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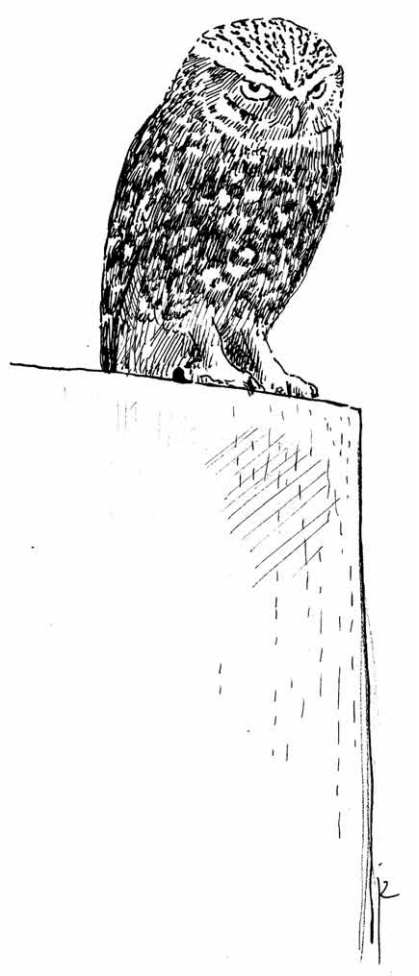
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Social interactions between two owl species sometimes associated with intraguild predation

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Species may act simultaneously as competitor and predator for other species at the same trophic level. This is known as Intraguild Predation (IGP). Most research on this topic describes the final steps of this phenomenon, when one species suffers lost progeny or decreased numbers due to predation and competition by another species. However, little is known about the mechanism that regulates this interaction in previous steps. In this work two species of the same guild (Little Owl *Athene noctua* and Barn Owl *Tyto alba*) were selected to test the hypothesis that the hunting and social behaviour of the Little Owl would be conditioned by the presence of Barn Owls. Nine Little Owls were radio-tracked and monitored for nine months. 1223 fixes were obtained and 250 hours of listening were recorded. Moreover, during this time Barn Owls were detected 66 times screeching, hunting or flying in the same areas as the monitored Little Owls. The subsequent activity (movements and voices) of tagged and untagged Little Owls was observed during 30-minute periods. The results show that Little Owl behaviour was affected by Barn Owl presence. When Little Owls noted the presence of Barn Owls, they stayed quiet and silent, or alternatively, sought refuge in the branches of trees or in secure holes in buildings, resuming their activities minutes later, when the risk of predation was presumably lower. This behaviour may have enabled survival and successful breeding of Little Owl in close proximity to Barn Owls.

Key words: *Athene noctua,* Barn Owl, competition, IGP, Little Owl, vocal behaviour*, Tyto alba*

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INTRODUCTION

Intraguild Predation (IGP) refers to the observation that many species act as both competitor and predator for other species at the same or similar trophic level (Polis *et al.* 1989, Morin 1999). IGP is a taxonomically widespread interaction within communities, which can occur at different trophic levels and has the potential to affect the distribution, abundance and evolution of the species involved (Sih *et al.* 1985, Polis *et al.* 1989, Kruger 2002, Arim & Marquet 2004). IGP systems are usually asymmetrical and size-based, with a larger, dominant species preying on a smaller one (IG prey) (Sergio *et al.* 2003, 2007). Research has shown that in these conditions, the IG prey may reduce conflict with its predator by resource partitioning and spatial avoidance (Sergio *et al.* 2003, Zuberogoitia *et al.* 2005). The interaction level and the effects on the IG prey are difficult to assess and sometimes casualties caused by direct predation are almost negligible (Palomares & Caro 1999, Zuberogoitia *et al.* 2005). In many IG prey, conflict arises between scanning for predators and foraging because both require time and visual attention (Cresswell *et al.* 2003). Empirical data confirm that predators select the most vulnerable rather than the most available prey (Quinn & Cresswell 2004). Hence, the behaviour of IG prey might be affected by the presence of the IG predator.

