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Ground nesting in recultivated forest habitats — a study with artificial nests

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Abstract. The study was carried out in the outskirts of the town of Pécs (southern Hungary) in a recultivated former coal mine. Bordered by Turkey Oak forests, this open area forms a wedge-shaped clearing in that woodland. Since trees and taller shrubs are rare in the area, it is mainly ground nesting bird species that occur in the clearing. In order to discover whether it is more advantageous to nest in the recultivated area (clearing) than in the nearby forest or at its edges, 150 artificial ground nests were constructed. On 7 May 2002, one quail egg and a plasticine egg of similar size were placed in each of the artificial nests. After a week it was found that 24% of nests in the clearing, 30% of those in the forest edge, and 44% of the ones inside the forest had suffered depredation. The proportions of damaged plasticine and quail eggs inside the forest and at the forest edge were similar, whereas the quail eggs in the clearings were significantly less damaged than plasticine eggs. Of all the experimental eggs, significantly more plasticine eggs (29%) were damaged than quail eggs (17%), which suggests that small-bodied predators are unable to break the quail eggs. 18% of the plasticine eggs attacked, and 72% of the quail eggs attacked were removed from the nest by the predator. Among the predators, small mammals were dominant in the clearing and inside the forest, and birds at the forest edge. Based on the predation of quail eggs, the survival chances of ground nests in the clearing are greater than at the forest edge or inside the forest.

Key words: artificial ground nest, plasticine egg, quail egg, nest predation, recultivated area

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INTRODUCTION

Many recultivated areas like dumps or spoils formed as a result of mining despite forestation activities that have been going on for a couple of years, are still covered with mostly herbaceous vegetation. Recolonisation by native mammals and birds will be more rapid if original tree and bush species are present (Szegi et al. 1988). Since trees and taller shrubs are rare in the recultivated area, mainly ground nesting bird species occur there. In these areas and in adjacent forests and forest edges, the survival rates of ground nesting bird nests are most likely to differ, due to unequal predation pressure. Experiments with artificial nests have proved that predation rates differ between habitats (e.g. Santos & Telleria 1992, Seitz & Zegers 1993). Nest predation significantly influences nesting success (e.g. Skutch 1949, Martin 1995, Saether 1996). It would be interesting to know if a recultivated area (a clearing) has its own predator fauna, and how successful nesting can be in these newly created habitat types.

Artificial nests have been widely used as a surrogate for natural nest to elucidate patterns of nest predation (e.g. Møller 1987, Gibbs 1991, Seitz & Zegers 1993). Ortega et al. (1998) found that predators respond differently to natural and artificial nests. Davison & Bollinger (2000) suggest that future artificial nests studies should use nests and eggs that mimic the real nests and eggs of the target species as closely as possible. According to Pärt & Wretenberg (2002) artificial nests may only predict the risk for real nests when the nest predator species are similar among the two types of nest. Despite these, the number of artificial nest studies addressing ecological questions has continued to grow exponentially (Moore & Robinson 2004). By applying artificial nests and plasticine eggs together with quail eggs we have intended to find out 1) if ground nests are safer in a clearing, in the forest edge or inside the forest, 2) if there is any difference between the three habitat types in respect of predation on plasticine and quail eggs, 3) if predation on plasticine and quail eggs is different within the same habitat type, and 4) to what degree one can allude to the predator fauna of the various habitats, based on the damage caused to quail eggs and plasticine eggs.

STUDY AREA AND METHODS

Coal mining in the north-eastern suburb of town Pécs (south Hungary) was launched in 1968. The pit is bordered from the west by the eastern slopes of Misina (535 m a.s.l.), the southernmost summit of Mecsek Hills. Opencast mining in the Karolina pit is still in operation. The northern part of the mine, covering approximately 15 hectares is recultivated. The covering layer is overgrown by herbaceous vegetation of the initial stage of primary succession (Purger et al. 2004). The recultivated area is bordered from the east, north and west by Turkey Oak forests (*Potentillo micranthae-Quercetum daleschampii* Horvát A.O. 1981). In order to survey ground nesting birds and their possible predators, the study area was visited in the spring of 2002. There were only three species that were found to be present in all of the three habitat types (clearing, forest edge, inside forest): Pheasant *Phasianus colchicus*, Nightjar *Caprimulgus europaeus,* and Yellowhammer *Emberiza citrinella*. Among potential predators, we noted the presence of Red Fox *Vulpes vulpes*, Wild Boar *Sus scrofa*, Stone Marten *Martes foina,* Pine Marten *M. martes* and Jay *Garrulus glandarius*.

