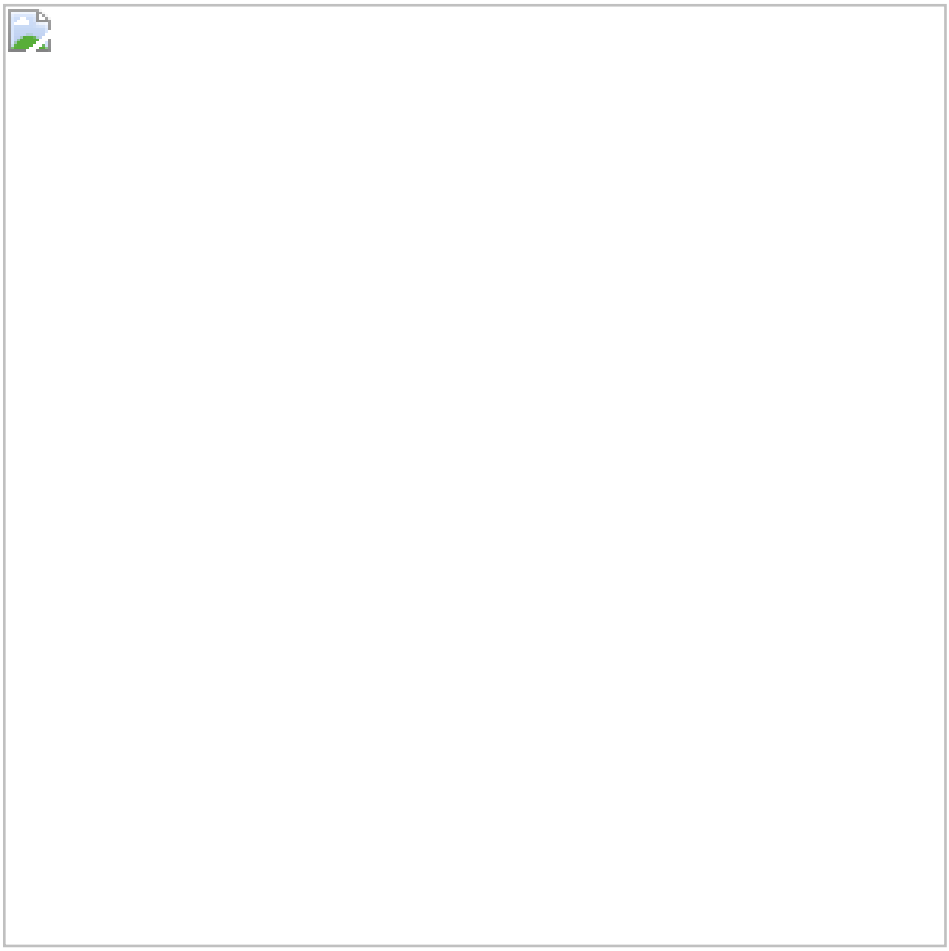

Nest-Box use by the Barn Owl Tyto alba in a Biological Pest Control Program in the Beit She'an Valley, Israel

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Nest-box use by the Barn Owl *Tyto alba* in a biological pest control program in the Beit She'an valley, Israel

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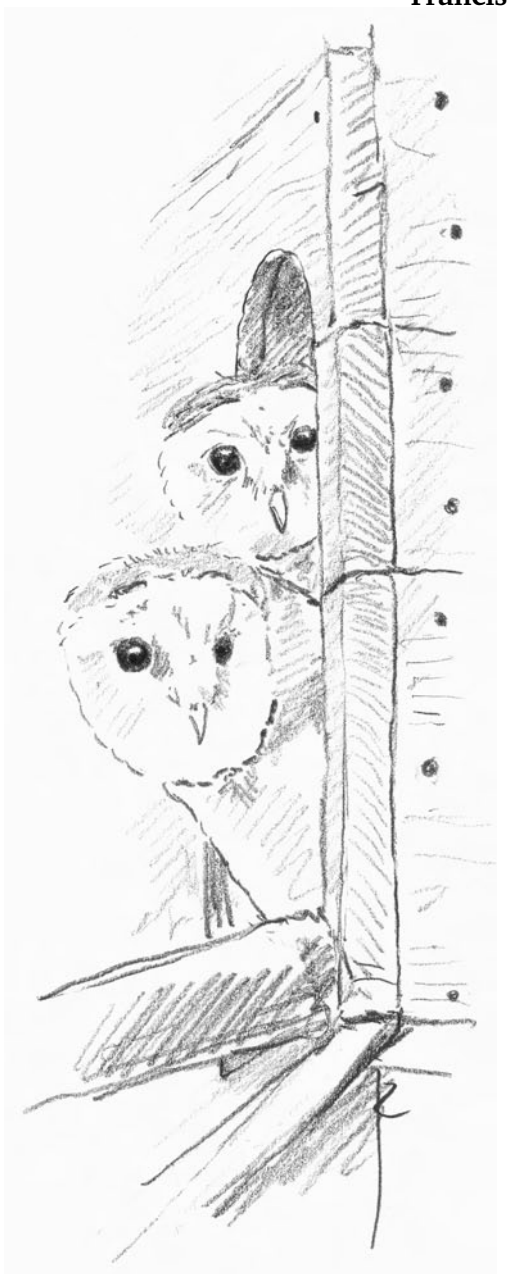

