehensive studies about whooper swans' winter food

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supply and nutritional diversity would help to inform habitat management and protection for the swans.

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