J Ornithol (2009) 150:909–913
DOI 10.1007/s10336-009-0420-4

SHORT NOTE

Notes on the breeding biology of the Sichuan Treecreeper (*Certhia tianquanensis*)

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Received: 12 March 2009 / Accepted: 8 May 2009 / Published online: 25 June 2009

Abstract The Sichuan Treecreeper, *Certhia tianquanensis* Li 1995, was recently recognized as an independent species. Apparently, it is an endemic relict occupying an extremely small range in western Sichuan and Shaanxi provinces, China. During April–July 2003, its breeding biology was studied using field observation and data logger records of five nests found on Wawu Shan in Sichuan province, southwest China. Nest materials were mainly mosses; eggs are white with dense red spots concentrated at the large pole. During the incubation period, the male fed the female outside the nest with 6–13 min intervals between the single feeding events; afterwards, the female regularly returned to the nest within 47.8 ± 25.2 s. The female took 22.14 ± 3.24 recesses per day, with the mean recess length of 8.18 min throughout the incubation period. After the nestlings hatched, the female went out more often than during the incubation period: 55 and 56 times during the first 2 days of nestling period (off-nest time of 6.55 ± 3.15 min). Both parents fed the nestlings.

Keywords *Certhia tianquanensis* · China · Nest · Egg · Incubation

Communicated by: F. Bairlein.

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Introduction

Of the nine *Certhia* species presently recognized in Asia and North America, six are known to occur in China: *C. familiaris*, *C. hodgsoni*, *C. himalayana*, *C. nipalensis*, *C. tianquanensis*, and *C. discolor* (Martens and Tietze 2006, Tietze et al. 2006; Tietze et al. 2008, Harrap 2008). Among the Chinese species, *C. tianquanensis* is the most spectacular. It was described as a subspecies of the widespread Common Treecreeper (*C. familiaris*) by Li (1995) and this taxon attracted little attention thereafter. But this changed when it was recognized as a species of its own according to a number of morphological, acoustic and genetic characteristics (Martens et al. 2002, 2003; Tietze et al. 2006; Harrap 2008). Its closest relative turned out to be *C. nipalensis*, another endemic species of Southeast Asia including parts of China (Tietze et al. 2006).

The presently known distribution of the Sichuan Treecreeper is confined to a few localities in the mountainous areas of Sichuan province (Li 1995; Martens et al. 2002, 2003; Rheindt 2004), and we discovered additional localities in the Qinling Mountains in Shaanxi province to the east of the Sichuan records (Sun and Martens 2005). Due to the few known localities, the Sichuan Treecreeper has been stated as "population trend decreasing" and as "near threatened" by IUCN (2008). Basic biological information on this species, i.e. habitat preference, breeding time and incubation rhythm, and population status and trends, are either not yet properly known or are totally missing, respectively. Presently, only one vital population is known of *tianquanensis*, on the table mountain Wawu Shan, where it lives in sympatry with *C. hodgsoni*.

During April–July 2003, we studied some breeding parameters of *C. tianquanensis* on Wawu Shan. Here, we present preliminary results on its nest, eggs, incubation and

nestling behaviour. The local government had already declared a provincial nature reserve here in 1993, mainly in order to protect the untouched fir forests but also to actively promote local tourism and to increase the reserve's income. This included the construction of a huge cableway, since when tourism has been increasing. Thus, any information on this Wawu Shan flagship species deserves high priority not only to collect basic biological information, but also to possibly influence the reserve's future fate and the long-time conservation of this treecreeper.

