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Assessing the effects of trapping on pest bird species at the country level

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ABSTRACT

Control to limit damage caused by undesirable organisms at the country level is a common management practice but its effects on the target populations are usually unknown. Monitoring consequences of control is however important to design and measure the efficacy of long-term management. Using data from the French Breeding Bird Survey and methodology that cope with detection bias, we studied the consequences of trapping on the age structure and spatial dynamics of the magpie (*Pica pica*), a bird considered as a pest species in France. Our results show that magpie occurrence in farmlands and semi-natural landscapes decreases with regional trapping intensity. Trapping increase the probability of populations becoming extinct locally, with less possibility of (re)colonising managed areas. Local extinction is likely the consequences of changes in the age structure of breeding populations which are composed of more immatures in intensively trapped areas. The effects of trapping are however mitigated in urban areas, which have become a refuge habitat for magpies.

Trapping is a long established and very common practice in France. Although trapping has a successful impact on the magpie in countryside, it is recommended only if justified by conservation specific purposes. Non-lethal methods exist like reducing availability of human-related food resources, especially in urban environments. Monitoring the dynamics behind species occurrence is a useful approach to understand how control affects species distribution. This study illustrates the value of a national monitoring scheme in helping to understand trapping consequences.

1. Introduction

Animals causing problems to human activities and conservation of other organisms are usually viewed as undesirable (Ormerod, 2002). In order to limit their impacts, populations of these species are managed (Côté and Sutherland, 1997). Because many management projects aim solely to eliminate these undesirable organisms (Conover, 2002), the contribution of science to this process is poor. Consequently, we know little about the efficiency of control activities and the impact on demography and distribution of target populations (Virgós and Travaini, 2005; Rushton et al., 2006; Zipkin et al., 2009).

The effects of management activities on target species (e.g. pests and invasive species) are usually assessed at relatively small spatial scale units such as nature reserves or small game properties where control is a common management practice (Virgós and Travaini, 2005; Treves, 2009; but see Whitfield et al., 2007). At this scale, the effectiveness of control activities depends, for example, on the characteristics of capturing methods, the efforts expended and the skills of practitioners (Díaz-Ruiz et al., 2010), as well as on the characteristics of the target species (Villafuerte et al., 1998; Tryjanowski et al., 2009; Servanty et al., 2011). At this scale, the impacts of management on abundant and widespread species are usually short-lived because the control only covers a small extent of the species range (Harding et al., 2002; Beja et al., 2009). Animal populations can compensate for losses with the arrival of new individuals or changes in the demography (McDonald and Harris, 2002; Novaro et al., 2005). But culling can also create local population sinks if managed areas continue to attract individuals that are then systematically eliminated (Baker and Harris, 2006; Péron et al., 2012). In the long term, culling repeated in many different sites could have thus important indirect effects on neighbouring populations (Heydon and Reynolds, 2000). Control could impact targeted as well as non targeted populations and result in the modification of species range at large scale such as a country. This is likely to occur insofar as considerable efforts are made to control populations of some birds and mammals in Europe and elsewhere in the belief that this reduces their impact on game or threatened species (Villafuerte et al., 1998). It is often assumed that such activities should not cause any long-term decline in target populations unless the culling is enduring (Harding et al., 2002; McDonald and Harris, 2002). So far, there has been no assessment of large-scale control programs on the distribution and demography of target species, especially when they are undesirable.

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Understanding how targeted populations respond to control on a large scale has probably been hampered by a lack of suitable data and appropriate methodology to describe relevant predictors. In recent years, there were more researches using large-scale monitoring schemes, such as national breeding bird surveys (BBSs) (Gregory et al., 2005; Newson et al., 2008). Although these surveys only yield a description of trends and distribution of populations, they can be of great value if population changes are combined with information on the predictors of these changes (e.g. changes in habitat use, fragmentation, climate; Gregory and Baillie, 1998; Julliard et al., 2004; Devictor et al., 2008). To our knowledge, no study has assessed the potential of monitoring to help evaluate the effectiveness of control activities on wildlife at a country scale.

In France, a total of six bird species are listed as pest species (ROC, 2000) that include the Rook (*Corvus frugilegus*), the Carrion crow (*Corvus corone*), the Eurasian jay (*Garrulus glandarius*), the European starling (*Sturnus vulgaris*), the Woodpigeon (*Columba palumbus*) and the Black-billed magpie (*Pica pica*, hereafter the magpie). The usual and long-established response to limit impacts of these species is to kill the birds, usually by shooting or trapping. Yet, consequences of ongoing management practices on these species in France are unknown. For this study, we have drawn on existing long term monitoring programmes on breeding birds (French Breeding Bird Survey, FBBS) and trapping programmes in France to study the control efficiency on magpie, the most frequently species targeted by control activities (ROC, 2000). The magpie is viewed as a recurrent problem by conservationists and many hunters in France and Europe because it is predator of song birds and game birds (Mora, 2000; Birkhead, 1991). However, the impact of magpies on abundance and persistence of prey populations as well as control of its populations is controversial. Recent studies have suggested no correlation between magpie abundance and decline of its prey at local and national scales (Thomson et al., 1998; Chiron and Julliard, 2007; White et al., 2008; Newson et al., 2010).