Experimental nest predation studies applying artificial nests and eggs have contributed significantly to learning about breeding success and nest predation (e.g. Paton 1994, Major & Kendal 1996, Söderström et al. 1998, Báldi 1999). With a view to the characteristics of the area, an amount of 150 artificial ground nests appeared to be optimally applicable. Ground nest were formed by creating a depression in the soil using our heel, and then lining it with leaf litter collected in situ (Marini et al. 1995, Fenske-Crawford & Niemi 1997). Nests were created at a distance of 20 metres from each other (e.g. Bayne & Hobson 1999): 50 nests in the forest interior, 50 in the forest edge and 50 in the clearing. Nests in the forest interior and in the clearing were aligned parallel with the forest edge (Lewis & Montewecchi 1999), at a distance of ca. 30 metres from them. On 7 May 2002 one quail egg and one plasticine egg of similar size was placed in each of the nests. Both types of eggs were stored outdoors for one week prior to the experiment. Before lining the artificial nest and positioning the eggs, we thoroughly rubbed our hands with leaf litter taken from the ground (Báldi 1999). For marking the location of the nests, a piece of pale pink flagging tape attached to a thin stick was used (Fenske-Crawford & Niemi 1997), which was positioned 1 m away from the nest, always in the same direction.

The content of the nests was checked on the first (8 May), second (9 May), fourth (11 May) and seventh (14 May) day after placement, between 16.00-20.00 hours each time. At the time of the last checking, all remaining eggs as well as index flags were collected and removed from the area. A nest was considered to have been depredated if either type of egg was missing or was damaged in some way (pecked, gnawed at, or trodden on, etc.).

In the statistical analysis G test for goodness of fit was used in two categories, and when df = 1, the Yates correction for continuity was applied (Zar 1999). A minimum probability level of $p < 0.05$ was accepted for all the statistics.

RESULTS

Altogether 24% of ground nests in the clearing, 30% in the forest edge, and 44% inside the forest were depredated ($G = 3.35$, df = 2, ns). The rate of damage to plasticine eggs was similar in the three habitats (24%, 24%, 40%) ($G = 3.17$, df = 2, ns). However, predation on quail eggs in the habitat types (clearing — 4%, forest edge — 22%, forest interior — 24%) differed significantly ($G = 9.35$, df = 2, $p < 0.01$). About 96% of quail eggs in ground nests of the clearing remained intact, this predation rate being significantly lower than that in the forest edge ($G_c = 5.29$, df = 1, $p < 0.01$), or inside the forest ($G_c = 6.27$, df = 1, $p < 0.01$, Fig. 1).

Predation on quail eggs in the clearing was significantly lower ($G_c = 6.27$, df = 1, $p < 0.01$), than that of plasticine eggs. However, predation on the two types of eggs was similar both in the forest edge ($G_c = 0$, df = 1, ns) and inside the forest ($G_c = 1.54$, df = 1, ns, Fig. 1).

During the course of one week, 29% of plasticine eggs and 17% of quail eggs in the 150 artificial nests suffered some sort of damage ($G_c = 4.75$, df

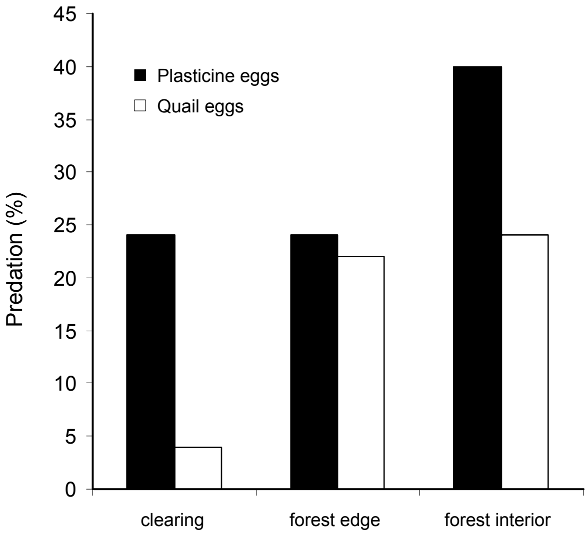

Fig. 1. Predation rate on artificial nests mounted in the three habitats.

