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The Activities of the Little Egret (*Egretta garzetta*) and Night Heron (*Nycticorax nycticorax*) in Their Colonies During the Breeding Season

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Abstract
In this study we have investigated the behaviors of the Little Egret and Night Heron during the breeding season at Poyrazlar Lake (SAKARYA) located in North-West Turkey (40°50'N, 30°28'E). The Ardeid colony consists of 330 adults; 150 of which are Night Heron (45.45%) and 180 are Little Egrets (54.55%). The breeding period starts at the end of March and lasts till the end of August. Neither the Night Herons nor the Little Egrets become active in the breeding period simultaneously. Due to the fact that the Little Egret is a species that is active in daytime and the Night Heron is active at night, making colonial activity continuous throughout the day and night (24 hours). While this situation limits the competition between the species, it provides advantages in terms of breeding success and colonial life.
Keywords: Breeding, daylight, little egret, night heron, temperature.

Küçük Akbalıkçıl *Egretta garzetta* ve Gece Balıkçılı *Nycticorax nycticorax* Üreme Dönemi Koloni Aktivitesi
Özet
Bu çalışmada Küçük Akbalıkçıl ve Gece Balıkçılının üreme dönemindeki davranışları Poyrazlar Gölü (SAKARYA)'nde incelenmiştir. Göl Türkiye'nin kuzey-batısında yer alır (40°50'N, 30°28'E). Koloni 150 (45,45%) Night Heron ve 180 (54,55%) Little Egret olmak üzere toplam 330 ergin bireyden oluşur. Üreme dönemi Mart sonu başlayıp Ağustos sonuna kadar devam eder. Hem gece balıkçılı hem de küçük akbalıkçıl bireylerinin tamamı üreme döneminde aynı anda aktif olmaz. Küçük akbalıkçılın gündüzcü gece balıkçılının gececi bir tür olması nedeniyle kolonial aktivasyon 24 saat boyunca sürer. Bu durum türler arasında ki rekabeti sınırlarken kolonial yaşam ve üreme başarısı açısından önemli bir avantaj sağlar.
Anahtar Kelimeler: Gece balıkçılı, gün ışığı, küçük akbalıkçıl, sıcaklık, üreme.

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INTRODUCTION

Ardeids usually nest in colonies, sometimes containing different species, with the size ranging from a few pairs to several thousands (Young and Cha 1995). The main factors contributing to the colonization of the birds are related to predation and resource utilization (Burger et al. 1981). Today, a general consensus presents itself regarding the effectiveness of living in groups for those birds which mock predators (Tinbergen et al. 1974, Wiklund and Anderson 1980). Furthermore, improved vigilance provides mutual protection for all members of the colony (Bertram et al. 1978). However, birds like herons and egrets do not exhibit mutual defence behaviors (Krebs et al. 1974, Voisin et al. 1991). Hence, the main advantage of living in groups can be related to the number of individuals (Pulliam and Caraco 1984), even though the cost of concentration in large numbers must include conspicuousness and competition.

In this study we investigated the activation frequency of the Little Egret and Night Heron colonies. We observed how the species' behaviors such as number of individuals, intra-specific fighting, inter-specific fighting, flying in colony, flying out of colony, and feeding changed depending on the temperature and daylight and then we compared these two species to one another.

MATERIAL AND METHODS

Study Area

Poyrazlar Lake is located in North-West Turkey (40°50'N, 30°28'E). It is 6 km from Sakarya Province and lies under one of the two major bird migration routes (Uzun et al. 2010). The area of the lake is 0.6 km^2. The Ardeids build their nests in the willows (*Salix* sp.) in a 4000 m^2 area near the north-eastern shore of the lake (Figure 1).

Methods

The study was conducted from March thru August 2008. The breeding period consists of three

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different phases: pre-laying (March 25th - April 5th), incubation (April 8th - June 10th), and fledging (June 10th - August 16th). Between March and August, field studies were performed 14 times. The observations began at 0600 hrs and lasted till 1900hrs in the pre-laying and incubation periods, and started at 0600 hrs and lasted till 2100hrs in the fledging period depending on the daylight duration. Data collection amounted to 192 hours in total: 52 hours in the pre-laying period, 65 hours in the incubation period and, 75 hours in the fledging period. The observations were carried out visually unassisted and with 8x30 binoculars. The temperature of the research field was measured with a digital thermometer every hour in a shady part throughout the whole field study. Six parameters: number of individuals, intra-specific fighting, inter-specific fighting, flying in colony, flying out of colony, and feeding were used to test the activity intensity of the species. The data recorded was from observing only the adult individuals each hour during the study duration. The nestlings and juveniles were not included in the records. However, to obtain, the fledging success, we randomly chose 50 nests from the breeding area for both species and observed these nests in a continuous manner till the chicks left them.

