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Nesting biology and population dynamics of Jankowski's Bunting *Emberiza jankowskii* in Western Jilin, China

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Summary

Jankowski's Bunting *Emberiza jankowskii* is endemic to China, Russia and Northern Korea, and was listed as a 'Vulnerable' species. The population in Dagang Forestry of western Jilin is one of the small remaining discrete breeding populations in the species' range. Very little information on the nesting biology and population dynamics has previously been published. We studied the nesting biology from 1999 to 2002 and population dynamics of the bunting from 1999 to 2006 (except 2003). A total of 74 nesting attempts were monitored. Jankowski's Bunting breeding season began in late April and usually ended in late July. Both sexes participated in nest-building, feeding young and defending the nest. Mean full clutch size for three years combined was 5.26 ± 0.76 eggs, and ranged from four to seven. Clutch size decreased with nest-initiation date. Mean hatching rate was 41.2%. Overall probability of Mayfield nest success to fledging was low for the three years, averaging 0.218 ± 0.007. The factors leading to low nest success include nest parasitization, nest predation, human activities and nest abandonment. Low survival of Jankowski's Bunting nests may be a factor in declining populations and the slow recovery of populations because of low recruitment at the population and the individual level. The population of Jankowski's Bunting in the Dagang Forestry grassland was small and declined dramatically from 1999 to 2006. The main threat is habitat loss and fragmentation due to agriculture, tree planting and housing following human colonization of the region. The habitat has been reduced in extent by *c.* 70% since the 1960s. In addition, grazing by domestic livestock dramatically destroyed their preferred vegetation. Furthermore, the restriction to several small, discrete sites makes the bunting inherently vulnerable to catastrophic and stochastic events that can eliminate subpopulations. Jankowski's bunting is one of the most threatened species in China and faces an unpredictable future. Maintaining the structure and general composition of remaining Jankowski's Bunting nesting habitat is important to ensure continued presence of this species in western Jilin and worldwide.

Introduction

Jankowski's Bunting *Emberiza jankowskii* was first recorded by Taczanowski (1888). It is a small-sized (*c.* 20 cm, bill–tail) grassland passerine, and is endemic to China, Russia and North Korea. Its breeding sites are restricted to Inner Mongolia, Heilongjiang, western and eastern Jilin provinces in China, extreme south-east Russia and the boundary region between Russia, China and North Korea, with several discrete breeding populations located in these areas (Dement'ev and Gladkov 1951–1954, Yamashina 1957, Fu and Chen 1966, Stresemann and Portenko 1981, Zhao *et al.* 1994, Gao 2002) (Figure 1). The distribution of the bunting was described as 'island-like' within its rather small breeding range (Fu and Chen 1966). It was listed as 'Vulnerable' both

