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Reproductive Biology and Breeding Success of the Common Babbler *Turdoides caudatus* in Khuzestan Province, Southwestern Iran

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Abstract
This study was carried out from 19 February until 1 June 2010. Reproductive activities of the Common Babbler *Turdoides caudatus* began on 10 March with observation of nest-building behavior and lasted to 1 June when the chicks fledged. Clutch size was 1–6 eggs (except 2 eggs), averaging 4.18 based on 38 nests studied. Brood size varied from 1 to 3 chicks. Group sizes observed were 7–11 individuals (average 8 individuals). The mean measurements of eggs (length, width and weight) were 23.52±0.99 mm, 17.25±0.55 mm, and 0.37±3.62 g, respectively. Breeding success was 27.7%. Brood size, clutch size and group size had no significant effect on breeding success. Mortality rate showed significant differences between the various stages (P<0.001). Most of the mortality rate in the incubation stage (66.0%) occurred due to predation by snakes such as *Echis carinatus* and *Platyceps rhodorachis*. According to the Mann-Whitney U test, among all nest parameters, only the height of nest showed a significant difference with breeding success (P<0.05).

1. Introduction

The Common Babbler *Turdoides caudatus* breeds in tropical and lower subtropical latitudes mainly extralimital. It inhabits arid regions of the southeast of the Western Palearectic (Ali & Ripley 1971), overlapping with Iraq Babbler *T. altirostris* on cultivated land, but not sharing its dispersion to water. It resides in arid and semi-arid desert areas and on stony lower hill slopes up to 2100 m, in dry thorn scrub, or on sandy flood-plains dotted with clumps of tamarisk *Tamarix*, shrubs, and sparse herbage, or on rocky terrain with sparse shrubs. It also inhabits groves, shrubs, and trees of cultivated areas, orchards, and gardens (Ali & Ripley 1971).

The Common Babbler has a large range. The population size has not been quantified, but it is not believed to approach the thresholds for Vulnerable under the population size criterion. For these reasons the species is evaluated as Least Concern (Birdlife International 2010). The Common Babbler has spread in Iraq, Iran, Afghanistan, Pakistan and India and has four distinctive subspecies: *T. c. salvadorii* (Iraq and southwest Iran); *T. c. huttoni* (southeast Iran, southern Afghanistan and western Pakistan); *T. c. eclipse* (northwest Pakistan (west of Indus river), grading into nominate subspecies in northern Pakistan (east of Indus) and in Himachal Pradesh and Punjab in northwest India); *T. c. caudatus* (plains of India from Punjab east to Calcutta and from foot of

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Himalayas to southern India, Rameswaram island, and Laccadives) (Cramp & Simmons 1993). The Common Babbler is a resident species in southern Iran and inhabitant of cultivated and dry regions with scattered bushes and trees (Mansoori 2008). There are a few studies on morphometric measurements of this species from Iran (Vaurie 1953, Diesselhorst 1962, Desfayes & Praz 1978, Cramp & Simmons 1993). However, as the Common Babbler is a dominant species in Dez areas (Haft-Tappeh & Miyan-Ab areas) and the most susceptible life stage for every species is the reproduction stage, breeding success was considered as a criterion for habitat suitability in the present study.

2. Study Areas and Methods

2.1. Study areas

There are only two narrow strips of forest with *Tamarix* and *Populus* trees along sides of the Dez and Karkheh which are considered as a protected area. This survey was carried out in two parts. Haft-Tappeh agriculture complex is located in 32°4'N, 48°21'E, 40–90 m a.s.l., c. 25,000 ha, about 90 km of north of Ahwaz city between the Dez and Karkheh rivers. The weather is influenced by hot and dry plains in the southern parts of Khuzestan Province. The study area selected in this part was about 852 ha. In the Miyan-Ab agriculture complex, c. 7,000 ha, located around the town of Shush, in the southeast of the Haft-Tappeh area, one part of the area (468 ha) was selected. These areas are joined to Dez Protected Area and are inaccessible areas due to military use; wildlife avifauna is rich in this area (Fig. 1).

