Agriculture, Ecosystems and Environment 211 (2015) 17–23

Contents lists available at ScienceDirect

Agriculture, Ecosystems and Environment

journal homepage: www.elsevier.com/locate/agee

Small mammals in farmlands of Argentina: Responses to organic and conventional farming

José Coda, Daniela Gomez, Andrea R. Steinmann, José Priotto *

Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Departamento de Ciencias Naturales, Universidad Nacional de Río Cuarto, Argentina

ARTICLE INFO

Article history:
Received 2 January 2015
Received in revised form 5 May 2015
Accepted 19 May 2015
Available online xxx

Keywords:
Agricultural management
Small mammal abundance
Specialist species
Generalist species
Vegetation volume
Border habitats
Cricetidae rodents

ABSTRACT

Despite the important positive role that small mammals have in agricultural systems, mainly through their contribution to food webs, few studies have been conducted on the biodiversity and abundance of this group. Considering that Argentina is one of the most important agricultural regions of the world, our objective was to assess the effect of farming practices (organic vs. conventional) on species richness and abundance of small mammals in border habitats from agroecosystems of central Argentina. We predicted that the effects of farming practices on small mammal populations would vary with the degree of habitat specialization of species. We expected higher species richness and abundance of specialist species in border habitats of organic than on conventional farms. We found that farming practices did not explain species richness; the number of species in border habitats was low with small variation between managements. Management, season and vegetation volume explained abundance of both specialist and generalist species in border habitats, but with additive effects in the former and interactive effects in the latter. During summer, *Calomys musculinus*,*Calomys laucha* and *Akodon azarae* were more abundant in border habitats of organic than on conventional farms. This could be related to the highest reproductive activity of these species in this season, associated to the highest habitat quality of organic border habitats. Also, organic farms may have an important role for specialist species in poor-quality habitats at the beginning and at the end of the reproductive period (spring and autumn). Our results showed a positive trend in small mammal abundance of organic farms in farmlands under intensive agriculture. The differences between Argentinian and European agriculture systems are discussed.

1. Introduction

One of the most worldwide land-use activities is the conversion of natural landscapes to croplands and pastures (Foley et al., 2005). This activity introduces alterations in habitat quality and suitability, producing agricultural landscapes widely variable in their degree of spatial heterogeneity (Fahrig et al., 2011). More heterogeneous landscapes are characteristic of traditional farming systems where many different production cover types are interspersed with more natural ones. Such patterns contrast with intensive agricultural systems characterized by only a few crop types in large uniform fields (Fahrig et al., 2011; Sirami et al., 2007). Organic farming involves practices similar to traditional farming systems since it has higher levels of habitat heterogeneity, and contains greater densities of uncropped habitats compared to conventional farming (Fuller et al., 2005). Also, insecticides, herbicides, fungicides and inorganic fertilizers are entirely or largely avoided, favouring well-maintained and more suitable border habitats (Norton et al., 2009). This practice is more environmentally friendly than conventional agriculture, which is mainly dependent on external inputs for crop and animal productions (Bengtsson et al., 2005; Tuck et al., 2014).

Studies conducted on plants, insects, birds and mammals have shown that organic farming practices can counteract the negative effects of agriculture intensification (Beecher et al., 2002; Fischer et al., 2011; Holzschuh et al., 2006; Macdonald et al., 2007; Roschewitz et al., 2005). However, the magnitude of their effects seems to vary greatly, particularly among taxa and across landscapes (Batáry et al., 2011; Bengtsson et al., 2005; Winqvist et al., 2012). In simple landscapes (<20% semi-natural areas), the introduction of organic farming would be important for the conservation of biodiversity in farmlands under intensive agriculture (Tscharntke et al., 2005).

* Corresponding author. Tel.: +54 358 4676236; fax: +54 358 4676230.
E-mail addresses: joseacoda@gmail.com (J. Coda), mdgomez1907@gmail.com (D. Gomez), asteinmann@exa.unrc.edu.ar (A.R. Steinmann), jpriotto@gmail.com, jpriotto@exa.unrc.edu.ar (J. Priotto).

http://dx.doi.org/10.1016/j.agee.2015.05.007
0167-8809/

The well-studied European systems are characterised by fine-grained farmland mosaics with relatively small fields, dense networks of hedgerows and roads, and highly intermingled rural and urban areas. This structural complexity differs deeply from the extensive and homogeneous cropland mosaic characteristic of many rural areas in Argentinian agricultural systems, which comprise large arable fields and sparse linear habitat networks (Baldi et al., 2006; Poggio et al., 2010). These linear habitats frequently receive intentional or unintentional spraying of broad-spectrum herbicides from the neighbouring crops (de la Fuente et al., 2010; Ghersa et al., 2002). In intensively managed agricultural landscapes, the maintenance of undisturbed linear habitat networks can attenuate the effects of agricultural intensification by providing suitable habitats for biodiversity conservation (Coda et al., 2014; Gomez et al., 2011; Simone et al., 2010).