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Starting in 1983, nest boxes for Barn Owls *Tyto alba* were erected as part of a biological pest control program to deal with rodents, in Kibbutz Sde Eliyahu, and later in other agricultural fields and plantations in the Beit She'an valley, Israel. More than a decade ago, the nest box scheme was extended to include other agricultural areas in the valley, and grew from 14 boxes on 3 km^2 in 1983 to about 300 boxes on 90 km^2 throughout the entire Beit She'an valley in 2007. Here we present the results of a study during the 2002 through 2006 breeding seasons, in which 156 to 243 nest boxes were monitored each season. Mean occupation of nest boxes during the study was 53.5% (SE 2.1, n = 248), and a total of 596 breeding attempts were recorded, of which 85.2% successfully fledged at least one young. Yearly occupation of nest boxes varied significantly between the years, ranging from 48.1% to 73.5%. The occupancy rate of first-year nest boxes was lower than that of those available for two or more years. The occupancy rate and the number of nestlings per box (per year) were positively correlated to the distance to the closest nest box and negatively correlated to the number of nest boxes within a 500 m radius. Similar to other studies in the world, the erection of nest boxes for Barn Owls in agricultural fields proved extremely successful in the Beit She'an valley, with 86.7% (n = 248) of nest boxes being occupied at least once during the five-year study period. This high occupancy rate demonstrates not only that natural nesting sites were lacking, but also that nest boxes can be used to increase Barn Owl populations in agricultural areas, both for conservation and for biological pest control.

Key words: Barn Owl, *Tyto alba*, nest boxes, occupancy, agriculture, biological pest control, Israel

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INTRODUCTION

The Barn Owl *Tyto alba* is one of the most widespread owls in the world (Burton 1984), but information on its breeding success in the Middle East is lacking. Barn Owls are secondary cavity nesters but also breed in a wide variety of natural cavities such as holes in trees (Taylor 1994), and in man-made nest sites such as buildings and nest boxes (de Bruijn 1984, Petty *et al.* 1994, Taylor 1994). Nest boxes are used by researchers and conservationists as a popular management tool to increase nest site availability in sites where these are

lacking. Furthermore, nest boxes can be easily designed to attract specific species to breed in designated locations, and are easily accessible, which allows capture of relevant species during the non-breeding seasons (Newton 1998). In areas where natural nest sites are limited, certain raptor populations nest almost exclusively in such nest boxes (Cavé 1968, Hakkarainen & Korpimäki 1996), whereas in other locations, although natural nest sites are present, the nest boxes are used because they are preferred (Petty *et al.* 1994). In many places in the world nest boxes are used as a conservation tool to increase populations in areas where natural nest sites are limited (Petty *et al.* 1994), and also in biological pest control projects (Duckett 1976, Hafidzi *et al.* 1999, Hafidzi *et al.* 2003), which promotes reduced use of pesticides (mainly rodenticides) and increased public awareness of owls.

