

BREEDING BIOLOGY OF THE YELLOW-RUMPED
FLYCATCHER *FICEDULA ZANTHOPYGIA*
IN NORTHEAST CHINA

BIOLOGÍA REPRODUCTIVA DEL PAPAMOSCAS CULIAMARILLO
FICEDULA ZANTHOPYGIA EN EL NORESTE DE CHINA

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SUMMARY.—*Breeding biology of the yellow-rumped flycatcher Ficedula zanthopygia in northeast China.*

The breeding ecology of the yellow-rumped flycatcher was studied in its natural cavities from 1993 to 2007 at Zuojia Natural Reserve, Jilin province, China. Yellow-rumped flycatchers built their nests in early May and started to lay in middle May. Mean clutch size was 5.27 ($N = 117$) and mean incubation period was 13.21 days ($N = 65$). Nestlings remained in the nest 11 - 14 days. Forty-eight of 86 nests (55.8 %) were successful in producing at least one young bird, with successful nests producing 4.13 young/nest. Based on exposure, probability of a nest surviving from egg laying to fledging was 0.51. The causes for nest failure were mainly nest usurpation by other secondary cavity-nesters (50 %) and nest predation by snakes (10.3 %).

Key words: breeding ecology, life history, nest, nesting success, yellow-rumped flycatcher.

RESUMEN.—*Biología reproductiva del papamoscas culiamarillo Ficedula zanthopygia en el noreste de China.*

Se investigó la biología reproductiva del papamoscas culiamarillo en sus cavidades naturales, durante los años 1993 - 2007 en la Reserva Natural de Zuojia, provincia de Jilin, China. Comienzan a construir sus nidos desde primeros de mayo, empezando la puesta a mediados de este mismo mes. El tamaño medio de la puesta fue de 5,27 huevos ($N = 117$), con un período medio de incubación de 13,21 días ($N = 65$). Los pollos permanecieron en el nido durante 11 - 14 días. Cuarenta y ocho nidos de 86 (55,8 %) fueron exitosos, produciendo al menos un joven, con un éxito medio de la crianza de 4,13 pollos/nido. Debido a su exposición, la probabilidad de supervivencia de un nido desde el comienzo de la puesta hasta el emplumado fue de 0,51. Las causas de los fallos fueron debidas principalmente a la usurpación por otros nidificantes en cavidades (50 %) y a la predación por serpientes (10,3 %).

Palabras clave: biología reproductiva, estrategias vitales, éxito de nidificación, nidos, papamoscas culiamarillo.

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INTRODUCTION

The yellow-rumped flycatcher *Ficedula zanthopygia*, a secondary cavity-nesting bird, is a common migratory species that breeds mainly in China, Mongolia, Russia and Korea migrating to Malay Peninsula and Sumatra for wintering (Cheng, 1987). The breeding birds occur either in broad-leaf forests or conifer forests, or mixed of the two. On migration and in nonbreeding areas it occurs in lowland, coastal forest, foothills, and montane forest, also parks, large gardens, coastal scrub and mangroves (Del Hoyo *et al.*, 2006). Copulation occurs between the middle of May and the first decade of June in Xiaoxinganling Mountain, Heilongjiang province, and nest building is carried out by the female alone in early June (Liu and Wang, 1981). The nest is made up of dry grass, plant fibres, moss, ferns, hair of small mammals, and is placed in hole in tree or in trunk (Fan, 1981). The food of the yellow-rumped flycatcher mainly includes small invertebrates and small fleshy fruits. The flycatchers frequently pursue insects in flight from regular perches and also snatch insects and small fruit from foliage while hovering (Del Hoyo *et al.*, 2006).

Despite the species' general abundance and large range, detailed information on yellow-rumped flycatcher breeding ecology remains poorly known. Without detailed information on nesting ecology and demographic variables, our understanding of the life history and evolution traits of the yellow-rumped flycatcher remains limited. Although the breeding ecology of the yellow-rumped flycatcher in nest-boxes has been noted briefly by Liu and Wang (1981) and Fan (1981), here we describe the breeding ecology of the bird in its natural cavities in a mixed conifer-broadleaf forest in northeast China, thus providing the first detailed breeding ecology information of the yellow-rumped flycatcher in its breeding range.

