

## 7. BEHAVIOURAL ECOLOGY OF REPRODUCTION

### 7.1 INTRODUCTION

Little Cormorants and Night Herons are colonial breeders. They use Raiganj Wildlife Sanctuary as a breeding colony. In this chapter attempts are made to correlate different reproductive behavioural patterns of Little Cormorants and Night Herons with various ecological situations.

Reproduction includes the process of mate selection in one hand and production of viable offspring on the other. In colonially nesting birds it begins with the arrival of the individuals at the colony and terminates with the laying of eggs. It is no longer a random process but a non-random one as some individuals perform better and fertilize more and some particular type of mating system attains advantage over others. This non-randomness of mating implies evolutionary importance with differential fitness consequences to different mating systems. On the whole, the interactions between intrasexual and epigamic selection determine the strategies of males and females and, therefore, control the evolution of the mating system of a species ( Emlen & Oring, 1977).

Several aspects of mating systems of birds have been discussed by different authors (Khal, 1971 ; Kushlan, 1973 ; Sengupta, 1976 ; Greenwood, 1980 ; Parker, 1983 ; Moller, 1986 ; Frederick, 1985 ; 1987 ; Johnson, 1988 ; Yom-Tov, 1992 ; Singha *et. al.*, 2003) in a number of species. Some studies in Night Heron ( Noble *et. al.*, 1938 ; Davis 1993) and in Little Cormorants (Baker, 1928 ; Ali & Ripley, 1968) are known to have discussed some of the aspects. Some aspects of mating have also been discussed for many other species of Cormorants (Potts *et. al.*, 1980 ; Boekelhelde and Ainley, 1989 ; Kortlandt, 1995 ; Bregnballe, 1996 ; Schjorring *et. al.*, 1999, 2000 ) and Night Herons ( Braithwaite and Clayton 1976 ; Hancock and Elliot 1978 ; Chuan-Chiung, 2000) but no one provided detailed accounts of mating of

Little Cormorants and Night Herons apart from stereotyped analysis of patterns. This study attempts to present the basic structure of mating of Little Cormorant and Night Heron.

## **7.2 METHODS**

Little Cormorant and Night Heron both are monomorphic species. To study the reproductive behaviour of these bird sexes could not be identified at sight which presented some difficulty to begin with. The behaviour of individual birds such as aggressiveness, territoriality, postures and vocalization patterns actually helped in identification of its sex much more than the physical traits such as body weight, body length, wing span, bill shape, colour and so on. Banding (Table 7.1) and colour paintings of individual birds, however, were of help with time it was possible to form an idea regarding the sex and age of an individual depending on its behaviour patterns, body size and body length. Observation procedures and equipment used in this chapter have already been discussed in the general method section.

## **7.3 RESULTS AND DISCUSSION**

### **7.3.1. Arrival of birds in the Sanctuary**

Arrival of the birds in the Sanctuary coincides with the onset of monsoon. But it is difficult to draw any significant relation between their arrival with any particular rainfall parameter (Table 7.2). Probably the birds follow the seasonal cycle to visit the sanctuary. Their arrival, however, is not indicative of the future water conditions in the area. Because in 1972, 1975 and 1976 birds had to desert the sanctuary after nesting due to very poor rainfall. So, it seems that the rainy season and not the actual amount of precipitation which triggers the intrinsic factors of Little Cormorants and Night Herons and other birds of the sanctuary to prepare to hit the sanctuary.

The first batch of birds start arriving at the sanctuary from the middle of June and in some years in the first week of July (Table 7.2). The periodicity of first arrival of the birds over the last 05 years varied within a range of 10-20 days.

Birds usually arrive in flocks. In Little Cormorants as well as in Night Herons each flock consisted of 20-60 birds. Flow of new members of both the species continued almost upto the first week of September.

The oldest males appeared first i.e. usually by June. Peak arrival for experienced breeders was in July. Experienced females (> 3 years) arrived slightly later than similarly aged males. Novice first year breeding males arrive at the end of July and first week of August, and 2 year old females come during mid-August. Therefore youngest males arrived 4-8 week later than older birds. The same patterns is followed by young females. Similar patterns were observed in Brandt's Cormorants (*Phalacrocorax penicillatus*) Boekelhelde and Ainley (1989).