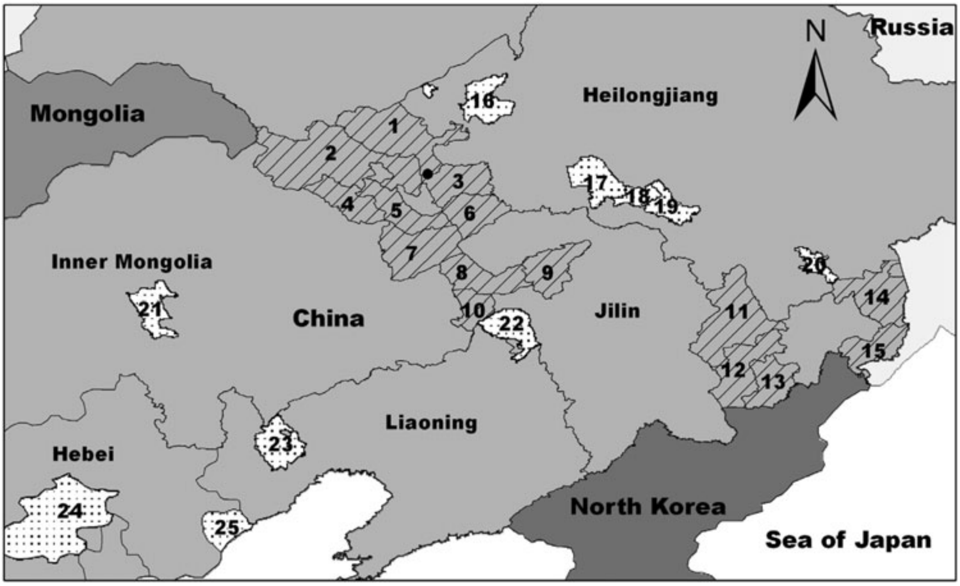

Figure 1. The historical recorded distribution of Jankowski's Bunting *Emberiza jankowskii* in China: (1) Zhalaite Qi; (2) Keerqinyouyiqian Qi; (3) Zhenlai County; (4) Tuquan County; (5) Taonan City; (6) Daan City; (7) Tongyu County; (8) Changling County; (9) Nongan County; (10) Shuangliao City; (11) Dunhua City; (12) Antu County; (13) Helong City; (14) Dongning County; (15) Hunchun City; (16) Qiqihaer City; (17) Zhaodong City; (18) Haerbin City; (19) Acheng County; (20) Mudanjiang City; (21) Linxi County; (22) Lishu County; (23) Chaoyang County; (24) Bejing City; (25) Beidaihe.Diagonal areas, historical recorded breeding and wintering distribution; white areas with dots, only recorded as wintering distribution. • Study site.

globally (BirdLife International 2001) and in China (Wang *et al.*1998) because of its very small distribution range and fluctuating population.

Jankowski's Bunting was a described as a ''locally common'' breeding bird in the extreme south of the Russian Far East before the early 1970s (Vorob'ev 1954, Litvinenko and Shibaev 1966, Panov 1973). However, none were recorded breeding there from the early 1970s to 1977 (Litvinenko 1989), and there have now been no records of the species in this region for more than 20 years (Litvinenko and Shibaev 1999). Very little information on the species in North Korea has been reported.

In China, Jankowski's Bunting was historically described as a ''locally common'' breeding and wintering bird in Dongning, Tumen and western Jilin (Yamashina 1957, Fu and Chen 1966), and ephemeral wintering populations or individuals were periodically found in winter in several regions of Inner Mongolia, Liaoning, Hebei and Beijing (Seys and Licent 1933, Morrison 1948, Cheng 1987, Huang *et al.* 1989) (Figure 1).

Jankowski's Bunting has undergone a dramatic decline in numbers during the last forty years (Gao 2002), and the eastern population in Jilin may already be extinct (no breeding or wintering birds were recorded in eastern Jilin during field surveys conducted by Wang *et al.* in 1997, 1999 and Wang *et al.* in 2004–2006, unpublished data). Fortunately, several small discrete breeding populations still remain in western Jilin and Inner Mongolia in China, and studies on its habitat selection, nest site selection, breeding biology, effects of rainfall and drought on population size, and impacts of fire on nest site selection have been carried out in recent years (Cheng *et al.* 2002, Tong *et al.* 2002, Bai *et al.* 2003, Gao *et al.* 2003). Factors thought to affect population size and reproductive success include drought (Cheng 2002), human activities, egg and chick predation (Cheng *et al.* 2002, Tong *et al.* 2002).

Although the importance of nest success to understanding Jankowski's Bunting population fluctuations has been recognized (BirdLife International 2001), it remains little studied. Tong *et al.* (2002) reported on the breeding biology, mainly focused on breeding behaviour and nestling development. Information on nest building dates, laying dates, hatching dates and clutch size has come from many sources (Yamashina 1957, Fu and Chen 1966, Stresemann and Portenko 1981, Zhao *et al.* 1994, Byers *et al.* 1995, Tong *et al.* 2002). A full understanding of Jankowski's Bunting reproduction is lacking because little information is available for nest survival rates.

Thus, studying the nesting biology and population dynamics of Jankowski's Bunting might lead to a better understanding of the reasons for its threatened status, as well as suggesting conserving measures. Here we amplify the findings of the earlier studies by presenting more information on the breeding biology of the species, particularly nest survival rates and causes for nest loss; we also report on population dynamics and related reasons for the species' decline from 1999 to 2006 (except 2003) within Dagang Forestry.