STUDY AREA AND METHODS

The study area, approximately 184 km² in size, was located in Zuojia Nature Reserve and included the Tumengling Mountains and Zhujia Mountains ranging from the eastern Changbai Mountains to the western plain (126°1 127°2 N, 44°6 45°5 E). Altitude at the site ranged from 200 m to 500 m above sea level. The climate is east monsoon, characterised by hot, dry summers and cold, snowy winters. The vegetation within the study area was quite diverse, although the forest type is only secondary forest. The seven tree species mainly present on the study area were mongolian oaks *Quercus mongolica*, dahurian birchs *Betula davurica*, manchurian linden *Tilia mandschurica*, japanese elm *Ulmus japonica*, scotch pine *Pinus sylvestris*, korean larches *Pinus koraiensis* and masson pines *Pinus massoniana* (Deng, 2001). In the study area, hawthorn raspberry *Rubus crataegifolius*, dahurian rose *Rosa dahurica*, korean rose *Rosa Doreana*, willowleaf spiraea *Spiraea salicifolia*, ural falsespiraea *Sorbaria sorbifolia*, prickly rose *Rosa acicularis*, amur barberry *Berberis amurensis*, amur honeysuckle *Lonicera maacki*, manchur honeysuckle *Lonicera ruprechtiana*, and sakhalin honeysuckle *Lonicera maximowiczii* dominated the shrub layer.

We searched for and observed yellow-rumped flycatchers and their nests from early May to late August, 1993 - 2007. We located yellow-rumped flycatcher nests based on their behavioural cues (singing, carrying nesting material and food) and tree holes. We found 117 nests in three sites during the study period (table 1). All study sites were at approximately the same elevation and similar vegetation characteristics. We found nests primarily during nest building (52%) and egg-laying (24 %) period. The nests found in incubation and in nestling periods were relatively less (10 % and 14 %, respectively). We documented adult behaviour at nests by observing di-

rectly from a concealed location 15 - 20 m away. Nest observations (159.5 hours total) averaged 2.5 hours in duration and occurred during nest building (30.5 h at six nests), egg incubation (80 h at ten nests), and nestling stages (49 h at eight nests), mainly between 06:00 and 11:00. We monitored nests every two days and approached nests to determine clutch size, egg characteristics, nestling characteristics, and nesting success. The device we used to look inside the cavities and check for nest contents is made up of a spotlight, two narrow mirrors, batteries and some wires, which designed by ourselves. We measured egg dimensions including width and length to the nearest 0.1 mm with vernier calipers, and determined egg weight and body mass of nestlings to the nearest 0.1 g with a Pesola balance. We measured 86 egg dimensions and 50 egg weights from 30 different nests. We recorded feeding rates in the third day both in incubation times and in nestling periods. Growth curves were fitted most closely by the logistic equation and logistic constants were used for comparisons. Nestlings were weighed with a Pesola balance and the length of their wing, tail, and tarsus were measured

with a ruler and a caliper to nearest to 0.1 mm at 2-day intervals. Wing chord was measured as the distance from the bend to the tip of the longest primary. The tail length was measured from the base to the top of the central rectrix. Tarsal length was measured from the intertarsal joint to the bend of the foot.

We considered a nest successful if it fledged at least one young. Also, we estimated nest survival based on exposure days (Mayfield, 1961; Johnson, 1979). We determined a failed nest to be the result of predation if nest contents disappeared before the latter part of egg and nestling period or if the nest material was disheveled. We distinguished different types of predators by observing them directly. Failed nests were often the result of nest usurpation by other cavity species (Deng and Gao, 2005). Parts of the nest data presented in Deng and Gao (2005) are here reanalyzed. Breeding data were compared between years using one way Analysis of Variance. We used *t*-test to test for differences in parental care during nestling period. Statistical analysis was conducted using SPSS11.0. Results were considered significant if $P < 0.05$. Values presented are mean + SD.