Beginning in 1983, nest boxes for Barn Owls were erected first at Kibbutz Sde Eliyahu and later in other locations in agricultural fields and plantations in the Beit She'an valley, Israel, as part of a biological pest control program to deal with rodents (Aviel *et al.* 2003). More than a decade ago, the installation of the nest boxes was extended to include other agricultural fields in the Beit She'an valley, and increased from 14 boxes on 3 km^2 in Sde Eliyahu in 1983 to about 300 boxes on 90 km^2 throughout the entire Beit She'an valley in 2007. In the past, the major part of the project was applied with little scientific background, little analysis of the breeding data, and reference to only a few scientific publications (Tores *et al.* 2005). Barn Owls are one of the most common owls in Israel (Shirihai 1996) but little information has been published on them other than on their diet (Dor 1982, Pokines & Peterhans 1997, Yom-Tov & Wool 1997, Tores & Yom-Tov 2003, Tores *et al.* 2005, Charter *et al.* 2007, Motro unpubl. data), and very few data are available on their breeding success (Kahila, unpubl. data). The main objectives of this study were to characterize the use of nest boxes by Barn Owls breeding in the Beit She'an valley, Israel, as part of a biological pest control program to deal with rodents.

METHODS

The study site comprised agricultural fields, orchards, and plantations located in the Beit She'an valley, Israel (32°30'N, 35°30'E), 150–250 m below sea level. The climate is arid with maximum and minimum mean daily temperatures (during March and July 1999) of 32.3°C and 16.7°C, respectively, and average yearly rainfall of 267 mm (for 2001–06).

The study site is divided mainly into crop fields and date plantations (combined area 90 km^2). The crop fields comprise cattle fodder (wheat, sweet corn, alfalfa, clover, vetch and oats), grain crops and seeds (wheat and sweet corn) and spices and herbs (oregano, hyssop, basil, and dill). During the study 156–243 nest boxes (50 cm wide × 75 cm long × 50 cm high; entrance 25 cm high × 15 cm, raised 2.5 to 3 m above the ground) located in the fields and date palm plantations were monitored yearly. The nest boxes were erected between 1983 and 2005 in Kibbutz Tirat Tsvi, Kibbutz Maoz Haim, Kibbutz Kfar Ruppin, Kibbutz Neve Eitan, Kibbutz Ein Hanatziv, and Kiibutz Sde Eliyahu. The project was led by the Israel Ornithological Center, Society for the Protection of Nature, Israel, during 2002–04 and by Tel Aviv University and the Society for the Protection of Nature during 2005–06.

Active nests were determined by visits during the 2002 to 2006 breeding seasons for each breeding attempt (defined as a nest in which eggs were laid, after Steenhof 1987). All nestlings and some of the adults found inside the nest boxes were banded. Mean occupancy rate of nest boxes was noted (number of breeding attempts/number of years the nest box was available during the period of study); as was the percentage of breeding pairs that successfully fledged at least one young; and the mean number of young (number of young per breeding attempts/number of years the nest box was available during the period of study minus the number of dead birds found in the nest boxes after the young had fledged). Similar to breeding Barn Owls in the USA (Taylor 1994), Israel Barn Owls are very sensitive during incubation and abandon clutches when disturbed, so the clutch size of most pairs was unknown and is not presented here. Distances between nest boxes and number of nest boxes within a 500 m radius were calculated using ESRI ArcMap 9.2. Data are presented as means ± SE. All statistical tests were two-tailed and all tests were non-parametric. Descriptive breeding data were analyzed using Kruskal–Wallis ANOVA and Spearman correlations to analyze correlations. Chi-square tests were used for comparing nest success. Levels of significance were set at $P < 0.05$. Statistical analyses were performed using Statistica 7.1 software.

RESULTS

Mean percentage of nest boxes occupied was 53.5% ± 2.1 ($n = 248$), during which time 596 breeding attempts were recorded, of which 85.2% successfully

fledged at least one young. Yearly occupation of nest boxes was significantly different between years (χ^2 = 35.0, df = 4, $P < 0.001$), ranging from 48.1% (n = 243) to 73.5% (n = 215) (Table 1). The percentage of first-year nest boxes occupied was lower than that of older boxes (χ^2 = 20.8, df = 4, $P < 0.001$). During the study, 86.7% of nest boxes were occupied at least once and only 13.3% were never occupied. The average number of nestlings per breeding attempt per nest box was 3.7 ± 1.5 (n = 211).

The mean distance between boxes was 182.8 ± 7.5 (n = 220), and the mean number of nest boxes in a 500 m radius was 6.33 ± 0.3 (n = 220). The distance of the closest nest box was positively correlated with both the percentage of nest boxes occupied (r_s = 0.22, n = 213, $P < 0.01$; Fig. 1A), and the number of nestlings per box (r_s = 0.17, n = 190, $P < 0.05$; Fig. 1B). The number of nest boxes within a 500 m radius per nest box was correlated with both the percentage of nest boxes occupied (r_s = –0.17, n = 220, $P < 0.05$; Fig. 1C) and the number of nestlings per nest box (r_s = –0.17, n = 198, $P < 0.05$; Fig 1D).

