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HYBRID AND NEW ZEALAND WHITE RABBITS KEPT IN FLOOR PENS: SPACE DISTRIBUTION AND AGGREGATIONS.

Ferrante V., Verga M., Canali E., Mattiello S., Carenzi C.

Ist. Zootecnica Veterinaria, Via Celoria 10, 20133 Milano, Italy

ABSTRACT

452 hybrids and 442 N.Z.W. rabbits (half females and half males) kept in 12 floor pens (850 sq cm/head) were used to verify the use of the enclosure mainly in relation to the grouping of the animals and their spatial distribution. The animals were 30 days old and the experiment lasted four weeks. All the males were individually marked to distinguish them from the females. Each pen was observed twice a week for four weeks; the enclosure was divided in five areas and the spatial distribution of the following aggregation was recorded: single female, single male, couple and bisexual group (more than 5 animals). Principal Component Analysis showed that the different areas in which the rabbit aggregations were found are divided into two groups: corner and step "protected area"; center, feeder and side "open space and feeding area". The bisexual group is well separated from the other aggregations. Moreover in the bisexual group it is possible to notice a separation between the two strain.
No differences were found in the spatial distribution between single male and single female.
Rearing fattening rabbits in floor pens at quite high density seems to be a possible alternative to the cages due to the good growth performance, spatial distribution in the enclosure and lack of aggression.

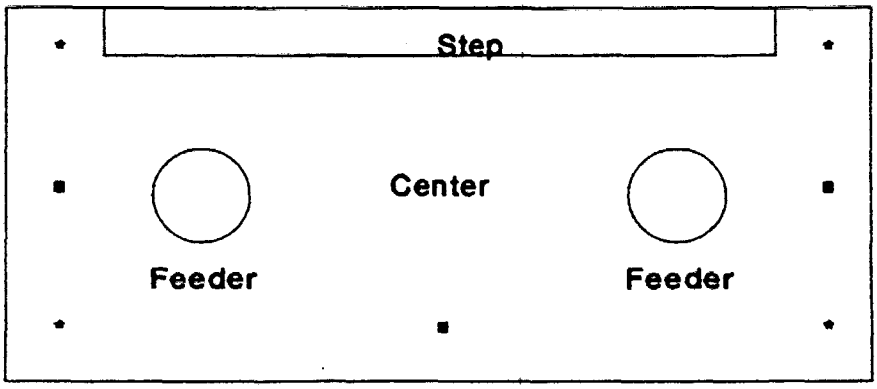
Introduction

Spacing behaviour of wild rabbits has been studied by several authors (Vastrade, 1987; Denenberg et al., 1969; Mykytowicz, 1960; Lockley, 1961; Myers and Poole, 1958), who found that animals show preference choices, and that they use areas of different sizes. In free-ranging colony rabbits a dominance hierarchy develops too, and it seems to be correlated, mainly in males, to the dimension of controlled surface. On the contrary, females seem to have smaller territories than males, and share their "home-range" with other females (Vastrade, 1987).
In domestic rabbit breeding, it is important to verify the spatial distribution of animals keeping them on ground pens after weaning till sexual maturity, in order to understand their preferred areas and their spatial and social needs. This could help breeders in improving this kind of rabbit housing, avoiding overcrowding that could stress the animals and therefore negatively affect their welfare and production. This could also allow reared rabbits to live in more "natural" conditions; in fact, according to Vastrade (1987), "spacing behaviour of the domestic rabbit seems to be similar to that of the wild rabbit".
Concerning the different kinds of rabbit housing systems

Podberscek (1991) pointed out that " penned housing system are more acceptable than caged systems but the negative aspects of pens should be addressed". In fact some authors found that caged rabbits could show inactivity atrophies, damage to skeleton as well as behaviour disturbances (Lehman, 1987; Bell and Bray, 1984). Moreover cage density can affect the behaviour and performances of the breeding rabbits (Maertens and DeGroote, 1984). On the other hand penned rabbits can show injuries that can occur at the end of the fattening period (Bell and Bray, 1984). The aim of the research was to verify the use of the enclosure in rabbits kept in floor pens mainly in relation to the grouping of the animals and their spatial distribution.

