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BREEDING ECOLOGY OF KRÜPER'S NUTHATCH (*SITTA KRUEPERI*) NEAR ANTALYA, TURKEY

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ABSTRACT

We studied the breeding ecology of Krüper's nuthatch *Sitta krueperi* (Pelzeln, 1863) in southern Anatolia between January 2000 and November 2003. The world distribution is mostly confined to coniferous forests in coastal Anatolia. Of 18 natural breeding cavities, 17 were located in coniferous trees, and the nest entrances were 11.8 ± 1.6 m (mean ± SE) above the ground, facing mostly an easterly direction. Data on breeding ecology of Krüper's nuthatch were obtained from broods in artificial nest boxes in the forests. The nuthatches used 16 of the 250 boxes. Main nest material was thin fragments of bark (57 ± 7.6%; n = 9). Egg laying in artificial nest boxes started on 24 March. Incubation lasted for 12–15 days (14.1 ± 0.2; n = 16) and the nestling period for 15–19 days (16.8 ± 0.3; n = 14). Clutch size ranged from 4 to 7 eggs, mean 5.6 ± 0.2 eggs (n = 16). Overall breeding success was 71.6 ± 7.8%. Main food for the nestlings was Coleoptera (33%) and Lepidoptera (14%) (n = 87).

INTRODUCTION

Nuthatches (*Sitta*) are found throughout most of Asia, North America, and Europe. Eighteen species live in Asia, most of them in the mountains of central and SE Asia (Matthysen, 1998). The five species of the *Sitta canadensis* group are a monophyletic group, within which *S. canadensis, S. whiteheadi*, and *S. villosa* form the sister clade of *S. krueperi* and *S. ledanti* (Pasquet, 1998). Its distribution is mainly confined to the coastal region of the Anatolian peninsula, with some 10,000–100,000 breeding pairs. Limited numbers are found on the adjacent Greek island of Lesbos (ca. 600 breeding pairs according to Hagemeijer and Blair, 1997; 50–100 breeding pairs according to Handrinos and Akriotis, 1997) and in the Caucasus region (Frankis, 1991; Hagemeijer and Blair, 1997). The species is mostly confined to red pine (Calabrian pine *Pinus brutia*) forests, but it also occurs in other coniferous habitats (Löhrl, 1988; Harrap and Quinn, 1996; Hagemeijer and Blair, 1997). The birds are mostly sedentary with some post-breeding dispersal and seasonal altitudinal movements (Cramp and Perrins, 1993; Harrap and Quinn, 1996; Handrinos and Akriotis, 1997).

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Krüper's nuthatch is categorized as a Species of European Conservation (SPEC) Concern 4 Tucker and Heath, 1994) and is listed in the *Red Data Book of threatened vertebrates of Greece* (Karandinos and Paraschi, 1992). Here we present aspects of habitat use and breeding biology of Krüper's nuthatch in the area of Antalya, southern Turkey, where the species is widely, although not abundantly, distributed in pine forests ranging from sea level to treeline at 2250 m a.s.l. in the Taurus Mountains (Löhrl, 1988; Frankis, 1991; Albayrak and Erdogan, 2005).

To date there is no study of the breeding success in natural cavities and in nest boxes, and also of nestling food, in the Anatolian Krueper's nuthatch.

STUDY SITES, MATERIAL, AND METHODS

Antalya province is located in the western Mediterranean region of Turkey, with hot and dry summers and temperate and rainy winters.

We studied Krüper's nuthatch in three different areas between January 2000 and November 2003: Lütfi Büyükyıldırım Research Forest (BAO; 650 m a.s.l, 180 ha) (Fig. 1), Köprülü Canyon National Park (KKMP, 950 m a.s.l., 100 ha), and Elmalı Cedar Research Forest (ESAO; 1700 m a.s.l., 260 ha) (Fig. 1). BAO are composed mainly of dense red pine (90%), with occasional plane tree *Platanus orientalis* and oak *Quercus coccifera* species. KKMP forests are composed mainly of dense black pine *Pinus nigra* (90%), and red pine. ESAO are more uniform, with a canopy composed of Taurus cedar



Fig. 1. Views of the red pine forest at BAO (left), and the cedar forest at ESAO (right).

