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Breeding biology of pond heron in Kerala, south India

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ABSTRACT

Regular intensive investigations to locate nesting colonies of Pond Heron were carried out during early monsoon of 1999 up to 2002. For detailed study a few breeding colonies were selected. The nesting trees, nest characteristics, eggs characteristics, incubation, hatching and hatchlings were documented.

Pond heron used altogether 17 plant species for nesting. Materials from 24 plant species were used for building the nest. The mean maximum size of the nest material used was 29.05 cm and the mean minimum size was 13.46 cm. The clutch size in the species varied from 2-5 and clutches of three were very common. The maximum and minimum length and breadth of eggs were 48.0 x 32.0 and 33.3 x 24.1 respectively. Eggs varied in weight between 17.8 and 11.2 gm. Both male and female take part in incubation that extends to 18-24 days. Hatching success reached 82%. Pond Heron food consisted mainly of fishes and both parents took part in feeding the nestlings.

1. Introduction

Indian Pond Heron, *Ardeola grayii* (Order Ciconiiformes, family Ardeidae) is a species frequenting paddy fields, ponds, reservoirs, jheels and other such natural wetlands. This chiefly solitary ground feeder feed on animal

matter mainly aquatic in nature (Ali and Ripley 1968). Factors affecting distribution of heronries and breeding biology of herons are discussed widely (Krebs, 1974, 1978, Fasola et al. 1978, McCrimmon Jr. 1978, Mitchell et al. 1981, Erwin et al. 1996, Gawlik et al. 1998, Martinez 1999, Poussart et al. 2001). Information on colonial nesting birds in India include studies on nidification, breeding, distribution, status and conservation (Ali and Ripley 1968, Jenni 1969, Mukherjee and Chandra 1973, Mukherjee and Saha 1976, Naik et al. 1981, Dharmakumarsinhji 1984, Parasharya and Naik 1984, 1988, Uthaman 1990, Subramanya, 1996, Mukherjee and Parasharya 2000). However, the breeding biology of Indian pond heron, a widely seen species, is less documented excepting for information on some aspects from certain parts of India and Bangladesh (Panday 1958, Lamba 1963, Parasharya 1985, Yesmin et al. 2001, Begum 2003). The present study was an attempt to examine the heronries and the breeding biology of pond heron in Kerala, South India.

2. Materials and methods

The study area extends over the districts of Malappuram and Kozhikode districts of Kerala (Fig. 1). The major part of the study was conducted in the breeding colonies in a residential area at Mampad (11°14′ N, 076° 11′ E) in Malappuram district. Other nest sites examined in the district were at Pathapiriyam (11° 11′ N, 076° 08′ E), Vaniyambalam (11° 11′ N, 076°15′ E), Melattur (11° 03′ N, 076° 16′ E) and Kizhissery (11° 10′ N, 076° 00′ E). Nest sites examined in Kozhikode district were located at Ramanattukara (11°10′ N, 075° 52′ E) and Eranhipalam (11° 16′ N, 075° 47′ E).