Methods

Study site

The study was carried out at the Dagang Forestry grassland, located in western Jilin, China, over a seven-year period beginning in April 1999. A three-year study of nesting success was conducted during breeding seasons from late April to late July, 1999–2001. A seven-year study of population dynamics was carried out from 10 May to 25 May, 1999 to 2006 (except 2003) at the site mentioned above. The study site is located at the western edge of Jilin, 45°28′N, 122°47′E, and close to Inner Mongolia. The climate is classed as inland east monsoon and is characterized by hot, dry summers and cold, windy winters. Annual average temperature is 11°C with great seasonal variation. Average annual precipitation is 395.1 mm. Elevation at the site ranges from 130 m to 160 m. The predominant habitat is grassland with the shrub Siberian Apricot *Armeniaca sibirica*. Vegetation is dominated by Baikal Feather-grass (*Stipa baicalensis*), Siberian Frost Grass (*Spodiopogon sibiricus*), Siberian Filifolium *Filifolium sibiricum*), Edelweiss (*Leontopodium leontopodioides*), Leafy Spurge (*Euphorbia esula*), and Chinese Pink (*Dianthus chinensis*).

Survey methods

Most nests (62.2%) were found by observations of birds carrying nesting material to nests and by the characteristic furtive behaviour of parent birds when approaching their nests. Some nests (37.8%) were located during the egg-laying or incubation periods by accidentally flushing females from nests during searches by observers. The position of nests was recorded using GPS (accurate to approximately 1 m) and marked with two different coloured plastic tapes, aligned to indicate the direction of the nest. One tape was placed 2.5–3 m from nest, another at about 4–5 m, and the two tapes were fastened to inconspicuous parts of shrubs or grasses. Nests were revisited at intervals of 2–3 days to monitor progress. During each visit, the nest was checked to determine the stage of the reproductive cycle (e.g. nest building, egg laying etc.), but nests were only approached closely during egg-laying, incubation and nestling periods to determine clutch completion, clutch size, hatching date, hatching success and fledging success. The eggs in 14 nests with full clutch size and nestlings in 12 nests were also measured over the study period. Adults did not appear to alter their behaviour in response to the presence of the researchers; they usually entered nests to hatch or feed young as soon as possible when the researchers left. We estimated clutch initiation dates of these nests from the earliest known point in the nesting sequence. If a nest was found during the egg laying period, we subtracted 1 day for each egg from the earliest date when we observed an incomplete clutch. If we found a nest during incubation, the clutch initiation date could be determined only if the nest was successful. In this case we subtracted from the hatching date 1 day for each egg in the full clutch and a 12-day incubation period beginning with the last egg. We attempted to determine the causes of failed nests by using a combination of clues whenever possible.

Nest observations were conducted to determine nest attendance times and nestling food delivery rates with binoculars in dawn-to-dusk (04h30 or 05h00-18h30 or 19h00, according to weather) from camouflaged blinds positioned 35–50 m from the nest so as not to influence normal behaviour during incubation and nestling periods. Two nests were observed during the incubation period for three days each. One nest was observed on the second and eighth day during the nestling period. We identified the sex of the adults by morphology.

The study area covers *c.* 26.06 km^2 (Wan *et al.* 2004) and is now highly fragmented and under considerable human pressure. Suitable breeding habitat for Jankowski's Bunting within this area decreased dramatically in recent years because of cultivation, tree planting, village extension and building of sheepfolds by herders. The remaining suitable habitat was estimated to be *c.* 12.30 km^2 in 1999. When collecting data on the population size of Jankowski's Bunting, we surveyed all patches within the study area using 4–5 observers walking paralleled in intervals of 100 m during the period from 10 May to 25 May. GPS was used to ensure full coverage and to avoid double counting, and each patch was surveyed at least three times. Visual observations were made using binoculars. All surveys were carried out during the time periods 05h00-09h00 and 15h00-18h00, and only when light and weather conditions were favourable for observation. Rate of movement was 1–1.5 km hr^{-1}, including occasional stops to watching and listen, and we only recorded the number of male individuals detected by sight or call within each patch. The whole population size was estimated by multiplying by two.

