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Breeding Biology of Grey Heron *Ardea cinerea* in Siahkeshim Protected Area, Northern Iran

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Abstract: The breeding ecology of Grey Heron was studied during 2008 and 2009 breeding seasons in Siahkeshim Protected Area of Anzali Wetland. In this study the chicks have been monitored in the nesting, egg-laying and fledgling stages. The nests were oval-shaped and the following parameters were measured: greater and smaller external diameter, greater and smaller internal diameter, external height and depth of nest. In the first year, the average clutch size (totaling 91 eggs) was 4.33 ± 0.68 , whereas the average number of hatched eggs and the average numbers of chicks surviving to fledging were 80.2% and 78.02%, respectively. In other words, 3.38 chicks, on average, arrived to fledging per nest in this region. But, in the second year, there were only five active nests with a total of 14 eggs from which only one egg hatched and fledged. The reduction of nesting and breeding success in the second year is compared and discussed.

Keywords: Anzali Wetland, *Ardea cinerea*, Breeding biology, Caspian Sea, Grey Heron, Iran, Siahkeshim.

INTRODUCTION

The Grey Heron *Ardea cinerea* is distributed throughout Iran. They breed in the southwest and southeast areas of the Caspian Sea, northwest and south parts of Iran and in Fars and Sistan provinces (Mansoori 2008). Breeding of Grey Heron has also been reported in the 1970s in Gilan Province (at small colony with other herons and egrets; c. 20 breeding pairs in the Anzali wetland and 6 breeding pairs in Asalem), Mazandaran Province (2 breeding pairs in Miankaleh Wildlife Refuge), West Azarbaijan Province (c. 25 breeding pairs in Gopi lake), and Sistan Province (c. 40 breeding pairs in Hamoon-e Sabari) (Scott 2007). However personnel of West Azarbaijan, Fars, and Sistan & Baluchestan stated that there is evidence of breeding Grey Heron since then.

This species has been observed in Gilan Province in all seasons and breeds in mixed colonies with other species of herons and cormorants in some regions of this province (a colony of 43 nests in Siahkeshim Protected Area (part of Anzali Wetland and edge of Bahambar river), Kiakolayeh wetland of Langarood (10–12 pairs), Alalan wetland of Asalem (7–8 pairs), Karfastan wetland of Amlash (1 pair), Steel wetland of Abbasabad Astara (1 pair) and Joukandan wetland (1 pair) (A.A. pers. obs.). Therefore it seems that the Anzali heronry is the largest colony of Grey Heron in Iran.

Grey Heron is normally a colonial bird and usually breeds in tall trees with nests up to 25 m above ground, but also in low trees and bushes or, reed-beds. 1–3 nests per tree are most common. Same nesting sites may be occupied for many decades (Cramp & Simmons 1977). The nest is built with a pile of sticks and twigs and usually

lined with smaller twigs, leaves and grass. In reed-beds, the nest is built of reeds; generally substantial but can be frail (Milstein *et al.* 1970 after Cramp & Simmons 1977). Previous year's nests are often re-used with a new lining or additions to the structure. Nest building is by both sexes. Eggs blunt oval, pale blue (often becoming stained during incubation) measured as 61×43 mm (53–70 × 39–50) of 300 samples (Schönwetter 1967 after Cramp & Simmons 1977) and weighed as 60 g (48–69, sample not given) (Bauer & Glutz 1966 after Cramp & Simmons 1977). In Siahkeshim Protected Area, Anzali Wetland, mean length of eggs was 59.24±3.008 mm ($n=105$), mean width was 43.37±0.93 mm ($n=105$) and the mean weight of eggs was 60.74±0.91 g ($n=37$) (A. Ashoori, unpubl. data). One egg is laid every 2 days on average; sometimes with a gap of 3–4 days. Clutch size is usually 4–5 (varies from 1 to 10). In the case of 10 eggs, two females might be sharing a nest. Normally has one brood but rarely two. Nestlings are semi-altricial and nidicolous, cared for and fed by both parents. They are brooded continuously for *c.* 18 days (range 11–21), and parents stand guard for further 11 days (7–15). Young leave the nest and clamber on nearby branches at 20–30 days. Fledging period lasts *c.* 50 days (42–55). Nestlings, at hatching, weigh 45 g, reaching peak of *c.* 1,200–1,600g at three weeks (Cramp & Simmons 1977).

The breeding success in waterbirds fluctuates remarkably and it depends on species relationships in colony, food reservoirs and predatory pressures (Frederick & Collopy 1989). Therefore the study and monitoring of breeding success can be a good indicator of any changes in environmental quality for species dependent on aquatic ecosystems (Van Eerden *et al.* 1995).

