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Wild small mammals in intensive milk cattle and swine production systems

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ABSTRACT

Some rodent species are considered important pests around the world because they cause economic losses and sanitary problems. Although rodents are found in many different environments, they select habitat patches where resources are available. There is scant information regarding community composition and habitat distribution of small mammals in dairy and pig production systems. The aim of this research was to compare the composition of wild small mammal communities between intensive dairy and pig farms and to describe their distribution among habitats within the farms in northeast Buenos Aires province, Argentina. The intent is to contribute to management strategies of small mammals in these production systems. Ten pig farms and eight dairy farms were sampled seasonally during one year. Cage and Sherman live traps were set in five habitats within the farms. A total of 505 small mammals (270 in dairy farms and 235 in pig farms) were captured in 7026 cage trap-nights and 7333 Sherman trap-nights. In both production systems, the rodents captured included the dominant murines: *Rattus norvegicus*, *R. rattus* and *Mus musculus*, native sigmodontines: *Azodon azarae*, *Calomys laucha* and *Oligoryzomys flavescens* and the native caviid *Cavia aperea*. The opossums *Didelphis albiventris* and *Lutreolina crassicaudata* were also captured. The introduced murines used mainly human buildings, food storage sheds and animal sheds, whereas native species were more common in the vegetated environments among dwellings. A recommendation for control of pest rodent species would be to apply rodenticides only in dwellings to avoid accidental poisoning of non-target native species. Further studies on the damage produced by small mammal species and their role in the disease transmission in these production systems are necessary to identify management priorities.

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1. Introduction

In this work we compare the composition of wild small mammal communities in intensive dairy and pig farms, and their distribution among habitats within the farms to develop management strategies for small mammals in these production systems.

Animal species occurring within the same region select different habitat patches from the options available (Cody, 1985), including those in agricultural settings. Differential selection allows species to coexist (Pulliam, 1988; Abramsky et al., 1990; Darmon et al., 2012). The community structure and the population abundance of each species depend on local conditions, the landscape context, historical events and evolutionary processes (Pimm and Rosenzweig, 1981; Pimm et al., 1985; Rosenzweig and Abramsky, 1986; Ricklefs, 1987; Kotliar and Wiens, 1990; Levin, 1992; Wiens et al., 1993). Small mammals select habitats and microhabitats, occupying mainly patches where resources are available (Braithwaite and Gullan, 1978; Van Deventer and Nel, 2006), suggesting that these animals perceive differences in patch quality and structure (Dueser and Shugart, 1978; Simonetti, 1989).

Synanthropic small mammals depend on food resources provided by humans (McKinney, 2006). Thus, small mammals such as some rodents and opossums are common in livestock production systems where food resources to feed livestock are abundant (Rowe and Swinney, 1977; Collins and Wall, 2004; Gómez Villafañe et al., 2004; Kijlstra et al., 2008; Leirs et al., 2004). Some rodent species are considered nuisance pests because they cause economic losses (Kravetz, 1991; Singleton et al., 1999; Drummond, 2001). In rural areas, particularly in livestock production systems, damage includes consumption and

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contamination of animal food, and structural damage to building components and equipment, all of which results in a decrease in production (Timm, 1987; Villa and Velasco, 1994). Rodents also cause sanitary problems since they are primary transmitters, reservoirs and mechanical vectors of more than 20 diseases (Webster and Macdonald, 1995; Glass, 1997). Opossums are considered a potential link between wild and domestic habitats for the transmission of zoonotic diseases (Gómez Villafañe et al., 2004; Pérez Carusi et al., 2009) since they have been documented carrying zoonotic etiological agents (Potkay, 1977Potkay, 1977 Schweigmann et al., 1999; Gomes et al., 2003; Bodini Santiago et al., 2007; Pérez Carusi et al., 2009) and have been found in many environments, including forests, rural, domestic and peridomestic habitats (Cabrera and Yepes, 1960; Hunsaker II, 1977; Contreras, 1983; Gómez Villafañe et al., 2004) both in Australia and the Americas (Wynne and McLean, 1999). Problems associated with small mammals led to the implementation of chemical control measures but in many production systems problems still persist (Singleton et al., 1999). The persistence of these problems is likely due to the high reproductive potential of these animals, especially when conditions are favorable (Aplin et al., 2003; Ylönen et al., 2003; Gómez Villafañe et al., 2005).

