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Breeding and Feeding Behaviour of Jungle Babbler(*Turdiodes striata* Dumont, 1923) in Agro-Ecological Zones of District Layyah, Pakistan

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INTRODUCTION

The ecology of tropical forests has been a major focus¹ in recent biological research. One of the most important aspects of such research has been trophic interactions. The feeding adaptations of birds are of particular importance, given the high level of avian metabolic rates. Peculiarities of these adaptations in passerines have been a core objective of field surveys in different regions of Ma Da Forest Enterprise(11Adeg20'N, 107Adeg00'E) and Cat Tien National Park(11Adeg27'N, 107Adeg18'E), both in Dongnai Province, Vietnam, which started in 1989(Kalyakin, 2008).

Passerines are quite suitable for morphological research. They have small bill size(except for corvids), along with a high degree of uniformity in the jaw apparatus(Kalyakin, 2008).

Feeding and reproduction are essential activities in all the bird species and requisites for survival while both the physiology and behavior of birds are considered significant challenges due to demands of food acquisition. Body coloration of the Jungle babbler is brownish grey with a yellow bill in both sexes with some mottling on the throat and breast and upper parts usually slightly darker in shade(Grimmett et al., 2008) makes quite difficult to distinguish sexes(Srivastava, 2013). Habitats of these birds range from dry deciduous woodland to moist semi-evergreen forest(Ali and Ripley, 2000). Many studies based on feeding of jungle babblers have been reported by as many workers around the globe. Past works suggest that an average social group of jungle babblers comprises of 6-10 individuals, hence approximately 7 individuals are found in a group, owing to which they are called as seven sisters(Anthal and Sahi, 2013).

Benefits for the species e.g. reduced vigilance and opportunities to access new feeding areas could be gained by association within a social group. Generally, these social groups include 3-10 individuals.

During foraging, sentinel behavior was witnessed within the social groups(Gupta, 2014). Decreased investment in territorial defence activities during the nonbreeding season is related to patterns in food availability and thus potential energetic constraints. Rainfall is strongly linked to the onset of desert phenological events such as the emergence of insects and the breeding of other invertebrates(Cumming and Bernard, 1997), as these are the primary food source for babblers(Ridley and Child, 2009).

Jungle babbler's breeding season differs lightly in different parts of India(Gaston 1978). Reproductive rhythms of jungle babbler were not modified under the influence of urbanization(Ridley and Child, 2009). Seven sisters social group splits up into a group of 3-4 birds during breeding season. In a 3-4 birds' group other individual members(except the breeding pair) are termed "helpers" that forgo their breeding in order to assist the breeding pair(Bharucha and Padate, 2002). Groups are often formed by the retention of young ones on the natal territory beyond the age of sexual maturity and much debate has centred around why individuals in cooperative societies delay breeding and remain at home(Ekman, 2006). The occurrence of species that remain on the natal territory without helping suggests that direct benefits are enough for the occurrence of delayed dispersal and group formation(Kokko and Ekman, 2002).

Experimental evidence suggests that the natal territory can provide a safe haven for individuals until dispersal opportunities become available(Ekman and Griesser, 2002).

Cooperative breeding is a social system in which breeding individuals are assisted by other individuals, often termed "auxiliaries", in raising off-springs(Emlen, 1991). Thus, auxiliaries may increase their inclusive fitness by assisting breeders leading to evolution of cooperative behaviour(Griffin and West, 2003). Cooperative breeding describes a social system in which animals live in groups, most often comprising of closely related individuals e.g. jungle babblers. Within a group, usually the dominant pair breeds whereas the other group members(helpers) assist in rearing the off-springs, despite not being the parents. Globally, it is a rare social system. Only about 3% of birds are thought to breed cooperatively. In the perspective of Pakistan there is sporadic information on peculiar breeding behavior of the species. Owing to this, studies were conducted to describe feeding as well as breeding uniqueness as affected by environmental fluctuations.