In recent years, some studies on breeding of this species have been conducted by Thomas & Hafner (2000) in Camargue delta, France and by Jakubas (2005) in North of Poland. However, few data are available about breeding from elsewhere in western Palearctic (Cramp & Simmons 1977). The aim of the project was to study the breeding biology, in particular breeding success, in Siahkeshim Protected Area in the Anzali Wetland by following the example of breeding activity of

Grey Heron. There appears to be no other important breeding study of Grey Heron in the Middle Eastern region.

STUDY AREA

Anzali Wetland encompasses the whole Anzali Wetland, Siahkeshim, Selkeh, Esfand and several other areas bordering the marshes. The Siahkeshim Protected Area is situated in the Anzali Wetland Complex, Gilan Province on the south coast of the Caspian Sea (37°22'–37°27'N, 49°17'–49°25'E) and covers an area of about 4,500 ha. About 60% of recorded rainfall occurs in the summer and autumn seasons, 20%–30% in winter and 10%–20% in the spring. The annual mean temperature is 16.1°C and the annual mean precipitation is 1950 mm. This permanent freshwater wetland (Riazi 1997) is extremely important for wintering and breeding waterbirds. Most parts of the wetland are covered by *Phragmites australis*. The central part of Siahkeshim (3,515 ha) was first established as a protected region in 1967. The reserve was enlarged to 6701 ha and upgraded as a wildlife refuge in 1971, but it was downgraded to its present size of 4,500 ha and as protected area in the 1980s (Scott 1995). The Anzali Wetland Complex (15,000 ha) was designated as a Ramsar site in 1975. The wetlands have also been identified as an Important Bird Area by BirdLife International (Evans 1994). Siahkeshim Protected Area is one of the important habitats for Pygmy Cormorant *Phalacrocorax pygmeus* in Iran. Each year Pygmy Cormorants breed there in a colony on willow trees and reeds together with Grey Heron (Barati *et al.* 2008, Sehhatisabet 2006).

MATERIALS AND METHODS

This survey was carried out in two periods: 8 February to 10 June 2008 and 15 March to 10 May 2009. Breeding population of Grey Heron in Siahkeshim colonies in 2008 were 43 pairs in a five-hectare area. On account of inaccessibility to each nest, just 21 nests were investigated in 2008.

Nest building at the present colony started in early February 2008 but, because we could not access them, the investigation was started in early March, when they started nest building on trees near Bahambar river. In 2009, five nests were recorded. Egg-laying did not take place until 26 March. To access the nest sites, we used a motor-boat, and a ladder to reach the nests high in willow *Salix* sp. trees. Nests were counted three times from the beginning of the study period to late March to estimate the breeding population in 2008. In total, 21 nests were accessed in early March 2008 and five nests in late March 2009.

When a nest was found, it was tagged by numbered wooden plaques. Nests and their contents were monitored at different intervals (3, 5, 6 and 7 days). In each visit, nest contents were monitored and recorded. Nest parameters; outer large diameter, outer short diameter, inner large diameter, and inner short diameter as well as height of nest and nest cup were measured by tape measure (to nearest 1 cm). Length and width of eggs were measured by Vernier Caliper (to nearest 1 mm). To identify mass and egg shape index, the following formula were used: $V(cc) = K \times L(cm) \times B^2(cm)$ where L indicates maximum length, B is maximum breadth and K as constant (0.51) and egg shape index = $B/L \times 100$ (Hoyt 1979) that means the more the index increases, the more spherical is the shape of the eggs.

Nestlings defined as newly hatched and downy birds without ability to move around and usually up to 10 days old, whereas post-nestlings as having lost the downy feathers and with ability to move around the nests on adjacent branches usually aged between 10 and 23 days but still not able to fly. Finally at fledging stage the nestlings can fly and leave the nests after about 23 days. To identify the rate of breeding success and production, numbers of nests, eggs, nestlings and post-nestlings between clutch sizes and numbers of chicks based on mean fledged chicks (Barati 2009) or mean rate for each breeding stage (Smith & Renken 1993) were calculated. Statistics were performed using SPSS (Norusis 1990). Means are presented \pm SD.