### **7.3.2 Activities following arrival**

On arrival in the sanctuary birds of both the species settle on higher branches of several tree species particularly Jarul, Chatim, Arjun in Little Cormorants and Eucalyptus, Sisoo, Jarul in Night Herons. Little Cormorants prefer specially the trees at the island of the sanctuary. They mostly settle on branches within a height range of 20-30 ft. from the ground. Just after arrival they settle on the top of the trees. Subsequently they make frequent movements from branch to branch. Little Cormorants also undertake short trips over the canals from one end to the other and visited the tree-stands. These appears to be some kind of appetitive act in search of a suitable nest site as also to advertize itself to members of the opposite sex in view of possible pair formation in a few days. This phase lasts for about 3-5 days. During this period both inter- and intraspecific interactions are observed.

### **7.3.2.1 Interspecific Interactions**

This mostly involves threats by other inhabitants i.e. Night Herons, Egrets and Open-bill storks, in case of Little Cormorant and Little Cormorants. Egrets and Open-bill storks in Night Herons when they unwittingly trespass into others territory or get very close to their nests. In most years Night Herons arrived first, so the Night Herons that come in the first batch do not have to face such situations. Interspecific squabbles, however, never escalated to real fights. In interspecific conflicts often the Cormorants retreated on being threatened by Night Herons, Egrets or Open-bill storks but the Night Herons most often showed aggressiveness.

### **7.3.2.2 Intraspecific Interactions**

In Little Cormorant this mostly involve, one individual moving very close (6-12 inch) to a conspecific who in turn moves to another spot and sometimes this recurs to a maximum of three times. The motivation behind this activity appears to drive away a conspecific from a particular spot.

In Night Heron few number (3 to 5) stand on the branches of the tree for a long time. One individual move very close to the other and move spot to spot and at this time drive away the conspecific ones.

Territory an exclusive area is intensive use by breeding males for display, mating and for resource. Mostly nest-site territoriality is exhibited by the males.

In Little Cormorant on the third day of arrival the males successfully establish some sort of territory where from they start emitting characteristic loud courtship calls.

In Night Heron breeding males defend an area around the immediate vicinity of their nests against any conspecific males. But if a female enters the territory, the resident male assumes a subservient attitude and in this way allows the trespasser to stay. A courting male never loses its territory. If a bird guarding a neighbouring territory should encroach upon his domain

he thrusts his head forward, indicative of vigorous aggressive encounters.

In both species the females, actively defend nest-sites after pair-formation and are strongly territorial to any intruder.

### **7.3.3 Age of pair-forming birds**

In Little Cormorants the male and females differed in the average age of first-breeding. Females first breed at  $2.2 \pm 0.5$  year ( $n = 27$ ) and males at  $3.1 \pm 0.6$  year ( $n = 21$  ;  $t = 3.75$  ;  $df = 46$  ;  $P < 0.01$ ).

The male and female Night Herons mature roughly about 2 to 3 years of age.

### **7.3.4 Mating Type**

Little Cormorants and Night Herons breed in monogamous pair bond. The males contribution to parental care is nothing less than that of females. However, in two cases two males and one female were found to breed as a unit.

### **7.3.5 Mating Display**

After the establishment of the breeding territory the following components of displays were exhibited by the male. In monogamous species it is mostly divided in two main components : (1) Pre-fertilization display or pair forming display which enables the sexes to come together to ensure fertilization and (2) pair maintenance display which is necessary for better coordination between mates to raise young successfully.

#### **7.3.5.1 Pairforming Display**

Usually the males initiate the displays. They were also found to perform soliciting displays. Terminology of displays are mostly based after Kortlandt (1995) in Little Cormorant and Noble, Wurm and Schmidt (1938) and Davis (1993) in Night Heron.

## **In Little Cormorant**

1) Wing-waving by male :- Male standing on a forked branch at and started wing-waving when he saw a female flying near by.