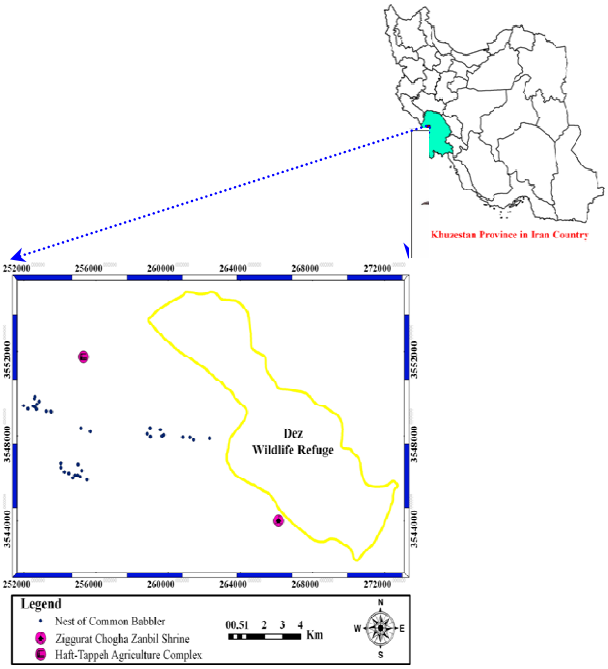

Fig. 1. Location of Common Babbler nests in Haft-Tappeh area.

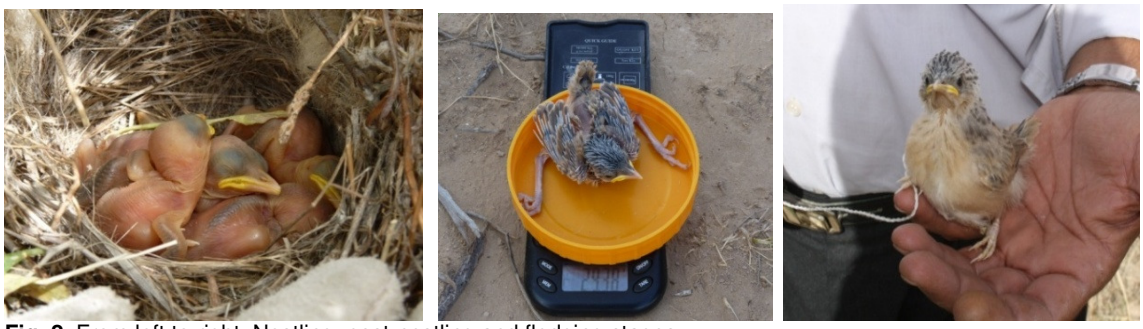

Fig. 2. From left to right: Nestling, post-nestling and fledging stages.

2.2. Materials and methods

A total of 38 nests were monitored during the study period (26 nests in Haft-Tappeh and 12 nests in Miyan-Ab). Because of lack of information about the reproduction biology of the Common Babbler in Iran, attempts were made to recognise nests, and record group behavior, courtship display (mating and copulation) and breeding success from 19 February. Common Babblers have weak flight and can be easily disturbed where vegetation is absent or scattered; thus, in some areas the total count method can be used to find group size. From the first day of reproductive behavior, the study began to search for nests in 2-day intervals. To access the nest sites, we used a ladder to reach the higher nests in *Ziziphus numullaria* thorny bushes. Nest parameters (outer large diameter, outer short diameter, inner diameter, the height of nests and nest cup depth) were measured by a measuring tape (to nearest 0.1 cm) (Table 2) at the end of study period in order to prevent any effect on the breeding success. To delineate the nest topology GPS (Garmin72H) was used. Length and width of eggs were measured by Vernier Calipers (0.02 mm precision). To identify mass and egg shape index, the following formula were used: $V\ (cc) = K \times L\ (cm) \times B^2\ (cm)$, where L indicates maximum length, B is maximum breadth and K as constant (0.4866) and egg shape index= $((B/L) \times 100)$ (Hoyt 1979). Eggs and chicks were weighed with a 0.01 g precision weighing-digital scale (105 eggs, 58 nestlings, 17 post-nestlings and 6 fledglings). The group size was the number of individuals living close to each other per group. To determine group size and number of nests within each group, an area size of c. 362 ha was selected in the west of the study area.

