Anales Inst. Biol. Univ. Nac. Autón. México, Ser. Zool. 68(1): 165-172. 1997

CAPTURE RATE AND REPRODUCTIVE PATTERNS OF NORWAY RATS (*RATTUS NORVEGICUS*) (MURIDAE: RODENTIA) IN A POULTRY FARM IN MEXICO CITY

BEATRIZ VILLA C.*
DESLEY A. WHISSON*
VÍCTOR SÁNCHEZ-CORDERO*

RESUMEN

Se describen algunas características poblacionales y reproductivas de la rata gris o de alcantarilla, *Rattus norvegicus* (Muridae: Rodentia), en una granja avícola que alberga aproximadamente 10000 aves de postura, ubicada en el SW de la ciudad de México. Se efecturaon muestreos mensuales de febrero de 1988 a enero de 1989, colocando en cada ocasión 100 trampas. Se capturaron 656 individuos, de los cuales 372 fueron machos, y 248 hembras. Se capturaron un mayor número de individuos en los meses de febrero a abril de 1988, alcanzando un pico de 77 individuos, disminuyendo notoriamente durante los meses de mayo a septiembre, hasta alcanzar 10 individuos. Posteriormente, se observó un incremento moderado en los meses de noviembre a diciembre de 1988, alcanzando 50 individuos. Del total de hembras adultas, 37% se capturaron gestantes y, 27% lactantes. Se capturaron hembras gestantes durante todos los meses de colecta, aunque se observó una mayor proporción de hembras gestantes en la época de secas (marzo a mayo), en comparación a la época de lluvias (junio a septiembre). El promedio de embriones fue de 7.9, con un intervalo de 1 a 15. Es necesario determinar la transhumancia de individuos de la granja y áreas adyacentes para proponer medidas de prevención de esta plaga en la granja avícola.

Palabras clave: roedores, plagas, roedores comensales, *Rattus norvegicus,* granjas avícolas, México.

* Departamento de Zoología, Instituto de Biología UNAM, Apartado Postal 70-153, México D.F. 04510, México.

ABSTRACT

We describe some population and reproductive characteristics of Norway rats, *Rattus norvegicus* (Muridae) in a poultry farm from southern México City in which 10000 hens are kept. Monthly trapping using 100 traps was conducted from February 1988 to January 1989. Six hundred and fifty six individuals were caught, (372 males, and 282 females). A higher number of individuals were caught from February to April 1988, peaking at 77 individuals. A significant decrease in the number of trapped individuals was observed from May to September, reaching a low of 10 individuals, and followed by a moderate increase. Pregnant females were observed throughout the study, peaking mostly during the dry season (March to May). Twenty seven percent of adult females caughts throughout the study were lactating. The average number of embryos per female was 7.97 ± 0.77, ranging from 1 to 15 (n = 108).

Key words: Rodent pest, commensal pest, poultry farms, *Rattus norvegicus* (Muridae), México City.

INTRODUCTION

Rodents are a serious problem in poultry farms throughout the world (Ashton& Jackson, 1986; Corrigan & Williams, 1986). Enclosed and insulated commercial poultry buildings provide ideal habitat which can support unusually large populations which can have significant economic impact to poultry operations (Corrigan & Williams, 1986). Rodents consume food as well as contaminate it with urine and faeces, gnaw on structural, mechanic and electrical components, and weaken structures as a result of their burrowing activities. Rodents are also potential vectors of several livestock diseases including erysipelas, fowl cholera and salmonellosis (Meehan, 1984).

In poultry farms around Mexico City, the Norway rat, *Rattus norvegicus* is the major pest species. The problem has become more serious in the last 10 years with the increase in urban development around poultry farms. This has resulted in an expansion of suitable shelter and food resources for *R. norvegicus*. The presence of large populations of *R. norvegicus* in poultry farms also means health problems for neighbouring urban areas.

Despite the seriousness of the problem, control currently relies on the indiscriminate applications of rodenticidal baits (pers. obser.). These are generally ineffective (Bishop & Martley, 1976), as they do not consider size or other characteristics of the rodent populations which are more valuable tools in pest control. In fact, there have been no quantitative studies of *R. norvegicus* populations in poultry in farms in Mexico City. This study was undertaken to provide some information on the capture rate and reproductive pattern of *Rattus norvegicus* in a poultry farm in suburban areas. We consider this information essen-

tial to developing more efficient and cost effective integrated management strategy.