= 1, $p < 0.05$). One quail egg was trodden on by a Roe Deer *Capreolus capreolus* (4%). The predators broke open and consumed 6 quail eggs (24%) in the nest, and took away a total of 18 (72%). Only 18% of damaged plasticine eggs were taken away, and marks of gnawing (59%), pecking (18%) and treading (5%) were observed on those that remained in the nests (Fig. 2).

The chances for plasticine eggs to disappear from the nests were greater in the forest edge. Treading (hoof marks on plasticine eggs) occurred in the clearing and in the forest edge. Damage to plasticine eggs in the clearing and inside the forest was caused mostly by small mammals (teeth marks), whereas in the forest edge birds (beak marks) were dominant (Fig. 2).

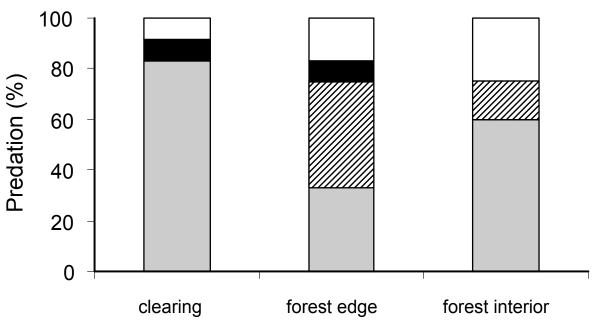

Fig. 2. Rate of damage to plasticine eggs in the three habitats (grey bars — gnawing, hatched bars — pecking, black bars — treading, white bars — taken from nest).

DISCUSSION

Results from artificial nest experiments may be highly dependent on the type of egg used, and caution is advised in their interpretation (Lindel 2000). As Pärt & Wretenberg (2002) suggested, nest predation on artificial nests did predict relative predation risk for real nest only when quail egg depredation was used as the criterion for artificial nest predation.

If predation on quail eggs is considered to be the indicative factor, our results suggest that it is more advantageous for ground nesting birds to nest in clearings and in open areas. In the same recultivated area the survival chances of nests in the bush were significantly greater than of those in the forest edge. This was the case also when the nests contained only one plasticine or quail egg (Purger et al. 2004). Santos & Telleria (1992) also found higher predation rates in forest patches than in agricultural land. Seitz & Zegers (1993) reported that survival of nests in successional habitats was greater than survival in the coniferous and deciduous habitats. Differences in predation among the three habitats may be due to anthropogenic factors as well as to other characteristics of the surrounding landscape (Seitz & Zegers 1993). In the study area where today there is a clearing, opencast coal mining used to proceed for several years, followed by restoration works, causing continuous disturbance for another few years. Despite all this, there are birds nesting in the clearing. During the creation and checking of ground nests one Pheasant nest and four Yellowhammer nests were discovered there. Another Yellowhammer nest was found in the forest edge and one inside the forest. Nightjars could be identified as being present in the area only by their calls. The suitability of quail eggs and plasticine dummy-eggs for modelling the nests of ground nesting bird species of the particular area is only limited, since the clutch sizes of these species are different. Large open nests suffered higher rate of predation than small open nests (Sasvári et al. 1995). The size and shell-thickness of eggs used in artificial nest studies can affect predation frequency (Maier & DeGraaf 2000). According to Niehaus et al. (2003) predation on quail eggs was greater in forest edges than in the interior, whereas Zebra Finch *Poephila guttata* egg predation was high in both forest edge and interior locations. The current frequency of predators, relative to the number of nests, also has an effect on nest survival. The ratio of rodent to corvid predators was found to be highest in years when rodent abundance peaked

– this effect was clear in the case of Yellowhammers (Weidinger 2002). One major difference between artificial and natural nests is that there are no parent birds with artificial nests. Parent birds may defend their nests from predators (MacIvor et al. 1990) or may attract the attention of predators by their movements, smell or noise made at the nest (Matthews et al. 1999).

According to Bayne & Hobson (1999) plasticine eggs do not attract predators better than quail eggs, yet, the number of plasticine eggs suffering damage in the clearing was much higher than that of quail eggs. The reason for this difference is revealed by the marks left on plasticine eggs by various small mammals (shrews, voles and wood mice): certain predators, especially small-bodied mammals, are unable to break up the shell of quail eggs (Fenske-Crawford & Niemi 1997, Maier & DeGraaf 2000, Zegers et al. 2000). In our study more than 80% of depredated plasticine eggs in the clearing were damaged by some small mammals. Nests containing plasticine eggs were depredated more often than nests containing only quail eggs and finch eggs (Rangen et al. 2000). The higher predation on nests with plasticine eggs may have resulted because small mammals, relying on olfactory cues, comprised a large portion of the predator assemblage (Rangen et al. 2000).

