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BREEDING BIOLOGY OF PHEASANT-TAILED JACANA *HYDROPHASIANUS CHIRURGUS* IN CENTRAL THAILAND

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ABSTRACT

Breeding biology of Pheasant-tailed Jacanas *Hydrophasianus chirurgus* was studied. They were polyandrous and bred in the rainy season, when food was presumed to be abundant. A single female studied paired with 4 males. Nests were built by the female on floating vegetation. The majority of clutches had 4 eggs. The interval laying between nests (clutches) by the same female was 17 to 21 days. Males incubated eggs alone during the hot period of the day and at night, perhaps preventing eggs from overheating or chilling. The Incubation period averaged 25.3 days. Egg translocation by males was observed when nests were disturbed. Hatching success was 71% and predation by rats and birds on eggs and chicks was 20%. Chick growth was highest during weeks 3 to 5. The male took care of the chicks from hatching until fledging which occurred at about week 8 after hatching. Territorial defence by females was observed early in the nesting stage (first two weeks) and later by incubating males within a radius of 10 to 12 m around the nest.

INTRODUCTION

In Thailand, Pheasant-tailed Jacanas *(Hydrophasianus chirurgus)* are resident birds found in open wetland in northern and central Thailand (DEIGNAN, 1963; LEKAGUL & ROUND, 1991). Nests of Pheasant-tailed Jacanas were found between May and October, in central Thailand at Beung Borapet Non-hunting Area, Nakhon Sawan Province (Thong-aree, unpublished observations). DEIGNAN (1931) reported that Pheasant-tailed Jacanas were abundant in summer in northern Thailand in Payao and Chiang Mai Provinces. In Songkhla Lake, southern Thailand, they have been reported as abundant between January and March, but scarce between September and October (TISTR 1981). These reports suggest that Pheasant-tailed Jacanas may move locally with the season.

Pheasant-tailed Jacanas are known to have typical polyandry, or sequential polyandry, as a mating system (ORING, 1982; COLLIAS & COLLIAS, 1984; KREBS & DAVIES, 1993). True polyandry is extremely rare among birds, and found mostly in some shorebirds. The degree to which polyandry develops depends on the intensity of female sexual selection and the environmental potential for monopolization of mates (ORING, 1982). Polyandry in which several males mate with one female in a breeding season is more or less sex role reversal (ALCOCK, 1993).