RESULTS

Nesting

All 43 nests in 2008 and five nests in 2009 breeding seasons were built on *Salix* sp. trees. Nests were mainly constructed of *Phragmites* sp. and twigs of *Salix* sp. Overall, in 80% of the nests, the main component was *Phragmites* sp. made up with 20% of *Salix* sp. In the other 20% nests, in contrast, 85% of the nest material was *Salix* sp. and 15% *Phragmites* sp. Inner parts of the nests were covered with soft, dry and wet twigs of *Salix* sp. as well as leaves and the fluffy tops of *Phragmites* sp. and nests were ellipsoid. Seventeen nests had been built on one tree and the other four in two trees in 2008. In 2009, five nests were built on five separate trees. Nests were built at a distance of 1.2–1.5 m from each others. Mean tree stem diameter under the nest was 44.11 ± 17.83 cm (ranges 29–83) and the height of the nests from the water surface was 3.18 ± 0.87 m (ranges 1.15–4.8). The height of nest from the canopy was 2.76 ± 1.17 m (ranges 0–6.5).

Egg biology

Egg-laying starts in early March and lasts until 26 March. The clutch size in 2008 averaged 4.33 ± 0.66 , consisted of 4 (47.6% in 10 nests) followed by 5 (42.8% in 9 nests) and 3 (in 2 nests) respectively. In 2009, only 14 eggs were laid in five active nests. Most probably, all nests have five eggs but to some unknown reasons, 2 or 3 eggs were found on the ground. Mean egg volume in 2008 and 2009 were 57.16 ± 0.38 and 52.55 ± 2.99 respectively. The egg shape index in 2008 and 2009 averaged 72.88 ± 3.39 and 76.63 ± 6.76 respectively.

Nestling

First egg hatched on 2 April and egg hatching continued to May. In late May, fledglings could fly and by mid-June (12–15), all young had departed the nests. The measurements for 2 to 4 day-old nestlings were: total length of 146 mm, tarsus length of 313 mm and bill length of 210.5 mm.

Table 1. Mean±SD of nest parameters of Grey Heron in Siahkeshin breeding colony during the 2008–2009 breeding seasons.

Parameter	Mean±SD	Min.–Max.
External greater diameter of nests (cm)	74.31±10.84 (N=26)	55–92
External lesser diameter of nests (cm)	64.82±12.60 (N=26)	46–89
Internal greater diameter of nests (cm)	26.52±5.15 (N=26)	15–33
Internal lesser diameter of nests (cm)	24.38±4.32 (N=26)	15–38
External height of nest (cm)	35.85±7.03 (N=26)	19–48
Internal height of nest (cm)	12.38±3.65 (N=26)	6–18
Diameter of branch at base of nests (cm)	44.11±17.83 (N=26)	29–83
Height of nests from the water surface (m)	3.18±0.87 (N=26)	1.15–4.8
Height of nests from the canopy (m)	2.76±1.17 (N=26)	0–6.5

Table 2. Breeding success in different stages of nests and clutch sizes of Grey Heron in 2008 in Siahkeshim wetland.

Clutch size	Frequency (nest number)	Hatched eggs	Eggs reached Nestling stage	Eggs reached Post-Nestling stage	Fledged chicks (Frequency): mean reared per clutch
3	09.5% (2)	50% (3)	50% (3)	50% (3)	3 (4.2%): 1.5
4	47.7% (10)	85% (34)	80% (32)	80% (32)	32 (45.1%): 3.2
5	42.8% (9)	80% (36)	80% (36)	80% (36)	36 (50.7%): 4
Total breeding success	100% (21)	80.2% (73)	78.02% (71)	78.02% (71)	71 (100%): 3.38

In the first days of hatching, nestlings had a long feather (36 mm) from crown to below the eyes and extending behind the eyes. Bodies were greyish white, eyes with black pupil and yellow iris, yellow/orange lower mandible, dark upper mandible, and legs olive. Hatching took place at unequal intervals over a period of 2 to 5 days at the same nest for about 80% of the total nests. Some six to eight weeks were estimated for the period between hatching and fledging.

Breeding success

Of 91 eggs (from 21 nests) in 2008 breeding season at Siahkeshim, 73 eggs hatched and 71 fledged. Breeding success was 78.02. The highest rate of breeding success was observed in clutch sizes of 4 or 5 eggs (80%) and the lowest in clutch size of 3 eggs (50%). On average, clutch size was 4.33 (SD =0.66) eggs. Mean brood and fledging per nest was 3.48 (SD= 0.98) and 3.38 (SD= 0.97) respectively. The mortality rate before hatching period was 0.86% and in nestling period was were 0.09%. In 2009, of five nests four were abandoned and from 14 eggs only one fledged.