Statistical Analysis

The relationship between the heat (temperature) and the six parameters in each period was assessed with regression analysis (linear). The T-test was used for the comparison of the periods and the species.

RESULTS

Temperature

The minimum field temperature measured in the breeding season was 6.7ºC and the maximum was 30.0ºC. The average temperature was 11.54±0.82ºC during pre-laying, 15.59±0.93ºC during incubation, and 23.05±0.61º C during fledging. The temperature difference was 4.05ºC between the incubation and pre-laying periods, 7.46ºC between the fledging and incubation periods, and 11.51º C between the fledging and pre-laying periods. The three periods were significantly different from each other in terms of temperature values (t-test, $p<0.05$). The average temperature throughout the daytime in the pre-laying period showed a variation between 7.33ºC-15.48ºC, in the incubation period between 9.74ºC-18.96ºC and in the fledging period between 19.10ºC - 26.68ºC (Table 1, Figure 2). While the coldest hours of the day were between 0600 and 0800hrs, the hottest hours of the day were recorded between 1200 and 1500hrs throughout the observation.

Number of Individuals

During the observation in the colony territory, the average number of individuals of the two species varied during the day and also between the three periods (pre-laying period, incubation period, and fledging period) (Figures 3 and 4). However, the numbers of Little Egret individuals were significantly similar in three periods (T-test, $p>0.05$). Whereas the average number of Night Heron individuals in the pre-laying period varied significantly than in the other two periods (T-test, $p<0.05$). In contrast, there was no difference between incubation and fledging periods (T-test, $p>0.05$). When the two species were compared with respect to their average number of individuals, the pre-laying periods were identical (T-test, $p>0.05$) while the other periods (incubation and fledging) were significantly different (T-test, $p<0.05$). The biggest number of individuals was recorded between 0600 - 1100/1600 - 2000hrs during the day. The number of individuals was the lowest in the midday due to the high temperature.

Intra-specific Fighting

The pre-laying period showed the most extensive intra-specific fighting behaviour. The frequency decreased in the incubation period and then increased again in the fledging period (Table 1). In the pre-laying period, there was no change in the intra-specific fighting behaviour during the day (between 0600 and 2000hrs). However, the intensity that decreased from morning till midday in the incubation and fledging periods began to increase again after 1600hrs. The Little Egret had more activity than the Night Heron in all periods. For both species, the pre-laying period was significantly different from the incubation and fledging periods (T-test, $p<0.05$). In contrast, there was no significant difference between the incubation and fledging periods (T-test, $p>0.05$). When the species were statistically compared their intra-specific fighting frequencies, pre-laying, and incubation periods were different (T-test, $p<0.05$), but the fledging periods were similar (T-test, $p>0.05$).

Inter-specific Fighting

The average number of inter-specific fighting

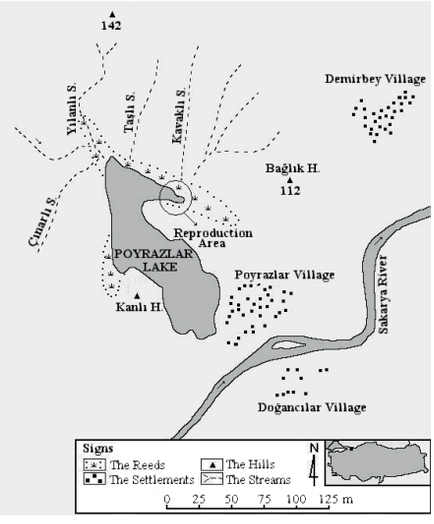

Fig. 1. Map of the study area (Poyrazlar Lake and close vicinity).

Table 1. The hourly means of observation parameters in the breeding periods.