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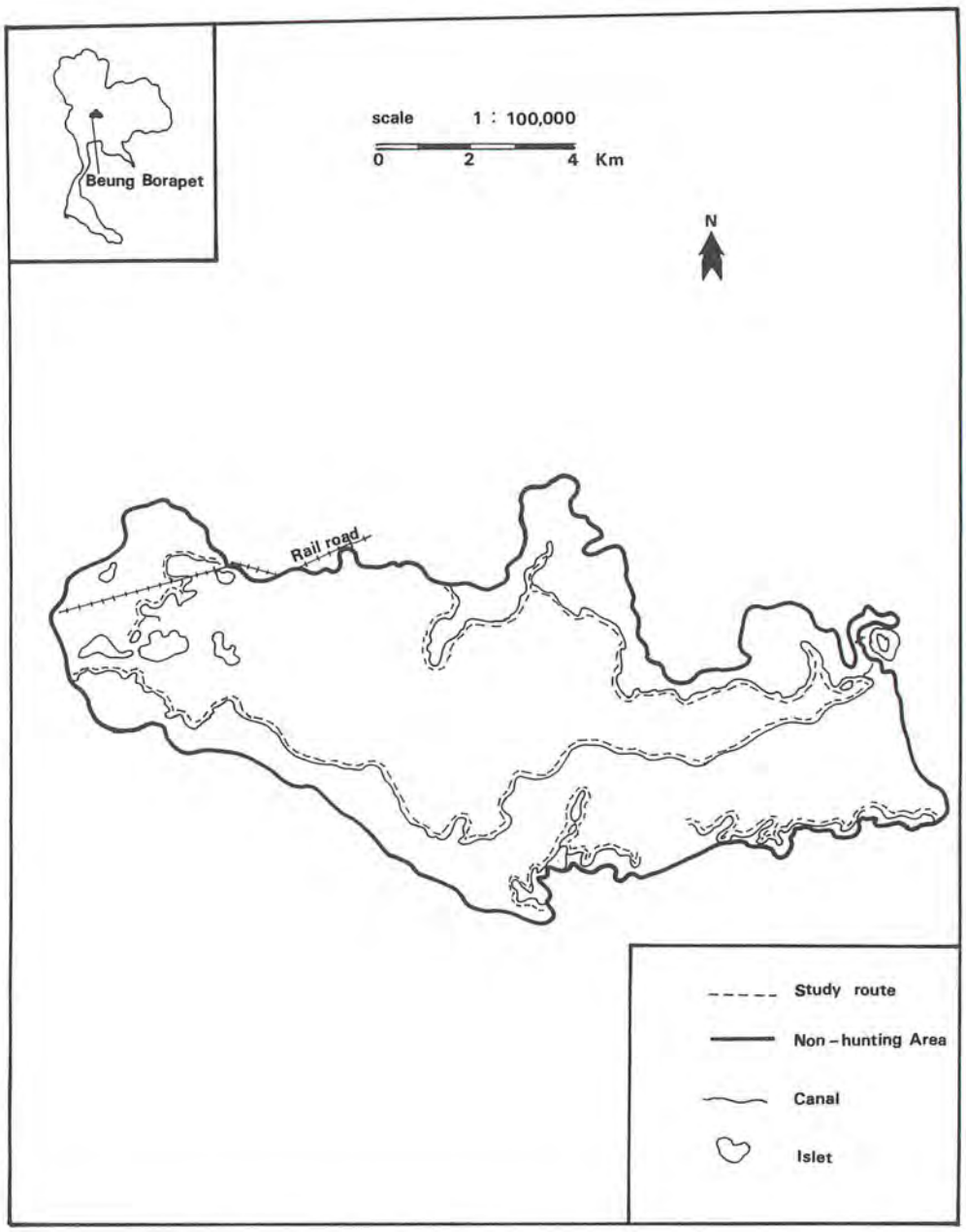

Figure 1. A map of Beung Borapet Non-hunting Area showing study routes.

Some basic information on the breeding of this jacana species has been obtained from India, Sri Lanka and Myanmar (Burma) (BIDDULPH, 1954; SMYTHIES, 1986; ALI & RIPLEY, 1987). However, virtually no information on breeding biology has been reported from Thai species. It is essential that we base conservation and management efforts on information collected from the local population. Therefore the present study was carried at Beung Borapet, in order to gain preliminary information on breeding biology, which included 1) nest and nest site characteristics; 2) breeding behavior; and 3) breeding success and predators.

METHODS

Study Area

The study was carried out during January 1982 to February 1983 at Beung Borapet Non-hunting Area, Nakhon Sawan Province, located between 15° 41' and 15° 45' N, and 100° 10' and 100° 23'E. Beung Borapet with an area of approximately 212 km^2 is one of the largest freshwater reservoirs in Central Thailand. Water level in the reservoir is controlled at 23.8 m m.s.l. through a water gate. Within the reservoir there are several islets formed by piles of solid aquatic weeds, totalling approximately 1.4 km^2 in area (Fig. 1). The water level in the reservoir was about 3 m deep over a muddy bed. We identified 73 species of aquatic plants, among which water hyacinth *(Eichhornia crassipes)* and *Potamogeton* were usually dominant. The most economically important aquatic plant was lotus *(Nelumbo nucifera)* which is planted for seed harvest by villagers. Aquatic plant plantations of lotus and other species cover approximately 25% of the water surface area.

Breeding Biology

Existing canals in the reservoir were used as study routes as shown in Figure 1. To detect nests of jacanas and to study their behaviour, we patrolled the routes once a month for 5 to 10 days from an observation hide installed on a long-tailed boat.