Bird calls are of great importance for social interactions. Indeed, the songs of many bird species are sexual signals that convey information on individual qualities and play a relevant role in advertising territory ownership and mate attraction (Galeotti & Pavan 1993, Appleby & Redpath 1997). However, certain IGP risks pertain to calling by making the caller vulnerable to attacks, and we studied whether IG prey indeed change their calling rate when in danger from the IG predator.

In some owl guilds, Barn Owl *Tyto alba* and Little Owl *Athene noctua* share similar hunting grounds and food items, such as rodents, shrews, lizards, snakes and small passerines (Mikkola 1983, Goutner & Alivizatos 2003, Zuberogoitia 2002). Barn Owls are known to prey on Little Owls and show aggressive behaviour towards them (Mikkola 1983, Sgorlon 2004, Zuberogoitia *et al.* 2005). Therefore, we tested the hypothesis that the hunting and social behaviour of the Little Owl could be affected by the presence of Barn Owls.

METHODS

The study was conducted in Mungia valley (Bizkaia, Northern Spain) in a 1-km^2 area dominated by grass fields dedicated to cattle and little orchards. We captured nine Little Owls using mist nets, and radio-tagged and radio-monitored them between January and September 2004. Radio-tags were slung over the back, using Teflon harnesses (Biotrack, Dorset, UK). All nine Little Owls survived throughout the study period.

Radio-tracking was conducted three or four times per week, under every kind of weather conditions. We used the point sampling method, recording the same number of locations for each individual at the same times of day, thus avoiding bias from autocorrelation, timetabling seasonal changes or other factors (Kenward 2001). We started monitoring at dusk for three hours each day. A hand-held 3-element Yagi antenna, a TRX-1000S receiver (Wildlife Materials Inc. Carbondale, USA), a Sika model receiver (Biotrack, Dorset, UK) and a RX8910 receiver (Televit International AB) were deployed on foot with three teams connected by walky-talky. A total of 1223 fixes were taken within 50 m of the animal using the homing technique (White & Garrot 1990) with an accuracy of 4 m^2. The artificial lights around the study area helped us find the exact location of the individual and observe its behaviour.

We radio-tracked owls and listened to owl calls simultaneously for a total of 250 hours. We recorded every Little Owl calling. Sometimes, almost all monitored Little Owls and other non-tracked Little Owls were in the same foraging field at the same time, even more than 12 Little Owls were observed in the same 100x100 m field. Hence, we recorded every data identifying monitored owls and determining the number and behaviour of unknown owls. In addition, we

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recorded every Barn Owl detected screeching, hunting or flying <100 m from the monitored Little Owls. The subsequent activity (movements and voices) of previously monitored Little Owls was observed during a 30-minute period, which was established *ad hoc* as being sufficient time to observe a behavioural response to the presence and detection of the potential predator. During this period we waited for every call produced by the Little Owls which had been detected in the area. We recorded the time lapse between the Barn Owl appearance and the first voice detected.

Statistical analyses

We performed a Chi-square test in order to detect relationships between Barn Owl presence and voice behaviour of Little Owls. We considered the number of cases in which Little Owls were calling or not calling before the Barn Owl presence. Next, we considered the number of cases in which any Little Owl was/was not detected calling in the considered area during the 30-minutes lapse. Alpha value was set at 0.05 in all cases.

RESULTS

Nine Little Owl nests and four Barn Owl nests were found in the study area; all of them in buildings. Little and Barn Owls shared the same building in three cases. Little Owls bred successfully in four cases (44.4%) and Barn Owls in two cases (50%). Little Owl nests were located in small holes in roofs or walls, which Barn Owls could not access, while the nests of the latter were located in lofts. During the study period none of the monitored Little Owls was predated by Barn Owls. However, in 2002 we had detected the feathers of a Little Owl chick eaten by a Barn Owl pair.

In the 250 hours of listening effort during the study period, we recorded Little Owl vocalizations with an average frequency of 1.87/hour (SD = 2.18) corresponding to an average of 415 seconds of vocal activity per hour (SD = 1248).

