Avian predators as a biological control system of common vole (*Microtus arvalis*) populations in NW Spain: experimental set-up and preliminary results

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Abstract

Ecologically-based pest management using biological control has been successfully tested elsewhere, but it has never been evaluated for cyclic vole plagues in Europe. We report the first large-scale replicated experiment to study the usefulness of artificially increasing populations of Common kestrels (*Falco tinnunculus*) and Barn owls (*Tyto alba*) to control common vole populations in agricultural habitats where nesting sites for raptors are scarce. The first preliminary results suggest: 1) population density of both predator species may be increasing in response to both nest-site availability and rodent density; 2) voles are a major prey; and 3) vole density during an increase phase of the population cycle may be reduced near nest-boxes.

Keywords: *Microtus arvalis,* outbreaks, biological control, *Falco tinnunculus*, *Tyto alba*, agriculture, Spain

Introduction

In Europe, *Microtus arvalis* is a major agricultural pest that can produce important crop damage during population outbreaks (Jacob and Tkadlec, 2010) as well as sanitary problems (Vidal et al., 2009). In Spain this pest is usually controlled by environmentally aggressive campaigns based on large-scale and massive rodenticide use, which can have an impact on non-target species such as the red kite (*Milvus milvus*) (Olea et al., 2009; Mougeot et al., in press). The development of alternative environmentally-friendly control strategies is essential. Artificially increased populations of barn owls have been tested in some areas as a biological control method of rodent pests. These can have similar efficacy to rodenticides at lower cost (Brown et al., 2006, Muñoz-Pedreros et al., 2010). Common kestrels may have a regulatory effect on common vole population density (Fargallo et al., 2009) and it has been suggested that increasing predator density could be a promising technique to control this pest (Pelz, 2003). However, the efficacy of this control method has yet to be properly tested (Jacob and Tkadlec, 2010).

Methods

The study took place in three areas of Castilla y León (NW Spain) where vole populations reached high densities during the last vole outbreak of 2007. Within each study area, we selected a control and an experimental plot of 2000 ha each. In the experimental plots, 100 nest boxes were installed, 50 of these specifically designed for kestrels, and 50 others designed for barn owls. We monitored occupancy and breeding success of raptors using nest boxes, and estimated the abundance of both rodents and diurnal avian predators in each area. The abundance of diurnal avian predators was measured using a Kilometric Index of abundance from eight road transects in each study area (four in each control and four in each experimental area). The abundance of rodents was measured using Sherman LFAHD traps, three times per year (March, July and November) on twelve trapping plots stratified by habitat (alfalfa, cereal, and uncultivated), each trapping plot with 35 traps. Additionally, an indirect abundance index of the presence of *M. arvalis* based on the presence of fresh droppings of and/or vegetation clipping was used in one of the study areas (Jareño, 2010). Diet of kestrels and barn owls was evaluated by analyzing fresh pellets and food remains at nests.

Results

The abundance of common kestrels observed during road transects increased more in the experimental areas than in control areas. Kestrel breeding population reached 1.75 pairs/100 ha in the area with highest overall vole density. Barn owls have occupied nest boxes later, coinciding with increasing rodent densities during spring 2011, and reaching by now 0.8 pairs /100 ha. The pattern of nest-box occupancy apparently matched, spatially and temporally, that of rodent density. Voles were a staple prey for both raptor species, but barn owls also consumed large amounts of wood mouse (*Apodemus sylvaticus*) and other small mammals. We found a significant positive relationship between distance to the nearest nest box, occupied or not, and the abundance of common voles (Wald Chi-square=8.554, df=1, p=0.003).

Discussion

Supplying nest boxes for avian predators produced an important increase in the numbers of kestrels and barn owls in the experimental areas; this was expected due to the scarcity of nesting places (no trees, few buildings) in the agricultural habitats of NW Spain. Common voles were a main prey of avian predators in the study areas, even at vole densities that were relatively low compared with those of peak-abundance years. Preliminary results suggest that kestrels may be selecting nest boxes near higher vole density areas. Vole density was positively associated to distance to nest-boxes, but independently of its occupancy status, while the effect of kestrel occupancy on vole density around the nest box was only near significance. Perhaps we were detecting a possible effect of the presence of nest boxes, not occupancy, as these can be used as perching sites by kestrels and other raptors breeding in the area, such as common buzzards. These preliminary results are encouraging, but obviously an experimental set-up on 6000 ha will not be able to stop a rodent plague that may affect $3x10^6$ ha in Castilla y León (Jacob and Tkadlec 2010), but may have local effects. Thus, caution must be kept until a new vole peak is reported in the study area, to assess relative vole density and crop damages in experimental areas as compared to areas without nest boxes.

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