Statistical analyses

We calculated nest success rates using the Mayfield method (Mayfield 1961, 1975). A nest was considered active if it was attended by an adult, and successful if at least one young fledged from the nest. We defined survival time as the period from egg to the last day chicks were observed. Chicks were assumed to have died if they disappeared before 10 days of age. We assumed nest status changed on the midpoint date between checks if no other data were available (Mayfield 1975). The standard errors and 95% confidence intervals for nesting success were calculated following Johnson (1979). Time of different breeding stages used in analyzing nest success from egg laying to fledging was calculated based on our obtained data. Nest success in different breeding stages was calculated as $(1-[\text{number of nests failed/number of nest exposure days}])^N$. The exponent of N represents the average duration of different breeding stages. Standard errors were calculated as the square root of $1/([\text{number of nest exposure days}]^3/[\text{number of nest exposure days - number of failed nests}][\text{number of failed nests}])$. Nest success was considered significantly different if there was no overlap in 95% confidence intervals (Sokal and Rohlf 1995). Two nests in 2002 and one nest in 2004 was not used included in the analysis of nesting success because they were not monitored over the reproductive cycle. We used linear regression to determine whether clutch size decreased with nest initiation. SPSS 13.0 was used to conduct statistical analyses. Means are presented ± SE.

Results

Nest chronology and behaviour

The Jankowski's Bunting breeding season began in late April and usually ended in late July. Copulation behaviour was observed as early as 27 April 2000. Nest construction behaviour was observed as early as 3 May 2000 (pairs carrying nesting material), but we did not observe the initial attachment stage of nest building. The earliest nest was found on 10 May, and was half-completed when found. All nests had a basic cup design and were built in small hollows on the ground (71 nests), under dense grasses such as *Stipa baicalensis, Spodiopogon sibiricus* etc. (59 nests) or among branches or roots of Siberian Apricot (12 nests). Three nests were above ground and supported by grasses. Both sexes participated in nest-building, feeding the young, and defending the nest. We estimated the duration of nest construction to be 6–11 days. Earliest eggs were observed on 14 May 1999 and the latest were laid on 3 July 2001. The egg laying period was 5.57 ± 1.04 days (range 4–8 days, $n = 35$). Incubation was performed exclusively by the females and began with clutch completion. The incubation period lasted 12.17 ± 0.87 ($n = 24$) days (range 11–14 days, $n = 24$) and hatching was synchronous within broods. We accumulated a total of 85.5 hours of nest observation at two nests during incubation and found that females spent an average of 67.1% of daylight hours on the nest. The balance of time was primarily spent on foraging away from the nest; males occasionally provided food for females. Earliest nestlings were observed on 31 May 1999 and the nestling period was 11.45 ± 1.04 days (range 10–13 days, $n = 11$). Nestlings were fed by both adults at a rate of 4.4 feeding bouts hr^{-1} and 9.1 feeding bouts hr^{-1} on the second and eighth days respectively,

Clutch size

Mean full clutch size was 5.11 ± 0.70, 5.47 ± 0.72 and 5.40 ± 1.14 eggs in 1999, 2000 and 2001 respectively (Table 1), and there was no difference across the three years ($F = 1.227$, df = 2, Sig = 0.289, $P > 0.05$). Mean full clutch size for three years combined was 5.26 ± 0.76 eggs ($n = 49$). Clutch size ranged from four to seven. 16.3% ($n = 8$) contained four eggs, 42.9% ($n = 21$)

Table 1. Reproductive parameters for Jankowski's Bunting (*Emberiza jankowskii*) during the 1999–2001 breeding seasons in Western Jilin, China. Results are presented as mean and (SD) unless otherwise indicated.

Variable	Year			
	1999	2000	2001	total
Total nests followed	45	21	8	74
Number of nests with eggs	31	20	6	57
Number of nests with full clutch size	27	17	5	49
Number of nests that successfully hatched eggs	15	6	3	24
Number of nests that successfully fledged young	5	4	2	11
Number of eggs laid	145	99	30	274
Number of eggs hatched (% of laid)	71(49.0)	26(26.3)	16(53.3)	113(41.2)
Number of young fledged (% of hatched)	24(33.8)	12(46.2)	11(68.8)	47(41.6)
Clutch size	5.11 ± 0.70	5.47 ± 0.72	5.40 ± 1.14	5.26 ± 0.76
(range, n)	4–6, $n = 27$	4–6, $n = 17$	4–7, $n = 5$	4–7, $n = 49$
Mayfield nest success probabilities (95% CI)				
Egg period [a]	0.50 (0.49–0.51)	0.33 (0.32–0.35)	0.49 (0.47–0.51)	0.44 (0.43–0.44)
Nestling period	0.27 (0.24–0.30)	0.65 (0.62–0.67)	0.67 (0.64–0.70)	0.45 (0.43–0.47)
Overall from egg to fledging	0.22 (0.21–0.23)	0.19 (0.18–0.20)	0.33 (0.31–0.35)	0.22 (0.21–0.23)
Number fledged per breeding pair[b]	0.77	0.60	1.83	0.82