Pairing and Morphological Changes

Morphological changes were observed through a pair of binoculars (8 x 40) to determine sex differences and courtship behaviors. Trapping of jacanas was done at roosts and/or nests at night using mist nets. A breeding pair was trapped and was marked by staining the head and flight feathers (primaries and secondaries) with orange color dye (Dylon, fabric dye). Once the marked female was seen pairing with new males, trapping and marking of the male mates by feather staining with blue, pink and yellow, were sequentially done. Trapped birds were measured and weighed.

Nest Building

Nests of Pheasant-tailed Jacanas were detected by observing the behaviour of paired birds. Sex of the jacanas observed to build nests was determined by trapping. Nest sites

and nests were studied and examined for species and parts of vegetation used in nest construction. The shape, diameter and depth of the nests were also recorded.

Eggs, Egg Laying, Clutch Size and Incubation

Nests found were marked with colored plastic tags. The number, color, shape and size of the eggs were recorded. Egg laying date was written on the egg shell and was checked daily to determine the egg laying interval and incubation period, which was counted from the time the female laid the last egg until the hatching of the last egg of the clutch (Welty, 1975). The clutch laying interval between nests was counted from when the female laid the first egg of one clutch until the first egg of the next clutch in sequence.

Egg Relaying

We carried out an experiment on egg relaying by removing eggs from some nests.

Chick Hatching, Chick Growth, Parental Care and Chick Mortality

We observed the hatching process as well as parental care behavior. Chicks were weighed and wing-tagged with an alloy tag. The length of closed wing, bill and tarsus were measured weekly until the chicks left the nests. The causes of egg loss and chick mortality were recorded.

Territory

In order to determine territory the marked birds were observed and followed by binoculars from the mobile observation hide.

RESULTS

Courtship

Pheasant-tailed Jacanas bred once a year during the rainy season. Courtship for pairing began in late March after breeding plumage had been attained. In the non-breeding season (November–February), Pheasant-tailed Jacanas lived in flocks of 3 to 20 individuals. In March, it was observed that the jacanas lived singly.

Four females and 17 males (female:male ratio = 1:4) were trapped. One among 4 marked females selected for study was observed to pair with 4 males which had been marked. We did not study breeding behaviors of the other 3 females and 13 males trapped. Female jacanas, which could be distinguished by their larger size, (Table 1) initiated courtship behavior. The female flew acrobatically around the selected male and foraged close to him. While she was flying she also made loud calls, perhaps to attract the male. Sometimes the female tempted the male to fly up.

Table 1. Average measurements of mature male and female Pheasant-tailed Jacanas at Beung Borapet Non-hunting Area in 1982 breeding season.

Characters	Average measurement (cm)	
	Males (n = 17)	Females (n = 4)
Total Length	45.91	50.27
Tail	25.76	28.34
Wing	24.76	25.83
Bill	2.89	3.12
Tarsus	5.72	6.33
Weight (g)	129.20	140.70

Nest and Nest Site

After pairing, only the female built the nest and laid eggs, for each male mate successively. Nests of Pheasant-tailed Jacana were most frequently found during June and July (22 out of 32 nests). Rainfall may have triggered the onset of breeding, since there was no obvious change in the water level (Fig. 2). Nests of Pheasant-tailed Jacana were found along the edge of the reservoir where aquatic plants were dense (Fig. 3). The dominant plant species included *Nelumbo nucifera, Nymphaea pubescens, Salvinia cucullata, Potomogeton malianus and Trapa quadrispinosa.* Water depth at the nest sites varied from 0.3 to 2.0 m.

The nests were loosely built on rafts of floating vegetation and took the form of a pile of solid vegetation with a shallow depression in the centre (Fig. 3). The average diameter and depth of the nests were 13.7 cm and 3.4 cm, respectively (N = 16 nests). The vegetation material used for nest building consisted of leaf stalks of *N. nucifera,* young leaves of *N. pubescens,* stems of *P. malianus* and leaf stalks of *T. quadrispinosa.* The nests were partially submerged and the eggs in the nest were partly surrounded by water which penetrated through the nest material. The distance between adjacent active nests varied from 15 to 20 m (N = 16 nests).