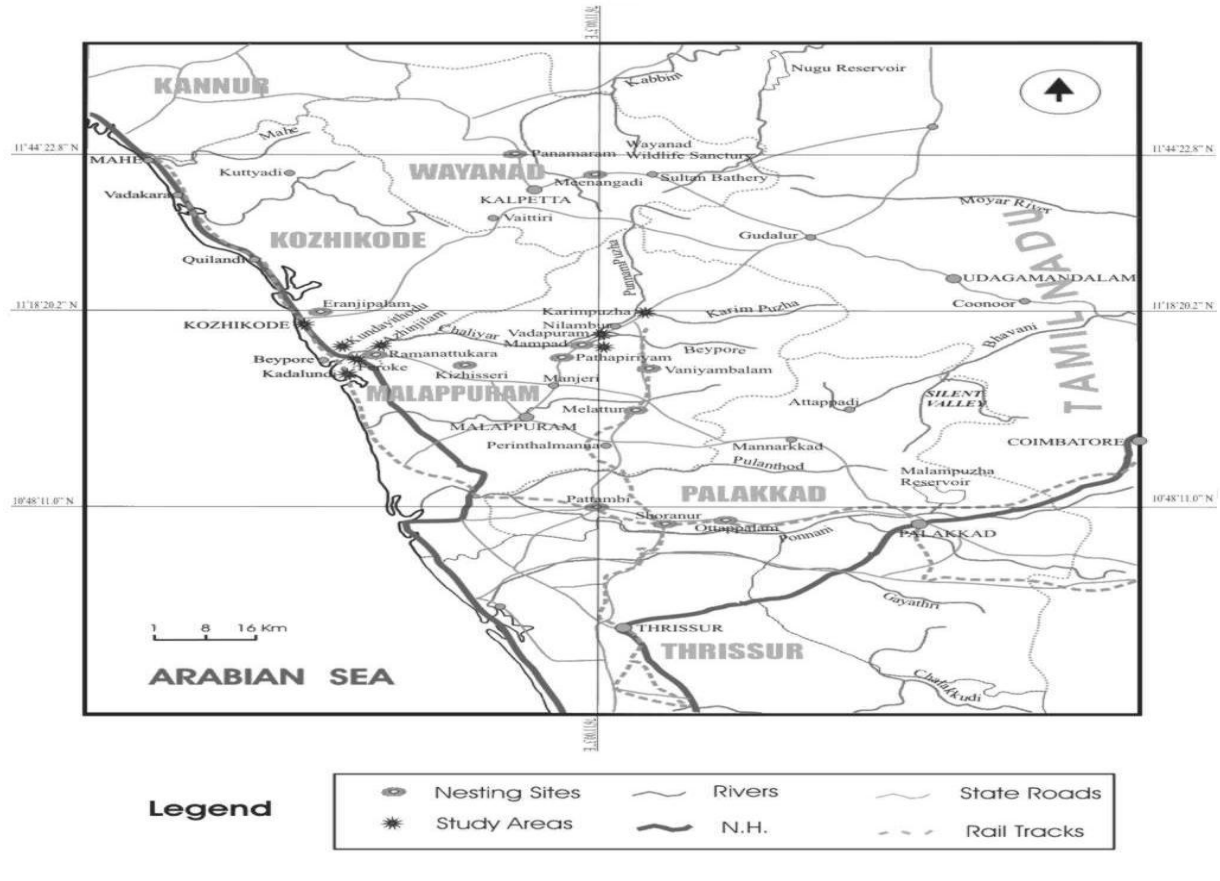

Fig. 1. Study area.

Since 1996, attempts were made to locate breeding colonies of Pond Herons at different localities of the study area. However, regular intensive investigations to locate nesting colonies of the species were carried out

during early monsoon of 1999 onwards up to 2002. In the breeding colonies, the nesting trees were numbered and numbered plates, camouflaged to the best, individually marked several nests. The freshly laid eggs were numbered with a felt-tipped pen, measured with digital vernier calipers and weighed to the nearest 0.5g with a Pesola spring balance, taking care to cause least disturbance, at an opportune occasion when the parent bird would not be alerted. Shape index of eggs was computed using the formula (Romanoff and Romanoff 1949, Prasanth et al. 1994) Si=B*100/L, where Si = shape index, B =breadth and L = length of the egg in centimeters.

The nests were checked every day during the egg-laying period; at four or five-day intervals during incubation and hatching periods and at weekly intervals from the time chicks hatched, until they reached the age of 24 days. The weight of freshly hatched hatchlings was taken using a 100 gram capacity Pesola spring balance. Regular observations on the nests were made from the top of a nearest building or vantage point and using 10x30 binoculars**.** Some preliminary observations on plumage and color of the nestlings were also made.

3. Results

The nesting colonies of Pond Herons at Ramanattukara Township was on a large Tamarind tree in a 250 square meter compound at the rear of a shopping complex at the heart of the township on the northern side of the Palakkad - Kozhikode National Highway. The tree is under strict vigil of nearby shopkeepers and nobody is allowed to disturb the nest or climb the tree. Little cormorants occupied the top, the inner and outer periphery of the nesting tree whereas Pond Herons occupied the outer and inner periphery of the tree crown interspersed with the nests of little cormorants. The Spatial distance between the nearest nests of Pond Herons was half a meter and that between the little cormorant and pond heron was 0.5 -1m, but never more than about a meter**.**

At Mampad, where totally 84 nests were seen, the nests were built on different plant species, in residential areas. The nests were solitary or in colonies in company with Little Cormorants. Based on the plant species the nest height varied (Table 1).

Table 1
Nesting trees of Pond Heron at the intensive study sites Mampad (MP) and Ramanattukara (RN) during 2000 and 2001.

