Rapid Decline of Common Cuckoo Cuculus canorus Parasitism in Red-Backed Shrikes Lanius collurio

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Rapid decline of Common Cuckoo *Cuculus canorus* parasitism in Red-backed Shrikes *Lanius collurio*

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Several 19th and 20th century studies on Common Cuckoo *Cuculus canorus* brood parasitism suggest that Red-backed Shrikes *Lanius collurio* used to be one of its common hosts in central Europe. However, since the late 1960s parasitism ceased to occur in Red-backed Shrikes in Hungary. Using data from bird ringing records in the Czech Republic and Slovakia we evaluate whether this finding holds on a broader scale. We found a rapid decline in the parasitism rate, expressed as the frequency of Common Cuckoo chicks encountered in Red-backed Shrike nests, during 1964–2006. During the first decade of the study, on average 2.19% of Shrike nests contained a Cuckoo chick, while in the last decade Cuckoos occurred in 0.37% of the nests only. This suggests a six-fold decline over the study period. Parasitism rates showed strong regional variations which were positively related to the size of regional host populations. In addition to the high ability of Shrikes in discriminating Cuckoo eggs, as found in previous studies, we suggest that decreases in regional host population numbers might lead to host abandonment within a few decades. Whether these two factors work in tandem, or independently, remains to be answered.

Key words: bird ringing, brood parasitism, Common Cuckoo, long-term study, Red-backed Shrike

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INTRODUCTION

Interactions between Common Cuckoo *Cuculus canorus*, an obligatory brood parasite, and its hosts are commonly viewed, on an evolutionary scale, as an ongoing arms race (Moskát 2005). Several studies, which observed these interactions over a longer time-span found that the temporal changes in parasitism rate can be fast (Brooke & Davies 1987, Takasu *et al.* 1993, Soler *et al.* 1998, Brooke *et al.* 1998, but see Lindholm 1999). However, despite the large number of host species, long-term reports on brood parasitism rates are quite rare.

A majority of studies on brood parasitism rates were conducted over relatively short time scales, thus making it difficult to adequately assess the dynamics of the host–parasite interactions. Also, historical data on the frequency of parasitism are sometimes difficult to interpret, as past activities of naturalists were commonly limited to egg collection only (Brooke & Davies 1988, Moksnes & Røskaft 1995, Honza *et al.* 2001). Consequently, many museums have large collections of cuckoo eggs from various hosts but since the search effort of collectors is not recorded (e.g. how many nests of a given species they had to check in order to find a Cuckoo egg), these records do not allow calculation of parasitism rates. Long-term monitoring programmes, e.g. the BTO's Nest Record Scheme (Crick & Baillie 1996), may provide a source of data on temporal changes in parasitism rate. In addition, we suggest that

ringing records stored in national ringing centres constitute a largely unexplored source of information on host–brood parasite interactions. In many countries bird ringing has a long tradition, dating back to the early 1900s (Baillie 2001, Bairlein 2003). To date, only few studies used ringing records to study brood parasitism (Benecke 1982, Lindholm 1999).

Here we use data from the Czech bird ringing scheme to document temporal changes in parasitism rate by the Common Cuckoo on one of its regular hosts, the Red-backed Shrike *Lanius collurio*. Studies in Hungary found a sudden decline in the use of this host by Cuckoos during the past few decades (Moskát & Fuisz 1999, Lovászi & Moskát 2004). Earlier 19th and 20th century studies on Cuckoo brood parasitism suggest that Red-backed Shrike used to be one of its regular hosts in central Europe (Čapek 1896, Rey 1897, Wenzel 1908, Makatsch 1955). Based on our personal observations, Cuckoos in the Czech Republic are still parasitizing Red-backed Shrikes, though at a low rate.

METHODS

The Red-backed Shrike is one the most commonly ringed bird species in the Czech Republic (Hušek & Adamík 2006). Prior to 2002, the ringing scheme encompassed both the Czech Republic and Slovakia. However, the ringing effort in Slovakia was low (c. 900 Shrike nests during 1964–2002) and scattered across the country. Therefore, we added the figures from Slovakia to the overall calculation of parasitism rate, but we refrained from calculating regional parasitism rates for Slovakia (see below). Annually, nestlings from 60 to 700 nests were ringed. This high ringing effort enables the assessment of long-term trends in breeding biology (Hušek & Adamík 2008). Of Cuckoos, on average 20 nestlings across all host species were ringed annually (Table 1). However, in 33% of Cuckoo nestlings, the ringers did not identify the host. This could potentially bias the estimates of parasitism rates. We evaluated whether there were any trends in reporting rates in 1964–2006. First, we excluded those cases where Cuckoos were ringed by a specialised research group (M. Honza and his colleagues) in *Acrocephalus* warblers in southern Moravia. For the remaining dataset, we calculated the annual reporting rate as the proportion of host-identified Cuckoo nestlings among all Cuckoo nestlings. Overall, the reporting rate increased over the study period ($r_s = 0.42$, $n = 43$, $P = 0.005$), i.e. recently the ringers have been reporting host species identity more frequently. For the next step, we selected those records where ringers identified Red-backed Shrikes as the host species. From these records we calculated the annual parasitism rate as the proportion of Red-backed Shrike nests in which a Cuckoo had been ringed. Traditionally, the term parasitism rate is used for the frequency of nests parasitized by the Cuckoo during the egg-laying phase of the host species. In this study, for simplicity, we refer to this term as the frequency of Common Cuckoo chicks in Red-backed Shrike nests (see also Discussion).