Material and Methods

452 hybrids and 442 NZW rabbits (half females and half males) were used. The animals were 30 days old. All the rabbits were housed in twelve floor pens (850 sq cm/head) on a concrete floor with straw bedding. The barn was not air-conditioned and there was no light schedule. The rabbits were fed pelletized feed (18% crude protein) ad libitum. All the males were marked to recognize them from the females. The animals were individually weighed every week. Each group of rabbits was observed twice a week for four weeks. The observations were always made by two people, in the morning and in the afternoon. The enclosure was divided into five areas (fig.1) and the observers recorded the spatial distribution of the following aggregation: single female; single male; couple; bisexual group (more then 5 animals); two females; two males; group of females; group of males. The last four aggregations were not considered in the analysis, due to their low frequency; moreover the sides, the feeders and the corners of the enclosures were analyzed as: one side, one feeder and one corner. As preliminary analysis showed that the enclosure did not affect the variable considered, this effect is not considered in this paper. The data were analyzed by multivariate analysis: Principal Component Analysis (PCA), Classification Analysis (KNN = K-Nearest Neighbours) and Cluster Analysis (Forina et al. 1987) with the SCAN software package (Todeschini et al., 1990).



•=corner ▪=side

Fig.1

Results and Discussion

PCA shows that the different areas in which the rabbit aggregations were found are divided into two groups: 1) corner and step, that could be called 'protected area'; 2) centre, feeder and side, that could be called 'open space and feeding area' (Fig. 2a and Tab. 1). We can see a difference in the distribution of the aggregations in which the bisexual group is well separated from the single animals and the couples (Fig. 2b). Moreover, in the bisexual group it is possible to notice a separation between the two strains. These differences are confirmed even by KNN (Tab. 2). The bisexual group is mostly found in open space and feeding area, with higher frequencies of presence in the group of hybrid rabbits. The couple was seldom observed in all the areas; the single animals are found mainly in the "protected area" (Fig. 3). The higher frequencies of presences of single animals in the corner seem to disagree with Mykytowycz (1958) who found that young animals try to access the central warren. However in this case the center of the experimental enclosure is the less protective area while the corner seems to be the safer. The aggregations of N.Z.W. rabbits show lower frequencies in all areas, as they were often observed even in the other aggregations, not considered in the present analysis. Cluster Analysis confirms the presence of three main clusters: 1) Single males, single females and couples of the two strains; 2) Bisexual group of N.Z.W. rabbits; 3) Bisexual group of hybrid rabbits (Fig. 4). The lack of differences between the spatial distribution of single females and single males seems to contrast the results of Vastrade (1986, 1987) who found different spatial distribution between males and females. The result of this research can be due to the fact that the animals were younger (30 days old at the beginning of the experiment) than those observed by Vastrade. The young age of rabbits can also account for the high frequencies of presence of the bisexual groups and the lack of aggressive problems; in fact the maximum aggression in young rabbits was found between days 60 and 90 (Dudzinski et al. 1977; Lehmann, 1991). No differences were found between morning and afternoon as to spatial distribution and type of aggregations. All the rabbits had regular growth and their weights were similar to those kept in cages. Hybrid rabbits weighed more than N.Z.W. rabbits whose growth seems less homogeneous (Tab. 3), perhaps because these animals were more scattered in the enclosure and especially the bisexual group had lower frequencies at the feeder.

Conclusion

The results of this study show that rearing fattening rabbits in floor pens at quite high density could be a possible alternative to the cages due to the good growth performance, spatial distribution in the enclosure and lack of aggression. However it will be useful to continue the research and keep the rabbits in floor pens till the age of slaughter, in order to verify the use

of the space, the aggregations and the possible problems of aggression due to the older age of the rabbits.