No	Nesting tree	Nests (2000)		Nests (2001)		Height (m) (2000)		Height (m) (2001)	
		MP	RN	MP	RN	MP	RN	MP	RN
1	*Acacia sp.*	0	3	0	2	0	3	4-5	0
2	*Albizia lebbek*	3	0	4	0	5-6	0	5-6	0
3	*Ailanthus excelsa*	3	0	2	0	8	0	4-5	0
4	*Artocarpus heterophyllus*	6	12	5	16	6-9	9-12	7-8	9- 12
5	*Bambusa arundinacea*	2	0	1	0	4 -5	0	4 -5	0
6	*Ficus hispida*	2	0	1	0	3-4	0	3 -4	0
7	*Mangifera indica*	10	4	12	6	7-8	6-7	7-8	7-8
8	*Mimosops elengi*	6	0	4	0	5.5	6-7	0	8-9
9	*Pongamia pinnata*	3	0	2	0	3 -4	0	5 -6	0
10	*Stereospermum colais*	6	0	4	0	9- 10	0	9- 10	0
11	*Strychnos nuxvomica*	1	5	2	6	4 -5	5-6	4 -5	5 –6
12	*Swietenia mahagoni*	3	0	4	0	7-8	0	6-7	0
13	*Sygium cumini*	4	5	3	6	6-7	8-9	5-6	8-9
14	*Tectona grandis*	1	0	0		6			
15	*Tamarindus indicus*	12	85	15	78	6-7	6-9	6-7	6-9
16	*Tetrameles nudiflora*	0	12	0	10	0	18	0	10-15
17	*Terminalia paniculata*	2	0	3	0	9-10	0	8-9	0

At Vaniyambalam, 12 nests of Pond Herons with 7 nests of little cormorants were seen on a mango tree. This was in a homestead situated near a railway - cross on the Wandoor - Vaniyambalam road. At Pathapiriyam, 20 nests of Pond Herons spotted were on two mango trees, the first tree having 8 nests placed within 6 -7 m height and the second 12 nests within a height of 7-8 m. There were 12 nests of little cormorants on the same tree. The

nesting site located at Kizhissery had eight nests of Pond Herons, 4 of Little Cormorants and 5 of Night Herons on a mango tree in a residential area. A Tamarind tree in the same area was site for five nests of Pond Herons, 8 of Little Cormorants and 3 of Night Herons. At Melattur, a mango tree located in the Police Station yard, had 12 nests of Little Cormorants and five of Pond Herons.

3.1. Nesting season

Pond herons usually breed from May to September corresponding with the onset of southwest monsoon. Occasionally, when with good pre-monsoon showers breeding is accordingly advanced. During 2000 and 2001 as there were heavy summer rains in April the birds commenced breeding in April 1st week itself. The peak nesting was during June and July. Much earlier to the onset of monsoon, at Mampad and Ramanattukara, large number of pond Herons were seen roosting on some trees (*Tamarindus indicus* and *Mangifera indica*) on which they were not normally roosting during other seasons. With the onset of monsoon, the birds established their nests on those trees.

3.2. Nest-site selection

Finding a nest site is a joint effort by both male and female. After selecting a convenient site for building the nest, the pair stay put in that spot for a few hours. During nest building, the pair of pond herons are seen close by; one of the pair collects the nest material and passes it over to the other partner that arranges the material in the form of a nest. Courtship progresses there, culminating in copulation that lasts only for 6-8 seconds. Thereafter, the female (perhaps) stays in the vicinity of the nest site, while the other (maybe male) flies off to collect more nest materials. Males collected more nest materials than females. Female arranged the materials in a crisscross fashion to form the nest. No clear cut sexual dimorphism is reported in Pond Heron. However, during the breeding season, one of the pair in the nest develops dark untainted maroon plumes on its back (breeding plumage) while the other has maroon plumes with distinct black tinge (Plate-1). From this color difference and further activities of each individual, it is assumed that the one with maroon plumes tinged with black and actively building the nest as female, and the other one that only supplements the nest building activity as male. However, we have not made any attempt to catch the birds, sacrifice and confirm their sexual dimorphism. Some of the nest materials fall off during the course of nest building and no special attempt were made by the bird to retrieve them. Most of the nesting materials were collected from the vicinity of the nesting tree and even from the nesting tree itself. More materials were collected in the morning and afternoon. 5-6 days are taken to complete the nest. There was foliage cover over most of the nests. Only a few nests were exposed to the open sky. Of the 84 nests on two *Mangifera indica* at Mampad only 8 were exposed to the sky. Of the 78 nests on a *Tamarindus indicus* at Ramanattukara, only 16 nests were exposed**.**