The frequency of parasitism often differs between nearby sites or regions (Lindholm 1999, Stokke *et al.* 2007). Hence, we calculated the parasitism rate by administrative districts within the Czech Republic. Only those districts where at least 100 nests of Red-backed Shrikes had been ringed were included. Parasitism rate may depend on host population size or its densities (Lindholm 1999, Alvarez 2003, Stokke *et al.* 2007). To evaluate this hypothesis, we collated data on regional host population sizes (number of breeding pairs) for each district, as published in the annual reports of the Czech Shrike Working Group (Holáň 2004, available at http://lanius.wz.cz/). Reliable data on breeding densi-

Table 1. Alphabetical list of 23 host species in which at least one Common Cuckoo nestling was found by bird ringers in the Czech Republic and Slovakia during 1964–2006.

Great Reed Warbler *Acrocephalus arundinaceus*
Marsh Warbler *Acrocephalus palustris*
European Reed Warbler *Acrocephalus scirpaceus*
Sedge Warbler *Acrocephalus schoenobaenus*
European Robin *Erithacus rubecula*
Chaffinch *Fringilla coelebs*
Red-backed Shrike *Lanius collurio*
White Wagtail *Motacilla alba*
Grey Wagtail *Motacilla cinerea*
Spotted Flycatcher *Muscicapa striata*
Great Tit *Parus major*
Black Redstart *Phoenicurus ochruros*
Common Redstart *Phoenicurus phoenicurus*
Northern Chiffchaff *Phylloscopus collybita*
Wood Warbler *Phylloscopus sibilatrix*
Dunnock *Prunella modularis*
Blackcap *Sylvia atricapilla*
Garden Warbler *Sylvia borin*
Common Whitethroat *Sylvia communis*
Lesser Whitethroat *Sylvia curruca*
Barred Warbler *Sylvia nisoria*
Winter Wren *Troglodytes troglodytes*
Song Thrush *Turdus philomelos*

ties were not available. To avoid possible bias in reporting rates, we only included data from those members of the Group who were active ringers. Data on host population sizes were available for 1994–2006 only. Therefore, within this period, we categorized the regions (districts) as parasitized (n = 6; at least one Cuckoo nestling was found during the 13-year period) and unparasitized (n = 11).

RESULTS

Of 787 Cuckoo nestlings ringed among 23 host species (Table 1), 124 were ringed in Red-backed Shrike nests (15.76%). During 1964–2006, Cuckoo nestlings were reported in 124 out of 11 946 Shrike nests, yielding a mean parasitism rate of 1.04%. Over the same period, the parasitism rate of Shrike nests showed a significant decline (r_s = –0.64, n = 43, P < 0.001; Fig. 1). During the first decade of the study, 28 nestlings were reported in 1276 Shrike nests (2.19%), while in the last ten years, only 10 Cuckoos were found in 2689 nests (0.37%).

We found marked differences in parasitism rate across the country, often among neighbouring regions (Fig. 2). The highest rates of parasitism were found in the Nymburk and Uherské Hradiště districts. Districts where parasitism had been reported during the past 13 years had significantly higher Shrike populations (mean number and SE of breeding pairs was 140 ± 41) than those where parasitism was not recorded (mean 40 ± 8; t-test, $t_{1,15}$ = 3.06, P = 0.008).

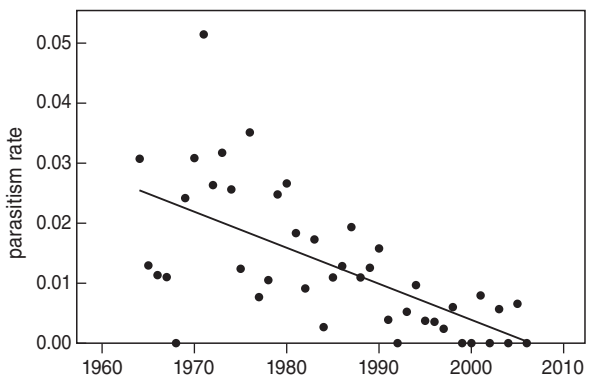

Figure 1. Trend in parasitism rate (% nests found by bird ringers containing a Cuckoo nestling) of Red-backed Shrikes in the Czech Republic, 1964–2006.