Methods

Our study area is the forested top plateau of the Wawu Shan Natural Reserve, an isolated table mountain in Hongya county of Sichuan province, southwest China (29°25′–29°34′N, 102°49′–103°00′E, approx. 2,830 m asl). The area is situated within the monsoon climate belt. Due to the isolated position of the mountain, there is heavy annual rainfall up to 2,000 mm which is largely concentrated in the summer months, June–August. The annual average temperature is about 16.8°C, with a maximum of 36.2°C and minimum of −3.3°C. The average temperature in January and July are 6.6 and 25.7°C, respectively. The top plateau covers about 9 km^2 and is dominated by extended stands of mainly open forest of the Emei fir (*Abies fabri*) mixed with a few birch (*Betula utilis*). Most of the fir trees are old and at their climax, thus young trees are extremely rare (habitat photo in Martens et al. 2003). Undergrowth is dominated by bamboo (*Bashania faberi*) and a good variety of *Rhododendron* species forming low bushes and also tall trees, among them *R. ambiguum* and *R. maculiferum*. Search for nests was concentrated close to paths which traverse the fir forest; they were used as easy-to-follow guidelines within the bamboo undergrowth which otherwise is difficult to penetrate. Egg temperature was measured using data loggers (Gemini Data Loggers, UK). The conductor of the logger was embedded into the nest material of the bottom of the nest cup. The female accepted the arrangement without noticeable irritation. Information on the incubation rhythm was gathered by registration of the temperature records and their variation; sudden changes in egg temperature indicated departure or arrival of the incubating bird, respectively. During daytime, this was verified by direct observation of the bird approaching or leaving the nest. To ensure the accuracy of the interval between the individual temperature recordings, the data logger was programmed to measure temperature every 50 s. Additionally, in order to analyze the nest sites and the nearby habitat, canopy cover, height and stem diameter of the nest tree, and the distances to paths were measured; 10 × 10 m plots of plant diversity were investigated in order to check main vegetation characters and vegetation type around trunks carrying nests.

Results

Habitat and population density

The Sichuan Treecreeper holds a remarkably strong population on top of Wawu Shan. Eight active pairs were found along 1,300 m of paths traversing the fir forest.

According to 22 random vegetation samples, the nesting habitat consisted of scattered old firs with dense bamboo clumps. The average fir density was 0.68 trees/ha with the average diameter at breast height of 51.7 cm.

Breeding time

We found active nests in May and June; incubation takes place mainly in May, raising young in June (Table 1).

Nest and eggs

Five nests were discovered during May and June 2003. All nests were situated in cracks and fissures of dead fir stems (see Table 1 for nest characteristics). Because of the weakness of the dead stems, three nests could not be investigated closely and the only known clutch size was 4 (nest no. 2). Nest materials were mainly mosses, the hole being lined with a few hairs and feathers, the upper wall with a few dried bamboo leaves. Eggs are white with dense red spots, concentrated at the large pole. Measurements and weights of eggs from one clutch: 13.0 × 17.2 mm, 1.5 g; 12.9 × 16.9 mm, 1.4 g; 13.0 × 16.9 mm, 1.4 g; and 13.1 × 16.6 mm, 1.4 g. Eggs of a clutch of a Common Treecreeper from Wawu Shan measured 11.94 × 17.16 mm, 1.3 g; 12.10 × 17.00 mm, 1.3 g; 12.10 × 17.10 mm, 1.3 g; and 11.90 × 17.00 mm, 1.2 g, being smaller and lighter than eggs of the Sichuan Treecreeper ($P = 0.005$ for egg weight, $P = 0.000$ and 0.256 for egg size, $n = 4$; two-tailed t test).

Incubation

We obtained details about the incubation behaviour from nest no. 4 based on direct observation. During incubation, the male regularly fed the female. It normally flew to a fir stem 5 m from the nest at a height between 2.4 and 4 m above ground and presented an extended trill call. The female left the nest, flew to the same stem below the male, approaching it with wings flapping, and took over the food. For a total observation span of 280 min, the male fed the female nine times, with 6–13 min between the single feeding events. After the female had received the food

Table 1 Nest characteristics of the Sichuan Treecreeper, *Certhia tianquanensis*, at Wawu Shan, Sichuan

Nests	1	2	3	4	5
Date of discovery	23 May	12 June	15 June	15 June	18 June
Status upon discovery	Egg laying with 1 egg in the nest	Incubating	Incubating	Incubating	Nestlings
Canopy cover	0.45	0.65	0.05	0.90	0.05
Clutch size		4			
Height (m)	5.5	1.7	13	5.5	4.5
Stem diameter (cm)	33	36	41	22	50
Distance to path (m)	1.5	6	30	20	20
Microhabitat around the nest stem, square 10 × 10 m	Bamboo 80%, road 20%, 1 fir	Bamboo 65%, Rhododendron 5%, river 30%, 1 fir	Grass 100%	Rhododendron 65%, bamboo 35%, 4 fir	Bamboo 100%
Reproductive success	Disturbed	Predated on 24 June	Nestling feeding observed on 10 July	Unchecked, both parents fed on 3 July	

from the male, it regularly returned to the nest within a short time (20–100 s, 47.8 ± 25.2 s, $n = 8$). Once after getting the food from the male, the female searched for food itself for 4 min and within 3 m from the nest trunk. During the observation period, the female took seven recesses averaging 7.7 ± 2.7 min (range 4–11 min). The female was silent when taking recesses and normally fed close to the nest, within about 20–50 m.