Nestlings of Common Babblers were defined as newly hatched and bare chicks without ability to move around (<7 days), whereas post-nestlings had feathers and ability to move around the nests, but did not leave the nest aged 7 to 13 days. At the fledging stage, chicks can leave the nest hopping but are still unable to fly (>13 days) (Fig. 2). During the breeding stages, data were recorded about the clutch, group, and brood size in each nest. To calculate the rate of breeding success, numbers of nests, eggs, nestlings and post-nestlings were recorded among clutch sizes and numbers of chicks was based on mean fledged chicks (Barati 2009) or mean rate for each breeding stage (Smith & Renken 1993). To determine factors decreasing the breeding success of the Common Babbler, mortality rates were divided into natural factors (such as predation by birds, rodents, reptiles and delay in hatching) or human factors. The causes of these factors were determined by observations and signs on eggs and dead chicks, as well as pellets of mammals near the nests. Snakes swallow the eggs, thus we attributed the egg loss to reptiles whenever we did not find egg shells. The rate of egg loss (percentage of lost egg to total eggs) was calculated for various causes.

Because the data of breeding success in all nests were not normally distributed (Kolmogrov-Smirnov test: Z=1.876, N=38, P<0.05), in order to examine relationships among variables, data were compared non-parametrically. The Kruskal-Wallis test was used to examine the effects of brood, clutch and group sizes on breeding success; Friedman test to define possible differences of mortality among reproductive stages; Wilcoxon test to find the differences of mortality between egg and nestling stages; Spearman Correlation to find correlations between clutch, brood and group sizes and breeding success; Mann-Whitney U and Spearman Correlation tests to compare breeding success in different nests. Statistics were performed using SPSS 12.

3. Results

3.1. Mating

Mating and copulation were first observed on 16 and 19 March 2010. Breeding pairs were separated from their natal group for some days for mating. Mating was observed on the ground near *Z. numullaria* vegetation. Mating occurred 7 repeated times and each mating period took 58 seconds (N=2). Mating lasts an average of 6 seconds each time (N=7).

3.2. Population

Common Babblers live socially and have territory areas they defend all year long. The number of babblers in a group (Group size) differs with area. In the Haft-Tappeh area the group size was recorded as 7–11 individuals. Overall, 24 groups of Common Babblers were

found. In some territories, due to destruction of nests, the breeding pairs built second nests, leading to 38 nests for the 24 groups. In the selected area, the number of groups surveyed, the average number of each group, and number of nests within each group territory were 7, 8.5 (total 60 individuals) and 2 respectively.

3.3. Nest, egg and chick characteristic

Thirty-seven established nests in the study area were built in *Z. numullaria* and only one nest was built in *Lycium shawii*. According to the Mann-Whitney *U* and Spearman Correlation tests only the height of the nest cup had a significant negative effect on the breeding success of Common Babbler (Mann-Whitney *U* test: U=10, N_1=N_2=13, P<0.05) (r^2 = –0.557, P<0.05) (Table 3).

Mean clutch size was 4.18 with clutches of 5 (42.1%) and 6 eggs (2.6%) having highest and lowest frequencies, respectively. The egg parameters measured as follow: average (Mean±SD) of length, width, weight, mass and shape were 23.52±0.99 mm, 17.25±0.55 mm, 3.62±0.37 g, 3414.13±269.68 mm^3 and 73.38±3.56 (percent), respectively.