MATERIALS AND METHODS

Geographical location of study area

Paradoxically, Layyah is a wonderful blend of two extremes viz., the Thal Desert and the Indus River. Previously a Tehsil of Muzafargarh, Layyah gained the status of a district in 1982. The district of Layyah comprises of three tehsils viz., Layyah, Chaubara and Karor Lal Esson(Fig. 1). District Layyah is situated in the south of Punjab.

In the north, lies district Bhakkar and river Indus flows in the west. Across the river lies district Dera Ghazi Khan, district Jhang is located in the East and Muzafargarh in the south of district Layyah. The district is a semi-rectangular block of sandy land between the Indus and Chenab rivers in Sindh Sagar Doab. It is also part of the recently established civil division of Dera Ghazi Khan. The district of Layyah lies among 30-45 to 31-24Adeg North latitudes and 70-44 to 71-50Adeg East longitudes. Total area of district is 62915 sq. km. The Layyah district has an extremely hot climate: maximum temperature in the summer may rise up to 53AdegC. Observed highest temperature is more than 45AdegC in the month of June and the lowest 2AdegC in the month of January.

Average rainfall does not exceed 18 mm received in the months of July and August(monsoons), though some variations have occurred in the past. Some rainfall is also received during spring. The average annual temperature is 25.2AdegC in Layyah. The average annual rainfall is 195 mm.

Reconnaissance survey of seven study sites

A reconnaissance survey of the area was undertaken to familiarize the team with the area and birds. A field guide "Birds of Pakistan"(Grimmett et al., 2008) was used to familiarize and identify the jungle babbler. Detailed observations on nest performance of the species were started by observing nest building on February 23, 2014. Least efforts were made to conceal the observer due to natural tameness of the species to human presence. The GPS position of existing nests was recorded by Garmin's instrument(Table I). Nest measurements and microhabitat at seven specific nest locations and coordinates are given in the following paragraphs:

Nest measurement

The overall size of the nest i.e. depth, external diameter, internal diameter was taken by using the Vernier's caliper. Nest material was identified at the end of the breeding stages.

Egg measurement

The eggs were counted to record the average clutch size, weighed by the electric weight balance and measured by the Vernier's caliper.

Observations

Keen observations were recorded on the nest to check breeding behaviour and to evaluate the survival rate of young ones. A highly sensitive video camera was used to record the behavioral activities of the species.

Statistical analysis

The data were subjected to statistical analysis using MS Excel 2007 package. Mean and standard deviation were calculated for each parameter and statistical analyses were carried out using Statistix 8.1 software.

Table I.-Seven study site and nest location in agro-ecological zones of Layyah district.

S. No.###Coordinates###Study sites###Microhabitat around the nest

1###N 30 47.23 E 71###26.271###Layyah###Canal Side

2###N 30 57.36 E 71###11.52###Chowk Azam###Agricultural crop area

3###N 30 46.39 E 70###56.17###Kot Sultan###Agricultural fodder area

4###N 30 54.165E 71###30.15###Chaubara###Agricultural fodder area

5###N 31 06.14 E 71###31.49###Nawan Kot###Agricultural crop area

6###N 31 10.20 E 71###12.51###Fateh Pur###Agricultural fodder area

7###N 31 13.14 E 70###56.43###Karor Lal Ehsan###Agricultural crop area

Table II.-Nest measurements comparison of seven nests of *Turdiodes striatus* recorded in study sites.