Egg Laying and Clutch Size

Females laid eggs between 0630 and 0900 hrs (N = 16 nests). Eggs were laid on successive days. Clutch size was 3 or 4 eggs, the majority having 4 eggs (20 out of 22 nests). One full clutch therefore took 3 to 4 days to lay. The clutch laying interval was 17 to 21 days (N = 4 nests). Egg laying was completely terminated after the female laid the last egg of the clutch, even if eggs were removed. When the first or second egg of a clutch was removed the female tore the nest down and rebuilt another nest. Egg relaying did not resume when the last egg of the clutch was removed.

Shortly after the female laid one full clutch and the male began to incubate the eggs, the female then abandoned the nest to court and pair with another male.

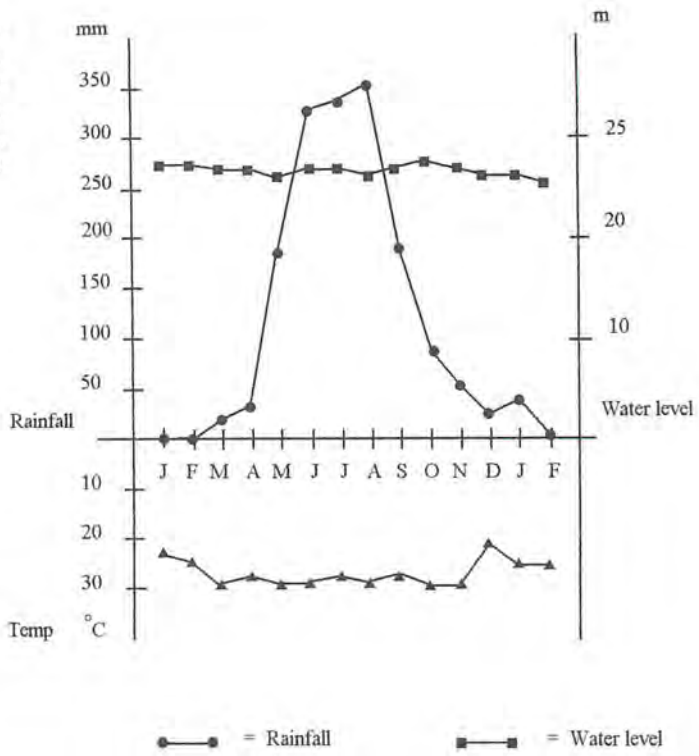

Figure 2. Rainfall, regulated water level and temperature measured at Beung Borapet Non-hunting Area between January 1982 and February 1983.

Eggs of Pheasant-tailed Jacanas were pyriform (top-like) in shape with one end rounded and the other rather pointed (Fig. 3). The texture of the egg shell was smooth and shiny. The color of newly laid eggs varied from olive to dark green (Fig. 3). When hatching approached, shell color turned to reddish to dark brown. The thickness of the egg shell ranged from 0.35 to 0.40 mm. Egg size and weight varied very little. Average size of eggs is presented in Table 2. The weight of eggs before incubation was highly significantly heavier than the weight just before hatching (Wilcoxon Paired Test, $P < 0.001$, $n = 86$) (Table 2).

Incubation

The male started incubating shortly after the female laid the first egg. After the female laid an egg she walked away a few meters from the nest. The male did not incubate eggs all the time, but mostly did at night and during the hottest period of the day (1100 to 1500 hrs) (Fig. 4). At other times the male attended the nest for egg turning. One week before hatching, the male incubated almost all day long. The incubation period took 24 to 26 days with a mean of 25.3 ± 0.91 (SD) days ($N = 14$ nests) but most males incubated for 26 days (8 nests).

Table 2. Size, weight before incubating and weight just before hatching of eggs of Pheasant-tailed Jacanas at Beung Borapet Non-hunting Area.