DISCUSSION

The occurrence of Cuckoo nestlings in Red-backed Shrike nests has significantly declined over the past 43 years. This finding is in line with the study of Lovászi and Moskát (2004) from Hungary, where Cuckoo parasitism in Shrikes ceased to be registered since the late 1960s. Red-backed Shrikes used to be a regular host for Cuckoos in central Europe (Čapek 1896, Rey 1897, Wenzel 1908, Makatsch 1955) (Fig. 3), with some Cuckoo females even laying mimetic eggs of the *Lanius* type (Moksnes & Røskaft 1995, Honza *et al.* 2001). Why then is the Red-backed Shrike now parasitized at such a low rate? Experimental studies on Red-backed Shrikes suggest that this species shows a high level of recognition of Cuckoo eggs, and hence a high rejection rate (Moskát & Fuisz 1999, Lovászi & Moskát 2004). Possibly, Shrikes evolved an ability to identify the parasitic eggs and reject them, leaving little chance for

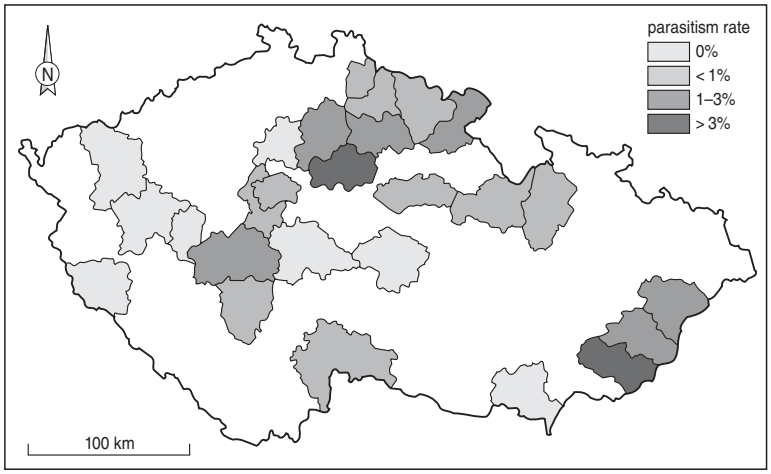

Figure 2. Regional differences in parasitism rate (% nests found parasitized) of Red-backed Shrike nests by Common Cuckoo in the Czech Republic, 1964–2006. The map indicates only those administrative districts where Red-backed Shrike nestlings from at least 100 nests were ringed.

Figure 3. A young Common Cockoo fostered by a Red-backed Shrike, 28 June 1985, Břeclav, Southern Moravia (Photo Oldřich Mikulica).

successful parasitism by the Cuckoo. Another explanation for the drop in parasitism is a decline of host numbers as explained below.

Several methodological issues should be considered here. Our calculations may have underestimated parasitism rates for two reasons. First, the ringers did not report the host species in all cases, making it likely that some Cuckoos in Shrike nests were omitted in our calculations. On the other hand, one may argue that not reporting the host is most likely to occur when the ringer was not sure of the host species identity, which is least likely in Red-backed Shrike (distinct nest, characteristic parental alarm calls). The proportion of Cuckoo hosts identified during ringing was lowest in the late 1960s and early 1970s, then improved to nearly 75% in 1997–2006. Hence, the real numbers of parasitized Shrikes were likely to be higher at the beginning of the study, leading possibly to even a steeper decline in the parasitism rate over the entire period of study. However, if not-reporting was distributed randomly among the ringed nests, the proportion of Shrike nests with a Cuckoo nestling is still an unbiased sample among those for which the host was reported. Secondly, Shrikes frequently eject Cuckoo eggs, or abandon nests in which Cuckoos have laid their egg (Lovászi & Moskát 2004). Therefore, the Cuckoo nestlings that were ringed must have represented a fraction of the original number of parasitized nests (i.e. of the nests found, Cuckoo eggs may already have been ejected in some). If rejection behaviour improved over the study period, this in itself could be responsible for the observed decline of parasitism. Between 1945 and 1982, Štancl & Štanclová (1987) found Cuckoo eggs in 18 out of 436 Shrike nests in Eastern Bohemia, yielding a 4.1% parasitism rate. Of these 18 eggs, 12 Cuckoo nestlings (66.6%) were successfully raised to independence. However, we do not know whether the authors did daily checks on nests with Cuckoo eggs. If not, then clearly some nests with ejected Cuckoo eggs must have been overlooked. More than a century ago, in Moravia (eastern Czech Republic) Čapek (1896, 1902, 1903) found that 4.6–8.2% of Shrike nests contained a Cuckoo egg. Out of 40 Red-backed Shrike nests in which he found a Cuckoo egg, 4 (10%) were aban-

doned by the host (Čapek 1896). However, Čapek (1910) was a keen egg collector and we can not rule out the possibility that he had already collected some of the Cuckoo eggs before ejection might have occurred. In contrast, recent experiments on the ejection behaviour in Hungary reported considerably higher rejection rates (Moskát & Fuisz 1999, Lovászi & Moskát 2004). Thus, it would be interesting to repeat similar experiments in the Czech Republic, where the Cuckoo still persists, albeit in diminishing frequency, as a brood parasite of the Red-backed Shrike.