Of 159 eggs, only 62 eggs were hatched (39.0%) and 37 brood (cohort) sizes were formed. The brood sizes were 1 (N=20), 2 (N=9) and 3 (N=8). The highest and the lowest percent were allocated to the brood size with 1 chick (54.05%) and 3 chicks (21.6%), respectively. Nestling and post-nestling stages lasted 7.23±1.53 and 5.54±0.72 days and varied 5–11 and 4–6.5 days, respectively. After that the fledging stage lasted 2–3 days (2.58±0.51) before the chicks left their nests.

3.4. Breeding success

The rate of success in hatching, nestling and post-nestling stages was 39.0%, 22.0%, 22.0%, respectively and the overall breeding success was 27.7%. There was no significant difference between breeding success and different clutch sizes (Kruskal-Wallis test: H_2=0.176, P>0.05) (Fig. 3). Breeding success and brood size showed no significant difference by the Kruskal-Wallis test (H_2=0.520, P>0.05) (Fig. 4), nor different group sizes (Kruskal-Wallis test: H_3=3.80, P>0.05). Alhough according to the Kruskal-Wallis test, clutch size had no significant effect on breeding success, the rate of breeding success was rather more in clutches of 4 eggs (32.85%). Also, though brood size did not show a significant effect on breeding success, the success in 2-chick broods was rather higher (66.7%).

According to the Spearman correlation test there were no significant differences between the clutch, brood and group sizes and breeding success (P-value respectively, 0.664, 0.987, and 0.362).

3.5. Mortality

According to observations and evidence (tracks, pellets and dead bird feathers) near the nests, damage signs on eggs and chicks gave information about the area's fauna and its feeding behaviour. A total of 97 eggs in the study (61.0% of all eggs) were destroyed before hatching and 27 chicks in the nestling stage (17.0% of all eggs) were destroyed (mainly due to snakes such as *Echis carinatus* and *Platyceps rhodorachis*). There was no mortality in the post-nestling stage. There is no doubt that predation due to snakes is the main effective factor on decreasing the breeding success of the Common Babbler in the study area. The rate of effective predation on the destroyed eggs was 66.0% by reptiles (snakes), 20.6% by rodents and birds, 10.3% due to delay in hatching time and 3.1% due to research activities.

According to the Friedman test, there were significant differences between mortality in the various reproductive stages (Friedman test: χ^2_3= 44.268, N=38, P<0.001). Also according to the Wilcoxon test, mortality among egg and nestling (Wilcoxon Test: T= –4.214, N=38, P<0.001) egg and post-nestling (Wilcoxon Test: T= –5.238, N=38, P<0.001) and nestling and post-nestling (Wilcoxon Test: T= –2.536, N=38, P<0.05) were significant (Friedman test: H_2=44.268, P<0.001).

Table 1. The Common Babbler reproduction phenology stages with their duration

Finish Time	Climax Time (percent of each stage)	Start Time	Stage (Duration)
29 March	19-27 March (56.5)	10 March	Nesting (20 days)
15 May	24 April- 10 May (40.0)	23 March	Egg laying (54 days)
24 May	10- 24 May (55.5)	8 April	Hatching (47 days)
24 May	10- 24 May (55.5)	8 April	Nestling (47 days)
1 June	22 May- 1 June (60.0)	27 April	Post-Nestling (31 days)
1 June	18- 29 May (63.0)	18 May	Fledging (15 days)

Table 2. Nest parameters of Common Babbler (N= 26 nests)

Nest parameters	Mean±SD	Range
Outer large diameter	15.61±3.97	11.60–20.10
Outer short diameter	12.81±3.56	8.40–17.65
Inner diameter	8.91±2.39	8.50–12.60
Height of nest	159.05±52.62	64.60–250.50
Depth of cup	8.47±2.52	4.55–13.80