Cedrus libani. In several stands at ESAO, trees over 400 years old form the canopy, the oldest being around 1200 years old. There are considerable temperature differences between BAO and ESAO (for example in 2000, BAO averaged 14.5 °C, max 28.6 °C in July, min 2.3 °C in January, and ESAO averaged 6.4 °C, max 19.3 °C in July, min –5.9 °C in January). At BAO and ESAO 250 artificial wooden nest boxes, made of red pine wood (inner dimensions 14 × 20 × 22 cm, entrance diameter 3.5 cm) were placed on trees in autumn 1999 and checked weekly throughout the breeding season, early March to late June 2000. First egg-laying dates were observed directly in the field or estimated indirectly by observing numbers of eggs present in the nest.The hatching date was considered to be the day before the appearance of the first nestling in a nest. We identified nestling food using collar rings, stomach-sampled freshly dead nestlings, and photographed food-carrying adults at the nest cavity entrance. During the nestling period, we took photographs (using a Canon EOS 10 camera and 500 mm f:8 objective) when the birds carried food into the nest cavity entrance. Statistical tests were conducted using the Mann–Whitney U test, chi square, and Pearson correlation analysis using SPSS (Norusis, 2002). Values are reported as mean ± SE.

RESULTS AND DISCUSSION

Natural breeding cavities of Krüper's nuthatch near Antalya were found only in coniferous trees. The diameter at breast height of nesting trees varied between 19 and 92 cm and averaged 50.6 ± 5.2 cm ($n = 17$). It depended on the tree species (Fig. 2). The species use nest cavities excavated by woodpeckers, or make their own entrance hole in slightly decayed, old tree trunks (Albayrak and Erdoğan, 2005). Thus, removal of dead timber and the older trees by forestry practices affected the availability of natural nest sites. Nine of 18 natural breeding cavities were located in red pine trees, 5 in black pine trees, and 3 in cedar trees; one nest cavity was excavated in a wooden telephone pole. Nest entrances were located between 2.1 and 24 m, on average 11.8 ± 1.6 m ($n = 18$) above ground level. Nest cavity heights found near Antalya are similar to the ones reported by Polivanov and Polivanova (1986) in northwest Caucasus (mean: 11.7 ± 2.0 m, $n = 11$) for Krüper's nuthatch. The frequencies of southern (39%) and eastern (33%) direction was higher, and those of western (22%) and northern (6%) directions lower, than expected ($n = 18$). The directional distribution of the entrance holes did not differ between the studies ($\chi^2 = 4.6$, df = 3, $p = 0.2$). Wesolowski and Rowinski (2004) also reported a predominance of southern-facing entrances in the Eurasian nuthatch *Sitta europaea*.

Nest height of natural cavities above the ground and diameter at breast height of the tree was positively correlated ($r = 0.57$; $p < 0.05$; $n = 17$) and is similar to the Eurasian nuthatch (Wesolowski and Rowinski, 2004). This suggests that the bigger the tree at breast height, the higher the birds choose to breed ($r = 0.57$; $p < 0.05$). Moreover, the height of the nest entrance above ground was positively correlated to the slope of the hillside of the breeding site ($r = 0.75$; $p < 0.05$; $n = 17$), with an average slope of 26.9° ± 4.7. This indicates that the birds prefer higher nest entrances when they use the tree that is located on a slope of a hillside.

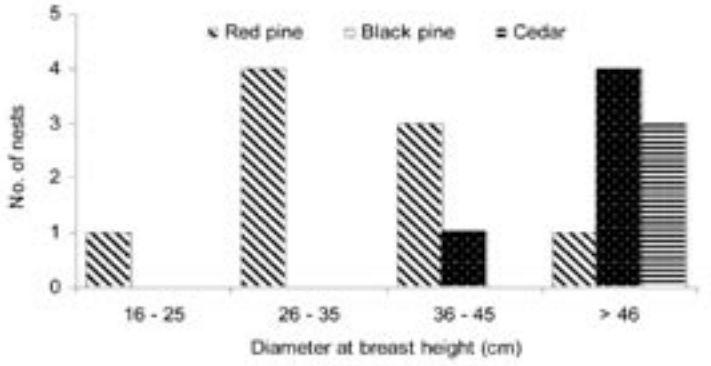


Fig. 2. Diameter at breast height (cm) of trees used by Krüper's nuthatch as breeding place.

Data on the breeding ecology of Krüper's nuthatch near Antalya were obtained from broods in artificial nest boxes in the forests of BAO and ESAO. The nuthatches used 16 of the 250 boxes, 12 in BAO and 4 in ESAO.

