Nesting and Cooperative Breeding Behaviours of a High-Altitude Babbler, Tibetan Babax Babax koslowi

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Abstract. The Tibetan Babax is a high-altitude babbler endemic to the NE Tibetan plateau. This is the first report of the species nesting behaviour: the study was based on information gathered during 2005 and 2006 in the upper Mekong River basin (32°N, 96°E, 3700–4300 m.a.s.l.), S Qinghai. The birds nested low (< 2 m) in conifers and laid eggs from early May to late July. The clutch size was 3–4 eggs. Nestlings fledged at 13–14 days, when they reached 52% of the adult female weight. In all four nesting attempts (three nests and one post-fledging social unit), more than two birds (3–6) were observed feeding the young or guarding the nest against conspecific intruders or potential predators. These results indicate that all three member species of the genus *Babax* (the two others are the high-altitude Giant Babax and the lowland Chinese Babax) display a cooperative breeding system. This provides a good example of phylogeny as a component responsible for the evolution of cooperative breeding behaviour.

The genus *Babax* is composed of three species, the Chinese Babax *B. lanceolatus*, the Giant Babax *B. waddelli* and the Tibetan Babax *B. koslowi*. The first species has a widespread distribution (22–35°N), from subtropical lowlands (< 1000 m elevation) in NE India, N Myanmar and S China to high mountains (up to 3700 m.a.s.l.) in W China. In contrast, the latter two are endemic to the Qinghai-Tibetan plateau and occur in alpine habitats from 3000 to 4500 m.a.s.l., making them two of the most alpine species in the Timaliinae (Zheng et al. 1987). Being largely restricted in distribution, the Giant Babax and the Tibetan Babax are identified as the characteristic species of two endemic bird areas, the Southern Tibet and the Eastern Tibet, respectively (Stattersfield et al. 1998). Both species are also categorised as Near Threatened on the IUCN Red List (IUCN 2005). For the Chinese Babax (Wu 1986, Zuo et al. 1995) and the Giant Babax (Lu 2004), breeding information is available and cooperative breeding has been observed (Lu 2004, Wei Liang pers. comm.). In contrast, no data have been published on the nesting ecology, life history and conservation status of the Tibetan Babax that inhabits a region difficult to access for ornithologists. We undertook field research to increase our knowledge of this little known species, with a special attempt to determine whether the species exhibits cooperative breeding behaviour as do its two congeners.

Living between 3600 and 4500 m in the upper reaches of the Salween, Mekong and Yangtze rivers in China, the Tibetan Babax is an alpine babbler that prefers forest edge as habitats. Visits were made to three sites in the upper Mekong river of southern Qinghai: Baqing (32°23'N, 96°25'E, 3700–4000 m.a.s.l., during 10–27 July 2005), Gaer (31°49'N, 96°28'E, 4000–4300 m.a.s.l., 28 July to 24 August 2005), and Beizha (31°49'N, 96°28'E, 3880–4200 m.a.s.l., 25 May to 20 June 2006). The three localities are adjacent (30–90 km) and similar in climate (annual average temperature 3.6°C, annual total precipitation 530 mm), topography (alpine valley) and vegetation (alpine coniferous forest). Dominant tree species consist of junipers *Sabina* spp., spruces *Picea* spp. and firs *Abies* spp. Many of the coniferous trees are short (< 3 m) as a result of logging and provide nesting habitat for many local birds.

During field days, we searched for babax nests by following the breeding activities of birds. For each nest located, we measured it and its contents, and carried out continuous nest watches (at least 1 h) with binoculars from a blind to record parental and other social behaviours at the nest (values given are mean ± SE). Nestlings were marked by clipping down feathers if less than 5 days old and using colour leg rings to identify older nestlings. We also noted babax social units wherever encountered in the field. The species is monomorphic, so we could not reliably identify the sex or age (during the late post-fledging period) of individuals that had not been caught and banded.

Nesting parameters. We located three babax nests, from which main breeding characteristics of this species were obtained (Table 1). All three nests were placed low (1.2 ± 0.3 m, 0.8–1.7, n = 3) in small coniferous trees (3–6 m height), between the lower and middle slopes of valleys. Two nests neared a stream (15–20 m) and one other was far from water (280 m). They were cap-shaped and constructed of tree bark and thin twigs with no feathers or hair inside. Mean measurements of three nests were as follows: 20.0 cm (± 1.7, 17–23) in external diameter, 11.7 (± 0.9, 10–13) in internal diameter, 6.0 (± 0.6, 5–7) in depth, and 13.7 (± 1.3, 11–15) in height. Babax eggs were greenish blue with no spots on their shell surface. Mean dimensions of three eggs (in nest III) were 29.3 (± 0.3, 29.0–29.8) mm long and 21.3 (± 0.2, 21.1–21.7) mm wide.

