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Research activity induces change in nest position of the Great Grey Shrike *Lanius excubitor*

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The Great Grey Shrike *Lanius excubitor,* as well as other species of family Laniidae, recognise humans as potential predators and actively defend nests. During an intensive study in western Poland we examined the influence of observer visits on breeding success and breeding behaviour of the Great Grey Shrike. We compared changes in nest position of pairs that were disturbed with those that were not disturbed. We did not found a negative impact of nest visits or the frequency of nests visits on the breeding success of Great Grey Shrikes. However, pairs with disturbed nests in one year significantly increased nest height in the following breeding season. In contrast, there was no significant change in nest height change in pairs which were not disturbed in the previous season. These findings suggest that even a short-term increase in predation risk due to a visit by an observer appears to trigger an adaptive anti-predator response. The results indicate that shrikes recognise humans as potential predators and are able to predict the probable return of predators even the next season. This result is interesting, because birds have reacted, clearly purpously, by heightening their nests after intrusion of a ground predator.

1. Introduction

Several studies have been performed to investigate the impact of nest visits by observers and their frequency on breeding success in birds. Some findings have shown no or only a low negative effect of research activity (O'Grady *et al.* 1996, Mayer-Gross *et al.* 1997, Purger 2001). However, other studies, including those on shrikes (Bart 1977, Lenington 1979, Major 1990, Tryjanowski & Kuźniak 1999), provided evidence that a high frequency of nest visits can seriously reduce breeding success, mainly due to an increasing risk of predation. Despite numerous studies on a wide range of species, only a few papers are devoted to other effects of human disturbance, such as the influence on time budgets or attendance of parents at the nest (Steidl & Anthony 2000, Verboven *et al.* 2001).

Many bird species like waders, terns, owls and some passerines, including shrikes, recognise humans as potential predators and actively defend nests and nestlings against them. This defence be-

haviour against human observers was used in several studies on defence behaviour in birds (e.g. Galeotti *et al.* 2000, Pavel *et al.* 2000, Carrillo & Aparicio 2001, Purger 2001, Sergio & Bogliani 2001, Tryjanowski & Goławski 2004). Parents engaged in nest defence risk injury, even death, but they also spend time and energy that could be invested in foraging, parental care or resting (e.g. Ueta 1999). Moreover, such behaviour may attract predators and give information about brood location and, therefore, increase predation risk (e.g. Snelling 1968, Tryjanowski & Kuźniak 1999).

Male Great Grey Shrikes *Lanius excubitor* tend to stay all their life in the same territory (Schön 1995, Lefranc & Worfolk 1997). Potential nest sites are chosen by males and presented to female during nest-display behaviour (Schön 1995, own observations). Here, we present results of a population of Great Grey Shrikes, where we studied changes in nesting height in the season following disturbance due to research activity. We hypothesize that disturbance by researchers is perceived by shrikes as an increase in nest predation risk, and would, hence, induce a change in the nest position. Furthermore, we analyse also the possible impact of the nest visits and the frequency of visits on breeding success in this species.

2. Materials and methods

2.1. Study area

We investigated the breeding biology of Great Grey Shrikes in Western Poland between 1999 and 2001 (for details about studied population see Tryjanowski *et al.* 1999, Antczak *et al.* 2004). The most intensive observations were conducted on two large plots, the first of 220 km^2 near Odolanów (51°34'N, 17°40'E) and the second of 176 km^2 near Koło (52°12'N,18°39'E). The study areas were in farmland with arable fields, meadows and small woodlots of different age sometimes interconnected by rows of trees.