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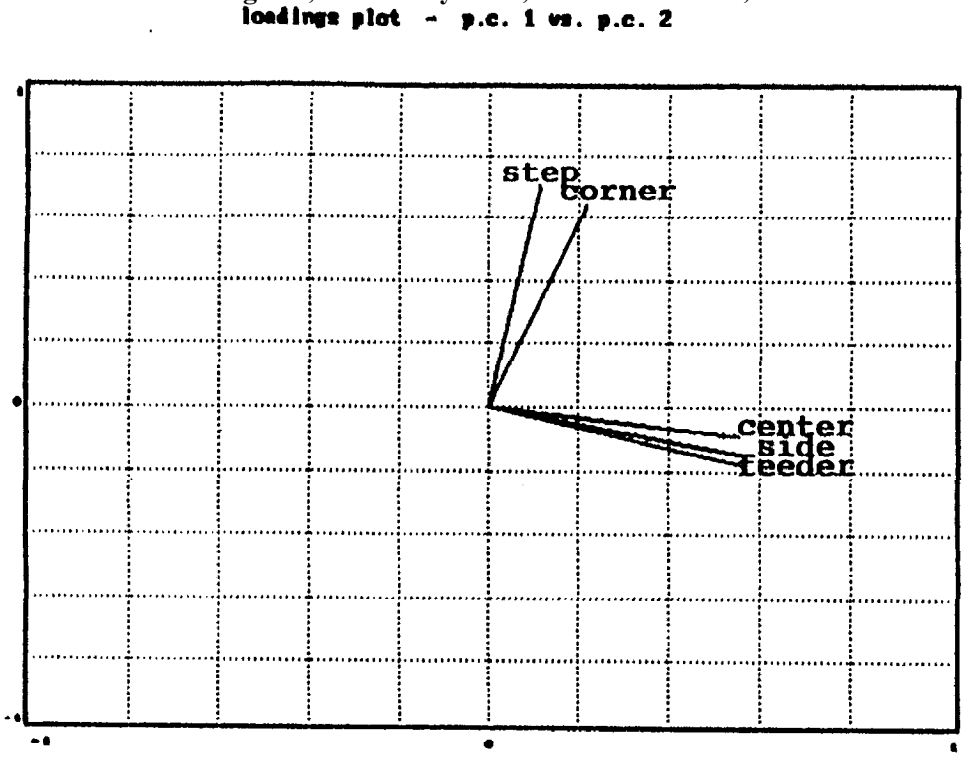


Fig.2a

Principal Component Analysis (PCA)

variables used : center step feeder side corner

		loadings -				> original variables <		
		var.%	cum.%	center	step	feeder	side	corner
p.c.	1	55.19	55.19	0.530	0.117	0.568	0.577	0.224
p.c.	2	26.54	81.73	-0.085	0.724	-0.175	-0.147	0.645
p.c.	3	11.59	93.32	0.062	0.678	0.036	0.053	-0.730
p.c.	4	6.06	99.38	0.840	-0.052	-0.426	-0.333	-0.023
p.c.	5	0.62	100.00	0.058	0.019	0.682	-0.729	0.004