2) Raising of feathers :- Display of the male consist of the raising of feathers on crown, neck and back to full extent.

3) Puffed-up posture by female : Female shows puffed-up posture which consist of an S-shaping of the neck and protrusion of the hyoid.

## **Mating Call**

Aroundt the third day of arrival the males usualy are able to successfully establish some sort of breeding territory where from they start emitting their characteristic loud mating call. As a response to the male calls a number of females appear at the stage who settle within a distance of 1.5 to 2.2m. They were observed to call from the same spot until pair formation is achieved, usually within 2-3 days. The characteristic call (Coo-Coo, Coo-Coo-Coo, Coo-Coo-Coo-Cook) continues until about two day prior to egg laying. Fig. 7.1 shows mating call frequency in the sanctuary.

## Activity Flow-Chart leading to Pair formation in Little Cormorants

### Male Activity / Response / Behaviour

1. Calling
3. Stops calling
  - i) Facultative motor Patterns :
    - a) Head/Neck/Back and wing feather raising
    - b) Peening in the female crown
  - ii) Obligatory Motor Patterns :
    - a) Defecation
    - b) Tail Raising
5. Calling starts  
Emits several calls followed by body movement similar to calling but without emission of sound.
7. (3) This acts alternate for a while.  
Repeats all the acts as in no. 3.
9. Mounting ensues which is followed by several Pseudomounting Playful mounting.
11. Tail Raising. The male excites of the female by its beak
13. Repeat Tail Raising
15. Copulation
17. Mutual Tail Raising
19. Calling
21. Remain side by side (with body touch) and preening (self).

### Female Activity / Response / Behaviour

2. Approach within 4"-6" of the calling male.
4. Female Retreats but remain close to the male.
6. Female (same or different) approach.
8. Female comes even closer.
10. Stays and to him in the males territory.
12. Remain side by side in parallel or antiparallel orientations.
14. Stays on close to male.
16. Mutual Tail raising
18. Change position (within 2 ft.).
20. Come close to the male
22. Remain side by side and preening (Self).

In Night Heron the males soon engages in two acts :

**(a) Snap Display & Snap-hiss or song and dance display**

The unmated male while standing alone on a forked branch or while moving alone about a tree, takes two or three steps forward, halts, arches its back, lowers the head until the bill comes down to its feet and then while raising one foot produces a click or snapping sound which is immediately followed by a prolonged hiss. The performance is repeated when either the same or the opposite foot is raised. Eight to ten such displays are performed in a minute and the series lasts for over two minutes, to be followed by another bout with an interval of a minute.

Peak-hiss display is a modification of snap-hiss call. It is given by the male soon after a female has joined him before pair bond is fully established.

**(b) 'Twig ceremony' - symbolic of nest building**

The male standing over the crude nest platform, or at a distance from it, holds a stick in its bill and vocalize loudly while its head is moved rhythmically up and down. Frequently the neck is stretched vertically upwards to its full extent and the bill is brought close to the neck while the snapping vocalization continues. Although the stick may eventually be placed in the crude platform it is more often dropped.

The receptive females are attracted by one or both of these displays and settle down on the tree occupied by the male. When a female arrives in the vicinity of the territorial male he orients to her and instead of attacking, adopts a rather conciliatory attitude to her. The male often stretches his head until the head is parallel to the ground. Some times he greets the female with a guttural call which is indicative of his sex and motive. The female continues to stay in the males territory and with further displays from the male a pair bond is finally established.

Further displays of the male consists of raising the head and raising of the feathers on the crown, neck and back. He bows, his pupils contract, eyes bulge, exposing the red iris to its maximum. The plumes are erected and may even fall forward over the head as the male bows. In response to the male displays the females emit a characteristic loud call with erection of plumage, contraction of pupil and protrusion of eyeballs.

#### **7.3.5.1.1 Preening**

On most occasions after the just mentioned displays both the partners were found engage themselves in self preening.

