Chinese Birds 2010, 1(3):167–174
DOI 10.5122/cbirds.2010.0011

ORIGINAL ARTICLE

Nesting records of 20 bird species in Lhasa region, Tibet

Xin LU ✉, Dianhua KE, Xiaoyan MA, Guohong GONG, Tonglei YU

Department of Zoology, College of Life Sciences, Wuhan University, Wuhan 430072, China

Abstract This paper provides the information on nesting biology of 20 bird species in alpine shrub (4000–4700 m a.s.l.) or alpine meadow-wasteland habitats (4300–4700 m a.s.l.) in Lhasa region, Tibet. Of these species, three are endemic to the Tibetan plateau and 17 widespread in altitudes. The data on these taxa are all new to the high-altitude environments, especially the upper limit of their breeding distribution. A few species are firstly reported with respect to nesting information in the world. The study will contribute our knowledge for natural history of birds occurring in the harsh, extreme habitats.

Keywords alpine shrub, alpine meadow-wasteland, breeding parameter, Tibetan plateau

Introduction

Breeding biology is the most important aspect of organisms' natural history. Alpine birds on the Tibetan plateau are among the groups for which their nesting knowledge is least known in the world. Previous ornithological surveys for this region (Walton, 1906; Ludlow, 1950; Vaurie, 1972; Zheng et al., 1983) were brief in time expenditure and focused on the species' occurrence and distribution, thereby obtaining almost no information of nesting ecology for most species. Since 1996, we have worked at Lhasa area in southern Tibet to collect the data in respect to natural history of high-altitude birds. With our efforts, life history mysteries of some species in this area have been uncovered (Lu, 2003, 2004, 2005, 2006, 2008, 2009; Lu and Zheng, 2003; Lu et al., 2003, 2007a, 2008, 2009, 2010a, 2010b). Here, we report the breeding data of 20 species inhabiting over 4000-m alpine shrub zones in the Lhasa mountains and 4300-m meadow-wasteland habitats characterized in the northern Tibetan plateau (Li, 1988; Miehe, 1996). This paper forms part of our studies on breeding ecology of alpine passerines in mid-Yarlong Zangbo River. All species involved in this study, either for those endemic to the plateau or for those with widespread altitudinal range, are at their distributional limits. There is a decreasing abundance of species at the margins of their distributions along environmental gradients due to resource depletion, physical stress and competitive exclusion (Brussard, 1984). Severe natural conditions and scarcity of food sources in the high-altitude sites support a low population density for the majority of the species reported here. As a result, nest samples are very small although great field efforts (39 summer months in the alpine shrub zone, 18 summer months in the meadow-wasteland environment) have been taken.

Our objectives are to provide the basic nesting information of the alpine birds that occur at altitudinal upper limit of their breeding distribution. We focus at breeding time, nest-site and nest characteristics, egg morphology and size and clutch size. In addition, data on parental care and young development, if available, are presented. These data will aid our understanding of the evolution of life history of birds along altitudinal gradients (Badyaev, 1997; Badyaev and Ghalambor, 2001), and conservation for the birds living in a vulnerable ecosystem (Lü and Springer, 2000; Lu et al., 2007b), in which small

Received 17 May 2010; accepted 8 July 2010

✉ Author for correspondence (Xin Lu)
E-mail: luxinwh@gmail.com

population size is a potential risk factor because of lower local genetic variability (Møller et al., 2007).

Study area and methods

The data of this study were collected in two sites during our long-term ornithological study from 1996 through 2008: 1) alpine shrub zone in Xiongse near Lhasa (29°27′N, 91°40′E; elevation 4000–4800 m, 1996, 1999–2007; Fig. 1a) and alpine meadow in Dangxiong Town (30°28′N, 91°05′E; elevation 4300 m, 2004–2008; Fig. 1b). Long-term annual average temperature and total precipitation are respectively 4.4°C and 566 mm in Xiongse and 1.3°C and 529 mm in Dangxiong. High winds prevail at the two sites from January to April (annual mean wind speed: Xiongse 1.9 $m \cdot s^{-1}$; Dangxiong, 2.4 $m \cdot s^{-1}$). Both the study areas are generally free from snow cover throughout the winter as winter snowfall only accounts for a minority (< 25%) of the annual total precipitation and strong solar radiation (more than 2900 hours per year) characterized in the plateau makes snow accumulation less likely to persist. The details of vegetation were provided by Lu et al. (2007b) for Xiongse and by Ke and Lu (2009) for Dangxiong. Only one species, Pied Wagtails (*Motacilla alba*), was studied near Lhasa city (3650 m).