Table 3. Results of Mann-Whitney and Spearman Correlation to define the possible effect of nests parameters on the breeding success

P-value of test	Outer largediameter	Outer shortdiameter	Inner diameter	Depth of cup	Height of nest
Mann-Whitney	0.663	0.866	0.364	0.910	0.003
Spearman Correlation	0.884	0.844	0.589	0.270	0.016

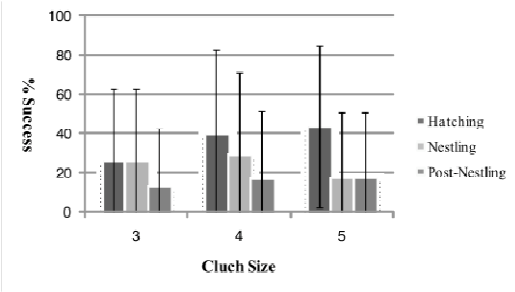

Fig. 3. The breeding success among different stages between the clutch sizes does not show any significant difference.

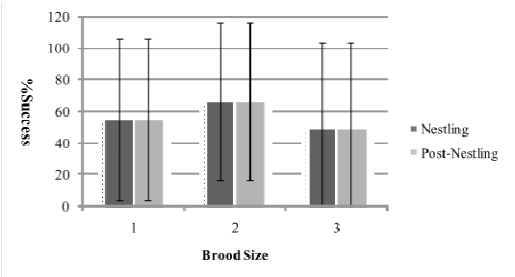

Fig. 4. The breeding success between the brood sizes does not show any significant difference.

4. Discussion

4.1. Nesting

Nest siting by Common Babblers differs considerably. In Al-Jadria (Iraq), it uses rather different sites from the Iraq Babbler *T. altirostris*, avoiding poplar Populus (main tree nesting site of Iraq Babbler) and preferring low Tamarix and dense thorny bushes. None are built in reeds (Al-Dabbagh & Bunni 1981). In Sistan Province, southeastern Iran, nests were built on *Tamarix* trees on Zahak road and at Jazinak, and on date and pomegranate trees around Kul village near Zabol Airport (Arbabi et al. 2008). In contrast to previous studies, Common Babbler's nests in Khuzestan were found in *Capparis spinosa*, *L. shawii* and *Z. numullaria*. The nest foundation is thorny twigs, roots and grass, with a compact inner cup of finer grass stems and rootlets, often lined with hair, mosses and leaves. In all surveyed nests, *Z. numullaria* was the main component of nests (32.7% in outer layer and 76.7% in inner layer)

4.2. Breeding season

In Iraq, breeding season is at least partly synchronous with Iraq Babbler, i.e. March–July (Marchant 1963, Al-Dabbagh & Bunni 1981). In India, egg-laying varies locally to cover almost the whole year, but occurs mainly during March–July and June–September (Gaston 1978). In Iran (Zabol), Common Babblers laid their eggs from March to April (Arbabi et al. 2008). In Haft-Tappeh (Khuzestan), the breeding season was from March to July, conforming with other studies. The breeding period in Haft-Tappeh area is shorter than in Iraq and India due to extreemly hot weather in the summer and low plant coverage (Table 2). Duration (Mean±SD) of incubation period was 14.90±1.57 days and this varied from 12 to 18 days, while in India it lasted 13.25 days (Gaston 1978).

4.3. Group size

Common Babblers are scattered in small groups (the mean group size was 8 in the study area) and change in group size is seldom seen. A group's territory has a core-area with less use made of the periphery, yet there is very little overlap between groups, and no instances of groups mixing, e.g. while feeding (Gaston 1978). In Iraq and Iran, groups are typically 6–7 birds (Moore & Boswell 1956, Érard & Etchécopar 1970), but in the study area, 7–11 birds were observed in groups.