#### **7.3.5.2 Pair Maintenance Display**

Activities designed to strengthen the pairbond and maintain it throughout the reproductive cycle are very important in monomorphic birds. Little Cormorants and Night Herons exhibit few pair maintenance activities almost throughout the breeding period. Pair Maintenance displays are :

##### **(a) Symbolic Nest Building**

Both the partners of a pair exhibit this display. It involves the picking up and manipulation of nest material on the nest.

##### **(b) Greeting**

The nest attending partner greets the incoming one with this display. The attendant immediately turns towards the incoming partner in a standing posture holding its head high and makes prominent hissing sound with widely open bills.

##### **(c) Gargling Call by Little Cormorant**

It is performed by both the sexes. The head and neck are repeatedly

thrown backwards, accompanied by a loud call by the male and by a soft call by the female.

**(d) Snap-hiss Call by Night Heron**

Hissing in this behaviour is more prominent than on any other occasion. This activity continues almost in the same frequency throughout the breeding season but its duration and details gradually diminishes.

**(e) Mutual Displays by Night Heron**

Throughout the course of mutual displays the male always holds its head higher than the female. Mutual displays involves lowering of the head by the female and raising of the wing and back feathers by the male while perching on or close to the nest. This is followed by billing ceremony i.e mutual raising of the head while holding each others bill tightly. They lower and raise their head alternately in the bill locked condition.

### **7.3.6 Copulation**

**In Little Cormorant**

The pair stand in opposite direction and raising their tail by bills. Then both the partners stand in parallel position. At this time female bent downwards and allow to stand the male on its back and to insert the penis into the cloaca of her. It is easy due to the presence of gap of tail feathers because these feathers are torned during tail raising.

**In Night Heron**

The pair usually takes position parallel to each other. The male preens the lateral and under neck feathers of the female several times. Then the female stoops with partially open wings and the male steps forward on her

back and with shuffling movements of his partially open raised wings and feet secures a grip on the back of the female while the tail is sharply bent downwards and forwards until the penis of the male is inserted in to the cloaca of the female. Throughout this period of about 90 to 120 seconds the female stays in the same position and helped the partner with subtle adjustive movements.

#### **7.3.6.1. Diurnal Rhythm**

Both the bird species were observed to copulate at any hour of the day but with a distinct preference for morning and evening hours (Fig. 7.2 and Fig.7.3). Actually these two peaks follow respectively the departure and arrival of the mate to and from the foraging ground. A smaller peak at the midday was also observed. This diurnal pattern demonstrates that before leaving their partner alone male ensures their insemination. Peak copulation is also observed immediately before laying.

#### **7.3.6.2. Influence of weather**

Copulatory activities are negatively affected by rain and storms in both the bird species. With the onset of showers they immediately stop all copulatory activity.

#### **7.3.7. Perpituation of pair maintenance**

Generally speaking, any form of courtship, nest building etc. when performed together, exerts a bond-strengthening effect on the partners. In Little Cormorants and Night Herons both the sexes of a pair appeared to be equally interested in retaining the pair-bond throughout the season and in some cases the pair-bond probably were retained through several seasons. This is also found in stork (Cramp, 1977).

### **7.3.8. Pair Dissociation**

Dissociation of pair-bonds is also observed in Little Cormorants and in Night Herons. Pair-bond dissociation over the four year study period ranged from 26 to 30% and 21-25% in Little Cormorants and Night Herons respectively. The causes of pair-bond dissociation are as follows :

#### **A. Unsuccessful copulation :**

##### **i) Copulatory failure**

After successful pairing and even after the initiation of proper nesting, pair-bond may break up due to copulation-failure. In most cases females were unable to maintain balance properly of their bodies during copulation. The males usually made further attempts for a few times and then readily drove out the females with vicious pecking. This, however, mostly happened in case of feeble novice females.

##### **ii) Female Noncooperation**

Here the females resist mounting by males probably because they are not receptive enough to go for the act. Female noncooperation may be due to lack of physiological or emotional maturity or failure of the male to gain acceptance by the female as a partner (female choice).