Table 1. Breeding parameters of Barn Owls breeding in nest boxes located in the Beit She'an valley, Israel, during the 2002–06 breeding seasons. Sample sizes are in parentheses.

	2002	2003	2004	2005	2006
Percentage of nest boxes occupied	56.4% (156)	60.1% (188)	73.5% (215)	51.7% (232)	48.1% (243)
Percentage of successful pairs	76.1 (88)	85.8% (113)	89.9% (158)	81.7% (120)	88.9% (117)
Number of young fledged per breeding attempt ±SE	3.3 ± 0.3 (86)	3.8 ± 0.2 (111)	4.7 ± 0.2 (155)	2.7 ± 0.2 (119)	3.9 ± 0.2 (115)

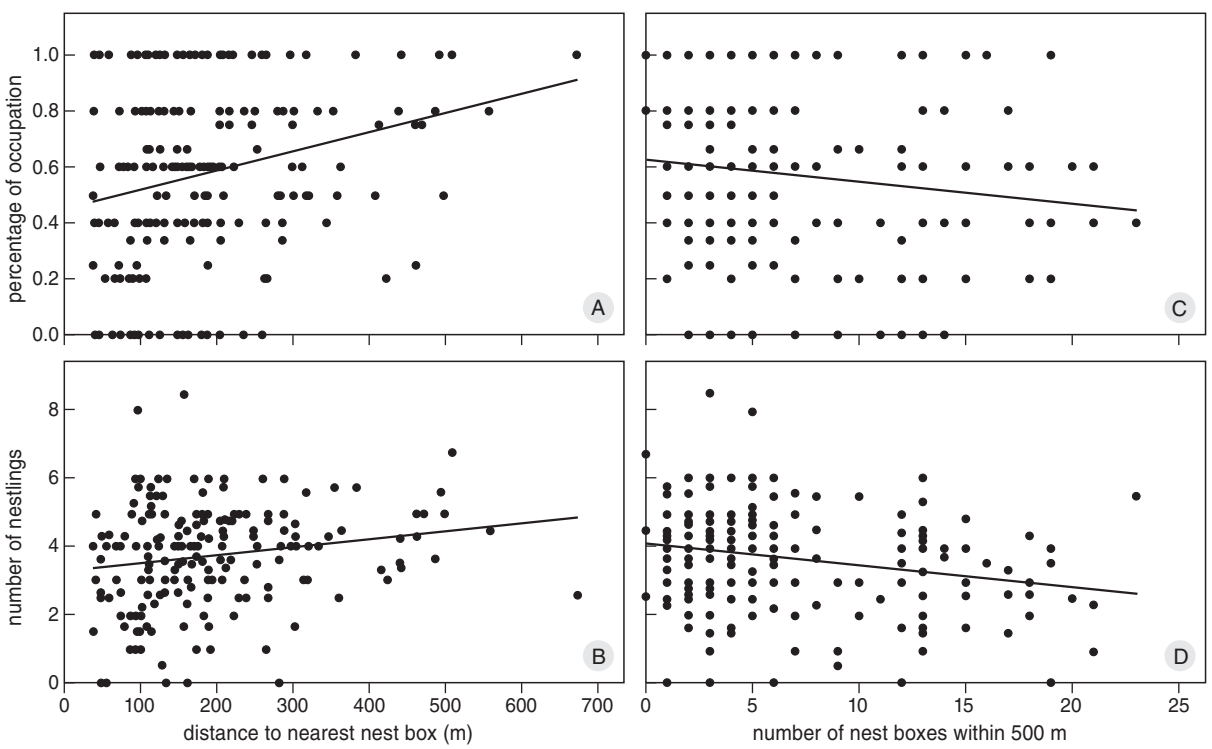

Figure 1. A-D. Correlations between breeding parameters (percentage of nest boxes occupied and number of nestlings) to the distance from the nearest nest box and the number of nest boxes within a 500-m radius.

