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MOVEMENTS OF NORWAY RATS (*Rattus norvegicus*) IN TWO POULTRY FARMS, EXALTACIÓN DE LA CRUZ, BUENOS AIRES, ARGENTINA

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ABSTRACT: The aim of this work was to study the range of movements of Norway rats in two poultry farms in Exaltación de la Cruz, Buenos Aires Province. Three female and three male rats were followed by radio-telemetry. The mean home range was 0.024 ha (0.0024 to 0.0525 ha) and the mean maximum distance between localization points was 33.70 m (10 m to 66 m). The maximum daily movement registered was 65 m. Individuals captured near sheds or pigpens did shorter displacements than those captured on the perimeter of each farm. Our results indicate that Norway rats moved only short distances in poultry farms.

RESUMEN: Movimientos de ratas noruegas (*Rattus norvegicus*) en dos granjas avícolas de Exaltación de la Cruz, Buenos Aires, Argentina. El objetivo de este trabajo fue el de estudiar el área mínima de movimientos de la rata noruega en dos granjas avícolas de Exaltación de la Cruz, provincia de Buenos Aires, para lo cual se siguieron los movimientos de seis ratas (tres hembras y tres machos) mediante radio-telemetría. El radio de acción promedio fue de 0.024 ha (0.0024 a 0.0525 ha) y la máxima distancia promedio entre puntos de localización fue de 33.70 m (10 m a 66 m.). El movimiento diario máximo registrado fue de 65 m. Los individuos capturados cerca de los galpones o chiqueros realizaron menores desplazamientos que aquellos capturados en el perímetro de cada granja. Los resultados indican que la rata noruega en las granjas avícolas solo se mueve distancias cortas.

Key words. Home range. Movements. Poultry farms. Radio-tracking. Rodentia.

Palabras clave. Granjas avícolas. Movimientos. Radio de acción. Radio-telemetría. Rodentia.

In many parts of the world, Norway and Black rats (*Rattus norvegicus* and *Rattus rattus*) are the main vertebrate pests; they cause crop damage, consume human and livestock food stores, damage buildings, prey over bird species and play a significant role as disease reservoirs (Dubock, 1982; Villa and Velasco, 1994; Webster and MacDonald, 1995; Glass et al., 1997; Singleton et al., 2003). In the beginning of the 20th century, the expansion of the agricultural frontier and the development of the railroad system in Argentina favored the dispersion of *R. norvegicus* and *R. rattus* between cities and villages (Bilenca et

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al., in press). The presence of rats is directly related to human activities because they colonize buildings and structures. In Exaltación de la Cruz (the study area), the presence of Norway rat populations is associated with animal breeding farms in which rats reproduce all year long because of the continuous availability of food and water and the favorable temperature conditions provided in the chicken sheds (Villa et al. 1997; Gómez Villafañe, 2003). In previous studies in the area, *R. norvegicus* was found to infest 34 of 48 poultry farms studied (Gómez Villafañe, 2003).

Farms are favorable habitats for Norway rats. In Buenos Aires Province, farms occur as isolated patches embedded within a matrix of crop fields which rats seldom invade. In these patchy environments where local populations are subject to control, the recolonization between farms plays a key role in the persistence of rat infestations. Thus, information about movement patterns is needed to design effective control measures, such as the determination of the area subject to control, or the spacing pattern of bait stations or traps (Pryde et al., 2005).

Reported mean home range sizes of Norway rats vary between 0.19-0.78 ha, with radius of 25 to 50 m (Jackson, 1982; Stroud, 1982; Norwak and Paradiso, 1983; Brooks and Rowe, 1987; Parker, 1990). However, rat home range sizes may vary greatly depending on habitat conditions (Taylor and Quy, 1978; Stroud, 1982). There are several methods to assess rodent home range and movements. Capture-mark-recapture and radiotelemetry methods are the most commonly used (Taylor and Quy, 1978; Lindsey et al., 1999; Cavia et al., 2005). The latter is more informative because it allows free movement of the individual animal, permitting the study of social behavior, activity patterns, range use, and travel distances (Schradin, 2006). The main disadvantage is the cost, which causes most studies using radiotelemetry techniques to involve a low number of individuals —in Norway rats this ranged in previous studies from 1 to 12 individuals— (Taylor and Quy, 1978; Stroud, 1982; Moors, 1985; Seamon and Adler, 1999; Lindsey et al., 1999; Pryde et al., 2005).