Nest no. 2 was equipped with a data logger on 13 June, and a period of seven incubation days were monitored (Table 2). While this female needed only short periods to take over the food from the male (less than 3 min), we only monitored the off-nest sequences caused by recesses (at least 3 min). On average, the female started the daily recesses at 0623 hours and finished at 1948 hours ($n = 8$) resulting in an active period of 795 min. The female took 22.14 ± 3.24 ($n = 7$) recesses per day, with the recess length of 8.18 ± 3.20 min ($n = 173$), predominantly (97%) between 4 and 16 min. Three additional off-nest periods occurred at night (for 69, 25 and 37 min, respectively) very likely caused by potential predators.

Nestlings

In nest no. 2, three chicks hatched on 21 June and the fourth one on the following day. The nest was predated on 24 June and therefore we can only describe the very young nestlings aged 2 days. Young up to 2 days old are yellow with the body bare except for some fluffs on the head and blackish feather roots on the back and wings. For measurements of the nestlings taken on the day of hatching, see Table 3. Both parents fed the nestlings. Normally one adult sat in the nest (possibly the female) and when the other parent arrived with food, it flew to a fir stem close to the nest tree and called. On this signal, the female left the nest and the male approached the nest and fed the young. The female also flew out to forage and took back food to feed the young. During an 80-min observation period, the female fed nine times, the male five times.

According to the logger data, during the feeding period the female left the nest more frequently and spent less time outside than during the incubation period: she went out 55 and 56 times on 22 and 23 June, respectively, with the

Table 2 The incubation rhythm of a female Sichuan Treecreeper, 13–21 June 2003 at Wawu Shan

Date	Daily recesses	Shortest recess (min)	Longest recess (min)	Average recess length (min)	Start (time in morning)	End (time in evening)
13 June[a]	10	6	13	9.3		19:35
14 June	20	3	16	8.5	06:08	19:52
15 June	19	4	14	8.0	06:18	19:58
16 June	23	4	16	7.9	06:17	19:55
17 June	20	4	22	9.35	06:15	20:00
18 June	27	5	16	8.15	06:25	19:42
19 June	20	4	12	8.2	06:34	19:20
20 June	26	5	13	7.4	06:16	20:02
21 June[b]	7	5	17	8.7	06:31	

[a] Incubation started at 11:37

[b] Chicks hatched at noon

Table 3 Measurements of four nestlings on hatching of the Sichuan Treecreeper at Wawu Shan in Sichuan, China

Nestling	Weight (g)	Tarsus (mm)	Tail (mm)	Wing (mm)	Bill (mm)
1	1.9	5.8	1.7	1.8	4.1
2	2.6	7.2	2.0	2.1	4.2
3	2.5	7.4	1.9	2.1	4.5
4	2.4	7.0	1.9	2.0	4.2

average off-nest time of 6.55 ± 3.15 min ($n = 111$). In the night of 23 June, the female left the nest at 2302 hours for 71 min, possibly disturbed by a predator, and in the late afternoon of 24 June; soon afterwards the nest was predated and abandoned.