Ecological studies on wild small mammals living on pig and dairy farms are scarce. There are many studies of small mammals on pig farms focusing on infectious diseases (e.g., Le Moine et al., 1987; Weigel et al., 2007; Friedman et al., 2008; Kijlstra et al., 2008; Van de Giessen et al., 2009), while studies of community composition and habitat use are rare (e.g., Leirs et al., 2004). To the best of our knowledge only two studies on small mammal composition on dairy farms have been reported in the last 40 years (Rowe and Swinney, 1977; Rowe et al., 1983). In the Pampas in central Argentina communities of small mammals have been studied in production systems such as poultry farms and agro-ecosystems, as well as in natural grasslands and urban environments. In these systems and environments, both native and introduced species of small mammals are present. The native species include six sigmodon species (*Oligoryzomys flavescens*, *Akodon azarae*, *Calomys laucha*, *C. musculinus*, *Necromys obscurus* and *Oxymycterus rufus*), one caviid (*Cavia aperea*), and three opossums (*Lutreolina crassicaudata*, *Didelphis albiventris* and *Monodelphis dimidiata*), and the introduced species are the three commensal murines (*Mus musculus*, *Rattus norvegicus* and *R. rattus*) (Mills et al., 1991; Busch and Kravetz, 1992; Bilenca and Kravetz, 1995b; Miño et al., 2001; Gómez Villafañe and Busch, 2007; Miño et al., 2007; Pérez Carusi et al., 2009; Muschetto et al., 2011). The small mammal composition, relative abundances of each species and their habitat distribution are different among systems (Dalby, 1975; Hodara et al., 2000; Castellarini et al., 2003; Castillo et al., 2003; Gómez Villafañe and Busch, 2007; Miño et al., 2007; Andreo et al., 2009; Cavia et al., 2009; Gomez et al., 2009). Although pig and dairy farms are important in the Pampas, small-mammal communities in these production systems have not been studied in this area (Ribicich et al., 2005). Knowledge about the composition of small-mammal communities and their habitat distribution in production systems is essential to optimizing rodent management, protecting non-target species and minimizing transmission of rodent-borne diseases to humans and livestock.

2. Materials and methods

2.1. Study area

Fieldwork was conducted in Marcos Paz, General Las Heras, Exaltación de la Cruz and San Andrés de Giles (northeast of Buenos Aires province, Argentina (34° S, 58.5° W)). The study area is located in the Rolling Pampa, a subdivision of the Pampas region (Soriano et al., 1991). The climate is temperate, with a mean annual temperature of 17.4 °C (IGM, 1998). It is the main agricultural area and one of the most important dairy production areas in Argentina. Almost all the original grasslands have been replaced by grain crops and natural or implanted pastures for raising livestock, consisting mainly of horses and dairy cattle (Soriano et al., 1991; Bilenca and Miñarro, 2004). The study area is a rural landscape also characterized by the presence of poultry and pig farms, both of which have increased significantly in numbers in recent years. Pig farms in this area account for 80% of the national pig production (Ribicich et al., 2005).

2.2. Production systems studied

On all the farms used for the study, cows were milked twice daily with milking machines. The milk was then stored directly in cold tanks. While milking, cows fed on nutritionally balanced food and then grazed on pastures, which were the main source of their diet. After each milking, farmers washed the dairy shed to ensure satisfactory hygienic conditions to prevent milk contamination and disease transmission. As a result, wastewater flowed into a drainage channel about 1.5–2 m wide, which usually ended into a pond located close to the shed. This wastewater contained cattle feces, hair and urine, along with substances used to sanitize the dairy shed. Storage sheds with food spread on the floor or in bags, silos and/or silage bags were common, providing ad libitum food sources to synanthropic mammals. Also, other buildings such as houses or warehouses were common. On most farms, the farmer's house was nearby the dairy shed. Vegetation growing spontaneously around the dwellings was used to feed cows, sheep and/or goats when present, as well as horses used to manage cattle. Because of grazing, vegetation was usually not mowed. However, the height, type of vegetation and vegetation cover varied among dairy farms and depended on the seasonality and type of management performed by the farmers. Poisoning was the only management action used against rodents. Personnel responsible for operating the farms were employees and all management decisions on each farm were made by the owners, managers or other professionals such as veterinarians or agronomists.

Intensive pig farms considered in this study consisted of indoor breeding in sheds, because free rearing for commercial purpose is forbidden (Res. No. 225/1995, SENASA, 1995). Pig age classes were held in different types of sheds since each age class has special management requirements. As on dairy farms, pig farms also included food storage sheds or silos, other buildings (houses, warehouses, offices) with spontaneous vegetation growing around, as well as pig sheds with their respective drainage channels. Food sources were also present ad libitum in all sheds, mainly in feeders, but also spilled on the floor. Pig sheds were also washed with water frequently and on some pig farms septic tanks were present. Drainage channels carried the wastewater from the pig sheds into a pond for wastewater treatment. This wastewater contained remnants of food eaten by pigs, together with pig feces, hair and urine. Drainage channels both in dairy and pig farms sometimes filled up with organic material and had to be emptied and thus often deepened. Soil removed from these channels was then subsequently placed alongside the drainage channel itself, resulting in dirt mounds where spontaneous tall herbaceous vegetation often grew to over 1 m height (Lovera, unpublished results).

Unlike dairy farms, pig farms rodent infestations were a major concern due to the threat of Trichinosis transmission to pigs, since Trichinosis is endemic in Argentina and can be carried by rodents. As a result, some pig farms frequently used chemical products for rodent control, applied by the farmers or by pest control companies. Nevertheless, there were periods in which farms

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