There are few studies on the ecology of the Norway rats, especially in South America (Arango et al., 2001; Castillo et al., 2003; Coto, 1997, 2001). At present, there is no information about movement patterns of this species in rural areas of Argentina, although it is one of the most significant pests in poultry breeding farms. The aim of this study was to study the movements of Norway rats that inhabited two poultry farms of Buenos Aires, Argentina, in order to contribute to the design of control measures.

The study was conducted in two poultry farms in the county of Exaltación de la Cruz, Buenos Aires Province, Argentina, 34° 16' 25.61" S, 59° 09' 00.38" W. The area is a gently sloping plain in the pampean sub-region. The climate is temperate, with a mean annual temperature of 16ºC and a mean annual precipitation of 1000 mm. The area is intensely cultivated and includes extensive cattle farming and intensive poultry farming.

Poultry farms usually have from two to six sheds where chickens are bred, areas with plant cover that is maintained at low height, and a perimeter usually covered by weeds that can be taller than 20 cm. A constant food and water supply is provided to chickens, and they are maintained at a comfortable temperature (for details see Gómez Villafañe et al., 2001).

A total of 80 live traps, 30 in farm "1" (**Fig. 1**) and 50 in farm "2" (**Fig. 2**) were placed around chicken sheds and on the perimeter of the poultry farms. The capture effort dependent on the characteristics of the farms was selected in order to obtain animals to follow with radio tracking, and not to estimate population densities. Traps were baited with meat and carrot and checked every morning until we caught seven rats (the number of available radio transmitters).

Seven rats (two in farm "1" and five in farm "2") were fitted with radio transmitters placed around their necks with plastic collars (AVM Instrument Company, Ltd.; 1.5 voltage; 2.9 mAd capacity; 20 ms pulse width, 1 month of

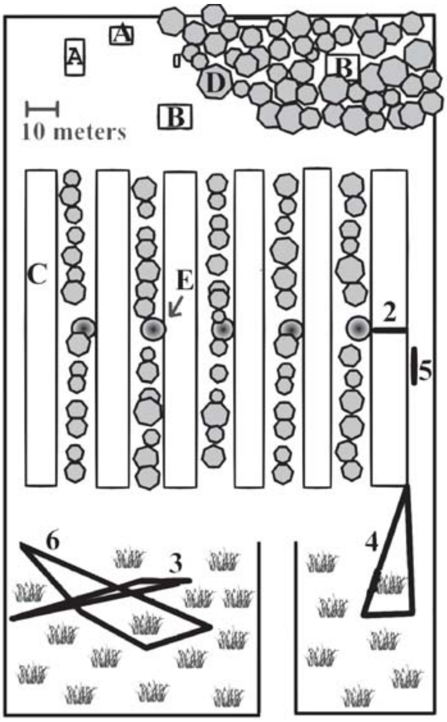

Fig. 1. Map of poultry farm "1". It included the location of the home ranges or Lmax of Norway rat 2, 3, 4, 5 and 6 (localization times: 8, 4, 21, 12 and 8, respectively). A = materiel sheds; B = house; C = poultry sheds; D = trees and E = silos.

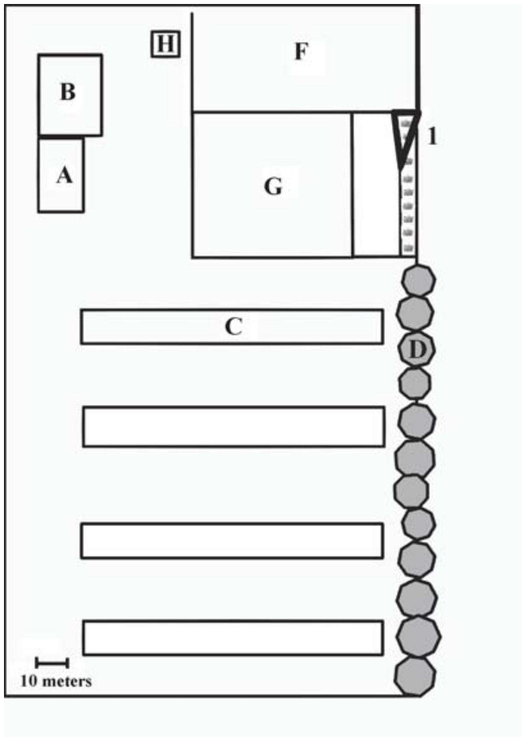

Fig. 2. Map of poultry farm "2". It included the location of the home ranges of Norway rat 1 (localization times: 3). A = materiel sheds; B = house; C = poultry sheds; D = trees; F = pigpen; G = stockyard and H = henhouse.

duration and 2.3 grams of weight, approximately). A portable telemetry receiver (Telonics TR4) and a directional Yagi antenna (142-220 mHz, 425 grams) were used to track individual rodents.