Parameters	Night Heron			Little Egret		
	Pre-laying Period	Incubation Period	Fledging Period	Pre-laying Period	Incubation Period	Fledging Period
Temperature±SE	11.54±0.82	15.59±0.93	23.05±0.61	11.54±0.82	15.59±0.93	23.05±0.61
Individual±SE	100.55±0.61	70.46±3.01	52.89±7.69	101.03±1.10	104.64±4.88	99.77±8.64
Fighting±SE (intraspecific)	13.86±0.27	2.56±0.32	6.22±2.60	25.94±1.91	7.20±0.68	10.50±1.36
Fighting±SE (interspecific)	9.63±0.38	1.41±0.25	1.46±0.38	9.63±0.38	1.41±0.25	1.46±0.38
Flying in Colony±SE	18.11±1.05	3.81±0.44	7.50±3.15	23.82±2.36	10.66±0.94	9.92±1.12
Flying out of Colony±SE	10.23±0.33	2.61±0.26	7.09±3.48	24.57±2.76	15.33±1.60	9.77±1.35
Feeding±SE	10.67±0.63	3.78±0.68	1.89±0.22	18.53±1.43	21.67±3.43	19.64±3.31

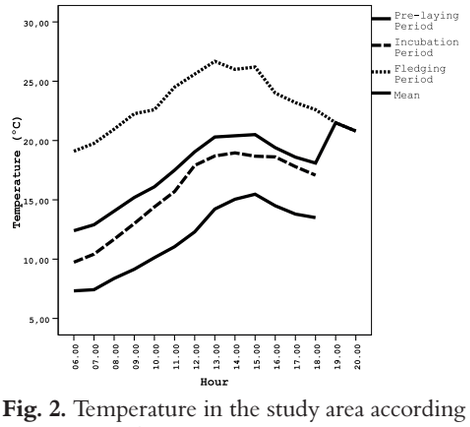

Fig. 2. Temperature in the study area according to the period.

events was 125.25 in the pre-laying period, 12 in the incubation period and 21.8 in the fledging period. While inter-specific fighting frequency varied between the periods (Table 1), there was no significant difference between the fledging and incubation periods (T-test, $p>0.05$). On the other hand, the pre-laying period significantly varied from the other two periods (T-test, $p<0.05$). Generally,

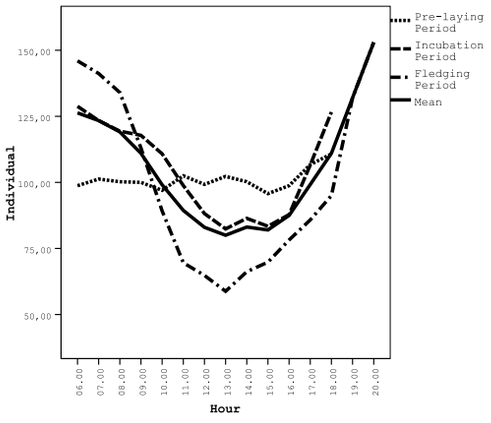

Fig. 3. The variation in the individual number of Little Egret according to the period.

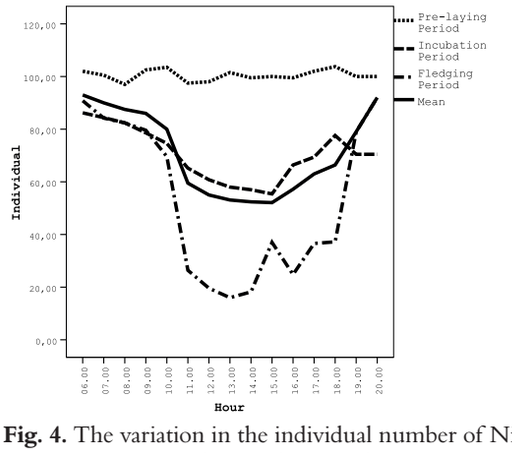

Fig. 4. The variation in the individual number of Night Heron according to the period.

the first attack leading to the fight was performed by the Little Egret. In the pre-laying period, 37.57% (30) of the first attacks were performed by the Night Heron and 62.43% (95.25) were by the Little Egret. In the incubation period, these ratios were 22.22% (4) and 77.78% (14) respectively. In the fledging period, all of the fights (100%) were initiated by the Little Egrets.