Egg character	N	Range	Mean	SD
Length (mm)	86	24.0–27.5	26.30	0.2532
Width (mm)	86	30.9–38.7	35.98	1.6160
Weight before incubuting (g)	86	10.5–13.0	12.11	0.5841
Weight before hatching (g)	86	8.1–10.2	9.38	0.4854
Weight loss (g)	86	2.3–3.0	2.72	0.187
% Weight loss	86	20.0–25.7	22.5	1.09

Egg Translocation

When there were disturbances, such as by humans, the Pheasant-tailed Jacana males would build new nests and move their eggs into them. This was observed in 6 out of 16 nests while males were incubating. One male was observed to build a new nest and translocate the clutch four times after successive disturbances. The distance between old and the new nests varied from 4 to 11 m (N = 6). The male was observed to kneel down and use its bill to move an egg with the pointed end toward its breast. It stood up and carried the egg between the breast and supporting bill. The translocation of a clutch from a former nest to a new nest took about 3 hours. Among six nests, only 2 eggs (of a 4-egg clutch) were seen to be damaged during translocation.

Territory

Pheasant–tailed Jacana females and males showed strong intra and interspecific territorial defence around their nests. They announced their territories by calling loudly. During the early period of egg incubation (first 2 weeks) the female was responsible for defending the nest. She attacked the invaders from acrobatic flight. The invaders included White-browed Crakes *(Porzana cinerea)* and Pond Herons (*Ardeola* sp.). Fighting between incubating males whose nests were adjacent was also observed. The radius of each nest territory appeared to be about 10 to 12 m.

Chick Hatching, Hatching Success and Mortality

The chick's voice could be detected within the egg one day before hatching and a puncture on the rounded end was observed. When the puncture was about 1 cm long the chick used its back muscles to push away the shell top whilst using its feet to kick the lower part away from it (Fig. 5a, 5b). The male got rid of the empty shells by carrying them in its beak and flying away from the nest (Fig. 6). The distance between the nest and the discarded shells was not observed. The hatching interval between eggs was 2 to 3 hours. Complete hatching of one full clutch (4 eggs) took 1 to 2 days. Hatching success was 71% (from a total of 62 eggs from 16 nests) (Table 3).

Table 3. Causes of egg loss and predation and chick mortality of Pheasant-tailed Jacanas in the 1982 breeding season at Beung Borapet Non-hunting Area.

Causes	No. nests	No. eggs	Unhatched eggs	No. chicks hatched	No. eggs preyed upon	No. chicks killed
Nests without any loss	3	11	0	11	0	0
Chick loss						
killed by parasites	1	4	0	4	0	2
killed by birds	2	8	1	7	0	2
Egg loss						
Egg shell damaged	1	4	2	2	0	0
Eaten by rats	2	7	0	0	7	0
Dead vegetation due to low water level	2	8	3	5	0	0
Unknown causes	5	20	5	15	0	0
Total	16	62	11	44	7	4
%	-	-	17.7	71.0	11.3	9.1

Unsuccessful hatching of eggs were caused by various threats during the male's nest caring period: two nests with three and four eggs were preyed upon by a rat; two newly-hatched chicks were hunted by a Black-shouldered Kite *(Elanus caeruleus)* and a Pond-Heron; two eggs of a four-egg clutch were cracked during translocation by the male, and loss of two four-egg clutches may have resulted from drying vegetation around the eggs due to the low level of the water (Table 3). The most important cause of mortality of eggs and chicks of Pheasant-tailed Jacanas therefore was predation (Table 3). During incubation, before hatching, average weight of the eggs declined 2.72 + 0.187 (SE) g on average, or 22.5% of the weight before incubation.

Parental Care

Newly hatched nestlings wore natal down which was wet upon emergence. It took 10 to 15 minutes for the chick to open its eyes and to be on its legs. The chicks went under their (presumed) father's wing immediately after they were able to stand, while the father bird continued incubating the rest of the eggs (Fig. 7).

Figure 3a, b. Nests and a nest sites of Pheasant-tailed Jacanas found at Beung Borapet Non-hunting Area. Photos: A. Tsuji.

Figure 4. A male Pheasant-tailed Jacana ready to incubate eggs. Photo: A Tsuji.

Figure 5. Hatching of the chicks. Photo: A. Tsuji.

Figure 6. A male Pheasant-tailed Jacana removing an empty shell. Photo: A. Tsuji.