Pond Heron nests were placed at varying heights. The nests at low heights were on *Pongamia pinnata*, *Ficus hispida* and *Acacia sp*. Nests at heights ranging from 9-10 m were observed on *Stereospermum colais* and *Terminalia paniculata* at Mampad, whereas nests built at a height of 18 m were seen on *Tetrameles nudiflora* at Ramanattukara. At Eranhipalam, 18 nests were placed on *Tetrameles nudiflora,* about 18- 20 m high. The nests were usually built on the vertical branches both inside and close to the periphery of the tree crown. Number of nests per tree apparently depends to an extent upon the availability of suitable forked branches. On a tamarind tree, with high number of forked branches, situated at Ramanattukara 85 nests were seen in 2000 and 78 nests in 2001 at a height of 6- 9 m (Table 1). More than 58 nests of Little Cormorants were also present on the same tree. Most of the nests were placed on quaternary branches (N=28) and a lesser number (N=18) on the direct sub branch arising from a quaternary branch. The mean thickness of the nesting branch was 10.8 $\pm$ 1.91 cm, computed from 10 randomly selected nesting locations (Table 2).

Table 2

Nest-branch location and nest-branch thickness in pond heron.

Nests on quaternary branch	Nests on 1st sub branch on Quaternary	No of nests studied	Mean thickness of nest-branch (cm)
28	18	10	10.8 $\pm$ 1.91

3.3. Nest materials

In Pond herons, addition of materials to the nest continued even during the incubation period. However, no further addition of materials was seen after hatching. Only materials from 24 plant species were used for nesting

(Table 3). The average number of pieces used for nest building was 91. Out of the 12 nests analyzed, one had 128 pieces while the other had only 54 pieces. The mean maximum size of the nest building material was 29.05 cm and the mean minimum size 13.46 cm (Table 4).

Table 3
Nesting materials used by pond herons.

No.	Items / species
1	*Anacardium occidentale*
2	*Artrocarpus heterophyllus*
3	*Bambusa arundinacea*
4	*Bambusa spp*
5	*Cleome viscose*
6	*Erythrina spp*
7	*Eupatorium odoratum*
8	*Ipomea spp*
9	*Loranthus spp*
10	*Mangifera indica*
11	*Mayflower leafless branches*
12	*Mimosa pudica*
13	*Mimosops elengi*
14	*Myrtagyna spp*
15	*Alstonia sp.*
16	*Sida acuta*
17	*Sida rhombifolia*
18	*Tamarindus indicus*
19	*Tectona grandis*
20	*Terminalia paniculata*
21	*Trema orientalis*
22	*Urena sinuate*
23	Unidentified creeper
24	Unidentified material

Table 4
Characteristics of the nest materials used by pond heron.

	Total items	Max length (cm)	Min length (cm)
Nest-1	66	31.1	10.8
Nest-2	113	26.6	14.6
Nest-3	128	31.2	15.9
Nest-4	54	25.7	10.9
Nest-5	90	25.8	13.1
Nest-6	120	31.6	14.7
Nest-7	86	27.2	12.4
Nest-8	105	29.1	15.6
Nest-9	90	26.9	13.0
Nest-10	72	27.2	14.2
Nest-11	87	30.0	15.0
Nest-12	81	36.2	11.2
Mean	91	29.05	13.46

3.4. Eggs

The eggs were laid generally during night or early morning. Of the 58 eggs that were observed, 35 eggs were seen in the nest first time during the early hours (i.e. 06-08 hrs). The eggs of Pond Heron are broad, oval and medium in size. Longer and thinner eggs had lower shape index while shorter and thicker ones had higher index. No correlation could be found between weight and shape index (r = -0.059, not significant, DF = 58). The eggs are sea green in color with no markings or spots**.** The highest weight of the eggs examined during the study was 17.8 gm, the lowest 11.2 gm and the average 15.51 $\pm$ 1.87 gm. The minimum length of egg was 33.3 mm and minimum breadth 24.1 mm. The maximum egg length was 48.0 mm and breadth 32.0 mm. The mean length was 37.36 $\pm$ 1.91mm and the breadth 28.34 $\pm$ 1.44mm (Table 5). Clutches of three were most common (87%). Clutches of five were very rare (Fig. 2). The 58 eggs examined during the present study belonged to 19 clutches.