After placing the radio collar and registering the sex, weight, corporal length and capture location, animals were released at the point of capture. Individuals were located by means of radio-telemetry at four hours intervals over seven days and nights (during three consecutive days, February 27, 28, and March 1, 2002; two consecutive days, March 12th and 13th, 2002; and in other two days, March 7th and 21st 2002). We registered the point of each radiotelemetry location and then calculated the frequencies of capture of each rat at each point. In addition, for each individual, we calculated the maximum distance between localization points (Lmax), and the home range size by means of the Minimum Convex Polygon Method when the number of location points per individual was three or more (Hayne, 1949; White and Garrot, 1990). Although this method does not give an indication of how intensively an animal uses an area, it is more robust than other methods when the number of fixes is low (Pryde et al., 2005).

Differences between sexes in the Lmax were assessed by means of the Student's *t*-test for independent samples (Zar, 1996). We assessed differences in Lmax between individuals trapped near sheds and pigpens and those on the perimeter using the Mann-Whitney U-test (Statistica 6.0). The Pearson parametric correlation (Zar, 1996) was used to assess the association between the corporal weight and the Lmax of the individuals.

Rats were detected in places with high plant cover (the shrub area in farm "2"), near the pigpen in the farm "1", and near sheds in farm "2" (**Fig. 1**, **2**). Each animal was located in 2 to 5 different location points, and 3 to 21 detections throughout the study period. The characteristics of individuals and the site with the most frequent location are specified in **Table 1**.

The mean home range size was 0.0240 ha (n = 4), and ranged from 0.0024 to 0.0525 ha For two individuals we could not calculate the convex polygon because we registered only two location points (eight localizations in one site and 12 in the other). The mean Lmax was 33.70 m (n = 6) and ranged from 10 to 66 m; the maximum daily movement was 65 m.

Lmax (maximum distance between localization points) did not differ between sexes (t = 0.53; p = 0.62; df = 4), nor was it significantly associated to individual body weight ($r_{Pearson}$= 0.6126; p = 0.19; df = 5). Individuals localized near sheds or pigpens made shorter displacements than those localized on the perimeter of the farms (mean = 12.16 m and 55.24 m; respectively; U = 0.00, p = 0.04; df = 1; 4). One month after the beginning of the observations, all signals were lost as a result of limited battery life.

Norway rats showed limited movements in the area of study and were apparently restricted within the farm boundaries. Although we lack records of their whereabouts between localizations, we are confident that the number of records and the time interval between them are sufficient to detect the range of movement in this species and in this system. Norway Rats appear to be able to cover considerable distances over agricultural land (Taylor and Quy, 1978), especially in summer (Huson and Rennison, 1981), but our data suggests that there were little displacements between the farm and the surrounding fields.

Our study, in agreement with previous studies, suggests that male and female rats have similar home range sizes (Moors, 1985; Tobin et al., 1996; Brown et al., 2001; Schradin, 2006); this result must be confirmed, however, with a larger sample size and in other seasons of the year.

The short distances traveled in poultry farms agree with those observed in other habitats with high resource availability, such as riparian habitats with high heterogeneity (Pocock et al., 2004), and with results of experimental studies with manipulation of the food supply, where movements were shorter than 100 m in patches with high food supply, while increased to 350 m when extra food was not provided (Taylor and Quy, 1978).

The home range sizes estimated in this work are small compared with those calculated in other studies; for example, New Zealand (Moors, 1985), or in other rat species, such *R. rattus* and *R. exulans* in Hawaiian rainforests (3-3.6 ha; Lindsey et al., 1999), *R. argentiventer* in lowland irrigated rice crops in West Java Indonesia (1.97-3.01 ha; Brown

Table 1

Weight, sex, site of most frequent location, home range size, Lmax and numbers of locations point (independently of the frequency) of the individuals tracked.