Incubation. Data were available only for nest III. Observations shortly before hatching indicated that incubation was shared by more than one adult. Twenty-eight transfers of incubation duty were recorded. These interchanges always occurred quickly such that the eggs were attended continuously. During each interchange only one new individual arrived at the nest, except for one

occasion when two adults arrived together. The duration of incubation bouts varied greatly, from 3 to 224 min (31.1 ± 10.1, n = 22). On four occasions, an adult returned to the nest but did not exchange places with the incubating bird. Egg turning by bill was performed 9 times (1.6/h) during 343 min 2–3 days prior to hatching and 16 times (3.8/h) during 251 min when hatching was occurring. No courtship feeding was witnessed over a total of 594 min of observation during incubation.

Young care. Nestlings were brooded for at least 6–7 days after hatching according to the records of nest III. However, we observed an adult from nest I performing the behaviour for 15 min 4 days before fledging. Twenty-eight transfers of brooding duty for nest III were noted, with the duration of individual brooding bouts ranging from 1 to 79 min (32.4 ± 5.9, n = 20). In a few cases (n = 3), an adult visited the nest briefly but did not take over brooding duty.

Frequencies of feeding trips and interval between successive trips differed among the nests (Table 2). The differences may be related with nestling age (for nests I and II relative to nest III), or the number of birds participating in rearing the young (for nests I and II in which the nestlings were similar in age, see below). The duration of staying at nest when feeding the nestlings (measured with a stopwatch) averaged 18.6 s (± 1.3, 4–34, n = 34) for nest II and 36.5 s (± 3.1, 5–122, n = 73) for nest III. In some cases (n = 5) adult babaxes visited the nest but showed no food-giving behaviour. Attending birds were seen to remove fecal sacs from the nest (32 of 271 trips to nest I) and drop them nearby (< 2 m from the nest site). Watches on nest I for a full-day (7 August, 7:15–20:19, 784 min) or through most of the day (9 August, 7:00–10:11 and 11:58–17:12, 565 min total) showed that these babaxes fed the chicks throughout the day with relatively low efforts in late morning (10:00–12:00, Fig. 1).

Table 1. Information on three Tibetan Babax nest sites in southern Qinghai, China.

	Nest I	Nest II	Nest III
Locality	Gaer	Beizha	Beizha
Date firstly located	5 August 2005	31 May 2006	2 June 2006
Elevation (m.a.s.l.)	4100	3900	3986
Nesting plant	Tibetan Juniper	Tibetan Juniper	Balfour Spruce
Nesting plant height (m)	2.9	3	6
Nest height above ground (m)	1.2	0.8	1.7
Nest content when firstly located	4 nestlings	4 nestlings	3 eggs
Nest fate	Fledged (11 August)	Fledged (4 June)	Hatched on 5-6 June, destroyed by storm (12 June)

Table 2. Observations on nestling care in three Tibetan Babax nests in southern Qinghai, China.

	Nest I	Nest II	Nest III
Brood size	4	3	3
Age of nestlings watched (day)	10-11	11-12	2-6
No. of birds engaged in nest care	4	3	4
Duration of watch (min)	1,349	330	907
No. of total feeding trip	271	38	85
Overall feeding rate at a nest/h	12.1	6.9	5.6
Feeding rate per contributor/h	3.0	2.3	1.4
Interval between feeding trips	4.7 ± 0.3	8.8 ± 1.3	9.7 ± 1.4
(range, sample size)	(0-32, 271)	(0-35, 31)	(0-62, 78)

Food brought to the chicks included adult insects (58.5% out of 65 trips in which food carried in the bill was identified), caterpillars (24.6%), pupas (4.6%), earthworms (6.2%) and plant fruits (6.2%).

Young at hatching were naked, except for cluster of gray downs present on median crown, orbit, nape, mid-black, elbows and flanks. When weighed 61.4 g (± 1.9, 55.4–66.7, n = 5), which was 52% of the adult female weight (119 g), the nestlings departed from the nests (Fig. 2). Based on the data from the three nests, we estimated the nestling period of this species to be 13–14 days. The fledged chicks from the nest I were fed in dense undergrowth at distances of 60 m on day 1 after fledging, 130 m on day 4, and more than 200 m on day 9.

Evidence for cooperative breeding. During the incubation stage of nest III, twice we observed three adult babaxes nearby (< 50 m) the nest in which a bird was sitting. Incubation was shared by more than one adult, but whether all group members were involved was unknown.