2.2. Study species

The Great Grey Shrike is a medium size passerine, occurring in a wide variety of semi-open habitats (Lefranc & Worfolk 1997, Tryjanowski *et al.* 1999, Harris & Franklin 2000). It builds open cup nests on a wide range of trees, including fruit trees (e.g. *Pyrus sp)*, other deciduous trees (such as *Populus, Quercus* and *Alnus*), thorn bushes (mainly *Crataegus* and *Prunus*) and finally conifers (mainly pines) (Lefranc & Worfolk 1997, Harris & Franklin 2000). In the studied population nests were mainly located in conifers (>70% of nests) and this did not differ significantly between the two studied areas (Antczak *et al.* 2004). There was no significant difference in laying dates between nests located in coniferous and deciduous trees (Median test $\chi^2 = 0.26$, $P = 0.6$). The population of the Great Grey Shrike in the western Poland, similarly to that in other Central European populations (Cramp & Perrins 1993, Lefranc & Worfolk 1997), is generally sedentary – the majority of the males stay (ca 30–70% in various winter seasons) in their territories or in the region.

2.3. Fieldwork

Some nests were not available for physical inspection, mainly because nests were located on the top of trees or in branches too weak for safe access by the observer, other reasons were: found empty at the first visit – either predated or because the brood had fledged before the human observer visit.

All nests (either available or not available for physical inspection) were checked from a distance using binoculars or telescope at least once per week. Intrusive nest visits were conducted at the end of the incubation and nesting period, when eggs and nestlings were measured and ringed. During the period of offspring fledging the nests and their surroundings were carefully surveyed for the presence of young birds and families in order to establish breeding success. We assumed the nesting attempt was successful if at least one nestling fledged. The influence of nest visits and their frequency on breeding success was tested by comparing the predation rates in three groups of nests: not visited, visited one to three times (n = 16 nests) and visited four to seven (n = 11 nests) times per season. The number of intrusive nest visits varied from 1 to 7, with average 3.2 ± 1.37 (SD). We compared nest heights in subsequent breeding seasons in reoccupied shrike territories in order to in-

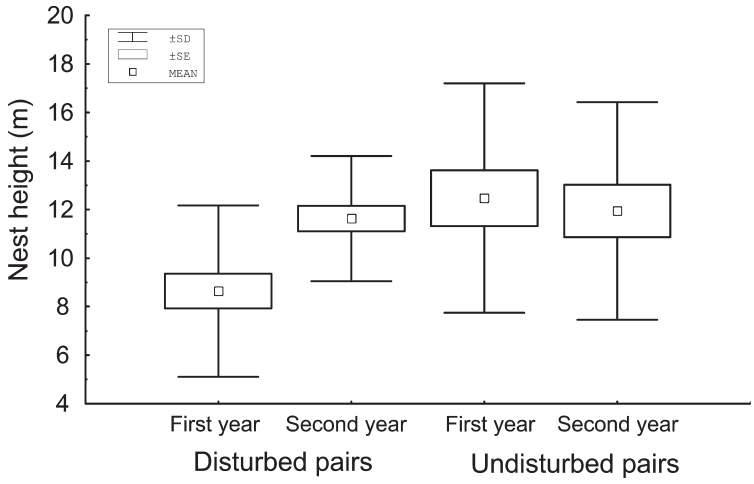

Fig. 1. Changes in nest height in reoccupied Great Grey Shrike territories that were either disturbed (n = 24 matched pairs) or undisturbed (n = 17 matched pairs) in the previous year.

vestigate the hypothesis that research activity induces change in nest height. For the latter comparison, the data were divided into two groups: not visited (n = 17) and visited (n = 24) nests. Breeding territories were defined as reoccupied when the nest was located in a radius of 300 m a nest in the previous season (for territory size see Tryjanowski *et al.* 1999), but the majority (> 70%) were noted in a radius of 50 m, or even in the same forest patch or tree (50% and 24% respectively).

Some of the breeding birds were individually marked by colour rings. In addition, individuals were identified using wing patterns and eye-masks, which are highly individualistic (see Schön 1994). These individual marks are relatively easy to identify for experienced observers, especially as the birds are often not particularly shy and perch prominently for a long time (see also Probst 2001).