Bird nests were located by observing parental behaviors or carefully detecting potential nesting habitats. Regular nest inspection for the located nests was conducted to obtain breeding parameters (nest, egg, nestling, incubation and young care) and determine nest fates. Focal observations were made on some breeding pairs to record nesting activities (incubating or young-feeding) and social interactions. Some behavioral events were opportunely recorded during the field days. During observation, we positioned ourselves more than 50 m far from the nest to reduce possible disturbance. Values are given as mean ± SD.

Results

Eurasian Hoopoe (*Upupa epops*)

The birds are a summer migrant to the alpine valley. They arrived at 4400 m in Xiongse in late March or early April and population numbers increased obviously within two weeks after the first arrival. Three copulation events were observed in late May in three different pairs that were building the nest. Before copulating no special courtship was performed. Feeding activities were observed from early June until early September. Nests were placed in cavity, lined with no any soft materials. All four nests located between 5 and 15 June in Xiongse each had 6 eggs, and one nest on 19 June included two nearly-hatched eggs and five nestlings (2.8–6.5 g). Two nests found on 13 and 28 June in Dangxiong both had a clutch size of 6 eggs, one nest contained 3 eggs and 3 hatchlings on 14 July, and two nests located in early July had respectively 5 (54.3–65.4 g, only 5 survived to fledging) and 2 nestlings (52.6–56.5 g). Eggs were pale and unspotted. Eight Xiongse eggs varied in length from 25.1 to 26.8 (26.2 ± 0.62) mm and 11 eggs in Dangxiong from 25.8 to 28.0 (27.0 ± 0.81) mm, and in width from 17.0 to 18.7 (17.9 ± 0.62) mm and from 16.9 to 18.7 (17.9 ± 0.58) mm respectively. During incubation the female received food from the male. Freshly hatched nestlings had white down of 15 mm on forehead, occiput, back and rump.

Common Cuckoo (*Cuculus canorus*)

Earliest arrivals in Xiongse were recorded between 2 and 8 May (5 ± 2 May, $n = 6$ years). The birds were rare (about 5 pairs over 400 ha) during most of the breeding period in the valley. However, from late May to early June, they were numerous around villages at the bottom of the valley (3900 m). Only three brood parasites were noted, all of which occurred in the nests of White-bellied Redstart (*Hodgsonius phaenicuroides*) ($n = 14$). The cuckoo eggs were similar in coloration to but larger in size (length, 25.5 ± 0.4 mm, 25.1–25.9; width, 18.0 ± 0.1 mm, 17.9–18.0; $n = 2$) than the hosts' (23.0 ± 0.1 mm, 22.0–24.0; 16.0 ± 0.04 mm, 15.6–16.5; $n = 22$). All the three observed breeding attempts failed.

Eurasian Eagle Owl (*Bubo bubo*)

Over 1000 field days during daytime in Xiongse, we flushed the birds 12 times, mostly single individuals, only once two and once three individuals. Five food pellets found in cliff habitats showed woolly hare (*Lepus oiostolus*) to be the major diet of the owls. On 28 May 1999, one nest was located on a 6 m high cliff at 4020 m elevation in Xiongse. There was no material in the nest. Food remains in it were largely the woolly hares. The nest contained one nestling weighing 750 g. On 3 July 2002 two adult birds with one juvenile were seen in the field.