Taking all broods into consideration, the egg-laying period lasted from 24 March to 22 May in BAO, and from 6 April to 22 April in ESAO. The incubation period lasted for 12 to 15 days (13.8 ± 0.24; $n = 12$) in BAO and for 14 to 15 days (14.8 ± 0.25; $n = 4$) in ESAO. Nestling period lasted for 15 to 19 days (17.1 ± 0.3; $n = 11$) in BAO and for 15 to 17 days (15.7 ± 0.7; $n = 3$) in ESAO. No second broods were observed during the study. Apart from incubation time, the sites did not differ significantly ($p < 0.05$). Volume of nest material was determined in 9 nests at BAO, and it was comprised of thin fragments of bark (57 ± 7.6%), pine seeds (27 ± 4.1%), lichens (10 ± 5.8%), bristles (3 ± 1.6%), feathers (2 ± 0.6%), pieces of nylon and cotton (1.3 ± 0.4%), and mosses (0.2 ± 0.2%).

Clutch size ranged from 4 to 7 eggs (5.6 ± 0.2; $n = 16$), and most clutches contained 5 or 6 eggs (81%). Incubation time ranged from 12 to 15 days (14.1 ± 0.2; $n = 16$), with significant differences between the lower altitude BAO forest and the higher altitude ESAO forest (Table 1). Incubation period may be related to local climate but is not within the scope of this study. Nestling period lasted between 15 and 19 days (16.8 ± 0.3; $n = 14$), and was slightly lower at the higher altitude ESAO, although the difference was not significant (15.7 ± 0.7 vs 17.1 ± 0.3; Table 1). On average, 4 (± 0.5; $n = 14$) young per nest were fledged, with fewer, though not significantly, at ESAO (Table 1). Breeding success from eggs laid was lower at ESAO. Nest predation was found to be low; only one nest box was interrupted by bats during the incubation time.

Nestling food was identified by using collar rings. We also stomach-sampled freshly dead nestlings and photographed food-carrying adults at the nest entrance. In total, 87 items were identified. Breeding parents were observed to bring to the nest Coleoptera (33.3%), Lepidoptera (13.8%), ants (4.6%), other Hymenoptera (1.2%), Homoptera (4.6%), Dermoptera (3.4%), Diptera (3.4%), Arachnida (2.3%), unidentified small insect larvae (20.7%), earthworms (6.9%), and seeds (5.8%). In the Caucasus, the main

Table 1
Breeding performance of Krüper's nuthatch near Antalya, Turkey; mean ± SE and min–max

	BAO nests (n = 12)	ESAO nests (n = 4)	Total nests (n = 16)	U test
Date of first egg	17 April	15 April	16 April	n.s.
Clutch size	5.6 ± 0.3 (4–7)	5.5 ± 0.3 (5–6)	5.6 ± 0.2 (4–7)	n.s.
Incubation time (days)	13.8 ± 0.24	14.8 ± 0.25	14.1 ± 0.2	p = 0.041
Hatched eggs	5.1 ± 0.4 (2–7)	3.8 ± 0.6 (2–5)	4.8 ± 0.4 (2–7)	p = 0.081
Hatching success (% of hatched eggs)	89.7 ± 5.1 (50–100)	70.0 ± 14.1 (33–100)	84.8 ± 5.4 (33–100)	n.s.
Nestling period (days)	17.1 ± 0.3 (n = 11)	15.7 ± 0.7 (n = 3)	16.8 ± 0.3 (n = 14)	p = 0.079
No. of fledglings	4.3 ± 0.51 (0–6)	3.3 ± 1.11 (0–5)	4.0 ± 0.5 (0–6)	n.s.
Breeding success (% of hatched young)	81.9 ± 8.3 (0–100)	75 ± 25 (0–100)	80.2 ± 8.4 (0–100)	n.s.
Breeding success (% of eggs laid)	74.9 ± 8.1 (0–100)	61.8 ± 21.7 (0–100)	71.6 ± 7.8 (0–100)	n.s.

prey for the nestlings were caterpillar larvae, small insects, and larvae of *Xilophages* (Polivanov and Polivanova, 1986).

The current status of Krüper's nuthatch in Turkey and its biology remain poorly understood, yet due to large-scale habitat destruction the species may be of current conservation concern. Further studies are urgently needed to reveal the species habitat requirements and the conservation implications of future land use for the continued survival of the species.

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