For Pond Herons one of the major causes for egg loss, in the study area, was falling off the nest. During heavy monsoon, at times strong wind and rain upset the nests, some of the nests built on comparatively weak branches towards the periphery of the tree shake violently, and the eggs fall off. However, the number of such loss was low during the present study. Five such eggs were seen fallen under the Tamarind tree at Ramanattukara during heavy rains. It is reported by local sources that rarely when somebody climbs up the tree negligently, the parent bird spurts out of the nest causing the eggs to role out of the nest.

Table 5
Length and breadth variations in the eggs of pond heron (N=58).

	Length (mm)	Breadth (mm)
Mean	**37.36**	**28.34**
Standard deviation	**1.91**	**1.44**
Minimum	**33.3**	**24.1**
Maximum	**48**	**32**

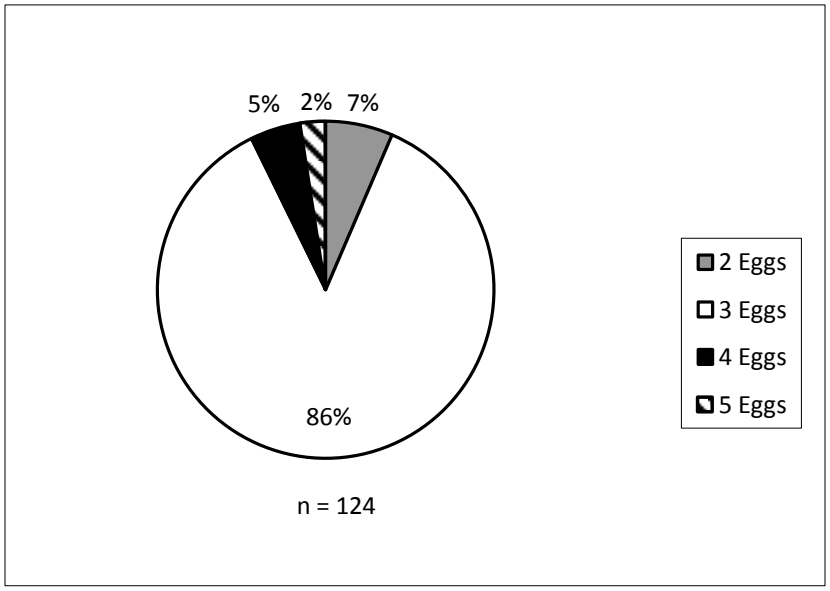

Fig. 2. Clutch size in pond heron.

3.5. Incubation

The first egg was laid with the close of the nest building. Incubation started immediately after laying the first egg. Once the egg was laid the nest was rarely left unattended, except when disturbed. The incubation period, of 62 eggs observed in the present study, ranged from 18-24 days. The mean incubation period was 20.9 $\pm$ 1.66 days (Fig. 3). Both the parents incubate the eggs. The incubating parent bird moved out of the nest only after arrival of its partner. The partner lands on a branch close to the nest and enters the nest to incubate, immediately after the

other partner leaves the nest. Then the first individual leaves the nest perhaps on a foraging trip, to return to the nest only after 3-4 hours. During 0600-1800 hrs, within the 12 day time hours, usually 3-4 changeover of duty occurs in the nest of Pond Herons. In one session of sitting in the nest each individual spends 3-4 hours. While one bird sat on the eggs, the other one, if back from foraging, remained close to the nest on another branch within its reach and watching over.