DISCUSSION

In this study, 43 nests were counted in Anzali Wetland in spring of 2008 while only 20 nests had been reported from this region in the 1970s by Scott (2007). The entrance of Grey Herons to the nesting and breeding sites of Siahkeshim starts from February. This is the same time as observed in the Camargue Delta in France (Thomas & Hafner 2000).

The nests had been constructed on trees in most of the studied colonies of Grey Heron and they built of small, dry twigs (Jourdan 1958, Clutz & Bauer 1988, Cramp & Simmons 1977). In Camargue delta in France, the nests have been created on Tamarix trees (*Tamarix gallica*) within the dense reed beds. This is similar to the Siahkeshim colony but here the nests are on willow trees. However, in Siahkeshim colony in 2007 (A.A. pers. obs.), one nest had been constructed on reeds. For the breeding season of 2008, the reeds had been crushed by heavy snowfall the previous winter and so were not available as a nesting site.

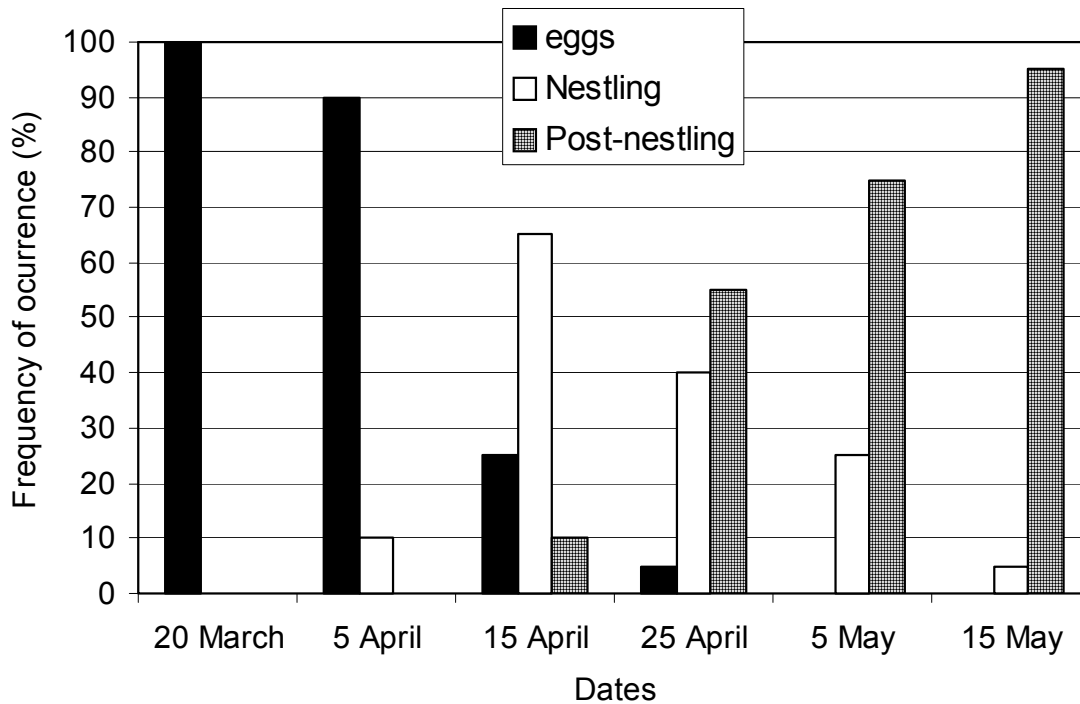


Figure 1. Breeding phenology stage of the Grey Heron *Ardea cinerea* colony in Siahkeshim Protected Area, northern Iran in 2008.

In the present study mean clutch size was 4.33 in 2008; clutch size 4 was the most common (47.7% of 21 nests), followed by 42.8% for clutch 5, placing Siahkeshim wetland close to France where a clutch of 5 was more common than a clutch of 4. Also in Switzerland where mean clutch size of 4.53 (of 85 clutches) (Glutz 1962, Guichard 1949; after Cramp & Simmons 1977) was greater than 4.33 of this study in 2008. In England, of 222 clutches, clutch 4 was more common (61%, mean 3.95) and similarly, in Denmark, 4-egg clutches were more common (Owen 1960 and Holstein 1927 after Cramp & Simmons 1977).