TABLE 1

Summary information on the number of yellow-rumped flycatcher nests in Zuoqia Natural Reserve, 1993-2007.

[*Información resumida del número de nidos de papamoscas culiamarillo en la Reserva Natural de Zuoqia durante 1993-2007.*]

| Site | Number of nests/year | | | | | | | | | | | | | | |
|---------|----------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Luchang | 0 | 1 | 0 | 4 | 3 | 6 | 4 | 4 | 3 | 0 | 2 | 5 | 2 | 3 | 4 |
| Shuiku | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 4 | 2 | 7 | 4 | 3 | 0 | 0 | 0 |
| Xuexiao | 4 | 4 | 2 | 5 | 3 | 6 | 6 | 1 | 6 | 6 | 2 | 1 | 1 | 4 | 2 |
| Total | 5 | 6 | 2 | 9 | 6 | 12 | 10 | 9 | 12 | 13 | 8 | 9 | 3 | 7 | 6 |

RESULT

Nest. Although both females and males participated in nest building, females appeared to build nests with little male assistance. Building females took material to nests 15.8 ± 3.1 times/h during morning observations at six nests (30.5 h total), however, males appeared shy to build nests. In our observations of the six nests, building males occurred only in three nests to take material 3.7 ± 1.1 times/h during the same observation period. The nest of the yellow-rumped flycatcher basically consists of two layers. The bottom layer is commonly made up of such material as pine needles, leaves, poplar inflorescences and ferny roots. Moss, hair or dry grass is commonly used to build the inner layer. The mean nest-hole diameter was 4.3 ± 0.9 cm (range, 2.8 - 8.4 cm, $N = 65$); mean hole depth was 11.5 ± 2.7 cm (range, 5.2 - 23.5 cm, $N = 49$); mean maximum cavity width was 9.5 ± 1.5 cm (range, 6.1 - 18.7 cm, $N = 49$). The nests were generally located 4 - 8 m from the ground (mean = 4.8 ± 1.6 m, $N = 65$), although one nest was only 1.5 m above ground. Most nest-holes were natural tree cavities (51 %, $N = 117$) and woodpeckers' abandoned holes (40 %, $N = 117$), although three nests were on the top of the broken tree trunks, two nests were in gaps of broken tree trunks, and one nest was in an abandoned nest of the common magpie *Pica pica*.

Breeding phenology. Yellow-rumped flycatchers began arriving on the study site during late April. The first time that a bird was observed singing near a nest was 15 April, 2000. Both male and female yellow-rumped flycatchers built nests after they had found a suitable tree hole or primary cavity-nesters' abandoned hole. On average, they began nest building 9 May (range, 3 May - 17 May, $N = 61$), about one week after arriving. The mean date that the first egg was laid was 12 May (range, 4 May - 29 May, $N = 50$). The mean hatching date was 27 May (range, 12 May - 8

June, $N = 50$), and the mean fledging date was 20 June (range, 11 June - 12 July, $N = 32$).

Eggs and incubation. Females typically laid one egg/day. The egg length was 17.5 ± 0.9 mm ($N = 86$) at the longest point and the diameter was 12.8 ± 0.6 mm ($N = 86$) at the widest circumference. The mean weight of 50 fresh eggs was 1.6 ± 0.5 g.

Mean clutch size was 5.27 ± 0.95 (range, 2 - 8; $N = 117$), over all and within the species' typical range of five to six eggs (fig. 1). The clutch size of yellow-rumped flycatchers did not differ significantly among years (one way ANOVA, $F_{14, 115} = 4.53$, $P = 0.31$). No evidence suggested that males participated in incubation. The incubation period for yellow-rumped flycatcher was 13.21 ± 1.22 days (range, 12 - 15 days; $N = 65$). Following clutch completion, females spent 80.55 ± 3.18 % of daylight hours incubating ($N = 10$ observations at five nests, total 80 hours). Males fed incubating females at the nest 1.35 ± 0.57 times/h (range, 0 - 7; total 60 hours). Average hatching success was 89.8 % for 65 nests.