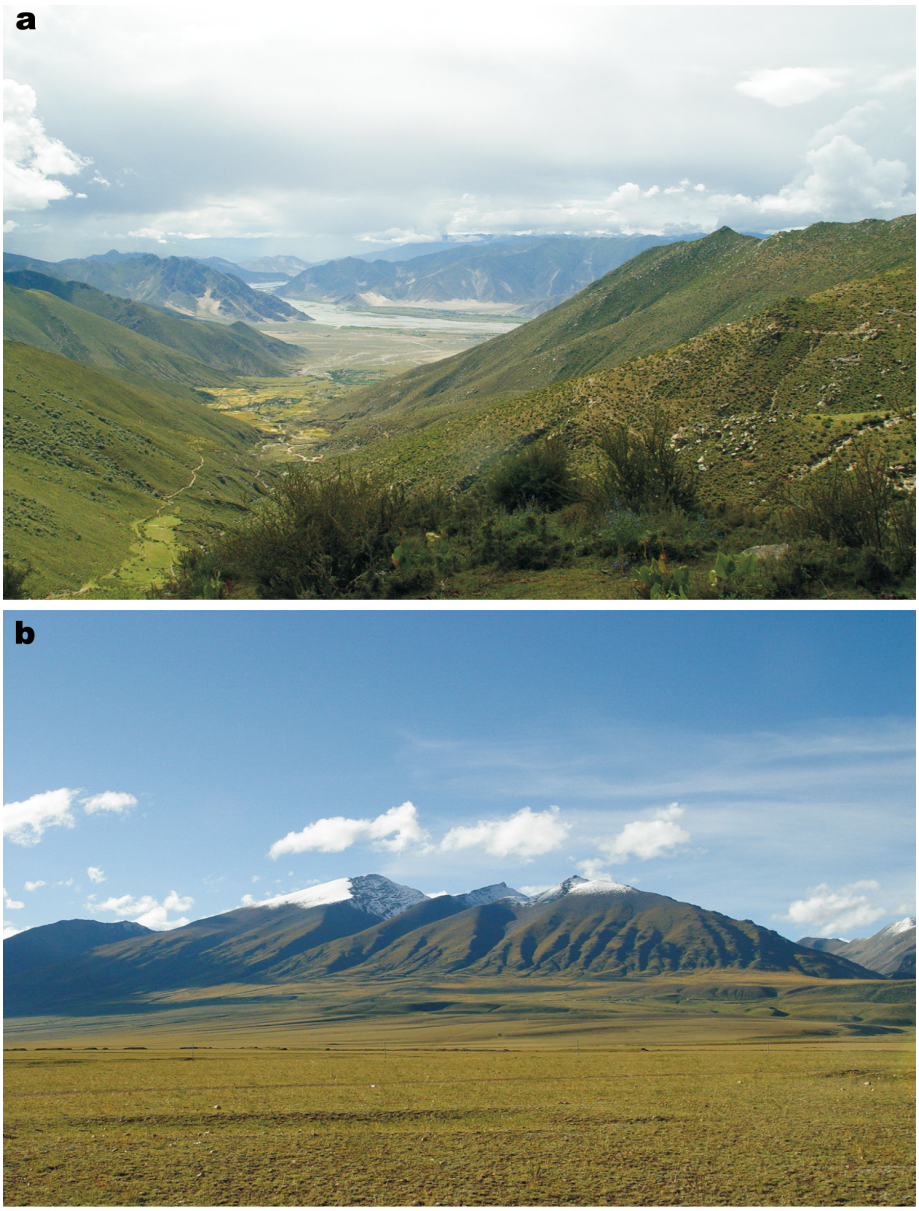

Fig. 1 The study areas. (**a**) Alpine shrub habitats in Xiongse valley near Lhasa city, Tibet. (**b**) Alpine meadow-wasteland habitats in Dangxiong, Tibet.

Common Magpie (*Pica pica*)

In Lhasa area, the birds occurred from 3600 to 4800 m, mostly solitarily or in pair, sometimes in flock (up to 14 individuals). Two nests were located at 4400 m in alpine willow of more than 6 m high, with the nest placements being about 4 m from ground. One nest found on 28 May contained 6 eggs, which were grey with light brown spots. One measured egg had a size of 38.7 × 26.0 mm; another nest seen on 27 May contained four nestlings of 138–160 g. In addition, a family with juveniles similar to the adult in body size was observed on 26 June.