Information on the total number of individuals eliminated each year is scarce but in 2000, at least 402,000 magpies were killed in France, with wide variations between regions in the numbers killed (ONCFS, 2000; ROC, 2000). Trapping can have detrimental effects on magpie populations as it removes breeding birds (i.e. adult and immature birds) during the reproductive season. In France, there has been a steep decline in magpie numbers in the countryside (76% since 1990, Jiguet, 2010), while at the same time, magpies have colonised and established populations in urban environments (Chiron and Julliard, 2007). We suspect that the decline of magpie populations in France is due to trapping which is much more common in agricultural and natural environments than in cities (Chiron, 2007). But evidence of causal link between the decline of magpies in the countryside and trapping pressure is lacking. Magpies become established in cities thanks to their ability to exploit man-made resources and to the low predation rate on their nests (Jerzak, 2001). Whether or not cities have become a refuge for magpies because of the lack of hunting and trapping pressure is also unknown.

We addressed these issues in a study of the spatial dynamics and demography of magpies in relation to human presence and management activities in France, using data on the occurrence and demography of magpies and control practices. Specifically, we assessed the impact of trapping activities on the age structure of local magpie populations. We estimated the age ratio between adults (i.e. more than one year) and immature (i.e. first year) to measure imbalances in breeding populations (Williams et al., 2002). The age ratio of breeding magpies is relevant because trapping activities target individuals that are reproducing when they are territorial, usually adults. By removing adults from breeding territories, trapping effort can attract immature in territories that they were previously excluded. We predict an increase of the proportion of immature occupying breeding territories relatively to adults with trapping effort. We then investigated the dynamics of magpie occupancy, extinction and colonisation to test whether any effects on the age structure could be linked with changes in the persistence of populations at landscape and regional scale. We predict that trapping effort increased the probability of local extinction, and subsequently decreased the probability of magpie occupancy. We concluded with a discussion on the effects of control on magpie populations, management strategies, and the usefulness of bird surveys in dealing with the potential consequences of control activities.

2. Materials and methods

2.1. Estimating age structure

We used data from a two-year national survey that we launched in 2003 to study the age structure of magpie populations. We asked volunteer trappers to send us the wings of magpies that had been killed between March and September during the breeding season. No magpies were killed for the purpose of this study and were trapped legally, following the appropriate guidelines for the human trapping and killing of the birds. To capture magpies, trappers use cages in which they place a live magpie to attract local breeding individuals (Díaz-Ruiz et al., 2010). Magpies typically start breeding as adults when they are two years old (Birkhead, 1991), but can sometimes reproduce when immature in their first year. We aged 98% of the wings received as adult, immature or young (i.e. year bird just fledged) depending on plumage characteristics: individual with small white patches on the tips of their feathers were aged as young (fresh feathers) or as immature (old feathers), adults (more than one year old) have large white patches on their feathers (Svensson, 1992). 2% Were undetermined because of unclear wing feathers pattern. As only breeding individuals are targeted by trappers and because of the purpose of the study, we removed young individuals from our sample. The age distribution was estimated in terms of the relative proportion of immature birds (PIs) captured in the breeding population (adults and immature). This measure is a composite index of both survival and recruitment of individuals into the breeding population and is suitable for assessing the impacts of control (Whitfield et al., 2007) as well as of hunting (Besnard et al. 2010; Miller and Otis, 2010).

2.2. Trapping effort

As well as collecting wings, we asked trappers for additional information on (1) the number of traps they used in the field, (2) the number of days spent trapping per year, (3) the proportion of years where trapping activities was carried out in the last ten years, (4) the number of other trappers working the same location, and the day and location of capture. With this information, we developed an index to estimate the trapping effort as the product of (1), (2) and (3). We took (4) as an additional factor in the calculation, to estimate the Local Trapping Effort (LTE) as:

$LTE = (1) \times (2) \times (3) + (4) \times [m\ (1) \times m\ (2) \times m\ (3)]$, where m (1), m (2) and m (3) are mean values per region.

In addition to the LTE index, we compiled information from the regional offices in charge of species regulation (DDAF) on the total number of magpies killed by trappers per region in 2000 (ROC, 2000). Total number of magpies reported by regional offices correspond to magpies captured using the same trapping techniques as those used by trappers who participated to the 'wing survey' in 2003 and 2004. We obtained the total number of magpies killed for 53 of the 95 French regions (Fig. 1, information was unavailable