Barn Owls were detected 66 times close (<100 m) to monitored Little Owls during the study period. On these occasions, the Little Owls stayed very quiet on the perch (57 cases) or moved to a sheltered perch in a tree (5) or inside a building (4). There was a significant association between the presence of Barn Owls and the silent response of Little Owls ($\chi^2_1 = 11.21$, $P < 0.001$, Table 1). The number of Little Owls that called after Barn Owl detection was lower than expected. Whether Little Owls were silent or not before the appearance of the Barn Owl did not change the results ($\chi^2_1 = 0.959$, NS). Little Owls resumed vocal activities 14 minutes after Barn Owl presence (Table 1).

DISCUSSION

Our results show that the presence of Barn Owls does influence the behaviour of Little Owls. Both species share the same resting, breeding and forag-

Table 1. Vocal behaviour of Little Owls in a 30-minute period when a Barn Owl was detected screeching, hunting or flying <100 m from the monitored Little Owls. Five situations were considered depending on the behaviour of Little Owls before appearance of a Barn Owl (calling or not), and on the behaviour afterwards (no calling, continue calling, start or resume calling after several minutes). Given is the number of cases observed for each situation. Period = average period in minutes after appearance of Barn Owl.

Calling before Barn Owl presence	No calling after	Continue calling	Start/resume calling	Period (min)
No (23 cases)	15	-	8	14.37
Yes (43 cases)	27	2	14	13.71

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ing places, and occasionally Barn Owls prey on Little Owls (Mikkola 1983, Zuberogoitia *et al.* 2005), although predation was not observed during the study and must therefore be rather uncommon. This relationship obliges Little Owls to develop a defence mechanism based on frequent scanning and an active avoidance of behaviours that might make them vulnerable, such as vocalising or moving to exposed perches that could attract the attention of the predator. When Little Owls noted the presence of Barn Owls, they stayed still and silent or alternatively sought refuge in the branches of trees or in secure holes in buildings, resuming their activities some minutes later, when the risk of predation was presumably lower. This behaviour seems to be sufficient to have ensured or at least increased the chances of survival of Little Owl individuals, since 1) all nine monitored birds were alive after nine months of radio-tracking, despite having been exposed to foraging Barn Owls; 2) two of the Little Owls had been ringed several years previously and had presumably been living and breeding in the same conditions for a long time; 3) four females were able to breed and raise owlets successfully even when they shared the same breeding or roosting places with breeding Barn Owls. These results suggest that the predator did not directly reduce the breeding success and lifespan of the prey (see for example Sergio *et al.* 2003, Petty *et al.* 2003). We suppose that the IGP mechanism first acts on the behaviour of the IG prey, which normally is not studied and therefore the consequences are poorly reflected in traditional field studies of breeding success, survival rates or occupancy. In this sense, we have demonstrated that Little Owl behaviour was shaped by IGP, where the final consequences (severe reduction of breeding success or survival) were not yet evident.

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SAMENVATTING

Er zijn soorten die met elkaar concurreren om dezelfde prooien, maar waarvan de ene soort ook moet vrezen door de ander te worden opgegeten. Dit wordt Intraguild Predation genoemd. Veel van het onderzoek hiernaar richt zich op de werkelijke predatie en kijkt niet hoe de soorten het gedrag van elkaar beïnvloeden. Het onderhavige onderzoek beschrijft hoe het gedrag van Steenuilen *Athene noctua* in Spanje beïnvloed wordt door de aanwezigheid van Kerkuilen *Tyto alba*. Beide soorten waren in het studiegebied in hoge dichtheden aanwezig, met soms wel 12 Steenuilen jagend op één hectare. Een deel van de Steenuilen werd voorzien van een kleine radiozender. Deze vogels werden gedurende het gehele jaar gevolgd. Tijdens de waarnemingen was soms een Kerkuil in de nabijheid aanwezig. De Steenuilen reageerden hier sterk op door geen geluid meer te maken en niet meer te bewegen of door zich te verbergen. Deze reactie duurde gemiddeld een kwartier, waarna de Steenuilen zich weer normaal gingen gedragen. Het lijkt er dus op dat Steenuilen niet alleen last hebben van Kerkuilen omdat ze deels hetzelfde voedsel eten, maar ook doordat ze minder tijd aan foerageren kunnen besteden. (CB)

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