Flying in Colony

The numbers of flight of the Little Egret and Night Heron, in the colony territory exhibited variation between the periods (Table 1). There was no significant difference between the incubation and fledging periods (T-test, $p>0.05$). The pre-laying period was significantly different from the other two periods (T-test, $p<0.05$). Depending on the average number of daily flights, the most extensive period was the pre-laying. The Little Egret was more active than the Night Heron in all of the periods. When the two species were compared with

respect to their number of flights, only the incubation period was significantly different (T-test, $p<0.05$). The other periods were similar for the numbers of flights (T-test, $p>0.05$). During the day, the morning and evening numbers were higher than the other times of the day for both species. The Night Heron performed 2.98 flights per hour until 1900hrs, 31.4 between 1900 and 2000hrs, and 42.4 between 2000 and 2100hrs.

Flying out of Colony

The number of flights that the Night Heron performed out of the colony territory exhibited variation between the periods (Table 1). However, only the pre-laying and incubation periods were significantly different (T-test, $p<0.05$). On the other hand, the number of flights of the Little Egret during each of the three periods were significantly different from one another (T-test, $p<0.05$). Both species flew out of colony quite frequently in the pre-laying period. The number of flights decreased during incubation, but increased again in the fledging period. When we compared the species according to their flying out-of-colony behaviour, the Little Egret was more active than the Night Heron in all periods. However, there was no significant difference between their fledging period behaviors (T-test, $p>0.05$), but during their pre-laying and incubation periods were significantly different (T-test, $p<0.05$). The Little Egret had the greatest number of flights from morning to midday in each period. The Night Heron flew out of the colony more frequently in the evening (1900 to 2100hrs).

Feeding

Both the Little Egret and Night Heron gathered food via two different methods. The first method consisted of flying to the water lilies near the breeding territory or the tree branches hanging down close to water and gathering food from the water. In the second method, both species gathered food via flying out of the colony. The Night Heron's feeding frequencies varied between each period (Table 1, T-test, $p<0.05$). On the other hand, the Little Egret's feeding frequencies were similar in all three periods with no significant differences between the periods (T-test, $p>0.05$). The Night Heron preferred feeding more frequently in the mornings during pre-laying and incubation, but in the fledging period it preferred after sunset. However.the Little Egret preferred the hours between morning and the midday for feeding. It was also observed that in the breeding territory, Little Egret individuals were also searching for food until sunset. Feeding hours and frequencies of both species varied between all periods (T-test, $p<0.05$).

DISCUSSION

The inter-specific and intra-specific coactions of the Ardeid colonies are dependent on the size of the breeding area, food abundance, climate (temperature and sun light duration), and the hereditary characteristics of the species (Burger 1981). Also, the proximity of the colony area to settlements and man-made roads for transportation purposes are important. However, there are only a few studies on the effect of roads on bird populations (Yamaç and Kirazlı 2012). Particularly, larger breeding territories and higher food abundance, with respect to the number of individuals, confined the competition. In addition, the Night Heron is nocturnal and the Little Egret is diurnal (Voisin 1970). This situation minimized the competition between the species within the colonial territory. However there was a significant competition between the species and within the species in order to find a place for nesting and mating during the pre-laying period. This increased the intensity of the inter-specific and intra-specific behaviors of both species during the pre-laying period compared to the other two periods (Table 1). The numbers of Little Egret individuals were similar for each period while the numbers of Night Heron individuals decreased during incubation and fledging (Table 1). However, in order to avoid high temperatures, the Little Egret would enter the vegetation between 1100 and 1600hrs during the periods other than pre-laying. The total number of observed individuals did not change significantly throughout the day between the periods, but this number changed with regard to the temperature within the day (regression, $p<0.05$). The decrease in observed number of Night Heron individuals in the incubation and fledging periods was a result of both the increase in temperature (regression, $p<0.05$) and genetic properties of the species. This species was active during the night. However in the pre-laying period, it exhibited activity during the hours of daylight also. The reason might be that the environmental temperature was not high enough to disturb the Night Heron individuals. The evidence suggesting that the activity of the species during the