This research revealed that the first nests built in early March (with 5 eggs) had 80% of breeding success rate for the period of hatching to fledgling. The success rate of fledgling in nests of year 2008 was 3.38 chicks per nest. This was about 78.02% of initial eggs. In comparison, the rate in the breeding colony of Grey Heron in the Camargue delta was 2.64 and 2.40 chicks per nest for nests in reeds and nests on trees, respectively

(Thomas & Hafner 2000). In north Poland, in Katy Rybackie, Mosty and Kiersity, the fledgling success was 3.2, 2.8 and 2.5, respectively. Average number of reared young in England was 2.0 from 29 broods of 2 at hatching; 2.6–2.9 from 63 broods of 3; 2.9–3.8 from 74 broods of 4; 3.1–3.5 from 9 broods of 5; all broods of 2 successful (Owen 1960 after Cramp & Simmons 1977).

Breeding success linked to brood size at hatching and to food supply: in Owen's (1960 after Cramp & Simmons 1977) work, broods of 3 lost no nestlings in years of good food supply, a few in bad years. Broods of 4 and 5 lost more in bad years; the smallest young always dying first in a year of food shortage. The probable reasons for the higher rate of breeding success of Grey Heron in Siahkeshim were appropriate situation for breeding colony and the availability of food resources and maybe because of favourable weather conditions (without a rainy day) in the spring 2008.

However, in the year 2009, from 5 initiated clutches, only one egg fledged. One probable

cause of this could be the height of nests on trees and consequently the reduction of stem diameter at base of the nest in comparison with previous year (Table 1). The eggs therefore may have fallen down or been thrown down because of severe winds. A second cause could be egg infertility. And a third probable cause could be the insecurity of the area of the colony with the stress to the birds caused by hunters and predators (especially jackal; in many parts of breeding sites in year 2009 the tracks of jackals have been seen frequently). The disturbances by hunters and predators could consequently have caused infertility or desertion of eggs (all of these eggs were broken and empty). These are probably the main reasons for the small size of the breeding colony and low rate of breeding success. In this study the chicks of small nests were going frequently on nearby branches after nestling stage (post-nestling).

The average length and width of the eggs were different between the two years of 2008 and 2009 (59.59 to 57.11 for length and 43.35 to 43.52 for width) and the index of egg shape in the year 2009 (76.63) was greater than that of 2008 (72.88). Therefore, the low breeding success along with more spherical index in 2009 (7.14%) than in 2008 (78.02%) and in clutch size 3 (50%) than other clutch sizes 4 and 5 (80%) in 2008 may suggest a relation between more spherical egg shape and lower breeding success rate in colonies of Grey Heron. However this is not what is well supported by our data and requires more studies among breeding waterbirds in the future.

The average number of the hatched eggs in 3 studied colonies in the north of Poland were 3–4 chicks (Kiersity, Katy, Mosty and Rybackie areas) while there were rarely 1–2 chicks in some nests (Jakubas 2005). In the Siahkeshim colony in 2008, 66% of total nests had 4 chicks and rarely 3 and 2 chicks have been observed, but no nest was observed with 5 nestlings. The chicks generally had been hatched in the morning at between about 07:00 and 11:00. In the non-synchronous hatching of eggs, chicks hatching earlier in the day were expected to have a higher survival rate. But in this study, we have not observed such a relationship. However, Van Vessem & Draulans (1987) found that breeding

birds with little experience of the area spent more time exploring than birds with more experience in the early stages of reproduction and that non-breeding herons and first-year breeders showed little site fidelity (see also Van Vessem & Darulans 1986, Van Vessem *et al.* 1986). All these need to be studied in the future. In the present study even the chicks hatching at 5-day intervals succeeded to fledge. The clutches with 3 eggs had the maximum mortality (50%, Table 2). All nests with 5 eggs ($n=9$) lost at least an egg in hatching stage and they produced a maximum of 4 fledglings.

It seems that the breeding colony of Grey Heron in Siahkeshim Protected Area in the year 2008 had a high breeding success rate because of the presence of willow trees, habitat security, no access to the nests, food resources, the proximity and low distance between breeding site and food resources, and also appropriate weather conditions. The fact that only five nests were constructed in the colony in 2009 was probably due to the frequent (continuous, successive) studies of researchers in several years in breeding season in the place of the colonies. Also drought in parts of the colonies and leading to easy access for predators (especially Golden Jackal), and poaching until the end of winter (mid-March) in the area. Effective habitat management plans must be speedily enacted to prevent further drying of the area of the colony to prevent further reduction in the number of nests, such as that which occurred between 2008 and 2009. Such a plan may need to include dredging of sediment or an embankment to restrict the flow of water away from the colony area. It is important to rehabilitate this site for breeding Grey Heron and especially Pygmy Cormorant.

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