Tab.1

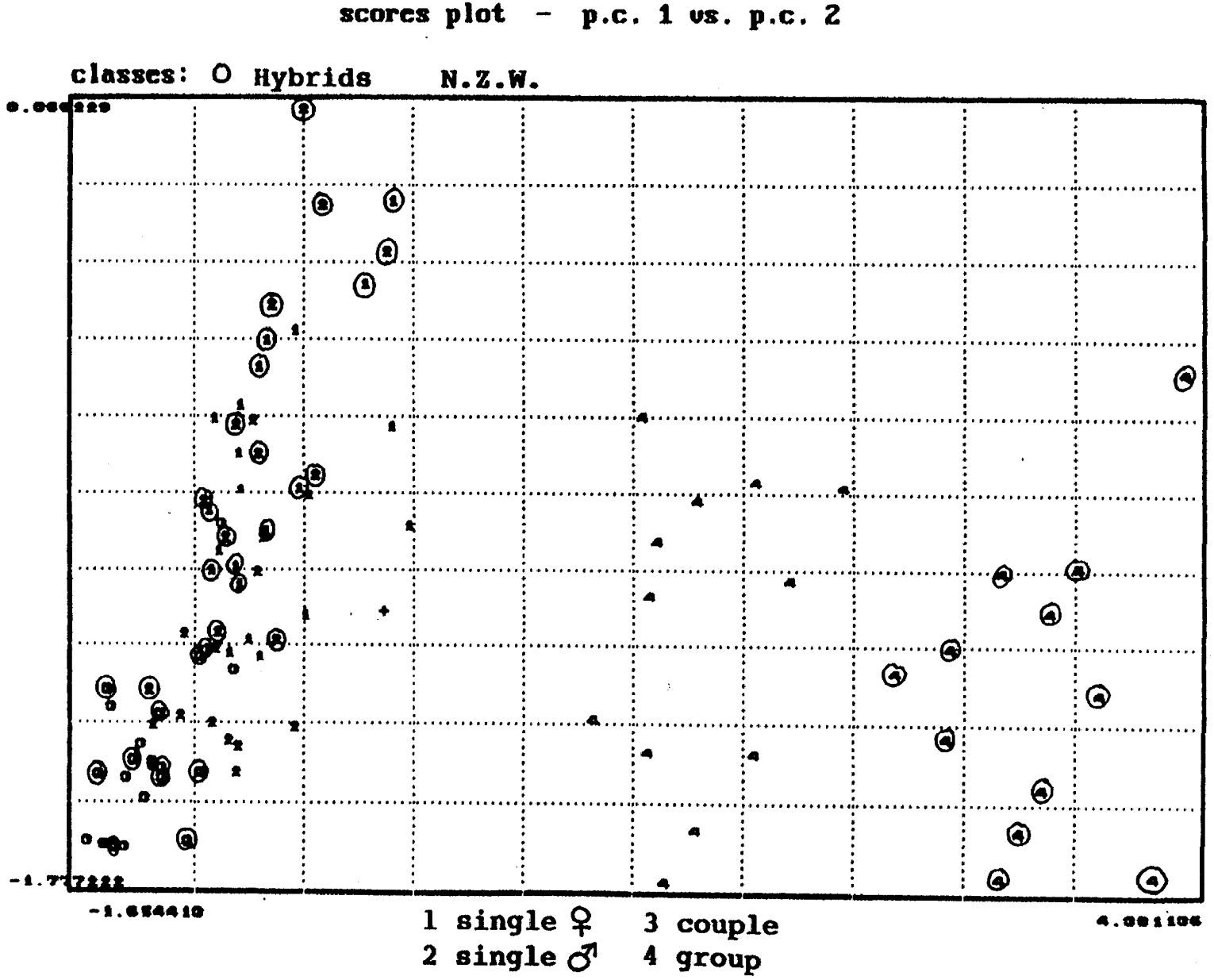
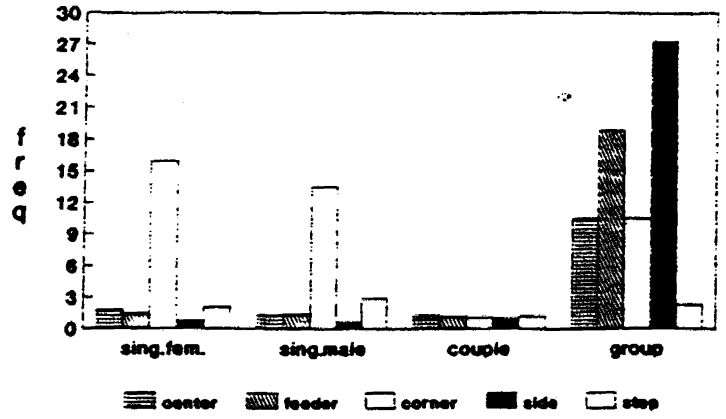

scores plot - p.c. 1 vs. p.c. 2
classes: O Hybrids N.Z.W.
1 single ♀ 3 couple
2 single ♂ 4 group