METHODS

The study was conducted from February 1988 to Januay 1989 in a poultry farm in Iztapalapa, a suburb in south Mexico City, Mexico. The farm comprised a large building enclosing 22 poultry housing structures. Each structure contained approximately 10 000 hens. The building is bordered by an urban area, a pig farm and a livestock food storage facility, and two large grassed areas.

On five nights per month, 30 leg-hold traps were placed in the warehouse in locations where rodent signs were most frequent. Conventional snap traps were not used as rodents had learned to avoid traps. All animals caught were necropsied, weighted and measured and their reproductive status was examined. For females, pregnancies and the number of embryos were recorded. Males were recorded as having scrotal or abdominal testes.

RESULTS AND DISCUSSION

A total of 656 *R. norvegicus* were trapped during the study. Trap success and characteristics of the population each month are shown in figure 1. Trap success varied significantly ($X^2 = 236.58$, d.f. = 11, $P < 0.05$) over the study period. Population levels were high at the beginning of the study from February to April, peaking in March with 78 rats, then decreasing from May to October, showing the lowest value in July with 10 rats; population levels increased again in November to December (Fig. 1). Due to the enclosed nature of the poultry farm, it is likely that there is little seasonal variation in habitat quality for rodent populations. One reason for the observed variation in population levels throughout the year might be related to extrinsic factors. For example, as higher populations levels were recorded during the colder months of the year, it is possible that rodents from outside the poultry enclosures were taking refuge inside where food resources and temperature were more favorable. Conversely, intensive removal trapping may have resulted in a rapid decrease in population size following the first months of trapping (Fig. 1).

Sex ratio of the population deviated significantly ($X^2 = 12.09$, d.f. = 1, $P < 0.05$), with males comprising 56.7% of the population over the study period. The relative excess of males may be due to them being more active and, therefore, having a higher probability of capture than females, as reported in other studies (Calhoun, 1962; Glass *et al.*, 1989).

Throughout the study, 37% of females were pregnant. An additional 23.7% of the females were lactating. The percentage of pregnant females varied signifi-

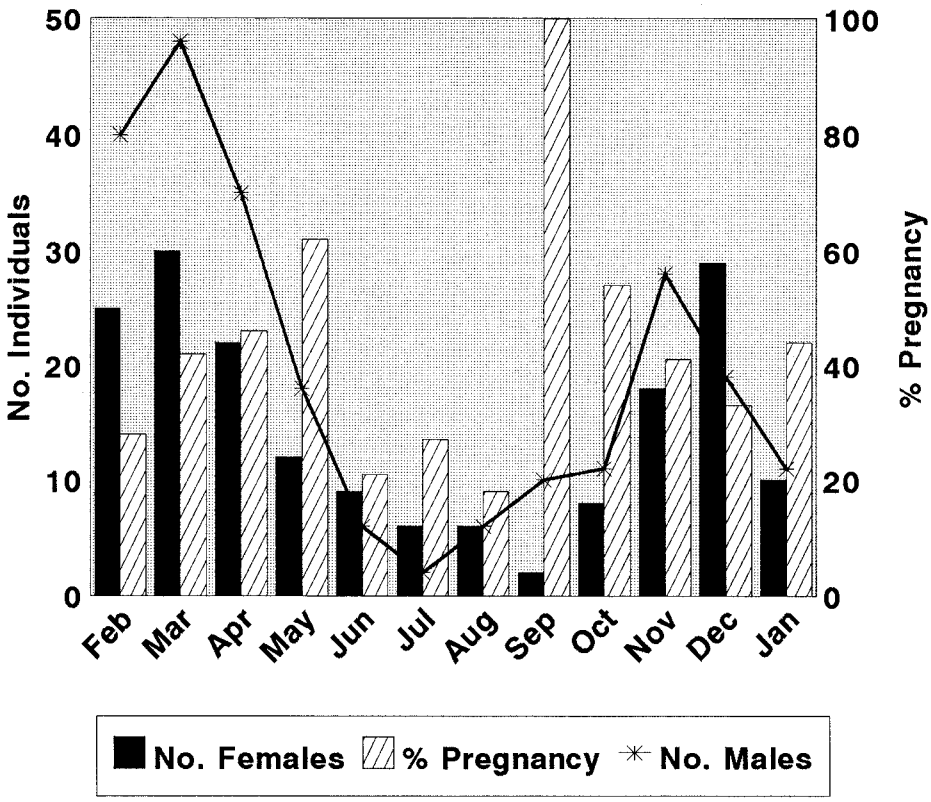

Fig. 1. Population characteristics of Norway rats (*Rattus norvegicus*) trapped in a poultry farm over the period February 1988 to January 1989.