a: Combined egg laying and incubation period (from nest initiation [first egg] to nestling) is 17.50 ± 0.14 ($n = 24$) days

b: Only nests with eggs were calculated

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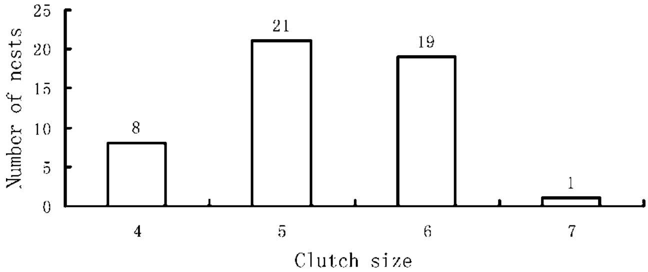

Figure 2. The distribution of clutch size of Jankowski's Bunting for three years combined.

five eggs, 38.8% (n = 19) had six eggs, 2.0% (n = 1) had seven eggs (Figure 2). Clutch size decreased with nest-initiation date (linear regression: $\beta = -0.671$, $F_{1,35} = 27.058$, $P < 0.001$).

Nesting success

A total of 74 nesting attempts were observed during the summers of 1999–2001 (Table 1), of which 57 nests were found with at least one egg, 49 nests reached full clutch size, 24 nests hatched successfully and only 11 nests successfully fledged young. Mean hatching rate was 41.2%. In 1999, 2000 and 2001, 33.8%, 46.2%, and 68.8% of nestlings fledged, respectively. In 1999 and 2000, 0.77 and 0.60 young fledged per breeding pair respectively, whereas 1.83 young per pair fledged successfully in 2001.

Overall probability of Mayfield nest success to fledging for the three years was 0.218 ± 0.007, and was low in all years: 0.216 ± 0.010 in 1999, 0.189 ± 0.014 in 2000, and 0.329 ± 0.019 in 2001 (Table 1). Nest success to fledging was significantly different for the three years. Nest success during the egg period in 2000 was significantly lower than that in 1999 and 2001, and nest success during the nestling period in 1999 was significantly lower than that in 2000 and 2001. Nest loss occurred at different breeding stages and differed for the three years combined ($t = 4.386$, $P < 0.05$). Of 63 nest failures, 27.0% occurred during nest building, 12.7% during egg-laying, 39.7% during incubation, and 20.6% during the nestling period.

Causes for egg and nestling loss

Of 161 eggs lost (Table 2), 5.6% were due to the nest being parasitized by Common Cuckoo *Cuculus canorus*; 11.8% were predated by snakes (observed directly) or probably European Suslik *Spermophilus citellus* and/or Eastern Red-footed Falcon *Falco amurensis* (these species were often observed near those nests); 23.0% were destroyed by humans; 5.6% were trampled by livestock; 6.2% had unfertilized or dead embryos; 21.74% were due to abandonment or predation of parents; and 26.1% were from unknown causes.

Of 66 nestling failures, 7.6% were parasitized by Common Cuckoo; 31.8% were preyed on by ants (observed directly) or probably by European Suslik and Red-footed Falcon; 13.6% were destroyed by humans; 7.6% trampled by livestock; 10.6% due to disease or sibling competition; 12.1% due to abandonment or predation of parents; 16.7% were due to unknown causes.

Population dynamics

Data from this study suggest that the population of Jankowski's Bunting in the Dagang Forestry grassland was small (Figure 3), and declined dramatically from 1999 to 2006 (linear regression: $\beta = -0.89$, $F_{1,6} = 19.2$, $P < 0.05$). The population appeared to be in a period of stasis during 2002–2006, and population size remained relatively constant at about 15 pairs.

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Table 2. Summary of Jankowski's Bunting egg and nestling loss, 1999–2001.