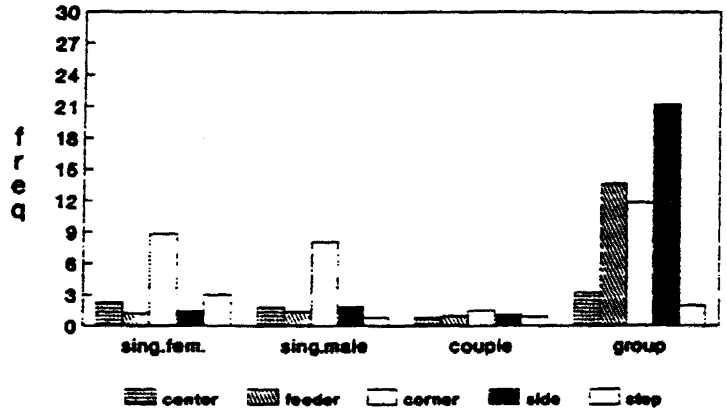
Fig.2b

Fig.3

Average presence of hybrid rabbits in the different areas



Average presence of N.Z.W. rabbits in the different areas

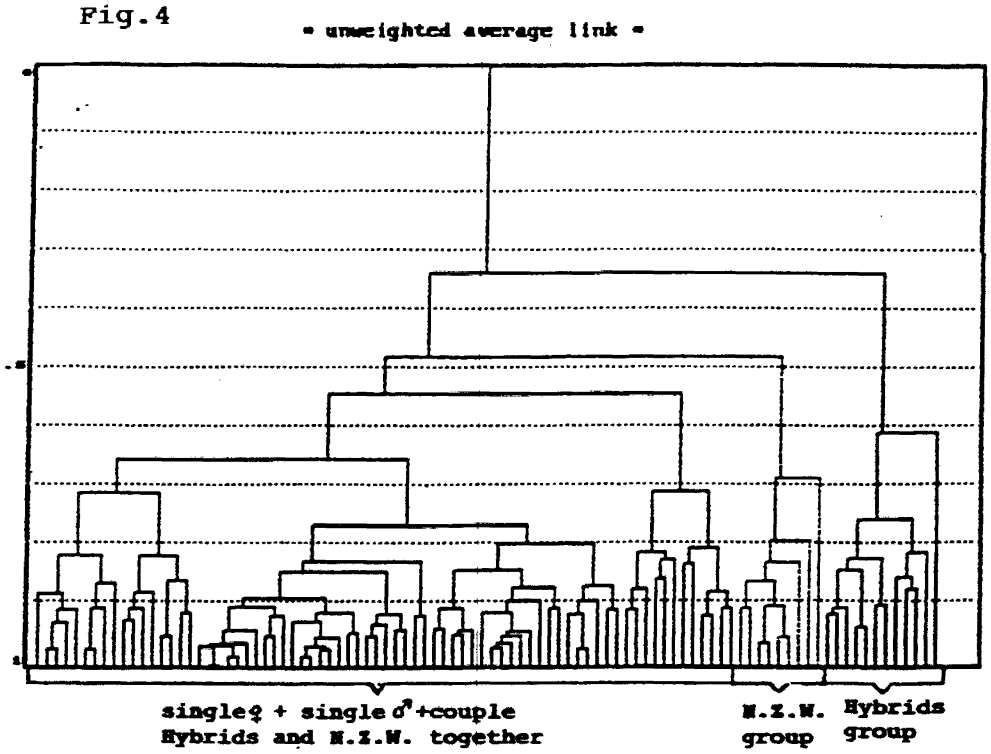


Tab.3

Average weight (g) of rabbits during the experimental period

	Hybrids		N.Z.W.	
	mean	std dev	mean	std dev
1st week	1.020	159	1.132	209
2nd week	1.260	184	1.245	257
3rd week	1.517	204	1.399	291
4th week	1.746	215	1.561	293

Fig.4



Tab.2

K-Nearest Neighbour method (KNN)

variables used : center step feeder side corner

k value = 3
Euclidean distance

total n.e.r (%) = 65.26
miscl. risk (%) = 34.96

n.e.r. for sing.fem. = 43.48
n.e.r. for sing.male = 33.33
n.e.r. for couple = 83.33
n.e.r. for group = 100.00

confusion matrix

ID	true class	n.obj.	> assigned classes <			
1	sing.fem.	23	43.5 (10)	56.5 (13)	0.0 (0)	0.0 (0)
2	sing.male	24	58.3 (14)	33.3 (8)	8.3 (2)	0.0 (0)
3	couple	24	4.2 (1)	12.5 (3)	83.3 (20)	0.0 (0)
4	group	24	0.0 (0)	0.0 (0)	0.0 (0)	100.0 (24)

K-Nearest Neighbour method (KNN)

variables used : center step feeder side corner

k value = 3
Euclidean distance

total n.e.r (%) = 72.63
miscl. risk (%) = 27.39

n.e.r. for hybrids = 70.21
n.e.r. for N.Z.W. = 75.00

confusion matrix

ID	true class	n.obj.	> assigned classes <	
1	hybrid	47	70.2 (33)	29.8 (14)
2	N.N.Z.	48	25.0 (12)	75.0 (36)