Red-billed Chough (*Pyrrhocorax pyrrhocorax*)

Nesting altitudes ranged from 3950 to 4700 m, mostly on cliffs (n = 11) and occasionally on big trees (n

= 1). Nest-building activities were observed between 2 April and 8 May (n = 5). Both the female and the male carried materials to the nest at a rate of 28 trips per hour (observation on one nest for 47 min). In most cases (69% of 13 trips) both sexes carrying nest materials returned to the nest together. Nests were made of shrub sticks lined with animal hair and sometimes feathers. Nests were shallow dished with diameters of 355–450 mm, depth of 67–75 mm and height of 180–250 mm (n = 2 nests). Eggs were dark white with brown spots, having a size 41.0 × 26.8 mm (n = 1). Clutch size was three eggs (n = 2) and one brood held two nestlings weighting 240 g and 260 g, respectively. Nests at incubation stage were recorded between 8 May and 1 June (n = 4), and at young feeding stage between 26 May and 13 June (n = 5). The males fed the incubating females. The choughs were seen to strongly attack Tibetan Eared Pheasants (*Crossoptilon harmani*) or magpies near the nests. During May to August, chough flocks of more than 10 birds (10–60) were frequently seen (9 of 27 sightings).

Brown Dipper (*Cinclus pallasii*)

In Xiongse, the dippers were observed between 3980 and 4250 m and in Dangxiong up to 4400 m. Average earliest arrival time in Xiongse was 3 May (± 2, 30 April to 6 May, n = 5 years). Initially arriving birds were mostly seen in pair. Nest-building began 3–4 days after arrival. One juvenile about two weeks after fledging was seen on 20 June.

White-capped Water-redstart (*Chaimarrornis leucocephalus*)

First sightings of the birds at 4200 m in Xiongse were on 30 April and 2 May (n = 3 years). The highest altitude at which the birds appeared was 4270 m in Xiongse and 4800 m in Dangxiong. One nest was located on 22 May at 4010 m in the Xiongse valley. It was on a cliff near a stream. Both sexes collected nest materials within 50 m from the nest. The nest was bowl-shaped and composed of moss and thin weed stems within an inner lining of wool and feathers. Its size was 125 mm in external diameter, 63 mm in internal diameter, 30 mm in depth, 76 mm in height and 45 g in weight. A second nest was located on 14 July on a cliff near a steam at 4537 m in Dangxiong. It contained two nestlings and one egg (24.5 × 17.5 mm).

Common Stonechat (*Saxicola torquata*)

As a summer breeder the birds arrived at 4400 m in Xiongse between mid-April and early May. First-egg dates were estimated to occur from 1 May to 25 June (n = 10), with 60% between 15 and 25 May. Nests were placed in bush bases or on small cliffs between 4050 and 4520 m. Materials comprising the nest included moss and grass stems outside the wall and animal hair and feathers inside the wall. The dimensions of 4 nests were as follows: external diameter 134 ± 30 (103–175) mm, internal diameter 71 ± 4 (65–75) mm, depth 50 ± 14 (38–69) mm and height 78 ± 17 (58–90) mm. Three nests weighted 31 g (± 9, 22–40) on average. Eggs were bright blue with beige spots. Twenty-four eggs had an average dimension (in mm) 18.9 (± 0.79, 17.4–20.2) by 14.1 (± 0.32, 13.7–14.9). Fresh egg weights were 1.8 ± 0.22 g (1.4 –2.0, n = 10). Clutch size averaged 4.80 (± 0.45, 4–5, n = 5), and brood size 3.60 ± 1.34 (2–5, n = 5) at hatching and 3.25 ± 1.26 (2–5, n = 4) at fledging. Of 6 known-fate nesting attempts, 5 (83%) fledged at least one young. Young fledged weighed 17.1 ± 0.4 g (16.8–17.8, n = 5), which were 120% of adult body weight. The female undertook nest building and incubation alone and the male defended the territory near the nest. Both parents fed the young but the female took more feeding trips than the male (female 24 and male 3 trips over 322-min observations on a 3-nestling brood). Among 17 food items the nestlings received, 29% were insect larvae, and the remaining 71% adult arthropods (Orthoptera 24%, Coleoptera 18%, Arachnoida 18%, Hymenoptera 6%, and Myriapoda 6%). Incubation period spread 14–15 days (n = 2) and nestling period 15 days (n = 1).