# rat	Weight (g)	Sex	most frequent location	home range (ha)	Lmax (m)	# location points
1	80	Male	pigpen	0.0024	16.5	3
2	210	Male	outside shed	-	10	2
3	460	Male	periphery with vegetation	0.01125	57	3
4	230	Female	periphery with vegetation	0.03	42.72	5
5	290	Female	outside shed	-	10	2
6	310	Female	periphery with vegetation	0.0525	66	5
7	160	Male	(disperser individual)-	-	-	-

et al., 2001) and *R. rattus* in a Hawaiian macadamia orchard (0.20ha; Tobin et al., 1996).

These limited movements, and the record of only one disperser, are probably related to the good conditions found inside the poultry farms, such as the great amount of food and water, and a moderate temperature.

We captured only one juvenile, and its home range was smaller than those registered for the adults, although it was expected a longer distance because in general juveniles are subordinates, and, in the breading season, they are necessarily immigrants (Leirs et al., 1996). More data would be necessary to confirm differences in home range between adults and juveniles in poultry farms.

The information about Norway rat home range is scarce around the world, more so in Argentina, therefore, this work is a contribution to increase the knowledge of the movements of *R. norvegicus*. Radiotelemetry was an adequate technique to follow the movements of rats for up to 30 days, which is the battery lifetime. Radio collars with a longer battery life are available and may be used in future studies in order to have better estimates of rat home range size.

According to our results, the rat populations on different poultry farms in our study area are probably semi-isolated from each other, although the exchange rate of individuals among these is unknown, it is possible that migration has no real effect on local dynamics in the existing populations. Our study, however, was conducted only in one season and with a small number of individuals, and our results must be confirmed with more data covering different seasons, since many animals show differences in dispersal rates according to the seasons or the state/age of individuals.

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LITERATURE CITED

ARANGO J, E CITTADINO, A AGOSTINO, GD de MAZZONELLI, C ALVAREZ, M COLUSI, A KOVAL, A CABRERA BRITOS, and FO KRAVETZ. 2001. Prevalencia de leptospirosis en *Rattus rattus* y *Rattus norvegicus* en el Gran Buenos Aires, Argentina. Ecología Austral 11:25-30.

BILENCA DN, M BUSCH, IE GOMEZ VILLAFAÑE, M MIÑO, UFJ PARDIÑAS, DH PODESTÁ, and OV SUÁREZ. (alphabetic order). In press. Roedores murinos introducidos: ratas (*Rattus norvergicus* y *Rattus rattus*) y ratones (*Mus domesticus*). *In*: “Los mamíferos de Argentina” (ML Merino, BN Carpinetti y A Scorolli, eds.). Administración de Parques Nacionales, Buenos Aires.

BROOKS JE and FP ROWE. 1987. Commensal Rodent Control. World Health Organization. Vector Biology Control Division, Geneva.

BROWN PR, GR SINGLETON, and JI SUDARMA. 2001. Habitat use and movements of the rice-field rat, *Rattus argentiventer*, in West Java, Indonesia. Mammalia 65:151-166.

CASTILLO E, J PRIOTTO, AM AMBROSIO, MC PROVENSAL, N PINI, MA MORALES, A STEINMANN, and JJ POLOP. 2003. Commensal and wild rodents in an urban area of Argentina. International Biodeterioration & Biodegradation 52:135-141.

CAVIA R, IE GÓMEZ VILLAFAÑE, EA CITTADINO, DN BILENCA, MH MIÑO, and M BUSCH. 2005. The effect of cereal harvest on abundance and spatial distribution of *Akodon azarae* (Rodentia, Muridae) in Central Argentina. Agriculture Ecosystems and Environment 107:95-99.

COTO H. 1997. Biología y control de ratas sinantrópicas. Agrevo. Editorial Abierta, Argentina.

COTO H. 2001. Determinación de áreas de riesgo con la presencia de roedores en la ciudad Autónoma de Buenos Aires. Maestría, Universidad de San Martín, Buenos Aires.

DUBOCK A. 1982. Pulsed baiting—a new technique for high potency, slow acting rodenticides. Proceeding of Vertebrate Pestes Conference 10:23-25.

GLASS G, J JOHNSON, G HODENBACH, C DISALVO, C PETERS, J CHILDS, and J MILLS.1997. Experimental evaluation of rodent exclusion methods to reduce hantavirus transmission to humans in rural housing. The American Society of Tropical Medicine and Hygiene 56: 359-364.