Figure 7. Adult male and three nestlings, the first going under the father's wing. Photo: A. Tsuji.

When chicks were 2 to 3 hours old, they were able to walk and swim. They began to forage in floating vegetation near the nest under the close care of the male. Male birds took chicks out for foraging and returned to roost at the nest if the nest remained undisturbed. We did not attempt to observe chick brooding by males during the night. The chicks remained under the male's care for 6 to 7 weeks before they were deserted to forage by themselves. Females were never seen coming back to help their mates take care of the chicks.

Chick Growth

The growth curve of chicks by weight is shown in Figure 8. The weight markedly increased from week 3 until week 5 and began to decrease after that. Chicks left the nests at week 8. The average weight of the chick at 8 weeks old (121.7 g, N = 10) was nearly equal to the average weight of the adult male (Table 1). The age of maturity, however, has not been determined. After week 8, growth rate may have been rather slow until the young reached maturity. Morphological change, especially in wing length, was rapid after week 2 and tended to be stable after week 8. The bill and tarsus, however, showed little change throughout growth to maturity (Fig. 9). After week 8, sizes of bill, tarsus and wing length of the chicks approached the average sizes for mature males and females (Table 1 and Fig. 9).

DISCUSSION

Onset of Breeding

Rainfall appear to trigger the onset of breeding of Pheasant-tailed Jacanas in Thailand. Food appears to be available in abundance in the aquatic habitat. This finding was supported by BIDDULPH (1954), ALI & RIPLEY (1987) and SMYTHIES (1986) who reported from India, Sri Lanka and Myanmar (Burma) that the breeding season began when the southwest monsoon arrived (June to September). But in Kashmir the breeding season begins in May through July (ALI & RIPLEY 1987). Rain may be related to production of food, particularly aquatic plants. Unfortunately, there has been no comparative study on abundance of aquatic plants and animals in dry and rainy seasons.

Nest and Nest Building

Our observation that females build nests alone is contrary to reports by COLLIAS & COLLIAS (1984) that the males of the Northern Jacana *(Jacana spinosa)* of Central America, the African Jacana *(Actophilornis africanus)* and Pheasant-tailed Jacana (source not cited) built nests alone. In our study, the males built new nests only prior to translocating the eggs. This is similar to a report by GRIZMEK (1972). BATES & LOWTHER (1952) found that when males translocated eggs, they rebuilt the nest about 1 to 15 m from the former one. The range of translocation distance recorded in our study was similar.

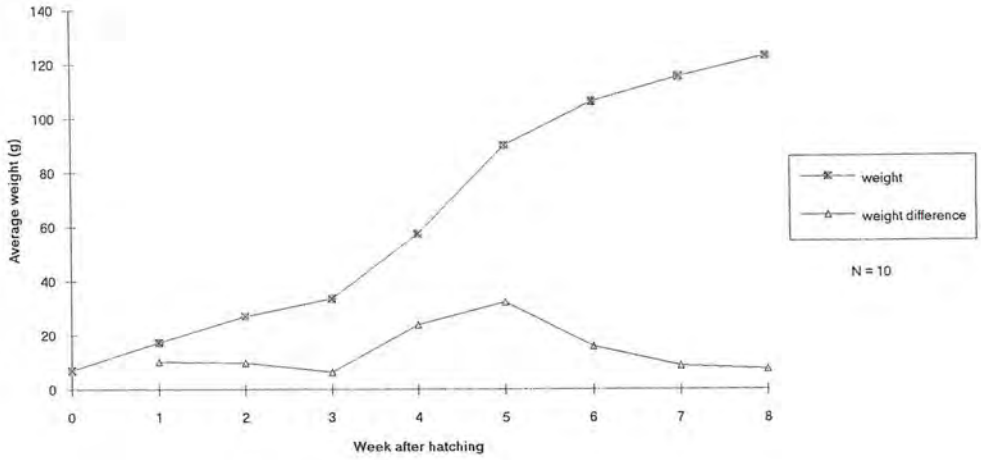

Figure 8. Average weekly weight and weight difference of chicks after hatching.