White-browed Tit (*Parus superciliosus*)

Three nests were located in cliff holes between 4200 and 4650 m. Tunnel length of nesting holes were 17 –25 cm. Nest materials consisted almost entirely of hare hair along with a few bird feathers and moss. External diameters of the nests were 121–125 mm, internal diameters 65–73 mm, depth 40–43 mm, height 62–68 mm, and weight 19–20 g. Four eggs measured 17.3 (± 0.9, 16.1–18.0) × 12.9 (± 0.1, 12.8 –13.0) mm. Two nests each contained 4 eggs and one nest 4 nestlings. First-egg dates fell between mid- and late May (n = 3 clutches). The birds preferred to forage in bushes (for flowers) and during the period of mid- to late July, family flocks were seen to for-

age on newly metamorphosed Lepidoptera insects in leaf buds of *Berberis hemleyana*.

Great Tit (*Parus major*)

The birds were uncommon in Lhasa area. Four nesting attempts were located in Xiongse, three at 4400 m and one at 4700 m. Nests were located in holes and consisted of mass with an inner lining of animal hair. Two of the three nests located in Xiongse were measured as follows: external diameter 125–160 mm, internal diameter 60–70 mm, depth 45–47 mm, height 52–80 mm, and weight 23–40 g. Eggs were white with brown spots and measured 19.5 (± 0.52, 18.6–19.9) × 14.0 (± 0.58, 13.1–14.6) mm. Clutch size was 5 eggs for all three nests. First-egg dates were estimated to occur between mid-May and late June. Both males and females were observed to pick newly metamorphosed Lepidoptera insects in leaf buds of *Berberis hemleyana* to feed the young.

Sand Martin (*Riparia riparia*)

The martins nested in hole on cliffs. The number of nesting holes depended on the size of a cliff, from one to more than 100. On a cliff of 15 × 4 m, there were 108 nest holes and the nearest neighboring distances, which were estimated based on a picture with a reference, averaged 0.38 m (± 0.29, 0.1–1.2, n = 75). Nesting holes were 67 ± 29 cm (40–150, n = 11) long and neighboring holes may be communicated. Nests consisted of grass roots inside lined with feathers. One nest was measured as follows: external diameter 136 mm, internal diameter 95 mm, depth 27 mm, and height 42 m.

Crag Martin (*Ptyonoprogne rupestris*)

First sight of the birds at 4500 m in Xiongse was 15–18 April (n = 4 years). Nests were placed on high cliffs. One nest was at incubation stage on 13 June, and two at young-rearing stage on 14 June and 21 July, respectively.

Asian House Martin (*Delichon dasypus*)

The birds arrived at 4100 m in Xiongse in early April. In Dangxiog the highest nesting record was at 4540 m. They regularly used specific cliffs as nesting substrates. In most cases 7–8 nests were built on the same cliff (nearest neighboring distance 3–90 cm), sometimes 1 or 2 nests were solitarily present. Nest-building activities were observed from early May to early July. Sometimes several individuals carried nest materials to the same nest. The dome nests were 95–160 mm high and 98–102 mm wide, made of mud mixed with grass stems, moss and feathers. A nest found on 29 May contained 4 white eggs, which had sizes of 19.0 (± 0.15, 18.8–19.1) × 14.2 (± 0.18, 14.0–14.4) mm. Another nest holding 3 nestlings (11–13 g) was observed on 19 June.