cantly between months (X^2 = 23.29, d.f. = 12, $P < 0.05$). Although pregnancies were recorded in all months, peaks were observed in spring (March-May) and autumn (September-November). This bimodal seasonal reproductive pattern is characteristic of most Norway rat populations (Davis & Hall, 1951; Pye and Bonner, 1980; Stoud, 1982; Glass *et al.*, 1988). Glass *et al.* (1988) suggested that a summer breeding decline may be due to the large influx of nulliparous young females born in the spring that have reached sexual maturity, but have not become pregnant, while a second autumn reproductive peak occurs as they are recruited into the breeding population. They also suggested that the winter decline in breeding may represent a delay in maturation because of enviromental conditions. Temperature extremes in summer and winter may also have inhibited breeding in those seasons.

Breeding intensity varied significantly between weight classes (X^2 = 19.07, d.f. = 4; $P < 0.05$) of females, and incidence of pregnancy increased with increasing

body mass (Table 1). Pregnacies were not recorded in individuals having a weight of less 100 g. Average litter size (based on the number of embryos per female) was 7.97 ± 0.77, with a range of 1 to 15 (n = 108). The number of embryos was not significantly correlated with body mass of females ($r_s = 0.0263$, $P > 0.1$).

Table 1. Incidence of pregnancies and number of embryoes by mass classes in Norway rats (*R. norvegicus*) in a poultry farm in Mexico City, Mexico

Mass class (g)	Percent	Average number of embryoes	S.D.	Min.	Max.	Sample size
101-200	11.1	6.25	3.50	1	8	9
201-300	10.0	8.06	2.49	4	14	49
301-400	36.7	8.61	1.92	4	12	101
401-500	34.7	7.62	2.91	2	14	94
>500	50.0	3.50		2	5	

An increase in incidence of pregnancy with body mass, with lack of reproductive activity in rats weighing less than 100 g, has been observed in other populations of Norway rats (Storer & Davis, 1953; Perry, 1954; Glass *et al.*, 1989). Glass *et al.* (1989) observed that individuals in larger weight classes tended to be pregnant throughout the year at a relatively constant rate, while females of less than 400 g showed seasonal breeding, and indicated social factors as being responsible for this pattern. They further observed litter size to follow a weight-specific pattern which is typical of this species (Davis, 1951; Leslie *et al.*, 1952; Perry, 1954). The latter, however, was not apparent in our study.

Distribution of individuals between five weight classes varied significantly between seasons for males ($X^2 = 30.44$, d.f. = 4, $P < 0.05$), but remained constant for females ($X^2 = 9.14$, d.f. = 4, $P < 0.05$). The change within the male population appeared to be due mainly to changing numbers of individuals in the smallest (<200g) and largest (>300g) weight classes (Table 2).

Seasonal changes in the size structure of *R. norvegicus* populations have also been observed in other studies (Farhang-Azad & Southwick, 1979; Stoud, 1982; Glass *et al.*, 1989). Following a comparative study of population of *R. norvegicus* in urban and parkland areas, Glass *et al.* (1989) suggested that changes in size structure are primarily due to changes in habitat quality and its effect on age-specific survival. In residential areas where population were not subjected to the same seasonal variations in food and shelter resources, the size structure remained constant throughout the year (Glass *et al.*, 1989).

Table 2. Frequency distribution of female and male *R. norvegicus* according to mass classes in a poultry farm in Mexico City, Mexico

Period	Mass classes					
	101-200	*201-300*	*301-400*	*401-500*	*>500*	*Total*
1988	5/3	7/2	24/3	40/52	23/5	42/60
Februay						
March	2/5	11/6	16/12	41/52	31/25	109/151
May						
June	5/0	16/25	14/9	24/28	41/38	37/35
August						
September	4/6	8/10	19/13	31/49	37/49	48/77
November						
1988-1989	2/0	11/4	17/23	32/48	38/25	47/52
December						
January						

Low seasonal variation in habitat quality for Norway rats in the studied poultry farm was indicated by the constant size structure of the female population. Despite the variation in size structure of the male population, it is significant that the population throughout the study was characterized by a large proportion of individuals in the larger weight classes (*e.g.*, 300 g) reflecting the abundance of favourable food resources.