No###GPS readings###Depth(cm)###Internal width(E/W) Internal width(N/S) External width(E/W) Width(N/S)

1###N30,47.23 E71, 26.271###7.1###8.5###10.3###15.9###15.5

2###N30,40.653 E71, 26.458###6.8###8.9###8.6###13.5###13.4

3###N30,47.268 E71, 25.334###6.5###9###8.5###11###11.5

4###N30,47.165 E71, 24.322###6.6###9.2###8.8###10.8###11.3

5###N30,40.670 E71, 26.458###7###10###10.8###12.8###13

6###N30,40.643 E71, 26.536###6.8###9.7###9.8###12.8###12.6

7###N30,47.271 E71, 25.291###6.1###7.6###7.7###11.2###11.4

RESULTS

Study area

Flora

Flora of the seven study sites consists of trees 5m in height, with large trees *Semal Bombax ceiba*, *Shisham Dalbergia sissoo* and *Black siris Albizia odoratissima* and overall dense understory. Sub-urban development covers three sides of the area hence there are few chances for the groups living within the study area to forage outside.

Nest material

Roots, straws of *Cynodon dactylon*, and dry leaves arranged in crisscross sequence(in 5-6 layers named as coat number) were the components of the nest. Nests were strengthened by the girders of straw and dry leaves.

Shape

Seven cup-shaped nests were observed in the study area.

Nest occurrence

Black siris is the key species on which all the nests were found. The bases of freshly growing branches of the tree were nest harboring parts.

Nest measurements

Detailed nest measurements have been given in Table II, average measurements(cm) of seven nests are: peripheral diameter, 13(E/W=12.57, N/S=12.67); nest core diameter, 9(e/w=8.98, N/S=9.21); nest depth, 6.7; coat number, 5.28; nest height, 135.28; tree/s diameter at breast height(DBH), 37.18.

Egg measurements

Egg numbers recorded at different nests during the study period are given in Table III. The mean length of eggs was 2.6 cm, mean width 1.7 cm and average weight 6.12 g. Average clutch size was four.

Table III.-Egg measurements done on seven different eggs.

No. of eggs###Length(cm)###Width(cm)###Weight(g)

1###2.6###1.8###6.1

2###2.6###1.8###6.1

3###2.7###1.7###6.2

4###2.5###1.6###6
 5###2.7###1.7###6.3
 6###2.6###1.5###6.2
 7###2.5###1.7###6

Mean###2.6###1.7###6.1

Table IV.-Breeding time frame.

S. No.###Breeding stages###Duration(days)###Percentage

1###Incubation###13###36

2###Nestling###5###13.9

3###Post-nestling###4###11

4###Fledgling###14###38.9

Breeding

Sex and breeding status

The sexes of jungle babbler were indistinguishable by external morphology. The identification of the breeding pair was also a difficult task in some cases because several birds(almost 13-15 birds) attended each nest. To solve this ambiguity, the two birds which took part in nest-building were recorded as breeding pair, egg incubating bird at night was taken as breeding female, a bird having frequent association with the breeding female in the period immediately prior to laying was marked the breeding male and birds losing their group association to exchange contact calls with members of other groups were expressed as the non-breeding females(Gaston, 1978). February rainfall mainly increased the local availability of food in the study area. Continuous summer nesting of Jungle babblers was observed in suburban gardens with regular water supply.

Breeding time frame

Overall time frame of breeding activity from incubation to fledgling encompassed 36-45 days(Table IV). Thirteen days were recorded as incubation period, five days nestling and four days post-nestling stages whereas fledglings took about 14 days to fly out.

Predation

Egg, nestling and post-nestling predation was recorded as 10%, 40% and 6.7%, respectively. At these three breeding stages, overall predation was calculated as 57%. Till nestling, predation rate increased gradually and after this stage it decreased. During early stages rate of survival was low; that rapidly rose during post-nestling and advanced stages of breeding. After overall predation, survival of the newborns was found to be 43%(Table V, VI).

Table V.-Clutch size, predation(egg, nestling and post-nestling) and survival.

Nest No.###No. of###Egg###Nestl.###P.N.###Survival

###eggs###Pred.###Pred.###Pred.

1###4###0###2###0###2

2###5###3###0###0###2

3###4###0###1###2###1

4###4###0###1###0###3

5###5###0###5###0###0

6###4###0###3###0###1

7###4###0###0###0###4

Total###30###3###12###2###13

%age Pred./###10###40###6.7###43

Survival

Table VI.-Survival observed after nestling over seven nests.