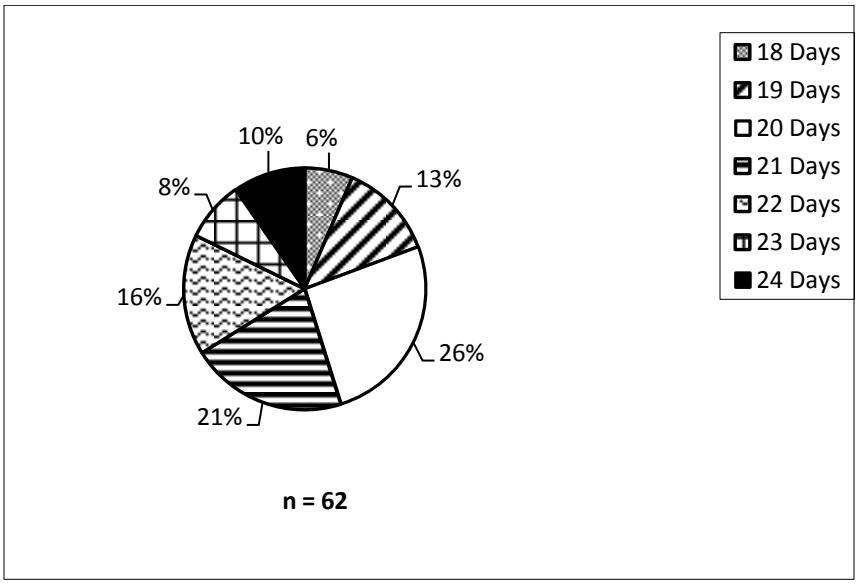

Fig. 3. Incubation period of pond heron.

3.6. Hatching

Out of 85 eggs examined, 70 hatched (82%, Table 6). Of the remaining eggs, five were lost due to nest loss, three by falling from the nest and seven remained unhatched. The unhatched eggs were those that surpassed incubation period failing the chick to emerge for several reasons such as being unfertilized or death of embryo. In one nest, two eggs were found unhatched for about 15 days after completion of the incubation period. Subsequently the nest was found deserted.

In Pond Herons, hatching is asynchronous happening in subsequent days. Of the 62 eggs, whose incubation period was watched closely, only in 12 cases the second hatching happened with an interval of a day after the first egg hatching. The freshly hatched (0 days) chick weighs an average 13.6 gm (N= 10). The hatchlings were almost naked with closed eyes. The eyes opened during third to fifth day after hatching. The hatchlings had a bulging almost transparent abdomen. The body was fleshy light in color. The natal plumage was prominent on the head. The nestlings did not take food for 1-3 days after hatching.

Table 6
Hatching success of pond heron.

	Mean	Std Deviation
Clutch Size (Numbers)	2.58	0.50
Eggs Hatched (Numbers)	2.12	1.02
Fledglings / clutch	1.67	1.05
Hatching Success (%)	0.82	0.36

3.7. Food of nestlings

Food of the nestlings was mainly fishes. Both the parents took part in feeding the nestlings. At one occasion, the parent bird was seen regurgitating into the nest that contained the head of a sardine (*Sardinella spp.*), dismembered by the parent bird. The regurgitated food of Pond Heron contain larvae of beetle (coleoptera), *Macropodus cupanus*, *Aplocheilus lineatus*, *Puntius amphibius*, *Parluciosoma daniconius* (Pisces), Tadpoles, *Rana*

spp (Amphibia), crabs (Crustacea), and Dragonfly naiad (Odonata, Table-7). It also included terrestrial organisms such as short horned grasshoppers (Acrididae) and *Arachnid sp.* Altogether, 41 prey items belonging to 12 taxonomic groups were present in the regurgitated material. The regurgitated materials contained Fishes (62.5% of the total number), Insects (22.5%), Tadpoles (10%), Arachnids (2.5%) and Crustaceans (2.5%). The most abundant item was the fish species *Parluciosoma daniconius* (29.3% of the total by number) followed by the fish species *Macropodus cupanus* (19.5% of the total by number).

Table 7
Abundance of food items in the regurgitated matter of Pond Heron nestlings.

Food item	Nestling -I	Nestling-II
Acrididae	2	1
Aplocheilus lineatus	1	
Arachnid spp	1	
Dytiscid larva	2	
Danio acquipinnatus	1	
Dragonfly naiad	4	
Macropodus cupanus	6	2
Paddy Crab	1	
Parluciosoma daniconius		12
Puntius amphibius		3
Limnonectes limnocharis	1	
Amphibian Tadpole		4
Total	19	22

4. Discussion

Pond Heron breed from April to September depending on the monsoon. If summer rain started earlier, they started breeding early. In Pond Heron, the nest site was also used for roosting. The nests were small and made of dry soft twigs loosely arranged, almost looking like that of a crow's nest. Ali and Ripley (1968) describe the nest of Pond Heron as 'an untidy structure of twigs slightly more substantial than a dove's nest'. Henry (1971) reports the nest as rather flat and devoid of any inner lining. Yesmin et al (2001), in their study in captivity reported the birds using small dry branches and petioles of different trees. In the present study, we found the birds using small dry twigs of 24 plant species growing in the neighborhoods to build their loosely-fitted nest structure. Addition of nest materials, i.e. repair and maintenance, continued throughout the incubation period, but was stopped fully on hatching, similar to the observations reported by Blaker (1969).

