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Bird nest predation in a southern Tunisian oasis habitat: No evidence of “edge effect”

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ABSTRACT

Numerous ornithological studies conducted in patchy habitats have linked high intensity of nest predation with habitat edges. This “edge effect” hypothesis was primarily investigated in temperate, boreal and tropical fragmented forests, and there is a need for investigations from different habitat systems. Here we provide the results of one study on bird nest predation in relation to edge context in one oasis in southern Tunisia. Our aim was to assess the importance of nest predation as a source of nest failure in the studied oasis and to test if the edge effect hypothesis applies in this habitat system. We found that although predation represents an important source of nest failure in all studied species, the edge effect hypothesis does not seem to apply in the studied oasis. Indeed, daily nest predation rate did not vary with edge context for all studied species, which could be explained by the fact that nest predator guild is mainly composed of small species that use oasis interior and edges in similar ways. The effects of predators coming from the surrounding areas do not seem to significantly increase nest predation rates in oasis edges compared to oasis interior. We also found that nest predation rates were similar for all bird species, suggesting that among-species differences in nest concealment and nesting behaviour did not seem to account for nest survival in the studied oasis. However, further more detailed species-level studies are needed to test this hypothesis and to identify more accurately the determinants of nest predation in the oasis habitat.

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1. Introduction

Edge-related nest predation is thought to be one of the most important factors causing declines in bird populations in fragmented habitats (Yahner, 1988). Several studies have shown that predation levels are higher near edges than in the interior of habitats (Gates and Gysel, 1978; Wilcove, 1985; Temple, 1986; Andrén and Angelstam, 1988; Paton, 1994;

Söderström, 1999). These higher predation levels near edges have typically been attributed to elevated generalist predator density and/or increased diversity at edges compared to the interior of habitats. In addition, some predator species may concentrate their prey searching at habitat edges as a response to the high density of prey found at the edge (Andrén, 1992; Nour et al., 1993). In this context, it has been hypothesised that edge effect is most likely to occur where

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there is a steep gradient in primary productivity across the edge and is least likely to occur where this gradient is less pronounced: the “primary productivity hypothesis” (Angelstam, 1986).

Although investigating edge effect on nest predation is important for understanding the ecology of bird populations in patchy habitats and for conservation purposes, this issue has almost exclusively been addressed in fragmented temperate, boreal and tropical forests (e.g., Gates and Gysel, 1978; Wilcove, 1985; Temple, 1986; Andrén and Angelstam, 1988; Paton, 1994; Söderström, 1999). However, the general tendencies found by these investigations and the proposed explanatory hypotheses do not necessarily apply for other patchy habitats, such as isolated woodlots in desert environments. For instance, desert patchy wooded habitats such as oases cannot be expected to behave like temperate and tropical systems, and patterns of edge effect on nest predation in these woody habitat systems could not be expected to be similar to those known in temperate and boreal forest systems. Here we provide one study on predation on natural bird nests in one oasis in southern Tunisia. Our main goal was to investigate if the edge effect hypothesis applies in this system.

Tunisian oases can be defined as permanent agro-ecosystems mainly characterised by palm trees, and which are directly dependent on the availability of water and on human activities for irrigation and maintenance (Kassah, 1996; Selmi and Boulinier, 2003). The existence of an oasis is conditioned by two main factors: the emergence of ground water as springs and the use of that water by humans for irrigation. Although the history of these oases is poorly known, there is some evidence that during the Roman occupation of Tunisia (from 105 BC to 429 AD), southern Tunisia contained several oases (Troussel, 1987). Within oases farmers classically use traditional farming methods to exploit in many different ways the available water and arable land, and to diversify the agricultural products (dates, other fruits, cereals and vegetables, livestock) in order to satisfy the needs of a subsistence local economy. Oasis is thus composed of relatively small and contiguous private fields. Over centuries, this traditional agricultural system has allowed the development of thick vegetation composed of a mixture of cultivated and spontaneous plants and organised on three main layers: palm trees, fruit trees and herbaceous plants. This thick vegetation provides a marked climatic contrast with the desert environment (Riou, 1990), which has allowed the establishment of many non desert-adapted bird species (Selmi, 2000; Selmi and Boulinier, 2003).