Nest No.###No. of eggs###Survival

1###4###2

2###5###2

3###4###1

4###4###3

5###5###0

6###6###1

7###7###4

Effect of nest height on survival rate

When the nest height from the ground was up to 241.4 cm the survival rate increased as the nest was unexposed and chances of predation and environmental severity were very low. Survival of the Jungle babbler was the minimum when nest height increased due to exposure of nests to breeding constraints described in Tables VII, VIII and IX. Even though survival was the maximum at 355.7 cm height as the nest at this height was in dense vegetation while at 330.09 cm height survival was zero due to some natural hazards and predation.

Breeding success

All nests were not detected before laying and a few were not found until after hatching. For the reason sample size varied for various breeding statistics. In a few cases eggs were missing after the completion of a clutch and observed clutch sizes, which were contained within nests during incubation. Observations were made for a period of six months.

Table VII.-Predation/survival ratio found during complete breeding cycle.

Parameters###Percentage

Overall predation###57%

Overall survival###43%

Table VIII.-Effect of nest height on survival(percentage).

Nest No.###Nest height(Ft.)###Survival(%)

1###13.92###15.38

2###9.17###15.38

3###13.33###7.69

4###7.92###23.07

5###10.83###0

6###12.08###7.29

7###11.67###30.77

Table IX.-Nest height vs. predation over seven nests.

Nest No.###Nest height(ft)###Predation(%)

Nest No.###No. of eggs###Survival

1###13.92###11.8

2###9.17###17.6

3###13.33###17.6

4###7.92###5.9

5###10.83###29.4

6###12.08###17.6

7###11.67###0

Food and feeding habits

Food at early stages

Insects, flies and their larvae were the food items for nestling to fledgling stages. Young chicks were fed by their parents in a manner that one adult remained within the nest to feed chicks, whereas another individual was present at the nest with the supply of food material. On reaching the nest second individual of the pair vocally alerted the individual feeding the chick urging it to leave the nest and to make chicks ready for getting food by opening their mouths with utterance of begging calls. The process of feeding young chicks continued till fledging stage when the fledglings started to learn searching their own food by following the adult feeding behavior. Helpers also assisted in providing feed to chicks besides breeding pairs(Table X).

Adult feeding behavior

Food contents of adults included grains, insects, mites, termites, crop insects and flies. This omnivorous bird collected food stuff by lifting dead leaves, probing and peering while hopping on the ground. During morning and evening times, they often foraged for food. They also explored the kernels of certain crops to find their diet components(Table XI).

Table X.-Feeding contents during different breeding stages.

Stages###Feeding Content

Nestlings###Larvae, spiders, flies, termites

Post-nestling###Grass hopper, wasps, spider, centipede

Fledgling###Termites, small grains of various grasses,

###berries, grasshopper

Table XI.-Food of adults.

S. No.###Feeding spots###Food material

1###Grasslands###Grains, grass hopper, spiders

2###Herbaceous plants###Mites, grass hopper

3###Leaf litter###Termites, centipedes

4###Holes and tree branches###Termites, wasps, spider

5###Holes on grounds###Cockroach, mantids, termites

6###Stores of seed###Grains

Sentinel behavior

The sentinel activity was observed at heights of 2 to 10 meters from the ground on the branches of trees, bushes, compound walls, telephone wires and lamp posts. As the day proceeded the time spent on sentinel duty was also enhanced. The mean sentinel activity was noticed in February, March and May. It appears that mean duration of sentinel duty performed by an individual increased from dawn to mid after-noon and decreased by dusk hours. A similar pattern of behavior was formerly reported by Gaston(1978) in jungle babblers in New Delhi.

DISCUSSION

The study revealed that group size of the Jungle babbler was 13-15 individuals during non-breeding season. The number of individuals in the group was recorded more than that of Gupta(2014) who detailed that social groups contained 3-12 individuals. Four to seven birds were counted in social groups during the breeding season which differs from the group size of 3-4 individuals reported by Bharucha and Padate(2010).