Causes	Egg loss n = 161	Nestling loss n = 66	Notes
Parasitized	9 (2 [a])	5 (1)	By Common cuckoo
Predation	19 (4)	21(4)	Associated with predation from snakes, ants, rats and falcons
Human disturbance	37 (8)	9 (2)	Eggs and nestlings together with nests taken away or destroyed by mowing with rakes
Grazing	9 (2)	5 (1)	Nests with eggs and nestlings trampled by livestock
Unfertilized eggs or dead embryos	10		Eggs were dissected to verify
Disease or sibling competition		7 (1)	Dead nestlings still in nests and parents found around nests
Abandoned or parents were predated	35 (8)	8 (2)	Eggs or nestlings still in nests, parents not found around nests
Unknown reasons	42 (9)	11 (2)	No obvious clues

a: Number of lost nests

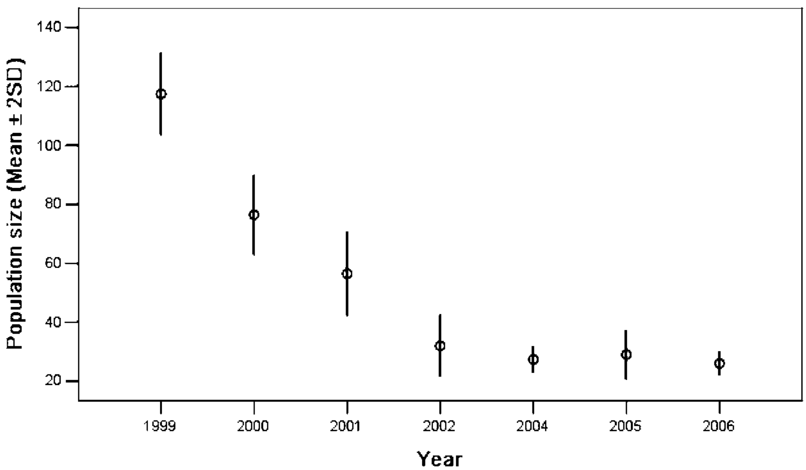

Figure 3. Population size of Jankowski's Bunting detected in 1991–2006 (expect 2003) surveys at Dagang forestry grassland in western Jilin, China.

Discussion

Several researchers considered that the Jankowski's Bunting may raise two broods per breeding season (Stresemann and Portenko 1981, Tong *et al.* 2002). Tong *et al.* reported that the breeding season of the bunting lasts from early May until 20 June (2002), and we found that the breeding season of the bunting extends from late April until late July, therefore a second brood is theoretically possible. Tong *et al.* (2002) found by tracking marked individuals that Jankowski's Bunting can renest (n = 3) if nest loss occurs in the early part of the breeding cycle, but they did not report whether any pairs produced two broods per season successfully. If it is the case that some pairs can renest when nest failure occurs or they have the ability to raise two broods per season successfully, the productivity per breeding pair might not be as low as Table 1 suggests.

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We found that the clutch size of Jankowski's Bunting decreased with nest-initiation date. Our observation that nest clutch size range is 4–7 eggs, differs from other studies, which reported 4–5 eggs (Yamashina 1957, Stresemann and Portenko 1981, Byers *et al.* 1995), 2–4 eggs (n = unknown) (Zhao 1985), and 5–6 eggs ($n = 3$) (Fu *et al.* 1998). The differences between the results for clutch size from this study and others may be due to the small number of nests observed or to other unknown reasons.

No comparable information about nesting success for the species can be obtained. In 1999–2001, Jankowski's Bunting had low nesting success (0.218 $\pm$ 0.007) for the three years calculated by the Mayfield Method (Table 1). Only 11 out of 74 nests fledged young successfully in this study. Fledging success is a reliable index of recruitment at the population and the individual level (Weatherhead and Dufour 2000). The low survival of Jankowski's Bunting nests may be a factor in declining populations and the slow recovery of populations from low periods during the eight year cycle observed at Dagang Forestry in western Jilin. Jankowski's Bunting is a small-sized bird, and its reproductive progress is vulnerable to disturbance. The known causes leading to low nest success include nest parasitization, nest predation, human activities and nest abandonment (Cheng *et al.* 2002, Tong *et al.* 2002).

