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Spatial and temporal patterns of brown rat (*Rattus norvegicus*) abundance variation in poultry farms

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Abstract

The temporal and spatial patterns of rat abundance variations were studied, and which factors might affect these patterns in poultry farms. Forty-eight poultry farms were sampled from spring 1999 to winter 2001 in Buenos Aires, Argentina. Environmental variables of farms, meteorological variables and distances among farms were registered to evaluate a possible association with rat abundance estimated by trap success. *Rattus norvegicus* was the dominant rat species in the study area. Rat abundance did not vary temporally and there was reproduction at all times. Trap success was more similar among neighboured farms than among farms further apart. Contrary to the abundance of other small rodents, rat abundance was not significantly related to farm characteristics. The lack of coincidence between rats and other small rodents suggests the existence of a differential response of rats to environmental factors of the poultry farms.

Key words: *Rattus norvegicus*, poultry farms, abundance

Introduction

Rats cause sanitary risks and economic losses because of food consumption and contamination, and also damage building components and equipments (Webster and MacDonald 1995; Glass et al. 1997; Pratt 1991; Villa and Velasco 1994; Villa et al. 1997; Charleton and Olson 1999; Singleton et al. 2003).

Although rats are mainly associated with human modified habitats, in many countries they have colonised rural habitats, which function as population sources for reinfection of human buildings after control measures.

In rural habitats of Central Argentina rats are scarce in crop fields. There are no studies on rat abundance in rural buildings such as poultry farms, which are favourable habitats inside a matrix of cultivated fields and pastures where rats are rarely found. Studies carried out in other countries, such as the United States of America, concluded that rats and mice are particularly abundant and destructive on farms and that there is approximately 1 rat per 5 chicken (Pimentel et al. 1999).

In poultry farms the abundance of small rodents (weight <45 g) is influenced by the perimeter, the amount of plant cover, the maintenance conditions of the farm sheds and the density of chicken (Gomez Villafañe et al.

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2001, 2003), while the factors that influence rat abundance where not studied yet.
The goal of this study was to assess three main questions: Which are the seasonal patterns of rat abundance and reproduction variations on poultry farms? Which are the spatial patterns of rat abundance in the rural landscape composed by a matrix of cropfields and poultry farms? Which factors affect these patterns?

Material and methods

Study area

The study was carried out in Exaltación de la Cruz, Buenos Aires Province, Argentina, 34°S, 59°W.
The study area is located in the Pampa Ondulada and has a temperate climate. Mean annual temperature is 16 °C, and annual rainfall averages 1000 mm. Nowadays, the area is intensely cultivated with maize, soybean, sunflower and sorghum. Other activities include extensive cattle farming and intensive poultry farming.
The study area includes about 55 poultry farms. At each poultry farm, chicken are reared for about 60 days and then sold for meat. During the next 20 days the sheds (100×10 m approximately) are prepared for the entrance of other chicken. In this period sheds can be treated with rodenticides. Chicken receive food and water and are maintained at a comfortable temperature along the year (for more information about management of the farms and sheds description see Gómez Villafañe et al. 2001).

Rat surveys

Forty-eight poultry farms, approximately 87% of the total poultry farms present in the study area, were studied from spring 1999 to winter 2001. We studied six farms per season of each year.
Rats were captured in live traps of $15 \times 16 \times 31$ cm (specific for rodents >30 g) baited with meat and carrot, for three consecutive nights in each farm. The bait used was selected after a preliminary survey in a farm where we knew the presence of a high-density population of rats. Traps were spaced at 20 m intervals surrounding the poultry sheds and other buildings. When a farm had more than 3 sheds, we randomly chose 3 sheds to be sampled.
Rat density was estimated as Trap Success: [number of rats captured/(number of traps $\times$ number of nights)] $\times$ 100.
For each animal captured we recorded species according to external morphology, weight, sex and reproductive condition. Active females included pregnant, individuals with evidence of lactation or with open vaginas. Active males included individuals with scrotal testes.
The age of the individuals was estimated on the basis of the dry weight of the eye lens, sum of the dry weight of the eye lens (mg) = 7.143 + 17.977 $\times$ log age (months). Eye lenses were removed from the individuals and dried at 60 °C until constant weight. According to Kataranovski et al. (1994) this parameter is a good age indicator for specimens aged 1–22 months. Individuals were assigned to groups of 5 month intervals (0–4.9 months, 5–9.9 months, 10–14.9 months, 15–19.9 months, >20 months old).
In each farm we registered characteristics related to food availability (vegperim, total cover, cover>20, age chicken, pigpen, residues, cars–machine; for mnemonics see Tab. 1), rodenticide application (poison, with/without poison) and probability of access of rats from the surroundings (area, vegperim).
Precipitation and temperature data of Buenos Aires City were provided by the Laboratory

Table 1. Mnemonics and description of the 10 variables used to assess the characteristics of the poultry farms.

Variable	Description
Vegperim	Perimeter of the farm covered by vegetation (%)
Area	Area of the farm (ha)
Total cover	Percentage of the farm covered by vegetation (%)
Cover > 20	Farm covered by vegetation 20 cm in height (%)
Poison	Time lag since the last application of rodenticide (days)
Age chicken	Days since the chicken were brought to the farm
Pigpen	Presence or absence of pigpen
Residues	Percentage of farm covered by organic or inorganic litter
Cars–machines	Presence or absence of car bodies, garbage or discarded tires on the farm
With/without poison	Employment or not employment of poison