Discussion

While at most of the few known distribution localities, only small numbers or single individual of *tianquanensis* have been recorded, the Wawu Shan is presently the only locality from which a viable population of Sichuan Treecreepers is known. Despite heavy logging activities at the base of this steep and rock-faced mountain in earlier decades, the forest composition of Wawu Shan plateau has largely remained unchanged due to difficult access for lumberers. This well-established local Sichuan Treecreeper population is possibly fostered by a few essential circumstances. The fir forest on Wawu Shan grows at a relatively low altitude to which *tianquanensis* seems to be adapted and restricted (Martens et al. 2002, 2003). Many other Southwest Chinese fir forests at altitudes above 3,000 m do not seem to hold this species (Rheindt 2004). On the other hand, fir forests at relatively low altitudes have suffered severely during former logging activities, and a multitude of former populations may have become extinct during the last decades. Another point important for *tianquanensis* habitat seems to be the presence of bamboo clumps on the forest floor. On Wawu Shan, this combination, light fir forest with bamboo undergrowth, is widespread and may have added to the favourable conditions there. The population density of *tianquanensis* may approach that of the European and/or the North African populations of *C. brachydactyla* in the most suitable habitats (Glutz et al. 1993). It is evident that only mature forests hold such high densities, and such crucial conditions are also known for the two European species, *C. familiaris* and *C. brachydactyla* (Glutz et al. 1993). The Common Treecreeper in China (*C. hodgsoni*; formerly *C. familiaris*; see Tietze et al. 2006), which is syntopic with *tianquanensis* on Wawu, is much rarer there, and in 2002 only four males could be spotted during several days of intensive search for this bird.

Nesting localities

These are very similar in all *Certhia* species, and *tianquanensis* does not seem to display exceptional traits. The nests found were situated in fissures and crevices below loose bark or in cracks within the rotten wood of trees still standing upright. This is also documented by photographs of a dead trunk holding a nest of the Wawu Shan population (Harrap 2008, p. 175), and another nest was also found within a dead trunk about 2–3 m high in Wawu Shan in 2007 (P.Z. Luo, unpublished data). Nonetheless, the number of nests encountered is still too small to be able to state whether dead stems are a prerequisite for nest sites. At the least, such tree conditions are numerous on Wawu and they may provide the easiest access to holes suitable for nesting. In all other *Certhia* species and local populations, the presence of suitable holes and crevices is important (not even always in trees), not the condition of the trees themselves.

Height above ground of nest holes widely varies in *tianquanensis*; just within this small sample of nests presented here, it ranges from lower than 2 m up to 13 m (see Table 1). This holds true for all other *Certhia* species so far investigated in detail. Bates and Lowther (1952) indicate in general "4–40 ft" for *C. himalayana* in Kashmir or from near the ground up to 15 m (Ali and Ripley 1973).

Apart from the very similar nest sites across the species, nests themselves vary in the materials used. The *tianquanensis* nest seems to be unique because the nest cup was built entirely of mosses lined with a few feathers and bamboo leaves (Fig. 1). The only nest of *C. nipalensis*, the closest relative of *C. tianquanensis* (Tietze et al. 2006), ever found was a loose construction of small twigs deposited in a shallow cavity in a tree stem (Martens and Eck 1995). Nests of other species (*C. familiaris*, *C. brachydactyla* in Central Europe) may be lined with dry grass and pieces of herb stems and different numbers of moss stems, with, uppermost, added feathers and hairs of large mammals (deer, hare etc.) (Glutz et al. 1993). In *C. himalayana*, the main nest usually consists of a pad of wool, straw and bits of bark, with an upper loose layer of feathers (Bates and Lowther 1952, Ali and Ripley 1973).

Again, egg colouring is very similar across all *Certhia* species. The whitish ground is heavily mottled with reddish spots which are concentrated at the large end. However, the size of the *tianquanensis* eggs is quite large compared with the eggs of the Common Treecreeper, which has mean weight of 0.95 g, while size averages 14.7 × 11.5 mm ($n = 40$; Wang and Zhang 1992), and this corresponds to our measurement from Wawu Shan.

Fig. 1 The no. 2 nest of Sichuan Treecreeper, *Certhia tianquanensis,* in Wawu Shan

Species coexistence

Syntopic occurrence of *Certhia* species is a rare phenomenon because in most of the genus's range only one species is present. Highest "density" of *Certhia* species occurs in the Himalayas of Nepal with four sympatric and up to three syntopic, species (Martens 1981, Martens and Eck 1995). In China, co-occurrence of *Certhia* species has not been well investigated, but in all *tianquanensis* localities studied in detail, *C. hodgsoni* was also present (Wawu Shan, Jiuzhaigou, Qinling range). At least in the lower parts of its range, *tianquanensis* is the more common species, but *hodgsoni* dominates in the upper parts of the coniferous forest belt with harsher climate up about 4,000 m where *tianquanensis* is absent. Despite syntopic occurrences, a trend for vertical segregation of *Certhia* species is obvious in Asia just as it holds true for central Europe (Glutz et al. 1993).