During nest building, the male collected the material and the female built the nest (Hancock and Elliot 1978). Both sexes took part in nest building; apparently the male is chiefly responsible for collecting the materials which the female puts together (Ali and Ripley 1968). The present study apparently endorses that most of the nest materials are collected by the male and is passed on to the female for making the nest. However it may be noted that in the present study no attempt was made to confirm the gender of the individuals. We have assumed males to be the partner in the pair that has bright maroon breeding plumage, while the female to be the one with dark tainted maroon breeding plumage. This assumption seems to conform with the activities of the each partner in the pair as well.

The height at which Pond Heron places its nest is found to vary widely. According to certain previous workers, nest was located two to ten meters above surface, on isolated large trees (Baker 1929, Ali and Ripley 1968 and Hancock and Elliott 1978). According to Begum (2003), the nests were more frequently built between 9 and 10m above the ground. In captivity, the height was considerably lesser (Yesmine et al. 2001, nest-height ranged from 0.12-3.35 m). In the present study, Pond Heron was seen to nest solitary as well as in colonies. Generally, they are less colonial than the Little and Cattle Egrets (Subramanya (2005). In the present study the nest height varied from 3 meters in *Acacia* and *Pongamia pinnata* to about 10 and 18 meters in *Stereospermum colais* and *Tetrameles nudiflora* respectively. It is felt that the level where nest is placed varied with the tree species and the available nest site.

The clutch size varied from 3-5 to five (Ali and Ripley 1968). 4-5 eggs per clutch were also reported. Clutches of 4-6 was most common in Burma (Smythies 1953) and 1-4 in captivity (Yesmin et al. 2001). In the present study, clutch size varied from 2 to 5 and the majority (86.3%) was 3. The average size of Pond Heron egg was 30.0 x 28.5 mm (Baker, 1929). A longer size (38.0 x 28.5 mm) was reported by Ali and Ripley (1968), while Henry (1971) reported slightly larger 39.5 x 29.5 mm. The average size of the 76 eggs observed by Yesmin et al. (2001) was 36.38 x 29.87 mm and the average weight 19.27 gm. In the present study, the eggs were longer, thinner and lighter than that reported by Yesmin et al (2001) and of higher dimensions than that reported by Baker (1929). The incubation period of Pond Heron was reported to be ranging from 21 to 24 days, the average being 23.02 days (Yesmin et al. 2001). In the present study, the incubation period varied from 18 to 24 days, the average being 20.9 $\pm$ 1.7 days. According to Yesmin et al. (2001), the hatching success of the Pond Heron was 46.1%, while in the present study the hatching success was 82%. The mean weight of newly hatched (0 days) chick was 13.6 gm. The weights of nestlings increased until two weeks after hatching. Thereafter, the weight dropped until the birds finally left the nest (Yesmin et al. 2001). As seen in the case of several species of birds asynchronous hatching (Inoue 1985, Magrath 1989, Skagen 1988, Viñuela 2000), which can be considered as a strategy for resource use optimization, is seen in the case of Pond Heron eggs. Incubation starts immediately after laying the first egg and the eggs hatch in successive days.

Both the parents took part in feeding the nestling. The food of nestlings is mainly fishes (62.5%). Other items include insects (22.5%), Tadpoles (10%), Arachnids (2.5%) and Crustaceans (2.5%, Table- 7). In the food items, aquatic organisms were found more than terrestrial ones. Fish were found to be important food item for Pond Heron. A major reason for the concurrence of breeding in this bird with monsoon may be the higher and growing demand of the chicks for fishes and other aquatic organisms. Yesmin et al (2001) reports 8.5% of the nestlings of Pond Heron were lost due to natural calamities, 5.7% succumbed to ectoparasitic diseases, and 2.85% died of starvation. In the present study, the loss of nestlings was much less. Carcasses of three nestlings were observed under a nest on *Tamarindus indicus* that harbored more than 100 nests in a season. All the three dead specimens were seen on the days following heavy rain and strong wind.

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