Greater Short-toed Lark (*Calandrella brachydactyla*)

The ground nests (n = 8) had an internal diameter of 63 ± 9.2 (57–85) mm and depth of 44 ± 4.4 (35–48) mm. Eggs were grey white with brown spots. Dimensions of 27 eggs were 20.8 ± 0.96 (19.1–22.0) by 14.5 ± 0.46 (13.4–15.4) mm. One egg was deposited per day (observations for 5 eggs in 3 clutches). Average clutch size was 3.00 (± 0.63, 2–4, n = 6). Distribution of first-egg dates was as follows: 3 in late May, 2 in early June, 3 in late June, and 3 in early July. Reproductive success was 27% (3 of 11 known-fate nests). Since early August, the birds formed flocks of 15–70 individuals.

Hume's Short-toed Lark (*Calandrella acutirostris*)

Nests were placed on the ground and their measurements (n = 7) were 62 ± 3.8 (55–67) mm in internal diameter and 42 ± 7.9 mm in depth. Eggs were similar in color with those of Greater Short-tode Larks. Twenty-six eggs measured 21.0 ± 0.74 (19.3–22.1) by 14.5 ± 0.45 (13.8–15.9) mm. One egg was laid daily (observations for 7 eggs in 3 clutches). One clutch was initiated in early May, two in late May, two in early June and four in late June. Clutch size ranged from 3 to 4 eggs (3.17 ± 0.41, n = 6). Incubation lasted 11 days and young rearing at nest 17 days for one nest. Of 8 known-fate nesting attempts, 2 (25%) fledged at least one young.

Tree Sparrow (*Passer montanus*)

The highest nesting record at Xiongse was 4700 m. Breeding activities at 4400 m in the valley took place from early April until late August. On 31 March in Dangxiong the birds were seen carrying nest materials. At this site three nests, two containing 4 eggs and one 5 eggs, were located on 7 July. The 9 eggs were

white with abundant brown spots, with a size of 21.0 (± 0.75, 19.9–22.3) × 15.4 (± 0.39, 14.9–15.8) mm. Two other nests, one with 4 nestlings (14.2–17.7 g) and the other 5 nestlings (5.5–11.4g) were found on 29 June and 7 July, respectively.

Pied Wagtail (*Motacilla alba*)

Nesting altitudes ranged from 3600 to 4010 m. In lowland Lhasa (3650–3800 m), males established territory in mid-April through driving or fighting with conspecific males. Copulations were observed within territories on house roofs, electric wires or ground, mostly in the morning (7 of 11 events) and sometimes in the afternoon (4). Nests were placed in holes (n = 9) or in the dense foliage of short conifers (n = 2). Both sexes constructed the nest for 7–8 days. A full-day watch on nest-building activities of a nest showed that the parents took 170 trips, averaging 14 trips per hour, with a peak at midday (up to 30 trips per hour). Nests were exteriorly composed of thin grass stems or roots, cotton threads and interiorly of moss. External diameter of 6 nests averaged 165 (± 24, 14–19) mm, internal diameter 81 (± 16, 60–90) mm, depth 61 (± 10, 58–80) mm, height 93 (± 15, 90–190) mm and weight 50.6 (± 9.6, 54 –73) g. Clutches were initiated between early May and mid-June (n = 7 nests). Eggs were grey-white with brown spots, being 21.3 (± 0.65, 19.8–22.3) × 15.8 (± 0.41, 14.7–16.4; n = 13) mm. Clutch size averaged 4.67 (± 0.52, 4–5, n = 6). Incubation by female only started with the last egg and lasted 11–12 days (n = 3). During incubation males defended the territory. Over a 720-min watch on a nest, the female was on nest for 450 min (63%). Hatching success rate was 93% (n = 4 nests). Both sexes fed the young for 15–16 days (n = 2 nests), when they reached 18.2–20.5 g (n = 7). A total of 171 feeding trips were recorded over 12 hours on a brood with four 6-day old nestlings, each parent sharing almost the equal efforts. Growth rate constant of body weight based on the logistic model was estimated to be 0.334 and asymptotic weight 23.1 g.