In a previous study, it has been demonstrated that the main predators of bird nests in Tunisian oases are small snakes, small mammals (rodents, genet and cats), but also humans (Selmi, 2004). Snake species, as well as rodents and genet inhabit oases and seem to have important impacts on bird eggs and nestlings. However, cats are originally domestic animals that were abandoned by their owners. They live free in urban areas as well as inside oases in a semi-feral manner. With regard to humans, previous observations have shown that children often search for bird nests and remove them as a spare-time activity (Selmi, 2004). Thus the oasis habitat suffers substantial effects, in terms of predator contribution,

from urban areas, while the effects of the surrounding desert seem to be negligible. Indeed, few if no arboreal predator species inhabit the desert area and can be expected to visit oasis for foraging. Because cats and children can be expected to more abundantly occur in the part of oases close to human settlements (suburban edge), we predict more important nest predation rates near human settlements (suburban edge) than in oasis interior and near the desert (desert edge). The specific objectives of our work were thus to answer the following questions: (1) does bird nest density vary from oasis interior to edges? (2) Is there any significant difference between oasis interior habitat and edges regarding nest predation intensity? (3) Is there any relationship between predator type and edge context?

2. Methods

2.1. Study area and species

Data used in this work was collected in Kettana oasis (33° 45' N, 10° 13' E) in south-eastern Tunisia, from April to July 2005 and again from April to July 2006. The study area was bordered from the north-west by the desert and from the south-east by an urbanised area (Kettana village) (Fig. 1). Kettana oasis is 464 ha large and corresponds to a mosaic of small and contiguous private fields within which the vegetation is composed of palm trees, fruit trees (mainly olive, *Olea europea* and pomegranate, *Punica granatum* trees) and a great variety of spontaneous and cultivated herbaceous plants. Within a given field, vegetation structure strongly depends on the choices made by the field owner rather than on field position within the oasis. The history of this oasis is poorly known, but like all traditional oases in south-eastern Tunisia, it seems to be very old.

Breeding bird community in the studied oasis includes species that are strongly associated with woody vegetation for foraging and nesting and that can rarely be observed in the surrounding desert, such as the Common Blackbird *Turdus merula*, Rufous Bush Robin *Cercotrichas galactotes*, Chaffinch *Fringilla coelebs*, Serin *Serinus serinus*, Orphee Warbler *Sylvia hortensis*, Western Olivaceous Warbler *Hippolais opaca*, Woodchat Shrike *Lanius senator*, Hoopoe *Upupa epops*, Turtle Dove (*Streptopelia turtur*) and Laughing Dove *Streptopelia senegalensis* (Selmi, 2001). Potential mammal nest predators inhabiting the study area were rodents, especially Black Rat *Rattus rattus*, Common Genet *Genetta genetta* and Domestic Cat *Felis domestica*. Potential nest predators among snakes are Egyptian Cobra *Naja haje*, Viperine Snake *Natrix maura*, Balearic False Smooth Snake *Macroprotodon cucullatus*, Montpellier Snake *Malpolon monspessulanus*, Schokari Sand Racer *Psammomys chokari* and Algerian Whip Snake *Coluber algirus*. These mammal and reptile species are known or suspected to consume bird eggs and/or nestlings in southern Tunisian oases (Selmi, 2004). Among the cited nest predators, rodents, genet and snakes could be considered as feral, while cats can be considered as semi-feral (see introduction). With regard to corvids, which are generally considered as important nest predators in forest systems (e.g., Andrén, 1992), they seem to have no effect on bird populations in the studied oasis. The

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