##### **iii) Damage of Plume**

In Little Cormorant when plumes are damaged males are rejected by the females. In Night Heron the plumes on the crown of the male are larger than those of his female and it acts as a secondary sexual character. It was observed that if those plumes are damaged the male is rejected.

## **B. Clutch or brood loss**

At the post-laying phase both the partners of a pair become more interested to retain pair-bond as they have already invested a lot. However, when the clutch or brood is lost due to predation, storms or heavy shower, the partners dissociate and desert the nest.

## **C. Mortality**

A small percentage of pair-bonds dissociated due to accidental death of either partner.

### **7.3.9. Extra Pair Copulation (EPC)**

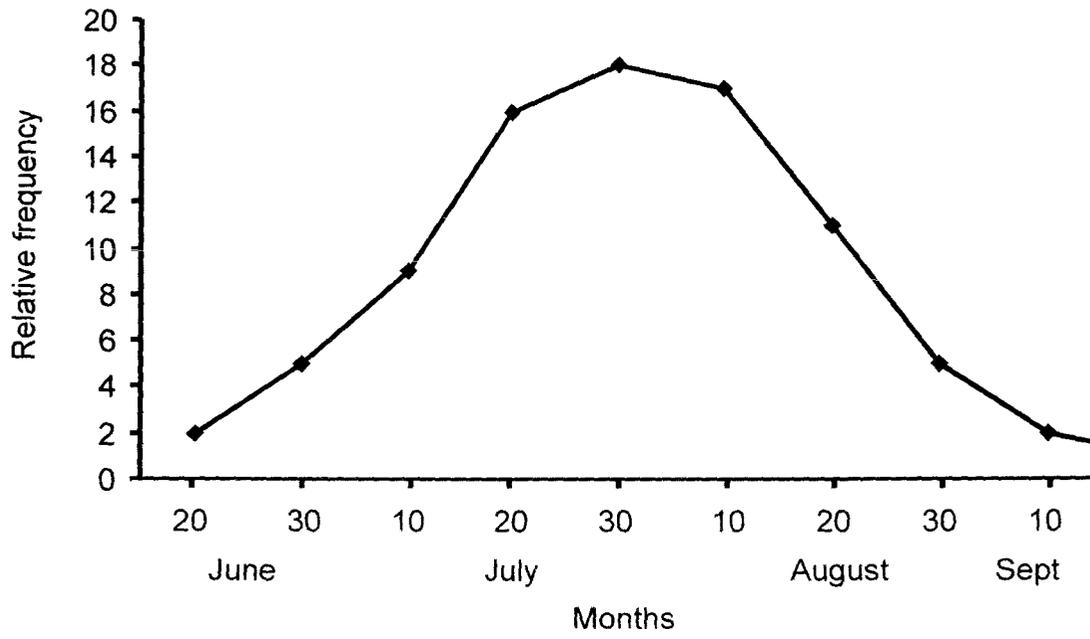
In both the species extra-pair copulation is almost absent. The partners were found to be faithful. However, nine cases of EPCs were found prior to laying in Little Cormorants and Night Heron over the whole duration of the study. This usually occurs when a stranger male visits a pair-bonded female in absence of the male. The stranger male departs before arrival of the pair-bonded male.