2.4. Statistical analysis

All basic statistical analysis was performed according to Sokal and Rohlf (1995). Statistica for Windows version 5.0 (StatSoft, Inc. 2000) was used for statistical analysis. Because we did not found any significant differences (at $P < 0.05$) in breeding success between study areas and seasons, the data were pooled. The Wilcoxon matched pair test was applied to test the changes in nest height location between breeding seasons in disturbed and undisturbed nests.

3. Results

3.1. Change of the nest position

The nest height in the reoccupied Great Grey Shrike territories increased significantly after visits by an observer (Wilcoxon test: $Z = 3.26$, $P = 0.001$, matched pairs n = 24, Fig. 1). In contrast, there was no significant shift in nest height of undisturbed pairs (Wilcoxon test: $Z = 0.23$, $P = 0.82$, matched pairs n = 17, Fig. 1). Successful, but disturbed pairs, also located their nests higher, but that change was not significant (Wilcoxon test: $Z = 1.83$, $P = 0.06$, matched pairs n = 12,). In the first year the nests of disturbed pairs were placed significantly lower than nests of undisturbed pairs (Mann-Whitney test: $Z = –3.01$, $P = 0.002$).

3.2. Influence of nest visits on the breeding success

Of the 84 detected nests with a complete history, 46 (55%) were successful. Nests, which were not disturbed, had a slightly higher average success than visited ones (69.6% vs. 50.0%, respectively), but the difference was not significant (χ^2 with Yates correction = 0.48, $P = 0.48$). There was no significant difference in breeding success between nests visited one to three times and those visited four to seven times (χ^2 with Yates correction = 0.13, $P = 0.72$).

4. Discussion

We found a significant shift in the position of Great Grey Shrikes' nests; after being visited by observers, Great Grey Shrikes nested at a greater height in the following year. Conversely, the nest height change in pairs which were not disturbed was without any obvious trend.

Nest visits trigger anti-predator reaction where parents attack human intruders. Moreover, we found that disturbance in one breeding season can affect choice of nesting place made in the subsequent season. Our findings suggest that even a short-term increase of predation risk, in our case observer intrusion in the nest, induce change in the nest site selection regarding nest height or position. As predation is one of the most important causes of breeding loss, birds should respond adaptively to risks of breeding failure and predation. In general, birds apply several tactics of avoiding potential predators such as nest defence, shifting to a new territory (Marjakangas *et al*. 1997), or choice of a safer nesting place or nest box (Dow & Fredga 1983, Hakkarainen *et al*. 2001).

Many mammalian predators memorise and revisit the nest or places where they successfully preyed, and birds are able to estimate this risk (Marjakangs *et al*. 1997, Hakkarainen *et al*. 2001). It is possible, and worth additional research, that shrikes treat observers like any other kind of ground predator. Shrikes may be able to anticipate the return of a human intruder in the next breeding season, especially where we disturbed nests several times in a season. Yosef and Pinshow (1988) recorded nestling transfer in the closely related southern grey shrike *Lanius meridionalis* in response to observer visitation and in a situation where the chances of predation increased rapidly, e.g. by the presence of a predator near the nest.

In one interesting experiment by Hakkarainen *et al.* (2001), Tengmalm's owl *Aegolius funereus* responded to risk from a ground predator by shifting territories in consecutive breeding seasons. After being exposed to a pine marten *Martes martes*, male Tengmalm's owls changed to nest boxes with a smaller hole size that presumably were safer. The Great Grey Shrike males may benefit from a return to the former breeding territory for several reasons. Knowing the territory and the resources in it may be beneficial, and allow them to be more competitive to others at the stage of territory formation. If predation risk increases, a better choice than leaving the territory may be to simply stay in the territory but change the nesting place or the nest height. Indeed, shrike territories occupy areas with varied microhabitats, long ecotones and suitable perches (Tryjanowski *et al.* 1999) and such places are limited in a landscape with intensive agriculture. Hence, there may be a high pressure for male Great Grey Shrikes to reoccupy their breeding territory the next year.