CONCLUSIONS

This study outlines some of the characteristics of *R. norvegicus* populations in a poultry farm of Mexico City. Population levels fluctuated throughout the year although there was little variation in habitat quality within the poultry enviroment. This may be a result of rodents invading the poultry enclosure from surrounding areas in response to a decrease in habitat quality (shelter and food resources) as may occur during winter months. However, further investigations are necessary to determine if this interaction between population inside and outside the poultry enclosures occurs. Low seasonal variation in food supply within the poultry farm resulted in continous breeding throughout the year and an abundance of individuals in the heaviest weight classes. Considering the opportunistic foraging behaviour of Norway rat populations, indiscriminate baiting with rodenticides will never provide efficient control of this species (Ashton & Jakson, 1986). Control

should aim to reduce the potential for breeding within population and the potential for invasion from surrounding areas. This may be achieved through modifications of the habitat, including the routine removal of chicken faeces from under chicken cages, filling holes used for shelter, and constant removal of spilled chicken feed.

ACKNOWLEDGEMENTS

We would like to thank Teresa F. López, R. Carmen Castro, and C. Olguín for their help in the field work. The colaboration of the poultry farm owners is also gratefully acknowledged. Comments by two anonymous reviewers helped to improved the clarity of the manuscript.

LITERATURE CITED

ASHTON, A. D. & W. B. JACKSON. 1986. Efficient and inefficient methods of controlling rodents in poultry houses. *Proc. Second Symp. Recent Advances in Rodent Control,* Kuwait, pp 339-349.

BISHOP, J. A. & D. J. HARTLEY. 1976. The size and age structure and rural populations of *Rattus norvegicus* containing individuals resistant to the anticoagulant poison warfarin. *J. Anim. Ecol. 45*:623-646.

CALHOUN, J. B. 1962. The ecology and sociology of the Norway rat. *U.S. Dept. Health, Education and Welfare, Public Health Serv. Publ. 1008*:1-288.

CORRIGAN, R. M. & R. E. Williams. 1986. The house mouse in poultry operations: pest significance and novel baiting strategy for its control. *Proc. 12th Vert. Pest Conf.,* California, pp. 120-126.

Davis, D. E. 1951. The relation between level of population and size and sex of Norway rats. *Ecology 32*:462-464.

DAVIS, D. E. & O. HALL. 1951. The seasonal reproductive condition of female Norway (brown) rats in Baltimore, Maryland. *Physiol. Zool. 24*:9-20.

FARHANG-AZAD, A. & SOUTHWICK, C.H. 1979. Population ecology and Norway rats in the Baltimore Zoo and Druid Hill Park, Baltimore, Maryland. *Ann. Zool. 15*: 1-42.

GLASS, G. E., G. W. KORCH & J. E. CHILDS. 1988. Seasonal and habitat differences in growth rates of wild *Rattus norvegicus*. *J. Mammal. 69*(3):587-592.

GLASS, G. E., J. E. CHILDS, G. W. KORCH & J. W. LEDUC. 1989. *Comparative ecology and social interactions of Norway rat (Rattus norvegicus) populations in Baltimore, Maryland.* Museum of Natural History, University of Kansas, Lawrence, Kansas. 130:1-33.

LESLIE, P. H., U. M. VENABLES & L. S. V. VENABLES. 1952. The fertility and population structure of the brown rat (*Rattus norvegicus*) in corn-ricks and some other habitats. *Proc. Zool. Soc. London 122*:187-283.

MEEHAN, A. P. 1984. *Rats and mice. Their biology and control.* Rentokil Ltd., East Grinstead, Sussex. 383 p.

PERRY, J. S. 1954. The reproduction of the wild brown rat (*Rattus norvegicus*) (Erxleben). *Proc. Zool. Soc. London 115*:19-46.

PYE. T. & W. N. BONNER. 1980. Feral Brown rats, *Rattus norvegicus*, in South Georgia (South Atlantic Ocean). *J. Zool. London 192*:237-255.

STORER, T. I. & D. E. DAVIS. 1953. Studies on rat reproduction in San Francisco. *J. Mammal. 34*:365-373.

STROUD, D.C. 1982. Population dynamics of *Rattus rattus* and *R. norvegicus* in riparian habitat. *J. Mammal. 63*:151-154.