**Table 7.1 Frequency of recovery of banded birds**

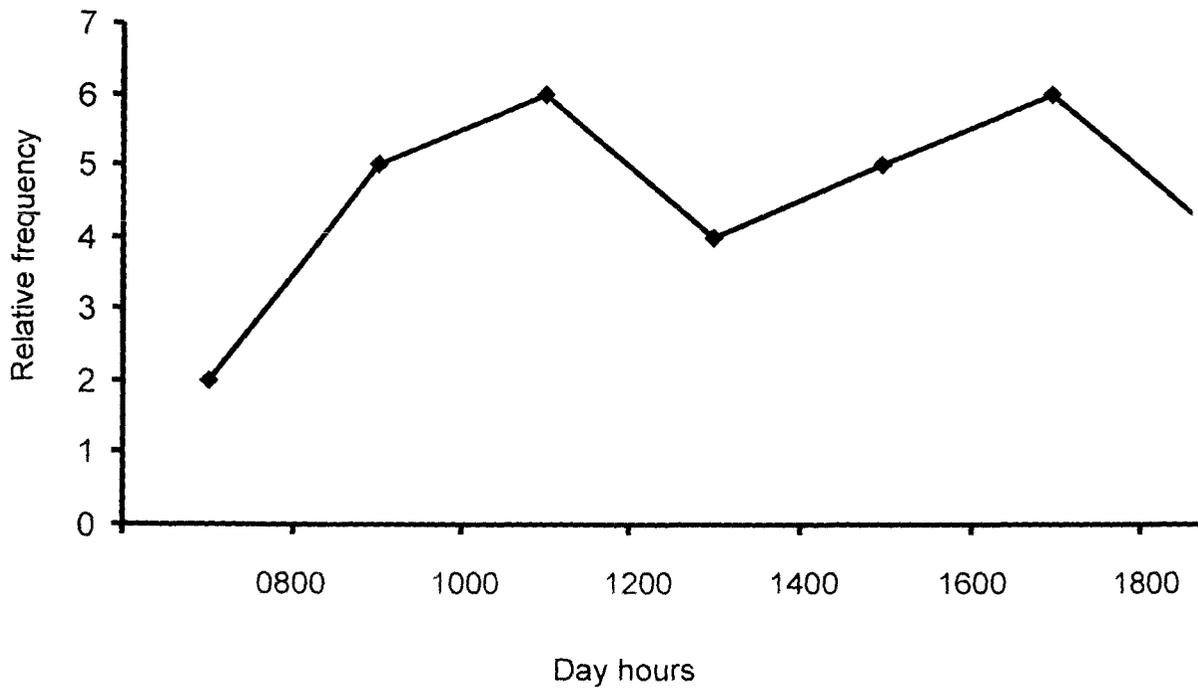
Name of bird species	No. of birds banded			No of birds recovered			
	Year	Phase	No	2001	2002	2003	2004
Little Cormorant	2000	Young	100	08	19	15	11
		Adult	18	01	01	01	--
	2001	Young	100	--	10	14	12
		Adult	16	--	01	02	--
Night Heron	2000	Young	100	07	13	08	03
		Adult	22	--	02	--	--
	2001	Young	100	--	13	18	08
		Adult	18	--	02	01	01

**Table 7.2 : Date of arrival of Little Cormorants and Night Herons in the sanctuary in relation to rainfall**

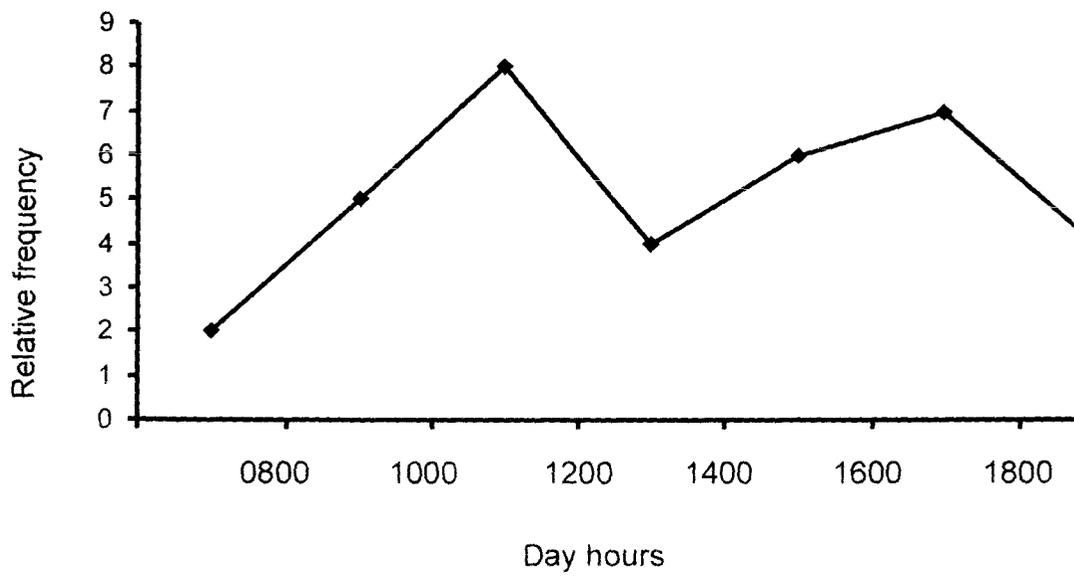
Year	Name of Birds	Date of arrival	Amount of rain in arrival date (mm)	Amount of rain in preceding 3 days (mm)	Amount of rain in following 15 days (mm)	Amount of rain in following 15 days (mm)	Amount of Total rainfall in the preceding year (mm)
2002	Little Cormorant	17 June	2.0	0.0	52.3	446.4	2259
	Night Heron	14 June	0.0	2.4	49.8	283.7	
2003	Little Cormorant	19 June	0.6	0.0	58.5	229.3	1943
	Night Heron	12 June	4.3	10.9	59	115.3	
2004	Little Cormorant	21 June	6.6	28.7	73.4	171.0	1971
	Night Heron	15 June	2.2	24.1	63.7	168.7	
2005	Little Cormorant	24 June	1.0	6.0	56	178.4	1512
	Night Heron	18 June	0.0	26	65	114.3	
2006	Little Cormorant	22 June	0.1	4.0	60.2	47.1	1826
	Night Heron	17 June	0.1	8.0	98.3	37.2	