Three patterns of breeding occurred in Common Babblers: (1) groups in which one pair attempts to breed in a season (most cases); (2) groups in which one male breeds successively with 2 different females; and (3) groups in which 2 pairs attempt to breed simultaneously (rarely observed) (Gaston 1978). Therefore, in groups with 2–4 breeding babblers, the other babblers are non-breeders or helpers. An extensive literature exists about helping in birds, where some reproductively mature or immature members of the species temporarily or permanently forego their own reproduction and help other members of their species to reproduce (Skutch 1935, 1961, Emlen 1984, 1991, Duplesis 1993). Among babblers, the role of helpers has been studied in the Jungle Babbler *T. striatus* and Arabian Babbler *T. squamiceps* (Gadakar & Venkatraman 1990, Sridhar & Karanth 1993, Zahavi 1974). The role of helpers in breeding activities of the Common Babbler in India, such as feeding the brooding female, nestlings and fledglings, and defending nests, influencing clutch size, hatching success and fledging success, has been discussed (Sharma 2002). According to the Kruskal-Wallis test, the different group sizes (7−11 individuals) had no significant effect on breeding success ($P>0.05$), but breeding success in bigger groups was rather higher (breeding success in the group sizes with 7−11 individuals calculated 28.6%, 48.6%, 52.3%, 57.1% and 62.5%, respectively).

4.4. Mortality

As we observed, in the incubation stage the breeding pair safeguards the eggs, but other members of the group are nearby and in case of any threat, they sound an alarm to the enitre area. However, the non-breeders' visits increase with egg hatching. We observed that the main eggs predators reach a nest quickly when the breeding pair is not present at the nest. Even if the attack is out of the vision of the eight Common Babblers, we observed that the predators are not far distant and can access the nests easily from their many burrows under the nest (many burrows of rodents and reptiles were near the nest site surveyed).

As was proven by Freidman's test, there is a significant difference between mortality in various stages, and mortality in the incubation stage was more than at other stages (61.0%). On the contrary, in the stages after hatching, with frequent visits of non-breeders for checking the nest and feeding the young (Sharma 2002), opportunity for predators decreases and probability of breeding success increases (mortality in the nestling stage was 17.0% from 159 eggs). However, causes of mortality in the after-hatching stages (nestling and post-nestling) should be studied in the future.

In general, 27 chicks were lost in the nestling stage and there was no mortality in the post-nestling stage. As we found many pellets of mammals near the nests with dead chicks, mammal's predation on the chicks was probably the second most important factor in decreasing breeding success after predation by snakes. The mammals present included Common Fox *Vulpes vulpes*, Sand Fox *V. rueppelli*, Golden Jackal *Canis aureus* and Small Mongoose *Herpestes javanicus*. Another reason for

involvement of mammals in chick mortality is the ability of mammals to detect nest sites by the call of chicks. After 2 days, chicks have a weak call which may increase probability of predation.

4.5. Conservation

Although the results of the present study about the low success rate of Common Babbler breeding (27.7%) is in accordance with the only study on the breeding success of this species in India (21.6%, Gaston 1978), we can see that population decrease is possible if habitat degradation also continues. Global information about this species is poor and the IUCN category of this species is only LC. Common Babbler in Iran is not on the list of protected species although its habitat quality is rapidly decreasing due to agricultural activities. However poor the plant coverage in the study area, it provides suitable habitat for breeding of many species such as Grey Hypocolius *Hypocolius ampelinus*, White-eared Bulbul *Pycnonotus leucotis*, Tree Sparrow *Passer montanus*, Collared Dove *Streptopelia decaocto*, Common Wood Pigeon *Columba palumbus* and Long-legged Buzzard *Buteo rufinus*, which may help wildlife managers to justify habitat conservation. The age of first breeding is not known (Gaston 1978), and fledging monitoring is necessary in aiding population management. Determination of population trends may help create suitable habitat conservation programmes. Therefore, population estimations should be conducted at least over the next five years.

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