SOCIOMETRIC INVESTIGATIONS IN GROUPS OF WILD AND DOMESTIC RABBITS WITH ONE BUCK AND TWO OR THREE DOES

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ABSTRACT

Four groups with one buck and two or three does both in wild and domestic rabbits were kept in two enclosures measuring 50m^2 each with 4 artificial nestboxes. The aggressive behaviour (aggressive attacks, biting, fighting) was continuously registered once a week during one hour before and one hour after dusk and dawn (total: 194 hours of observation). Data of wins and defeats were transformed into a winner-looser matrix and the sociometric parameters h, K, DC, matrix total as well as the percentages of unknown, one-way and two-way relationships were calculated. The results of the agonistic interactions and the calculation of sociometric parameters show a linear dominance hierarchy in groups of one buck and two or three does both in wild and domestic rabbits. With the exception of domestic rabbit group 1, 3, Landau's linearity index h and Kendall's coefficient of linearity K were very similar reaching values between 0.625 and 0.75. The sociometric parameter DC indicates a nearly or total complete unidirectionality (DC = 0.95 up to 1). This is in accordance with the result that the percentage of two-way relationships was zero in 3 of 4 groups. Although the social groups were relatively small between 33.3 and 50.0 % of all dyadic relationships were unknown relationships because the individuals did not fight against each other.

Key words: Wild rabbits, domestic rabbits, aggressive behaviour, sociometric measures.

INTRODUCTION

Aggressive interactions occur in wild rabbits especially in spring (VON HOLST *et al.*, 2001). In this season, a new rank order is established or an existing hierarchy is renewed. Once a linear hierarchy has become established, intensity and frequency of aggressive interactions will be decreased (ALBONETTI *et al.*, 1991) and fights are seldom. Subdominant animals never defended themselves against the attacks of animals with higher rank position (MYKYTOWICZ, 1958). An increased aggressiveness can be observed in close proximity to the nest (MYERS and POOLE, 1959).

It is known that aggressive behaviour in domestic rabbits takes place after onset of puberty both in male and female rabbits (BIGLER and OESTER, 1994, 2003; REITER, 1994). Because dominance is a multi-dimensional phenomenon it is necessary to characterise dominance not only at dyad level but on group level with standardised sociometric methods. The aim of the present paper is to analyse the social hierarchy in groups of both wild and domestic rabbits with one male and two or three females.

MATERIAL AND METHODS

The investigations took place during one year in two free range areas – one for the wild and the other for the domestic rabbits – at the Research Station of the Department of Animal Breeding and Genetics (Justus Liebig University Giessen) measuring 150 m^2 each. Each free range consisted of 4 artificial nestboxes. The housing conditions are described in detail by HOY and SELZER (2002).

In the first breeding season (spring and summer 2001), one buck and two does of wild and domestic rabbits (1, 2) were kept in the two enclosures. In December 2001 one doe was removed and replaced by two other does both for wild and domestic rabbits (1, 3).

The aggressive behaviour (aggressive attacks, biting, fighting) was continuously registered once a week during one hour before and one hour after dusk and dawn (total time of observation: 194 hours). Data on wins and defeats were transformed into a winner-looser matrix with rows labelled as wins and columns labelled as defeats. In order to characterise processes on the dyadic level the following sociometric parameters were calculated:

a) Landau's linearity index (h):

$$h = \frac{12}{N^3-N} \sum_{i=1}^{N} (S_i - ½ (N - 1))^2$$

where N is the group size and S is the number of individuals dominated by individual i (MARTIN and BATESON, 1993)

b) Kendall's coefficient of linearity (K):

$$K = 1 - \frac{24\ d}{N^3-N}$$ for odd values of N, and

$$K = 1 - \frac{24\ d}{N^3-4N}$$ for even values of N,

where d is the number of circular triads, and N is the group size (APPLEBY, 1983).

c) Directional consistency index (DC):

$$DC = \frac{(H - L)}{(H + L)}$$

DC is calculated across all dyads as the total number of times the behaviour was performed in the main direction within each dyad minus the number of times the behaviour occurred in the less frequent direction within each dyad divided by the total number of times the behaviour was performed by all individuals (VAN HOOFF and WENSING, 1987).

The parameter matrix total contains the total number of agonistic interactions between all individuals of the group.

Additionally, the percentages of
- unknown relationships
- one-way relationships and
- two-way relationships

were calculated using the option linear hierarchy of the MatMan program (Noldus).

RESULTS AND DISCUSSIONS

The results of the aggressive interactions (AI) in the groups of 3 or 4 wild or domestic rabbits are summarised in the matrices 1 to 4 where the rows represent the winner and the columns characterise the looser (fig. 1 and 2).

matrix 1	1	2	3
1		0	0
2	6		30
3	0	1	

matrix 2	1	2	3
1		0	0
2	1		17
3	0	0	

1 = buck; 2, 3 = does (2 = dominant, 3 = subdominant)

Figure 1. Winner-looser matrices 1 and 2 with rows labelled as wins and columns labelled as defeats (1 = wild rabbits; 2 = domestic rabbits)

The figures 1 and 2 demonstrate that the buck both in wild and domestic rabbits has never shown an aggressive attack against both females. The dominant doe has won 6 interactions against the male and 30 AI against the subdominant doe in wild rabbits (1, 2). The subdominant wild rabbit doe was the winner in one AI with the dominant female. In the group of domestic rabbits, only the dominant doe showed aggressive behaviour and won one AI against the buck and 17 AI against the other (subdominant) doe.