GÓMEZ VILLAFAÑE IE. 2003. Estudio de la ecología y epidemiología de *Rattus* spp. en un ambiente urbano y granjas avícolas del Partido de Exaltación de la Cruz, Buenos Aires, Argentina. Tesis doctoral, Facultad de Ciencias Exactas y Naturales. Universidad de Buenos Aires, Argentina.

GÓMEZ VILLAFAÑE IE, DN BILENCA, R CAVIA, EA CITADDINO, and M BUSCH. 2001. Environmental factors associated with rodent infestations in Argentine poultry farms. British Poultry Science 42:300-307.

HAYNE DW. 1949. Calculation of size of home range. Journal of Mammalogy, 30: 1-18.

HUSON LW and BD RENNISON. 1981. Seasonal variability of Norway rat (*Rattus norvegicus*) infestation of agricultural premises. Journal of Zoology, London 194:257-260.

JACKSON WB. 1982. Norway rat and allies. Pp. 1077-1088, *in*: Wild mammals of North America: Biology, management, economics (JA Chapman and GA Feldhamer, eds.). The Johns Hopkins University Press, Baltimore and London.

LEIRS H, W VERHEYEN, and R VERHAGEN. 1996. Spatial patterns in *Mastomys natalensis* in Tanzania (Rodentia, Muridae). Mammalia 60:545-555.

LINDSEY GD, S MOSHER, SG FANCY, and T SMUKER. 1999. Population structure and movements of introduced rats in a Hawaiian rainforest. Pacific Conservation Biology 5:94-102.

MOORS PJ. 1985. Norway rats (*Rattus norvegicus*) on the Noises and Motukawao Islands, Hauraki Gulf, New Zealand. New Zealand Journal of Ecology 8:37-54.

NORWAK R and J PARADISO. 1983. Walker's Mammals of the World: Fourth Edition. Baltimore, MD: The Johns Hopkins University Press.

PARKER S. 1990. Grzimek's Encyclopedia of Mammals: Volume 3. New York: McGraw-Hill Publishing Company.

POCOCK MJO, JB SEARLE, and PCL WHITE. 2004. Adaptations of animals to commensal habitats: population dynamics of house mice *Mus musculus domesticus* on farms. Journal of Animal Ecology 73:878-888.

PRYDE M, P DILKS, and I FRASER. 2005. The home range of ship rats (*Rattus rattus*) in beech forest in the Eglinton Valley, Fiordland, New Zealanad: a pilot study. New Zealand Journal of Zoology 32:139-142.

SCHRADIN C. 2006. Whole-day follows of striped mice (*Rhabdomys pumilio*), a diurnal murid rodent. Journal of Ethology 24:37-43.

SEAMON JO and GH ADLER. 1999. Short-term patterns of space use by a Neotropical forest rodent, *Proechimys semispinosus*. Journal of Mammalogy 80:899-904.

SINGLETON GR, LA HINDS, CJ KREBS, and DM SPRATT. 2003. Rats, mice and people: rodent biology and management. ACIAR (Australian Center for International Agricultural Research) Monograph 96:564 pp.

STROUD DC. 1982. Population dynamics of *Rattus rattus* and *R. norvegicus* in a riparian habitat. Journal of Mammalogy 63:151-154.

TAYLOR KD and RJ QUY. 1978. Long distance movements of a common rat (*Rattus norvegicus*) revealed by radio-tracking. Mammalia 42:63-71.

TOBIN ME, RT SUGIHARA, AE KOEHLER, and GR UEUNTEN. 1996. Seasonal activity and movements of *Rattus rattus* (Rodentia, Muridae) in a Hawaiian macadamia orchard. Mammalia 60:3-13.

VILLA B and A VELASCO. 1994: Integrated pest management of the rat *Rattus norvegicus* in poultry farms. Veterinaria-México 25:247-249.

VILLA B, D WHISSON, and V SANCHEZ-CORDERO. 1997. Capture rate and reproductive patterns of Norway Rats (*Rattus norvegicus*) (Muridae: Rodentia) in a poultry farm in Mexico City. Anales del Instituto de Biología de la Universidad Nacional Autónoma de Mexico, Ser. Zool. 68:165-172.

WEBSTER J and D MACDONALD. 1995. Parasites of wild brown rats (*Rattus norvegicus*) on UK farms. Parasitology 1211:247-255.

WHITE GC and RA GARROT. 1990. Analysis of wildlife radio-tracking data. Academic Press, San Diego, California.

ZAR J. 1996. Biostatistical Analysis. Third edition. Prentice-Hall, inc. United Stated of América.