The low breeding success was to a large degree related to a high degree of nest abandonment. Twenty-seven abandoned nests were recorded in our study (Table 1 and 2) and most (63.0%) occurred in 1999. The high rate of nest abandonment in 1999 may be partly result from by disturbance by livestock because the grazing frequency and intensity was greater in 1999 than in 2000 and 2001. Abundant rainfall through spring 1999 resulted in good pasture development and > 1,600 sheep, belonging to six owners, grazed there almost every day. In 2000 and 2001, there was little rain in spring (the first significant rain fell on 28 May in 2000 and 10 June in 2001), the quality of the grassland was low and those sheep were fed on the farm for most of the time, and only occasionally driven to the pasture. Another possible reason may be interspecific competition, as some pairs were observed chasing and fighting with Asian Short-toed Lark (*Calandrella cheleensis*), Eurasian Skylark (*Alauda arvensis*) and Greater Short-toed Lark (*Calandrella brachydactyla*). In addition, individual nest abandonment caused by researchers cannot be excluded absolutely, though we used a detailed research protocol and exercised great care when monitoring the breeding cycle during the study.

The importance of snakes and rats as predators of bird nests in grasslands and shrublands has been well documented (Best 1978, Atkinson 1985, Thompson *et al.* 1999). Taiwan Beauty Snake (*Elaphe taenuria*), Tiger-spotted Keeled Snake (*Rhabdophis tigrina*) and Eurasian Viper (*Vipera berus*) were common in our study area, and many species of snakes were introduced to the region to exterminate rats in 2001 (pers. obs.), which increased the density of snakes in the region. Eight failed nests can be ascribed to nest predation in this study and two instances were observed directly; one by a Taiwan Beauty Snake on eggs and another by ants on nestlings. We did not ascertain the extent to which those potential predators, European Suslik and Red-footed Falcon may have influenced nesting success, but we consider that they cannot be ignored. Human populations are expanding rapidly in our study area and local people are looking for alternative sources of income such as picking the fruit of Siberian apricot, digging up medicinal plants and grazing. Those activities not only destroyed vegetation structure, but also increased the probability of nest-robbing by fruit-pickers or shepherds. Through interviews, we found that most of these people are familiar with the bird and will take away eggs or nestlings when a nest is found. A total of ten failed nests were caused by human disturbance, and some of the 11 nest failures with no obvious clues are perhaps due to nest predation and human disturbance.

Jankowski's Bunting has clearly declined in numbers in Russia and China (BirdLife International 2001, Gao 2002). In Russia, Jankowski's Bunting has declined from a locally common breeding bird in the mid-1960s to apparent extinction (Litvinenko 1989). The known breeding population in Jilin province was estimated at 330–430 pairs in 1994 at three sites (Zhao et al. 1994), but no accurate estimation was done on population numbers of the species in recent years. The eastern population in China may already be extinct (Wang *et. al*. unpublished data).

Data from our study suggest that the population of Jankowski's Bunting in the Dagang Forestry grassland was small (Figure 3), and declined dramatically from 1999 to 2006. Up to now, Jankowski's Bunting is known to breed at only four sites - Dagang, Xianghai, Tumuji and Maanshan - and these remaining populations have a similar status (data from a current study). The future for this bunting is poor if specific strategies to protect it are not adopted immediately.

The most important problems facing threatened species are anthropogenic habitat loss and degradation (Collar *et al.* 1994, Bennun 1999). The main threat to Jankowski's Bunting appears to be the conversion of its habitats for agricultural land and possibly also Forestry (BirdLife International 2001). Human colonization of the grassland has led to several drastic environmental changes that have had massive impacts on the survival of Jankowski's Bunting (Gao 2002, Zhao *et al.* 1994). The primary change is loss and fragmentation of native habitat for agriculture, tree planting and housing, and this habitat has been reduced in extent by *c.* 70% since the 1960s. This change may lead to increased extinction rates and reduced recolonisation of suitable habitat. In addition, grazing by domestic stock dramatically destroys the natural vegetation, in particular grassland with Siberian apricot, which is a favoured microhabitat for Jankowski's Bunting (Gao *et al.* 2003). Furthermore, the restriction to several small, discrete sites makes the bunting inherently vulnerable to catastrophic and stochastic events that can eliminate populations. Another factor that cannot be ignored is increasing drought in the region and this could pose a severe threat to the survival of the species. The annual average rainfall 1999–2001 was 235.3 mm, far lower than the average of 434.8 mm during 1981–1998. The important issues are now (i) the continued protection of the remaining habitat; and (ii) the implementation of a consistent monitoring programme so that we have more reliable data on population size, breeding distribution and wintering distribution. Due to the loss of over 70% of native grasslands in western Jilin, maintaining the structure and general composition of remaining Jankowski's Bunting nesting habitat is important to ensure continued presence of this species in western Jilin and worldwide.

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