Robin Accentor (*Prunella rubeculoides*)

The birds were winter visitors to Xiongse, abundant from early September until late May. Three nests were found in short bushes in Dangxiong where its closely related congeners, Brown Accentors (*P. fulvescens*), were lack during the breeding season. Two nests were located on the ground sheltered by bushes. External layers of the nests consisted of *Caragana tibetica* twigs and moss, and internal layers of animal hair. Nest size averaged 130 (110 –150) mm in external diameter, 69 (65–72) mm in internal diameter, and 62 (60–63) mm in depth. Two nests were located on 29 June, one containing two nestlings (4.1 and 9.5 g, being brooded) and another three nestlings. Two newly-fledging juveniles were seen on 27 June.

White-winged Grosbeak (*Mycerobas carnipes*)

Two nests were recorded at 4050 and 4100 m respectively in Xiongse. Nest No.1 was in a 1.8 m high *Rosa sericea*, 1.2 m from ground and 10 m from a stream. When found on 29 May, two eggs were present and incubated by the female, which received food from the male. The attempt failed during the incubation period. Nest No.2 was in a 6 m high alpine willow, 3.2 m from ground and 5 m from a stream. On 5 June, both parents were constructing the nest. Incubation was done by female for about 16 days (n = 1). Two nestlings hatched and predated at the age of 6 days. Nests are cup-shaped and made of thin shrub twigs in outside layer and lined with glass stems or dead shrub barks. The two nests measured as follows: external diameter 134–160 mm, internal diameter 85–90 mm, depth 44–50 mm, and height 95 –110 mm. Eggs were grey-greenish with dark brown spots especially at the large end. Length of five eggs averaged 26.3 (± 0.80, 25.0–27.0) mm and width 19.1 (± 0.44, 18.5–19.6) mm.

Godlewski's Bunting (*Emberiza godlewskii*)

The birds were observed from 3900 to 4600 m in Xiongse. The time of the first eggs took place between late June and end-July (n = 3). Sizes of five eggs were 23.0 (± 0.91, 22.0–24.0) × 15.9 (± 0.41, 15.2–16.2) mm. Clutch size varied from 2 to 3 eggs (2.67 ± 0.58, n = 3). Nestling period spread over 12 days (n = 1). Growth constants of logistic regression of nestling body weight was 0.42–0.49, asymptotic weight 22.2–24.2 g. Nestlings opened the eyes at day 5. All nestlings in two broods successfully fledged and those in one brood died of bad climates. A nest contained three nestlings (4.8–5.7 g) was found in Dangxiong on 10 July.

Acknowledgements We thank Liqing Fa, Xuhui Ma, Yu-

anyuan Guo, Jie Tang, Zhiwei Peng, Xiuah Wu and many other people who helped in collecting the data reported here. This work was conducted in the Field Research Station for Tibetan Wildlife, which is jointly administered by Wuhan University and Tibet University. Financial support was provided by the National Natural Sciences Foundation of China (Grant Nos. 39800016, 30170156, 30270216, 30370241, 30425036, 30670337, and 30830019).

References

Badyaev AV, Ghalambor CK. 2001. Evolutional gradients: trade-off between parental care and fecundity. Ecology, 82:2948–2960.

Badyaev AV. 1997. Avian life history variation along altitudinal gradients: an example with cardueline finches. Oecologia, 111:365–374.

Brussard PF. 1984. Geographic patterns and environmental gradients: the central-marginal modelin *Drosophila* revisited. Annu Rev Ecol Syst, 15:25–64.

Ke DH, Lu X. 2009. Burrow use by Tibetan ground tits *Pseudopodoces humilis*: coping with life at high altitudes. Ibis, 151:321–331.

Li BS. 1988. An outline on history of the vegetation in Tibet. In: Institute of Botany of the Chinese Academy of Sciences and Changchun Institute of Geography of the Chinese Academy of Sciences (eds) Vegetation of Tibet. Science Press, Beijing, pp 23–40.

Lu X, Gong GH, Zeng XH. 2008. Reproductive ecology of brown-cheeked laughing thrushes (*Garrulax henrici*) in Tibet. J Field Ornithol, 79:152–158.