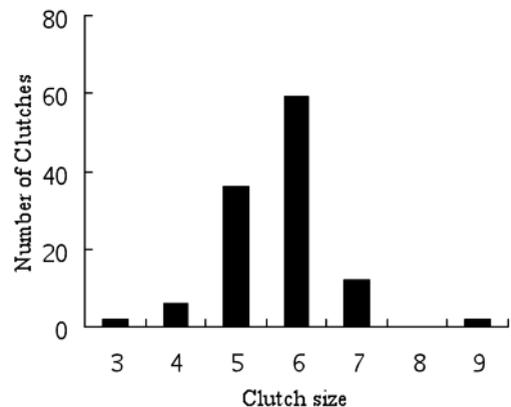


FIG. 1.—The distribution of clutch size in yellow-rumped flycatchers in northeast China. ($N = 117$). [Distribución del tamaño de puesta en el papamoscas culiamarillo en el noreste de China ($N = 117$).]

Nestlings. The mean nestling period, defined as the period between the day the first egg hatched to the day the last nestling fledged, was 12.35 ± 0.78 days (range, 11 - 14, $N = 45$). Successful nests produced on average 4.13 young/nest ($N = 45$). Both females and males fed nestlings, averaging 15.12 ± 3.07 feeds/h (range, 2.45 - 35.28; total 49 hours) throughout the nestling period. There was no difference on feeding times between males and females ($t = 0.78$, $df = 28$, $P = 0.43$) during the nestling period. Nestling feeding rate increased with nestlings age ($t = 25.74$, $df = 4$, $P < 0.01$). Nestlings on day 10 had attained asymptotic size with respect to mass and tarsus length, but not with respect to tail and wing length, at which time nestling mass was 12.03 ± 0.21 g (range, 10.33 - 13.57, 36 nests were measured), tarsus length was 17.45 ± 1.72 mm (range, 14.88 - 18.65, $N = 36$), tail length was 10.05 ± 0.19 mm (range, 9.37 - 11.55, $N = 36$), and wing length was 39.20 ± 3.46 mm (range, 32.89 - 41.46, $N = 36$) (fig.2).

Nesting success. Eighty-six nests were monitored in this study. Sixty-nine (80.3 %) nests reached at least the egg-laying or incubation stages, 59 (68.6 % of total) reached the nestling stage and 48 (55.8 %) successfully fledged at least one young. Nest usurpation and nest predation were the most important causes of nest failure, accounting for 19 and 12 of 39 failed nests, respectively. Three nests failed because adult females deserted or were predated. Two nests were soaked by rain water during incubation because the cavity entrance was facing upwards. No descriptions were recorded for the other three depredated nests. Nests were occupied commonly by secondary cavity-nesting birds, such as white-cheeked starling *Sturnus cineraceus* and eurasian nuthatch *Sitta europaea*. Most nest occupation occurred during the nest construction and egg laying periods (73.7 %, $N = 19$). Nest predators were snakes (10.3 %, $N = 39$) such as the dione rat-snake *Elaphe*