In groups of one buck and three does, the number of AI was much higher in the wild rabbit group (matrix total = 90 AI) compared with the 1, 2 group (fig. 2). Also, the frequency of AI was higher (66 AI) in the 1, 3 than in the 1, 2 domestic rabbit group (18

AI). The doe with the lowest rank position never won an AI both in wild and domestic rabbits (1, 3). The subdominant doe (animal number 3) was the winner only against the group-mate with lowest rank place (41 wins in wild and 29 wins in domestic rabbits). The dominant wild rabbit doe won 1 AI against the buck, 18 AI against the subdominant doe and 30 AI against the lowest-ranking doe. In the domestic rabbit group the dominant doe won 4 AI against the subdominant doe and 33 AI against the group-mate with the lowest rank place.

matrix 3	1	2	3	4
1		0	0	0
2	1		18	30
3	0	0		41
4	0	0	0	

matrix 4	1	2	3	4
1		0	0	0
2	0		4	33
3	0	0		29
4	0	0	0	

1 = buck; 2-4 = does (2 = dominant, 3 = subdominant, 4 = lowest rank position)

Figure 2. Winner-looser matrices 3 and 4 with rows labelled as wins and columns labelled as defeats (3 = wild rabbits; 4 = domestic rabbits)

Landau's linearity index (h) ranged between 0.4 (domestic rabbits 1, 3) and 0.75 (wild and domestic rabbits 1, 2). With the exception of domestic rabbit group 1, 3, Landau's linearity index h and Kendall's coefficient of linearity K were very similar (table). The values of h and K in the group of domestic rabbits with one buck and three does were much lower (0.4, 0.25 respectively) than in the other three groups. The directional consistency index DC was 0.95 in the wild rabbit group 1, 2. In the other three groups the DC was 1 (table).

Table. Sociometric parameters at group level of groups of wild and domestic rabbits with one buck and two or three does

Parameter	wild rabbits		domestic rabbits	
	1, 2	1, 3	1, 2	1, 3
Matrix total	37	90	18	66
Landau's linearity index (h)	0.75	0.7	0.75	0.4
Kendall's coefficient of linearity (K)	0.75	0.625	0.75	0.25
Directional consistency index (DC)	0.95	1	1	1
% of unknown relationships	33.3	33.3	33.3	50.0
% of one-way relationships	33.3	66.7	66.7	50.0
% of two-way relationships	33.3	0	0	0

The percentage of unknown relationships ranged between 33.3 and 50.0 (table). In one group the percentage of one-way relationships was 33.3, in one group 50.0 and in the

other two groups 66.7 (see table). Only in one case occurred a two-way relationship (one third = 33.3 % of all possible relations in the group): the dominant doe in the wild rabbit group 1, 2 won 30 attacks against the subdominant doe and vice versa the subdominant won one fight against the higher ranking doe (see matrix 1 in fig. 1).

Both in wild and domestic rabbits occurred aggressive behaviour. In general, the number of agonistic interactions in wild rabbits was higher (total number of AI in both groups: 127) than in domestic rabbits (total number: 84). The formation of a rank order took place both in wild and domestic rabbits. The aggressive behaviour was only a small part of the social interactions (SCHUH *et al.*, 2003). The animals with lower rank position tried to keep a sufficient distance to the group-mates with higher position in social hierarchy when housed outdoors in free range. With increased density of population (1, 3 vs. 1, 2) the number of aggressive interactions was increased in wild rabbits as also described by MYERS and POOLER (1961). In agreement with MYKYTOWICZ and HESTERMAN (1975), individual differences between the does concerning aggressive behaviour were found. The aggressive biting in domestic rabbits was mainly observed at the feeding place where the wall of the enclosure obviously hindered the quick flight of the doe with the lower rank position. Both sexes form a separate linear hierarchy when rabbits are in social group (MYKYTOWICZ, 1958; MYKYTOWICZ *et al.*, 1984; VON HOLST *et al.*, 2001). This could be the explanation why we seldom found the buck involved in agonistic interaction. In all 8 cases observed (6 in wild rabbit group 1, 2, one in domestic rabbit group 1, 2 and one in wild rabbit group 1, 3) the buck was the looser against the dominant doe.

The linear hierarchy observed in the present study is characterised by the result that only in one of 18 possibilities a two-way relationship was shown (in the wild rabbit group 1, 2 where the animal 2 won 30 fights against animal 3 and lost one fight against the same individual). Up to two thirds of all relationships were one-way relationships where one animal won all AI against the other in a dyad. Surprisingly, although the groups were relatively small between one third and two thirds of all possible dyadic relationships were unknown relationships where the two individuals did never interact with the respective other.

Also, the sociometric parameters h and K show that in the groups (with the exception of domestic rabbit group 1, 3) exist a more linear dominance hierarchy compared with groups of piglets or goats (LANGBEIN and PUPPE, 2004). The low values for h and K in the 1, 3 group of domestic rabbits are related to the high percentage (50.0 %) of unknown relationships. The sociometric parameter DC indicates a nearly or a total complete unidirectionality (VAN HOOFF and WENSING, 1987). This is in accordance with the result that the percentage of two-way relationships was zero in 3 of 4 groups.

CONCLUSION

The results of the agonistic interactions and the calculation of sociometric parameters show a linear dominance hierarchy in groups of one buck and two or three does both in wild and domestic rabbits. Although the social groups were relatively small between 33.3 and 50.0 % of all dyadic relationships were unknown relationships because the individuals did not fight against each other. The calculation of different sociometric

parameters (h, K, DC, % of unknown, one-way and two-way relationships) helps to describe the linearity, the directionality and the complexity of relationships in groups of both wild and domestic rabbits.

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