Jungle babblers consume grains, insects, termites and fruits(a rare component) as feed constituents. On this basis Jungle babbler was characterized an omnivorous passerine bird. Food content of adult jungle babbler comprised of all crop insects as described by Patankar et al.(2001) about its feeding on the larvae and pupae of *Helicoverpa armigera*(Bharucha, and Padate 2010). It is economically beneficial for crops and acts as biological control agent on larvae of various economic insects such as *Coccinella* larvae, *Cheilomenes* larvae, Jassids, Thrips and hoppers. Grains were ingested by adult birds which are similar to the study done by Anthal and Sahi(2013). To take out the larvae and pupae of insects from soil in the morning and evening times, spending more period on the ground, such kind of foraging was formerly evidenced by Gokhale(1993).

Cooperative and sympathetic behavior was found in Jungle babblers and was more privileged at 2-10 m height as well as during the day time. Cooperative breeding in birds is much more prevalent than has been previously realized, occurring in 18.5% of oscine passerines known to have biparental care, and is the predominant social system of some ancient oscine clades(Cockburn, 2003). Cooperative sentinel behavior may avoid the jungle babblers from predators as one of the member from group member make vocal sound to alert the group. Although the first observations of cooperative breeding in birds were made in New World tropical forests(Skutch, 1935), most avian cooperative breeders are found in semiarid tropical and subtropical environments, particularly in sub Saharan Africa and Australia. Cooperative species often occur in semiarid woodland and savanna habitats, rather than in rainforests or deserts(Ligon and Burt, 2004).

Cooperative breeders have been suggested to occur disproportionately in both seasonal(du Plessis et al., 1999) and unseasonal environments(Ligon and Burt, 2004).

Breeding pair(male and female) in social groups of Jungle babblers was helped by auxiliaries(helpers). Bhavna and Geeta(2010) termed these babblers social/ cooperative breeders because of the phenomenon that the breeding pair was assisted by other individuals of the flock(termed as "helpers"). These helper birds forego their own breeding and express allo-parental behavior and aid the parents in taking care of entire reproductive responsibilities excluding egg formation and laying.

While group size was bigger, number of nestlings was lower, improving the fledgling survival and vice versa, however group size did not seem to have any effect on the fledgling predation. Subsequently, young fledge earlier in small groups, thereby reducing the threat of predation. Similar conclusions were drawn by Raihani and Ridley(2007).

Jungle babblers are known to devour insects like Orthopterans and Lepidopterans(Gaston, 1978; Dhindsa and Saini, 1994; Gupta and Midha, 1994). These authors have also reported seasonal variation in the consumption of 6 insects during monsoon when the insect population was high. Thus the Jungle babbler is considered a useful bird as it feeds on the global pest, the pod borer, *Helicoverpa armigera*(Gokhale, 1993). Their most conspicuous diurnal activity is feeding wherein they spend the maximum time in foraging on ground. This foraging behavior of Jungle babblers is probably very effective in locating the underground pupae of pod borer or the root infesting white grubs(Patankar et al., 2001). Babblers utilized most time of the day on searching food, frequently on the ground, and desired to search food among drainage areas. Drainage zone preference possibly arose because they availed both the better vegetative shelter from aerial predators and the biomass of prospective prey(Porteli et al., 2009).

CONCLUSION

Jungle babblers are indistinguishable by external morphology due to same coloration. These are common birds around the agricultural field, and also found near cities and towns in Layyah district. The bird is an omnivorous species that makes cup shaped nest at the height range 241.4 to 424.28 cm with an average clutch size of 4 eggs. Jungle babblers are social birds as several birds(almost 13-15 birds) were found to attend each nest. It feeds on insects in cultivated sites, and also considered as pest controlling agent.

Statement of conflict of interest

The authors declare no conflict of interest.

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