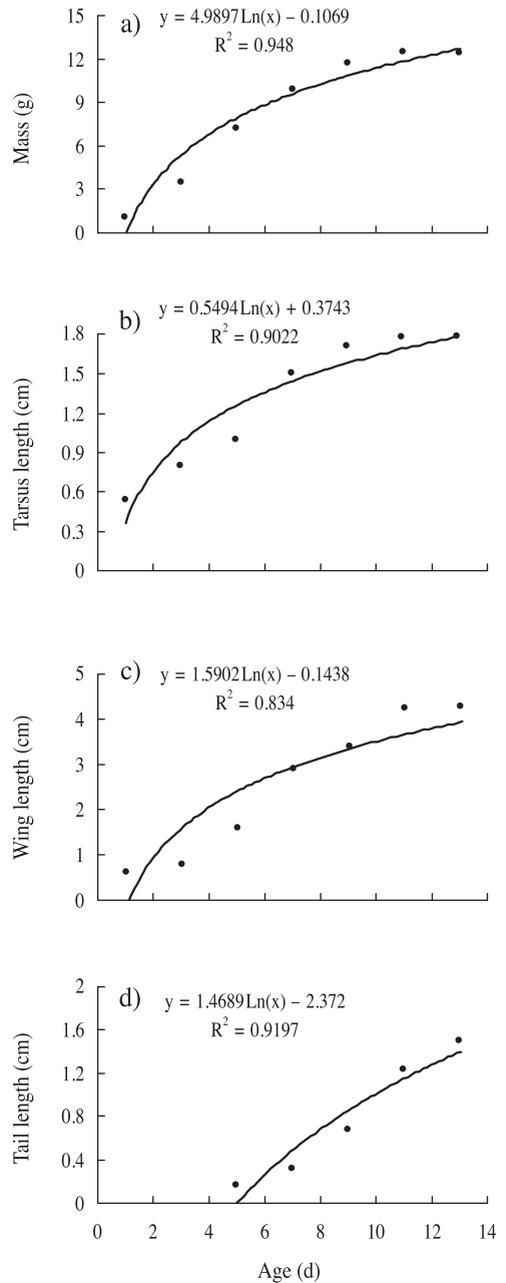


FIG. 2.—Changes of weight (a), tarsi length (b), wing length (c) and tail length (d) of yellow-rumped flycatcher nestlings in northeastern China. [Cambios en el peso (a), longitud del tarso (b), del ala y de la cola (d) de los pollos de papamoscas culiamarillo en el noreste de China.]

dione and small mammals (8 %, $N = 39$), such as siberian weasel *Mustela sibirica*.

Using the exposure method of calculating nesting success (Mayfield, 1961; 1975), the probability of yellow-rumped flycatcher nest surviving from egg-laying to fledging was 0.51. The probability of nest survival declined from 0.71 during the egg stage to 0.64 during the nestling stage. The daily probability of survival was 0.976 ($N = 48$ nests).

DISCUSSION

Nest. Nest structure and composition of yellow-rumped flycatcher were similar to descriptions of European pied flycatcher *Ficedula hypoleuca* (Lundberg and Alatalo, 1992) and collared flycatcher *Ficedula albicollis* (Mitrus, 2003). The nests of the European pied flycatcher and collared flycatcher are commonly made up of dry grass, dead leaves, plant stems, moss, hair and feathers (Del Hoyo *et al.*, 2006). However, nest structure and composition of yellow-rumped flycatcher were different from those of the dusky flycatcher *Empidonax oberholseri*. The nests of dusky flycatcher were small, open cups, composed primarily of shredded grass, thin forb, pine needles, and plant fibers (Dobbs, 2005).

Willow flycatcher, dusky flycatcher or european pied flycatcher females appear to build nests without male assistance (Ojanen, 1984; Brown, 1988; Del Hoyo *et al.*, 2006). Also, Liu and Wang (1981) suggested that nest building of yellow-rumped flycatcher was carried out by the female alone. However, yellow-rumped flycatcher males participated in nest building although the contribution of females was about five times greater than that of males.

Breeding phenology. Liu and Wang (1981) reported that the egg date of yellow-rumped flycatcher occurred in the middle of May and the first decade of June in nestboxes between

1976 and 1978. However, the bird egg date was earlier than those of Liu and Wang in our study. Over 50 % of the clutches of yellow-rumped flycatchers were started in early May, although egg-laying extended nearly a month. This difference is probably attributable to two reasons. Firstly, the works of Liu and Wang carried out in 1976 and was earlier nearly 20 years than that of our work. This was not surprising because climate change and global warming has occurred in the earth's atmosphere due to a buildup of greenhouse gases. Secondly, the study area of Liu and Wang's located in higher latitude than our study area. Compared with other flycatchers (Brown, 1988; Sedgwick, 1993; Sanz, 1999; Dobbs, 2005; Mitrus *et al.*, 2007), yellow-rumped flycatcher egg dates in northeast China were early. Late nests probably represented either second attempt nesting by females that had failed earlier, or the first attempts of young birds, which may start nesting later in the season.