Beside the long-term decline in parasitism rate, we also found that the geographical distribution of Cuckoo eggs in Shrike nests is patchy. Neighbouring regions often have strikingly different parasitism rates. This finding is supported by an earlier study of Holáň & Sviečka (1996) in the Czech Republic. In addition we found that this pattern could be explained by regional variations in host's population sizes. This is in line with the study of Soler *et al.* (1999), who found host population size to be a strong predictor of parasitism rate across a wide range of species. Unfortunately, we do not have reliable regional data on other variables (e.g. host densities, habitat patch size) that could also explain the observed pattern. Host population size and its density probably work in tandem and are likely to explain the frequency of parasitism (Lindholm 1999, Stokke *et al.* 2007). Data from the Czech national breeding bird monitoring program suggest stable, or even slightly increasing numbers of Cuckoos and Red-backed Shrikes during 1982 to 2005 (Reif *et al.* 2006). In contrast, Shrike specialists testified to many local declines in breeding populations (Štancl & Štanclová 1987, Holáň 2004). Based on the marked geographical variability in parasitism rate, such local declines in Shrike numbers may perhaps be connected to the detected decline in parasitism rate by Cuckoos at the national scale.

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SAMENVATTING

In de 19de en 20ste eeuw behoorde de Grauwe Klauwier *Lanius collurio* tot één van de algemene waardvogels van de Koekoek *Cuculus canorus* in Midden-Europa. In Hongarije kwam daar aan het eind van de jaren zestig opeens de klad in: sindsdien werd de Grauwe Klauwier niet meer als waardvogel geregistreerd. In het onderhavige onderzoek worden Tsjechische ringgegevens gebruikt om na te gaan of een zelfde ontwikkeling in Tsjechië heeft plaatsgevonden. Nesten van Grauwe Klauwieren zijn gemakkelijk te vinden, en alleen al in Tsjechië werden tussen 1964 en 2006 jaarlijks de jongen van 60–700 nesten geringd. Met uitsluiting van de Koekoeken geringd in gerichte studies naar *Acrocephalus*-soorten in zuidelijk Moravië werd vervolgens de frequentie berekend waarmee nesten van Grauwe Klauwieren door een Koekoek waren geparasiteerd. Deze waarde is niet geheel conform de werkelijkheid, omdat het gaat om nesten met een jonge Koekoek erin; gewoonlijk wordt de parasiteringsgraad berekend over nesten in de eifase. De Tsjechische veldmensen ringden 787 Koekoeken onder 23 soorten waardvogels. In 1964–2006 werden 11.946 nesten van Grauwe Klauwieren gevonden waarvan alle jongen werden geringd; daaronder bevonden zich 124 nesten met een koekoeksjong, wat neerkomt op een parasiteringsgraad van 1,04%. Over de periode 1964 tot 2006 daalde de parasiteringsgraad van 2,19% in de eerste decade naar 0,37% in de laatste decade. Tussen districten in Tsjechië vonden de auteurs aanzienlijke verschillen; er waren meer nesten geparasiteerd naarmate de dichtheid aan broedende Grauwe Klauwieren hoger was. Hoewel het Tsjechische broedvogelmonitoringprogramma een lichte toename van Grauwe Klauwier èn Koekoek laat zien in de periode van 1982 tot 2005, is de ervaring van Grauwe-Klauwierspecialisten anders: op veel plaatsen in het land neemt de Grauwe Klauwier af. Deze afname wordt als mogelijke reden aangeduid voor de afnemende parasiteringsgraad van Koekoeken. Een andere reden zou kunnen zijn dat Grauwe Klauwieren zich in de loop van de afgelopen decennia hebben verbeterd in hun vermogen een ei van een Koekoek als zodanig te onderscheiden (en het ei verwijderden, of hun nest in de steek lieten). Beide factoren kunnen ook tegelijkertijd opgeld hebben gedaan. Hoe het zij, de afname van de parasiteringsgraad, zoals vastgesteld in Hongarije, is nu ook voor Tsjechië vastgelegd, echter nog niet tot het punt dat parasitering helemaal niet meer voorkomt. (RGB)

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ARDEA

TIJDSCHRIFT DER NEDERLANDSE ORNITHOLOGISCHE UNIE (NOU)

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