Zusammenfassung

Bemerkungen zur Brutbiologie des Sichuanbaumläufers (*Certhia tianquanensis* Li)

Dieser Baumläufer wurde erst im Jahre 1995 entdeckt und 2002 als eigenständige Art erkannt, die sich durch offensichtlich extrem beschränkte und reliktäre Verbreitung in den chinesischen Provinzen Sichuan und Shaanxi auszeichnet. In der einzigen bisher bekannten kopfstarken Population des Sichuanbaumläufers auf dem Gipfelplateau des Wawu Shan wurden mittels Feldbeobachtung und Datenlogger-Erfassung erste brutbiologische Erhebungen durchgeführt. *C. tianquanensis* ist auf Tannen-(*Abies*)-Wälder im Klimaxstadium und relativ geringer Meereshöhe bis höchstens bis etwa 3,000 m angewiesen. Die Brutzeit liegt spät im Mai und Juni. Nester werden in Höhlungen und Spalten abgestorbener und morscher noch aufrecht stehender Tannen angelegt; Nester sind überwiegend aus Moos gebaut. Brut-und Fütterungsrhythmus wurden erhoben.

Acknowledgments This work was supported by the BP Conservation Programme, IFS and NSFC (30620130110). We thank Wawu Shan Management Bureau for local help. J.M. was supported by the Feldbausch Foundation and Wagner Foundation at Fachbereich Biologie, Johannes Gutenberg-Universität Mainz, Germany.

References

Ali S, Ripley SD (1973) Handbook of the birds of India and Pakistan, vol 9. Oxford University Press, Bombay

Bates RSP, Lowther EHN (1952) Breeding birds of Kashmir. Oxford University Press, Delhi

Glutz v. Blotzheim UN, Bauer KM (1993) Handbuch der Vögel Mitteleuropas, vol 13. Aula, Wiesbaden

Harrap S (2008) Certhiidae (treecreepers), S. In: del Hoyo J, Elliott A, Christie D (ed) Handbook of the birds of the world, vol 13. Penduline-tits to Shrikes. Lynx Edicions, Barcelona, pp 166–187

IUCN (2008) 2008 IUCN red list of threatened species. http://www.iucnredlist.org. Visited on 22 December 2008

Li G-Y (1995) A new subspecies of *Certhia familiaris* (Passeriformes: Certhiidae). Acta Zootax Sinica 20:373–377 (In Chinese, English summary)

Martens J (1981) Lautäußerungen der Baumläufer des Himalaya und zur akustischen Evolution in der Gattung *Certhia*. Behaviour 77:287–318. doi:10.1163/156853981X00428

Martens J, Eck S (1995) Towards an ornithology of the Himalayas. Systematics, ecology and vocalizations of Nepal birds. Bonner Zool Monogr 38:445

Martens J, Tietze DT (2006) Systematic notes on Asian birds. 65. A preliminary review of the Certhiidae. Zool Meded Leiden 80–5:273–286

Martens J, Eck S, Sun Y-H (2002) *Certhia tianquanensis* Li, a treecreeper with relict distribution in Sichuan, China. J Ornithol 143:440–456

Martens J, Eck S, Sun Y-H (2003) On the discovery of a new treecreeper in China, *Certhia tianquanensis* Li. Bull Orient Bird Club 37:65–70

Rheindt FE (2004) Notes on the range and ecology of Sichuan treecreeper *Certhia tianquanensis*. Forktail 20:141–142

Sun Y-H, Martens J (2005) New distribution of the Sichuan treecreeper in the Qinling Mountains, Shaanxi. Chin J Zool 40:33 (in Chinese)

Tietze DT, Martens J, Sun Y-H (2006) Molecular phylogeny of treecreepers (*Certhia*) detects hidden diversity. Ibis 148:477–488. doi:10.1111/j.1474-919X.2006.00547.x

Tietze DT, Martens J, Sun Y-H, Päckert M (2008) Evolutionary history of treecreeper vocalisations (Aves: *Certhia*). Org Divers Evol 8:305–324. doi:10.1016/j.ode.2008.05.001

Wang JP, Zhang J (1992) Observations on the breeding ecology of the Common treecreeper. Sichuan J Zool 11(1):16–18 (in Chinese)