DISCUSSION

Similar to other studies in the world (Marti 1994, Taylor 1994, Petty *et al.* 1994), the erection of nest boxes for Barn Owls in the Beit She'an valley proved extremely successful, with 86.7% of the 248 nest boxes being occupied at least once during the five-year study. The occupancy of first year boxes was lower than in the following years but, interestingly, no differences occurred thereafter. Barn Owl nest boxes have been used in the region since 1983 and, unlike new regions to the project in Israel, where the rate of occupation of nest boxes is lower (Charter, unpubl. data), the high rate of occupancy reported in the second and following years have been an artifact of the large population of Barn Owls already present in the valley, and the length of the project.

In addition to nest boxes, Barn Owls also breed in the surveyed villages in man-made structures (Meyrom *et al.* 2008) and in Mexican Fan Palms Washingtonia robusta. Meyrom (unpubl. data) estimated 50 such pairs yearly, while in the fields themselves few to no nest sites are available. Even though Barn Owls breed anyway in the nest boxes, the particularly high nest box occupancy reported in this study is most likely due to a lack of nest sites in the valley.

The number of young per nest was found to be within the range of other studies (range 1.9–4.6 nestlings) in Europe (Pikula *et al.* 1984, Baudvin 1986, Muller 1989, Taylor 1994, Martínez & López 1999), USA (Otteni *et al.* 1972, Klaas *et al.* 1978, Marti & Wagner 1985, Marti 1994), Asia (Lenton 1984) and Africa (Wilson *et al.* 1984). The high occupancy of nest boxes in 2004 was probably due to a high abundance of Levant Voles *Microtus socialis guentheri*, which peaked during that year in the study sites as well as in some other agricultural regions in Israel (Aviel pers. comm.). No rodent trapping took place during the study, but Motro (pers. comm.) counted vole burrows during the study and found more burrows during 2004 than in other years (in some areas almost 10 000 burrows/ha). The percentage of nest boxes occupied and the number of nestlings per box were positively correlated to the distance of the closest nest box and negatively correlated to the number of nest boxes within a 500 m radius per nest box, possibly due to intraspecific competition and first-year Barn Owls breeding in crowded areas. However, these two latter hypotheses require experimental verification.

Examination of pellets from the region revealed that 90% of the Barn Owls diet is composed of rodents from agricultural fields and plantations (Tores *et al.* 2005, Charter *et al.* 2007). The presence of Barn Owls is thus welcomed by farmers. Since the establishment of the pest control project, many farmers use Barn Owls as an alternative method of rodent control and thereby drastically reduce the use of rodenticides. The high occupancy of nest boxes by Barn Owls detailed in this study demonstrates, as also found in other studies throughout the world, that not only were natural nest sites lacking in the area, but also that nest boxes offer Barn Owls alternative nest sites, that can increase owl numbers in agricultural fields both for conservation and biological pest control projects. Further studies are needed to compare between the use of Barn Owls and of pesticides in order to determine whether these result in economic differences in crop yield.

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SAMENVATTING

Vanaf 1983 zijn in Israël in het kader van een biologisch bestrijdingsprogramma tegen knaagdieren nestkasten voor Kerkuilen *Tyto alba* geplaatst, eerst alleen in de kibboets Sde Eliyahu, later ook in de rest van de Beit She'an vallei. In 1983 waren er 14 nestkasten op 3 km^2, in 2007 300 op 90 km^2. In dit artikel worden de resultaten van de broedseizoenen 2002 tot en met 2006 (156–243 nestkasten gecontroleerd per seizoen) besproken. De bezetting van de kasten varieerde van 48,1% tot 73,5% en bedroeg gemiddeld 53,5%. Dit leverde 596 broedpogingen op, waarvan 85,2% minstens één uitgevlogen jong voortbracht. De bezettingsgraad was het eerste jaar na het ophangen van de kasten lager dan later. De bezettingsgraad en het aantal nestjongen per jaar correleerden beide positief met de afstand tot de dichtstbijzijnde nestkast en negatief met het aantal nestkasten binnen een straal van 500 m. Tijdens het vijf jaar durende onderzoek waren 215 kasten (86,7% van de 248) minstens eenmaal bezet. De hoge bezettingsgraad toont aan dat aanvankelijk natuurlijke nestgelegenheid in de onderzochte landbouwgebieden ontbrak en dat het aanbrengen van nestkasten kan leiden tot een toename van het aantal Kerkuilen in zulke gebieden. Uit oogpunt van soortbescherming en de biologische bestrijding van knaagdieren een interessant gegeven.

ARDEA

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