

Economic evaluation of biological rodent control using barn owls *Tyto alba* in alfalfa

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Abstract

Rodents are common pests in various agricultural cultivations. Utilization of barn owls for rodent pest control has long been used. In Israel, the indirect effect of barn owl predation pressure on alfalfa crop yield has been examined. Using radio-telemetry, barn owls were tracked to form a density-distance function, which was later used to estimate predation pressure on whole fields. This function was utilized on all barn owls nesting in the vicinity to assess accumulated predation pressure on fields, which was compared to crop yield in contemporary alfalfa harvests. Results show that barn owl presence has a positive effect on alfalfa crop yield, enhancing crops by 3.24% and allowing a net profit of 30 US\$/hectare-year. These results are important since they encourage farmers to use this environmentally friendly, healthy method owing to agricultural-economical considerations, thereby evading the environmental-financial conflict.

Keywords: alfalfa, barn owl, biological control, economy, Israel, predation pressure, rodent,

Background

Rodents are major pests to a variety of agricultural crops (Stenseth et al., 2003). Of the rodent pests in Israel, levant voles (*Microtus guentheri*) are major pests in field crops, with alfalfa (*Medicago sativa*) being, perhaps the main victim due to a number of reasons: Year-round fresh vegetation, nutritiousness, perennality, summer irrigation and lack of soil cultivation during crop growth period (Moran, 2003). Vole populations can accumulate in alfalfa to thousands of burrow openings per hectare and harm crops severely (Motro et al., 2010). Chemical poisoning is dangerous and quite inefficient due to the palatability of the crop itself. The use of wild barn owls (*Tyto alba*) in artificial nesting boxes for the control of rodents has been suggested a few decades ago and is implemented in many regions of the world (Charter et al. 2010; Meyrom et al., 2009; Motro et al., 2010; Taylor, 1994). Alas, it has never been shown before that this environmentally friendly control regime is cost effective.

Methods

The study site was in Kibbutz Sde-Eliyahu, Israel (32°30'N, 35°30'E). 58 nesting boxes for barn owls were erected in 1983-1996, and their annual occupation and success have been monitored since. A total of 429 alfalfa harvests were examined in 21 fields over 10 years (1999-2008). The predation pressure was calculated by fitting 16 of the owls with radio-telemetry and tracking their movements (White and Garrott, 1990) to form a function of their occurrence probability by distance from the nest (Venables and Ripley, 2002). The predation pressure was integrated on all the fields' area and accumulated for all active nesting boxes during the specific harvest period. This gave a total predation pressure estimate for a certain field in a certain point in time. The total predation pressure was then compared to the crop yield of the harvest of the same field at the same time.

Results

In this study, the effect of predation pressure on rodents by barn owls was shown to have significant positive effect on alfalfa crop yield and on the financial income for the farmer. Among other factors analyzed, predation pressure was found to have a statistically significant positive effect on alfalfa crop yield, enhancing crops by 440 kg/hectare-year which consists of 3.24% of the annual production. The associated revenue increase amounted to 100 US\$/hectare-year. Attributing the costs associated with installation and maintenance of all the 58 nesting boxes to the 41.8 hectares assigned in an average year to alfalfa production at Sde-Eliyahu, one obtains a net benefit of 30 US\$/hectare-year. Further modeling studies have shown that alfalfa outputs would convexly increase with predation pressures, meaning that better nest box layout may have an even greater effect on rodents and crops.

Discussion

These results show that despite the apparently low contribution in terms of alfalfa yields, and the fact that the potential contribution of the nesting boxes to the yields of other crops is completely ignored, rodent control by barn owls is found to be profitable. The use of rodenticides was not calculated as a substitute, since their ineffectiveness discourages farmers from using them. Two other important elements that have not been considered here are the environmental and health issues. The reason for this is that the aim of this research is to verify whether this control method is profitable for the farmer, not for the environment or the society. These results are important because they encourage farmers to utilize this method and gain profit even without the intervention of the authorities (by subsidies, laws or fines) and avoiding the environmental-financial conflict from their aspect: they use an environmentally friendly control method – and save money.

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