incubation and fledging periods correlated with the temperature supported our hypothesis. Therefore, environmental temperature has an important effect on the time and intensity of species behaviour. Another behaviour which environmental temperature had an effect on was the time and amount of feeding (regression, $p<0.05$). The Little Egret's feeding was similar between the periods (Table 1). While the total number of feeding individuals throughout the day did not change significantly between the periods, the individuals did not exhibit a feeding behavior between 1100 and 1600hrs in the incubation and fledging periods. Individuals fed throughout day in the pre-laying period but preferred morning hours with lower temperatures in the incubation and fledging periods. On the other hand, there are various ideas about the time of feeding of the Night Herons. Cramp and Simmons (1977) proposed that this species hunts only during the night while Hanzak (1970) stated the opposite. Watmough (1978) stated that morning hunting was infrequent while most feeding took place at night for the Night Herons. Voisin (1970) and Fasola (1982) have divided the feeding period of this species into two periods. They proposed that they hunt only during the night during the breeding period, but during both night and morning outside of breeding period. Also, in a study performed on the feeding regime of the species on the same lake in 2005, we showed that the Night Heron fed only at night (Uzun and Uzun 2008) as shown by Cramp and Simmons (1977). According to the data of this study, even though the Night Heron exhibited feeding behaviour during daylight (especially during pre-laying), its major food supply was coming from night hunting.

Apart from the observed number of individuals and feeding behaviour, inter-specific fighting, intra-specific fighting, and the flying in colony and flying out of colony behaviors were independent of environmental temperature for both species. In other words, there seemed to be no correlation between these behaviors and temperature ($p>0.05$). This is because both the Night Heron and Little Egret exhibited these behaviors all day during each period. However, the intensities of behaviors varied between the periods. Intra- and inter-specific fights were most frequent during the pre-laying period for both species. Fights within the species decreased during incubation and increased again in the fledging period. The incubation period was the quietest period with respect to these behaviors because the parents prioritized the safety of the nest. Especially due to the risk of predators, birds did not prefer flying out of the nest territory. One of the parents waited next to the nest while the other was sitting on the nest. One of the parents flew out of the nest for a short time only when food was needed. This situation led to minimum inter- and intra-specific fighting. However, in the fledging period, the increase in the number of individuals in both species and play fighting between younger individuals resulted in an increase in the number of intra-specific fights. Perching fights for branches in the evenings was the other reason for the increase in intra-specific fights. Overall, the frequency of fights between two species did not change. Both in the incubation and fledging periods the species rarely disturbed each other. The number of short-range flights in the colony territory had its peak values in the pre-laying period for both species. The fight for defining a nest place resulted in frequent movements of the birds inside the vegetation. This led to an increase in the number of short-range flights. However in the incubation and fledging periods, there seemed to be a decrease in the number of short-range flights for both species. The short-range flights in the incubation period were dependent on movements of birds towards shadier places in order to avoid high temperatures, and also in an effort to search for food. Additionally, in the fledging period there were other reasons such as fights for perching places between younger individuals because of the increased number of individuals, short-range flights for playing and flying trials. This resulted in an increase in the number of short-range flights of the Night Heron. On the other hand, the numbers of short-range flights of the Little Egret were similar in the incubation and fledging periods. The reasons for short-range flights of the Night Herons were the same as for the Little Egrets. However, the number of short-range flights of the Little Egret did not increase in the fledging period because the Little Egret adults did not fly for short-ranges. Therefore the number of flights was similar to that of the incubation period. The Little Egret, especially the adults, preferred to fly out of colony more frequently in each period. The aim of this type of flight was to search for food. Therefore depending

on its diurnal behavior, the numbers of out-of-colony flights of the Little Egret feeding in the mornings were similar in each period. The Night Heron flew out of colony more infrequently in the incubation and fledging periods compared to the pre-laying period however. Because the Night Heron is nocturnal and feeds during the night, the number of flights out of the colony became less during the incubation and fledging periods.

Consequently, the Little Egret is more active than the Night Heron. The fact that the observations were performed in daylight and the Night Heron is nocturnal might have influenced the results. The variation and intensity of the activity within colony is shaped via the genetic properties of the species and the environmental factors. Also changes in water level significantly affected the existence of key habitats and their distributions, resulting in significant changes in the number of breeding waterbirds and their breeding activities (Gul et al. 2013). But, temperature and daylight in particular have essential effects.

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