Eggs and incubation. The clutch size within the typical range of 5 to 6 eggs of yellow-rumped flycatcher was similar to that of European pied flycatcher and collared flycatcher (Gustafsson and Nilsson, 1985; Slagsvold, 1987; Mitrus, 2003). In early reports, the clutch size of flycatchers increases with latitude. Clutch size of apocal flycatcher at Hacienda Arizona was 2.6 (Kattan *et al.*, 2000), whereas clutch size for the great crested flycatcher *Myiarchus crinitus* in Florida was 5.1 (Taylor and Kershner, 1991). The clutch size of yellow-rumped flycatcher increases with latitude remains unknown because of lacking data. Also, because small samples of flycatchers were colour-banded it is difficult to know which nests were reposition clutches and which were not. The incubation period for yellow-rumped flycatcher was 13.21 ± 1.22 days (range, 12 - 15 days; $N = 65$), which was similar to that of European pied flycatcher and collared flycatcher (Gustafsson and Nilsson, 1985; Mitrus, 2003).

Nestlings. Skutch (1985) also reported that tropical birds have longer incubation and nestling periods than temperate birds. In our study, we found that the incubation period for the yellow-rumped flycatcher ranged from 12 to 15 days ($N = 65$) and the nestling period ranged from 11 to 14 days ($N = 45$). Our results are similar to those of Liu and Wang (1981) whose incubation period is 11 - 12 days and nestling period is 14 - 15 days, and Del Hoyo *et al.* (2006) whose incubation period is 12 - 14 days and nestling period is 13 - 15 days. In Honduras, Teul *et al.* (2007) reported that the incubation period for the fork-tailed flycatcher ranged from 10.0 to 13.5 days ($N = 4$) and the nestling period ranged from 16.5 to 18 days ($N = 4$). In these studies, the sample size used to determine the incubation and nestling periods was low (< 7), and it is possible that the duration of incubation and nestling periods may vary among pairs and among years based on the weather and the resultant food availability (Teul *et al.*, 2007).

Nesting success. Nesting success and daily probability of survival of yellow-rumped flycatcher in our study were relatively high comparing with the flycatchers with open-cup nests. The rate of nesting success of dusky flycatcher was 40.6 % (Dobbs, 2005) grey-hooded flycatcher (*Mionectes rufiventris*) was 24.4 % (Aguilar *et al.*, 2000), and only 11.5 % for fork-tailed flycatcher (Teul *et al.*, 2007). The low reproductive success of the flycatchers with open-cup nests may be due to the higher visibility of their nests, built in trees or shrubs in areas of open habitats and predators easily to access. In this study, nest usurpation was the most important cause of nest failure which was different to early studies on flycatchers (Kelly, 1993; Liebezeit and George, 2002; Cain and Morrison, 2003; Dobbs, 2005; Teul *et al.*, 2007). Snakes have been described as being important avian nest predators (Weatherhead and Blouin-Demers, 2004; Robinson *et al.*, 2005), especially for cavity-nesting birds. Nine of 12 failed nests (75 %) were predated

by snakes in our study. This was consisted with early studies. Snakes were often observed in the nest plots during nest searching and monitoring or during vegetation studies. Nesting success of yellow-rumped flycatcher was affected by edge effects in this area (Deng and Gao, 2005). The rate of nesting success of yellow-rumped flycatcher increased with distance from the edges. Also, Huhta and Jokimaki (2001) found pairing success and nesting success of the pied flycatcher was affected by proximity to edge.

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