For all the three nests observed, we found more than two babaxes attending the nestlings (Table 3). They were also seen to gather within 100 m of the nest — perching, calling loudly, searching for food for nestlings or themselves on the ground, or jointly defending the nest against disturbances by the human observer (n = 8), Magpies *Pica pica* (n = 2), Thick-billed Crows *Corvus macrorhynchos* (n = 2), or conspecific intruders (n = 4).

Post-fledging young were cared by group members based on observations for nests I and II. Additionally, in Baqing valley we observed a babax groups consisting of six adults and two fledglings (86.0 and 89.2 g, respectively). All the six adults disturbed our attempt of trapping the young. Five other social groups encountered between June and July of 2005 comprised 4–6 birds (it was unclear regarding whether the groups included fledged young). These observations suggested that this species exhibited strong social aggregation at least during the breeding period, with group size ranging from 3 to 6 birds
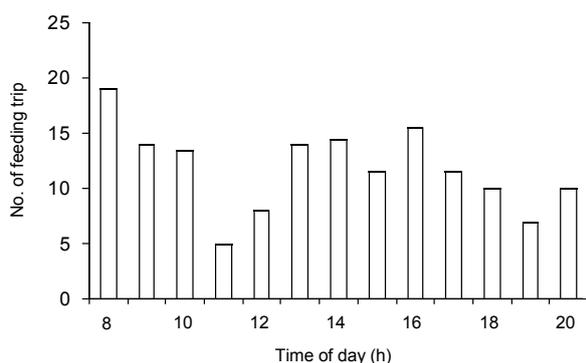

Fig. 1. Daily pattern of overall provisioning rates for four nearly-fledging nestlings in nest I by four Tibetan Babaxes. The data presented are the average of observations made on day 6 and day 4 before fledging.
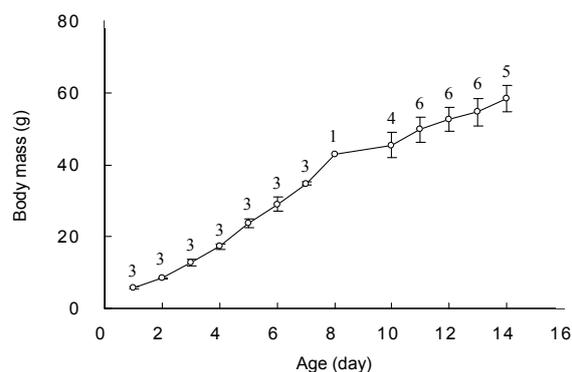

Fig. 2. Growth curves for the body mass (mean ± SE) of Tibetan Babax nestlings from three different nests. Because we did not know the actual hatching time for nests I and II, age of the nestlings was backdated by assuming that the nestling period was 14 days. The figures above the standard error bars are the number of nestlings measured.

Table 3. Direct observations of more than one individual engaged in nestlings care or in nest defense. Duration of nest watch is given in parentheses.

Cases	No. of individual	Nest I (1349 min)	Nest II (330 min)	Nest III (907 min)
	2	25	3	
Feeding young within a short time	3	2	3	3
	4			
	2	4		
Nest defense	3	10	4	1
	4	3		4

(4.3 ± 0.6, n = 4). The sociality was also suggested by allopreening behaviours between group members (3 observations).

As the data on the Tibetan Babax become available, we may make a general comparison of nesting ecology among *Babax* species. For the Chinese Babax, data were collected by Wu (1986), Zuo et al. (1995) from SW China, 26°20′, 2100–2500 m.a.s.l.; the data of the Giant Babax were obtained by Lu (2004) from Lhasa mountains, Tibet, 29°27′, 4000–4400 m.a.s.l.). They all are forest-edge species, nest low to the ground (mostly < 2 m) in bushes or small trees, mainly use relatively sturdy twigs as construction materials and produce greenish blue eggs. A slight difference is that Chinese Babaxes add moss to their nest, while Giant and Tibetan Babaxes do not. The Tibetan Babax in our sites had an extended egg-laying period (early May to late July, 60 days), obviously longer than its high-altitude but lower-latitude congener the Giant Babax (early May to mid-June, 40 days), and slightly shorter than the lowland Chinese Babax (early May to early July, 70 days). For other breeding parameters, Tibetan Babax also performed a pattern (clutch size 3.3, egg volume 13.293 cm^3, nestling period 13–14 days, mass at fledging relative the female's 52%) immediate between Chinese Babax (3.1, 11.585 cm^3, 12–13 days, 60%, for corresponding parameters) and Giant Babax (2.9, 15.730 cm^3, 16–18 days, 65%). It is difficult to explain the inter-species variation in life history trait unless more data become available.