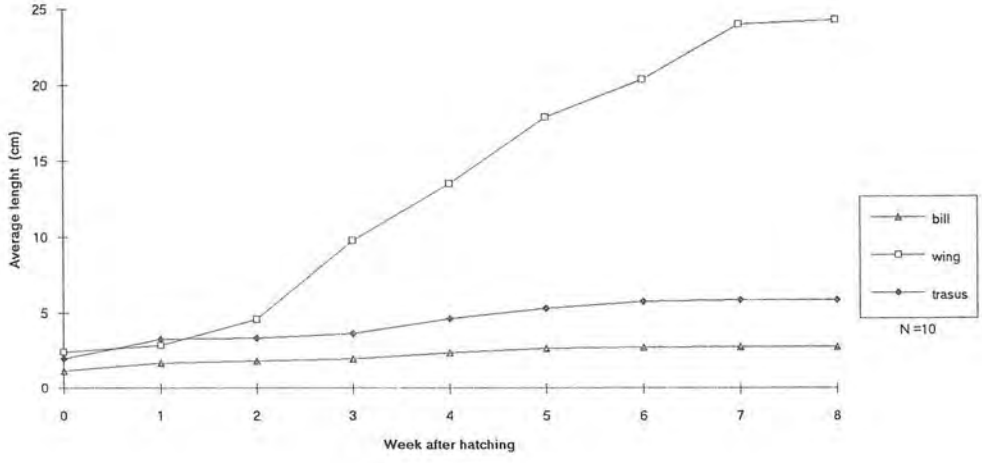

Figure 9. Average weekly changes in length of wing, bill and tarsus of chicks after hatching.

Polyandry and Predation

JENNI (1974) suggested that the evolution of polyandry may have due to an erratic food supply and a high rate of egg predation. Our findings suggest a rather different situation in regards to food. Food was probably abundant in the study area during the rainy season (unpubl. data), but predation was fairly high (20.4%) and appeared to be the most important among the threats. Important predators in our study were rats for eggs and Black shouldered Kites and Pond Herons for newly-hatched chicks. Predation by herons was also reported from Sri Lanka (CLARKE 1983). Therefore, it seems likely that the high egg and chick mortality combined with abundant food favors high productivity of females, and hence the opportunity for male incubation to increase production of young. However, the loss of eggs in this study was unlikely to have resulted from the females attracting predators, as stated by COLLIAS & COLLIAS (1984), due to reverse sexual dimorphism. In our study, predation seems to have resulted more from the absence of the male during much of the male's incubation period. Males incubated mostly at night and during the hot period of the day, probably preventing eggs from chilling at night and overheating during midday. Actually, males may have reduced predation by carrying empty shells away from the nests.

Besides food and predators which seem to influence polyandry and from our findings, we suggest that for further studies one should look into the sex ratio in the population of this species. From trapping of Pheasant-tailed Jacanas in this study the ratio of females to males was about 1:4, heavily skewed toward males as we might expect in polyandry. There has been no report on the demographic pattern of any Pheasant-tailed Jacana population. It is unclear whether this shortage of females is due to sexual differences in mortality or in maturation rate.

In general, breeding behaviors, breeding biology and ecology of Pheasant-tailed Jacanas at Beung Borapet Non-hunting Area were similar to those reported by BIDDULPH (1954), WHISTLER (1963), WELTY (1975), ALI & RIPLEY (1987) and SMYTHIES (1986). GRIZMEK (1972) reported the possibility of one male incubating two clutches of eggs when females lay 6 to 8 clutches. This was not observed in our study. Unfortunately, we observed only one female. However, from our findings in regards to clutch interval and egg incubation period, it may be possible for one male to incubate two clutches.

Physical factors affecting hatching include temperature and water level surrounding the nest and the eggs. We agree with BATHES & LOWTHER (1952) that hatching is controlled by nest material decay, which may increase the temperature of the nest. Higher water level may enhance hatching (BATHES & LOWTHER 1952), by preventing eggs from dehydrating. If the water level around the nest is too low it would cause the vegetation to dry out and result in overheating the eggs (BATHES & LOWTHER 1952).

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