The fact that the majority of disappearing plasticine and quail eggs were taken from nests situated in the forest edge and inside forests suggests that larger predators capable of carrying eggs away usually do not leave the forest. Based on the marks observed on plasticine eggs left behind in the artificial nest it can be concluded that the most active predators in the forest edge are birds. Impressions from pecking at the dummy eggs were left behind by Jays in most of the cases. Similarly to our results, Söderström et al. (1998) found that Jays may be important predators on nests located close to forest edges. These authors also reported that ground nests located inside the forest and in the forest edge were exposed also to predators that search for birds nesting in shrub and on trees (Söderström et al. 1998). According to Melampy et al. (1999) ground nests suffered significantly more predation than tree nests, indicating that mammals were the primary predators. Moreover, not only the typical mammal predators can damage ground nests, but also Roe Deer and Red Deer *Cervus elaphus* grazing in the clearing. Nest treading by grazing farm animals, especially by sheep, has been reported by Pescador & Peris (2001), but these authors also suggest that herding dogs can cause greater damage than the herds themselves. In the majority of ground nests in the clearing we found, besides the intact quail eggs, toothmarks left on the plasticine eggs by small mammals. These predators do not mean a considerable threat to quail eggs or to other larger eggs (Pheasant, Nightjar). Maier & DeGraaf (2001) found that plasticine eggs were marked by mice more than any of the studied real eggs. Small mammals, however, were successful in breaking up smaller eggs with thinner shell, e.g. Zebra Finch eggs were breached more often than House Sparrow *Passer domesticus* eggs (Maier & DeGraaf 2001). Yellowhammer eggs, smaller than quail eggs, are not safe from these predators either, unless the parent birds successfully repel the attacks with their nest defending behaviour. Our artificial nest experiment results suggest that the survival of real ground nests is greater in the clearing (recultivated area) than in the forest edge or inside the closed forest. This is mainly due to the fact that no permanent predator fauna has developed in the recultivated areas (man made habitats). Eggs exposed in the nests could be damaged only by small mammals and grazing game animals.

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STRESZCZENIE

[Presja drapieżników na lęgi ptaków gniazdujących na ziemi na terenach objętych rekultywacją — badania przy użyciu sztucznych gniazd]

Badania prowadzono na części terenu kopalni węgla objętym rekultywacją. Teren ten otoczony jest drzewostanem liściastym, z dominacją dębów, porośnięty jest roślinnością zielną. Badania miały na celu ocenę czy gniazdowanie na terenie poddanym rekultywacji jest bezpieczniejsze niż w otaczającym lesie lub na jego skraju. W każdym z wyróżnionych środowisk: wnętrzu lasu, skraju lasu i na terenie otwartym wyłożono po 50 sztucznych gniazd. Gniazda w każdym transekcie oddalone były od siebie o ok. 20 m, do każdego wyłożono do nich po jednym jaju przepiórczym i jednym wykonanym z plasteliny. Po tygodniu od wyłożenia jaj stwierdzono, że udział gniazd znalezionych przez drapieżniki był podobny w każdym z transektów (Fig. 1). Jednakże rozpatrując wyłącznie drapieżnictwo na wyłożonych jajach przepiórczych, stwierdzono istotnie mniejsze drapieżnictwo na terenie otwartym niż w lesie i na jego skraju (Fig. 1). Ślady pozostawiane na jajach wykonanych z plasteliny sugerują, że głównymi drapieżnikami skraju lasu były ptaki, natomiast na terenie otwartym i w głębi lasu — ssaki (Fig. 2). Analizując wyniki z wszystkich gniazd znacząco więcej jaj plastelinowych nosiło ślady drapieżników (29%), niż zostało zniszczonych jaj przepiórczych (17%), co wskazuje, że drobne ssaki nie są zdolne do przebicia skorupy jaj tej wielkości. Uzyskane wyniki wskazują, że w przypadku większych ptaków (bażant, lelek), presja drapieżników na lęgi może być mniejsza na terenach otwartych, niż w otaczającym tereny rekultywowane lesie.