Lu X, Ke DH, Zeng XH, Yu TL. 2009. Reproductive ecology of two sympatric Tibetan snowfinch species at the edge of their altitudinal range: response to more stressful environments. J Arid Environ, 73:1103–1108.

Lu X, Ma XH, Fan LQ. 2007a. Nesting and cooperative breeding behaviours of a high-altitude babbler, Tibetan babax *Babax koslowi*. Acta Ornithol, 42:181–185.

Lu X, Zhang LY, Zeng XH. 2007b. Comparisons of the alpine bird communities across habitats and between autumn and winter in the mid-Yalong Zangbo River valley, Tibet. J Nat Hist, 41:2511–2527.

Lu X, Yu TL, Liang W, Yang CC. 2010a. Comparative breeding ecology of two white-bellied redstart populations at different altitudes. J Field Ornithol, 81:167–175.

Lu X, Wang C, Yu TL. 2010b. Nesting ecology of the grey-backed shrike (*Lanius tephronotus*) in south Tibet. Wilson J Ornithol, 122:395–398.

Lu X, Zhang LY, Ci R. 2003. Breeding ecology of the rufous turtle dove (*Streptopelia orientalis*) in alpine scrub vegetation, Tibet. Game Wild Sci, 20:225–240.

Lu X, Zheng GM. 2003. Reproductive ecology of Tibetan eared pheasant *Crossoptilon harmani* in shrub environment, with special reference to the effect of food. Ibis, 145:657–666.

Lu X. 2003. Notes on flocking and breeding behaviour of snow pigeon *Columba leuconota* in eastern Tibet. Forktail, 19:151–152.

Lu X. 2004. Conservation status and reproductive ecology of giant babax *Babax waddelli* (Aves, Timaliinae), endemic to the Tibet plateau. Oryx, 38:418–425.

Lu X. 2005. Reproductive ecology of blackbirds (*Turdus merula maximus*) in a high-altitude location, Tibet. J Ornithol, 146:72–78.

Lu X. 2006. Abundance and breeding ecology of brown accentors *Prunella fulvescens* in Lhasa, Tibet. Acta Ornithol, 41:121–128.

Lu X. 2008. Breeding ecology of an Old World high-altitude warbler, *Phylloscopus affinis*. J Ornithol, 149:41–47.

Lu X. 2009. First breeding record of the greenish warbler *Phylloscopus trochiloides* in alpine habitats, southern Tibet. Forktail, 25:159–160.

Lü Z, Springer J. 2000. Conservation and Management for Biodiversity in Tibet. China Forestry Publishing House, Beijing. (in Chinese)

Ludlow F. 1950. The birds of Lhasa. Ibis, 92:34–45.

Miehe G. 1996. On the connexion of vegetation dynamics with climatic changes in high Asia. Palaeogeogr Palaeocl, 120:5–24.

Møller AP, Garamszegi LZ, Spottiswoode CN. 2007. Genetic similarity, breeding distribution range and sexual selection. J Evol Biol, 21:213–225.

Vaurie C. 1972. Tibet and Its Birds. H. F. and G. Witherby, London.

Walton HJ. 1906. On the birds of southern Tibet. Ibis, 1906:57–84, 225–256.

Zheng ZX, Li DH, Wang ZX, Wang ZY, Jiang ZH, Lu TC. 1983. The Avifauna of Tibet. Science Press, Beijing. (in Chinese)

西藏拉萨地区20种鸟类的繁殖资料

卢欣，柯坫华，马小艳，贡国鸿，于同雷

（武汉大学生命科学学院，武汉，430072）

摘要：本文提供了西藏拉萨高山灌丛（海拔4000–4700 m）和高山草甸荒漠环境（海拔4300–4700 m）20种鸟类的繁殖生物学信息。这些物种中，3个是青藏高原特有的，17个则有广泛的海拔分布。所有这些繁殖资料是关于高海拔地区、特别是鸟种的繁殖海拔上限的首次报道。其中，几个物种的信息以前从未有过描述。本项研究可以增加我们的极端严酷环境下鸟类自然历史的知识。

关键词：高山灌丛，高山草甸荒漠，繁殖参数，青藏高原