In some cases, the breeding fate of the previous season may induce a shift in the nest site. Such an influence of former breeding success on dispersal and nest position change was reported in several studies and could be a general pattern among bird species (Dow & Fredga 1983, Marjakangas *et al.* 1997). During our study of the Great Grey Shrike in Poland, we did not find any negative influence of intrusive nest visits on breeding success. Furthermore, also successful shrike pairs placed their nests higher in the next season after disturbance, although this trend was not significant, probably due to limited sample size. Nevertheless, nests positioned higher up may possibly become more exposed to bird predators.

Despite a large body of published literature on shrikes (Lefranc & Worfolk 1997, Harris & Franklin 2000) there is still a lack of information about similar impacts on nest position in other shrike species. We suggest two factors responsible for these findings: other species of shrikes have different return rates to breeding places and/or habitat features. Fidelity to previous breeding territory in migratory species, like the lesser grey shrike *Lanius minor* or the woodchat shrike *Lanius senator*, is usually lower than in resident populations of the Great Grey Shrike. Therefore, the probability that "observer experienced" individuals return to former breeding sites is rather low (Krištín *et al.* 2000, Rehsteiner 2001). Even in intensively studied sedentary shrike species nest site shifts have not been documented. Intensively investigated resident populations of loggerhead shrike *Lanius ludovicianus* in Florida (Yosef 2001) or the southern grey shrike in Israel (Yosef 1992) occur in shrubby habitats and, therefore, the possibilities for building nests higher may be limited by the availability of taller trees or shrubs. In contrast, shrikes in our study area inhabit woodlots

and rows of trees in different successional stages which consequently have trees which vary strongly in height (Antczak *et al.* 2004). Thus, in contrast to the above mentioned populations, Great Grey Shrikes have considerable possibilities for vertical shifts in nest places in our population.

Experience with different kinds of predator and predation avoidance is projected into individual fitness. It is possible that adult birds apply different strategies according to their experience from previous breeding seasons and predator types. Plasticity of adaptive anti-predator behaviour of the birds, regarding various predation factors offers great possibilities for future research, especially for more detailed experimental studies.

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Pesilläkäynti aiheuttaa muutoksia isolepinkäisen (*Lanius excubitor*) pesäpaikan sijoittumisessa

Isolepinkäinen, *Lanius excubitor*, kuten muutkin heimon Laniidae pitävät ihmistä mahdollisena petona ja puolustavat aktiivisesti pesiään vierailijoita vastaan. Seurasimme ihmisten pesilläkäyntien vaikutusta isolepinkäisen pesintämenestykseen ja pesimiskäyttäytymiseen Länsi-Puolassa suoritetun intensiivisen kenttätutkimuksen aikana. Vertailimme pesien sijoittumista häirittyjen ja häiritsemättömien parien välillä. Pesälläkäynneillä tai niiden määrällä ei havaittu olevan negatiivisia vaikutuksia isolepinkäisen pesimismenestykseen. Sen sijaan ne parit, joita yhtenä vuotena oli häiritty, tekivät seuraavana pesimiskautena pesänsä merkitsevästi korkeammalle kuin edellisenä kautena.

Häiritsemättömät parit taas eivät muuttaneet pesiensä korkeutta lisääntymiskausien välillä. Tämä viittaa siihen, että jopa lyhytaikainen pesäpredaatioriskin kasvu ihmisen vierailun johdosta laukaisisi adaptiivisen toiminnon pesätuholaista vastaan. Tulokset osoittavat, että lepinkäiset pitävät ihmistä petona ja pystyvät ennakoimaan saalistajan todennäköisen paluun seuraavana pesimiskautena. Tämä tulos on kiinnostava, koska linnut reagoivat selvästikin tarkoituksenmukaisesti pesimällä korkeammalle maapedon pesälle tunkeutumisen jälkeen.

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