In the last decades, the rate of agricultural expansion in Argentina has increased considerably due to technological changes (e.g. no-tillage techniques, genetically modified crops) and market conditions (e.g. global increase in soybean demand) (Baldi and Paruelo, 2008). The farming area dedicated to no-tillage cropping system increased from 2 Mha in 1992–1993 to 27 Mha in 2010–2011 (Aapresid, 2012); and during this process, many field borders were removed to enlarge crop areas (Aizen et al., 2009). In Argentina, the area of organic farmland is small; currently there are 3.6 Mha under this practice, only 240,000 of them are intended to crop production, whereas, the rest is dedicated to pastures for cattle production (SENASA, 2013). Organic farming is characterised by the use of tillage for mechanical control of weeds and no-use of synthetic fertilizers or pesticides, and there is no intentional management on border habitats. On the other hand, conventional management includes external inputs of synthetic pesticides and soluble fertilizers and no-tillage systems where the weed control depends almost exclusively on the use of herbicides (Satorre, 2005).

The effects of agriculture intensification on the diversity and abundance of species could vary with the degree of specialization of species. Specialist species are more dependent on habitat quality and they suffer more from habitat disturbance than generalists, which are able to use other habitats and resources (Filippi-Codaccioni et al., 2010). An increase in agriculture intensification affected small mammal diversity and abundance in the Pampean region (Medan et al., 2011), with habitat generalist species such as the Cricetidae rodent *Calomys laucha* and *Calomys musculinus* being favoured, and habitat specialist species such as *Akodon azarae* being negatively influence (Bilenca and Kravetz, 1995; Cavia et al., 2005; Fraschina et al., 2012). The south-eastern area of Córdoba province (central Argentina, Juárez Celman, Union and Marcos Juárez Departments) has not been free from agricultural intensification, with approximately 1,879,900 ha under crop production, and only 2700 ha of these are under organic management (MAGyA, 2013).

Although many studies have shown the effects of organic farming on biodiversity, they have been heavily biased towards agricultural systems in Europe and North America. In order to have a balanced global assessment of organic farming effects on biodiversity, studies on other regions and at different spatial scales are needed (Tuck et al., 2014). In spite of the important positive role that small mammals play in agricultural systems, mainly through their contribution to food webs (Michel et al., 2006; Salamolard et al., 2000), few studies have been conducted on their biodiversity and abundance (Brown, 1999; Fischer et al., 2011; Macdonald et al., 2000).

Our objective was to assess the effect of farming practices (organic vs. conventional) on species richness and abundance of small mammals in border habitats of agroecosystems of central Argentina. We predicted that the effects of farming practices on small mammal populations would vary with the degree of specialization of the species. We expected higher species richness and abundance of specialist species in border habitats of organic than of conventional farms.

2. Materials and methods

This study was carried out since spring 2011 to autumn 2013 in an agricultural landscape of south-eastern Córdoba province, Argentina (Fig. 1). This period included two annual abundance

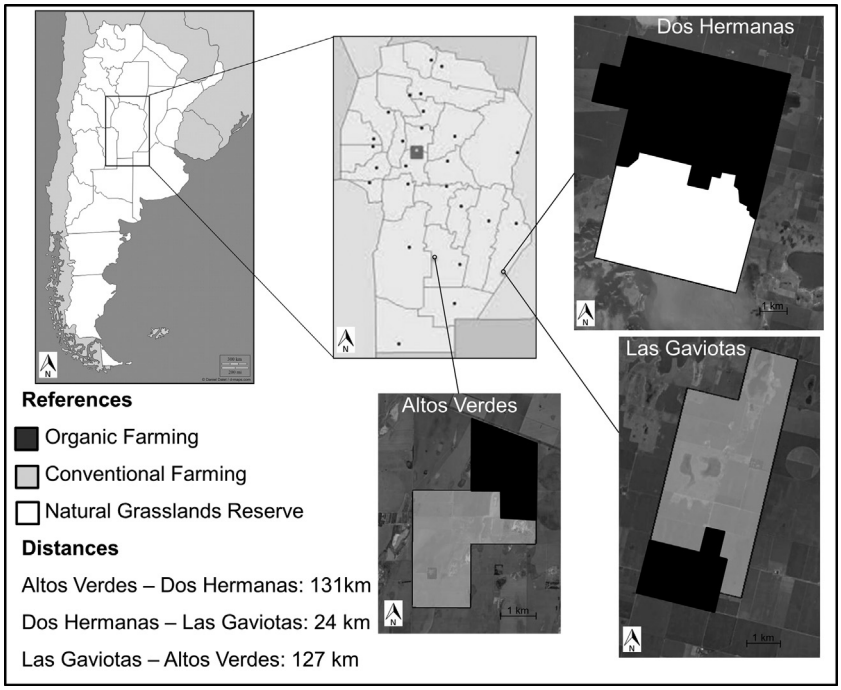

Fig. 1. Study area, agricultural systems of south-eastern Córdoba province with the three farms (Dos Hermanas, Las Gaviotas and Altos Verdes) that include organic and conventional managements, with distances between them.