**Fig. 7.1 : Mating call frequency of Little Cormorant**



**Fig. 7.2 : Diurnal rhythm of copulation in Little Cormorant**



**Fig. 7.3 : Diurnal rhythm of copulation in Night Heron**



**Plate 7.1**      **Adult Little Cormorants at the top of the canopy with an important purpose,-- to select a mate.**



**Plate 7.2**      **Adult Little Cormorants on the look out for a suitable mate.**



Plate 7.3  
(A) Erect back and crown feathers by male adult Little Cormorant



Plate 7.3  
(B) Excited posture at the time of mating call of male adult Little Cormorant.

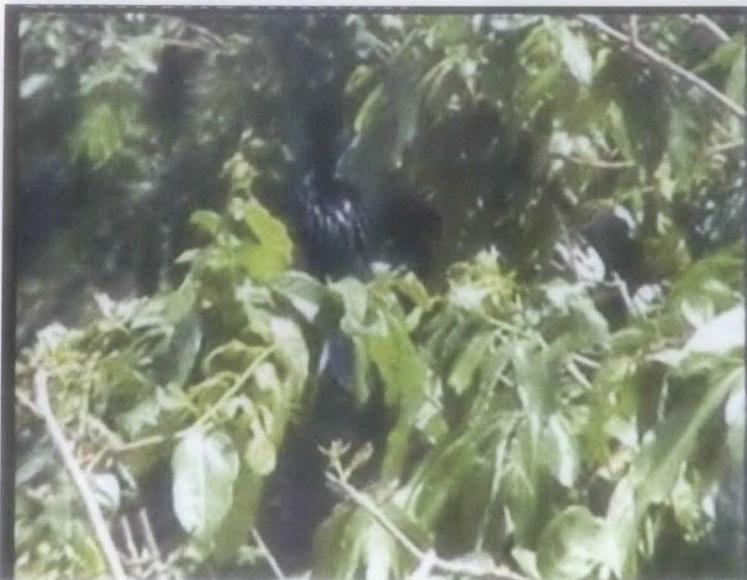


Plate 7.3  
(C) Male and female adult Little Cormorants for pair formation

Plate 7.3 Pair forming display of Little Cormorant.



**Plate : 7.4**  
**Adult Night Herons on the top**  
**Canopy of a Jarul tree immediately**  
**before pair formation.**



**Plate : 7.5**  
**Male and female adult Night Herons**  
**during pair formation.**



**Plate : 7.6**  
**Adult Night Herons after pair**  
**formation.**