Our numerous observations of more than two individuals behaving parentally toward the offspring of a single nest reveal a cooperative breeding system in the Tibetan Babax. The same strategy has been found in the high-altitude Giant Babax (4.5°C in annual average temperature and 566 mm in total annual precipitation, Lu 2004), and recently in Chinese Babax in a subtropical montane habitat (28°15′, 1500 m.a.s.l., 11.1°C in annual average temperature and 1325 mm in total annual precipitation, Wei Liang pers. comm.). In terms of biogeography, cooperative breeders, which comprise around 9% of extant avian species (Cockburn 2006), most often occur in stable tropical or subtropical regions, and sometimes in climatically-equable temperate habitats (Ricklefs 1975, Brown 1987). Our findings in the two high-altitude babblers represent rare exceptions.

Ecological constraints such as a shortage of vacant territories for independent breeding or poor probabilities of finding a mate have been suggested to promote the evolution of cooperative breeding (Emlen 1982, 1994). However, the habitat saturation hypothesis does not appear to provide a satisfactory explanation of the behaviours observed in these babax species. At least for the two high-altitude babaxes, breeding densities were low (0.03 birds/ha for the Giant Babax, Lu 2004; 0.06 birds/ha for the Tibetan Babax, this study) and there are a quantities of potentially suitable but unoccupied woodland patches in their habitats. Moreover, climatic and ecological conditions experienced by the two species are greatly different from those experienced by the Chinese Babax. Following the recent argument by some evolutionary ecologists (Ligon & Burt 2004), we believe that the occurrence of cooperative breeding in all the three member species within the genus *Babax* is largely due to their phylogenetic history. Gaston (1977) estimated that 28 of 29 species within the genus *Turdoides* to be potential cooperative breeders; Ligon & Burt (2004) listed 13 Timaliinae species where cooperative breeding has been reported, of which 11 belong to the genus. *Turdoides* babblers are widely distributed in west Asia, the Middle East and Africa and have a close relationship with *Babax* birds (Cibois 2003). This gives further supports for the phylogeny hypothesis.

In the Taiwan Yuhina *Yuhina brunneiceps*, more than one pair contributes genes to a single nest, resulting in a larger clutch (3 to 8 eggs, Yuan &

Liu 1998, Yuan et al. 2004). The small clutch size (2–4, mode = 3) of babax species suggests a helper-at-the nest system as reported for most Timaliinae babblers (Ligon & Burt 2004). In the Tibetan Babax, cooperative breeding was performed by all four social units we located, compared to a relatively low frequency (5 of 12 nests) in the Giant Babax (Lu 2004). The number of helpers is similar in the two species, ranging from 1 to 4 birds. Combined chick provisioning rates (5.6–12.1 feeds/h) of the Tibetan Babaxes in our alpine sites were higher than those of the Giant Babaxes in Lhasa mountains (3.8 feeds/h, Tang 2006).

Extensive logging of the primary forest and conversion of the landscape to agriculture or pasture have occurred in the upper Mekong River. This is expected to have reduced the habitat of Tibetan Babaxes (Stattersfield et al. 1998). However, our observations revealed that the edge habitats preferred by the babaxes are widespread in these valleys and an abundance of short coniferous tress may provide sufficient nesting habitat. Also, local human activities pose few direct threats to the birds. Therefore, the alpine babblers appear to face no immediate threats, as suggested by Alström (1993, cited from Stattersfield et al. 1998). However, their low population density, cooperative breeding behaviour, and the strong home range fidelity associated with this behaviour may render them more vulnerable to further habitat fragmentation and thus, as emphasized for cooperatively breeding birds (Walters et al. 2004), these *Babax* species may require special conservation attention.

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STRESZCZENIE

[Pierwszy opis lęgów tymalaka tybetańskiego]

Gatunek ten jest endemitem występującym w północno-wschodnim Tybecie. Na podstawie obserwacji 3 gniazd stwierdzono, że gniazduje on nisko nad ziemią, składa 3-4 jaja, młode wylatują z gniazda w wieku 13-14 dni, a sezon lęgowy trwa pomiędzy majem a lipcem (Tab. 1). Opisano tempo wzrostu młodych i dobowy rozkład karmień (Tab. 2, Fig. 1, 2). w We wszystkich obserwowanych przypadkach obserwowano grupy rodzinne składające się z 3-6 ptaków, które były zaangażowane w opiekę nad potomstwem (Tab. 3). Porównanie czynników związanych z występowaniem lęgów kooperatywnych sugeruje, że u tego rodzaju filogeneza musi być brana pod uwagę, jako czynnik leżący u podstaw takiego zachowania.