

Synchrony in two captive ruminant species: *Rangifer tarandus* and *Bos grunniens*

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Abstract

Synchrony in mammals and particularly in ruminants is a well documented phenomenon. Synchrony is thought to have evolved to reduce predation risk and allow individuals to forage for longer periods of time. In this study the degree of synchrony was measured in two groups of ruminants caribou (*Rangifer tarandus*) and domestic yaks (*Bos grunniens*) using the kappa statistic. The caribou group was a same-sex group, and the yaks were a mixed-sex group. Many studies have shown same-sex groups have a higher degree of synchrony than mixed-sex groups. The results of this study show that the caribou had a high degree of synchrony and the yaks did not show significant synchrony. When the two female yaks were analyzed without the other group members synchrony increased, but still failed to reach significance. The results of this study show that not all ruminant species display synchrony and that the sex composition of groups is not the only factor that affects synchrony in ruminants.

Introduction

Group living is common in many species of mammals, from small rodents to large carnivores. Although group formation is common it involves a trade off between costs and benefits of living in close proximity to others (Meldrum and Ruckstuhl, 2009). There are many possible benefits to living in social groups, and group living is the rule rather than the exception for most species of large herbivores (Searle et al., 2010). Many hypotheses have been proposed to explain sociality in ungulates, but predation risk and foraging strategy are often cited as the most important determinants (Côté et al., 1997). These hypotheses predict habitat segregation based on differing dietary requirements and vulnerability to predation between the sexes (Michelena et al., 2006). Forming large groups facilitates a reduced risk of predation through the dilution effect, many eyes effect and confusion effect (Meldrum and Ruckstuhl, 2009). The collective vigilance of the group allows individuals to reduce their time spent searching for predators and increase their time spent foraging, without increasing their risk of predation (Meldrum and Ruckstuhl, 2009).

In gregarious species the synchronization of activities is thought to be necessary to avoid the breakdown of group cohesion (Searle et al., 2010; Gautrias et al., 2007). In groups of ruminants individuals characteristically alternate between bouts of activity (foraging) and

inactivity (resting or ruminating) and synchrony within groups has been reported, although the degree synchrony varies with group composition (Rook and Penning, 1991; Côté et al., 1997; Michelena et al., 2006; Gautrias et al., 2007).

Outside of the breeding periods many sexually dimorphic ungulates, with males being substantially larger than females, form same-sex groups (Ruckstuhl, 2007; Meldrum and Ruckstuhl 2009). Ungulate body size is generally regarded as the principal determinant of foraging strategy and antipredator behaviour; therefore divergent pressures on group living amongst different sex classes are expected (Côté et al., 1997). It is thought that in sexually dimorphic ruminants males require longer foraging time, to fill their larger rumens, and spend more time lying down, due to having a longer retention times of forage than females (Côté et al., 1997; Meldrum and Ruckstuhl, 2009). Côté et al. (1997) found that in Muskoxen (*Ovibos moschatus*) when males were in a bachelor herd they spent more time foraging and less time resting than when in mixed groups. Similar results were also found in another group of muskoxen and in bison (*Bison bison*) (Côté et al., 1997). Due to the differences in foraging requirements there is an increased cost of maintaining synchrony in mixed sex groups, if the costs become too great the group will split (Michelena et al., 2006). Although there are benefits to segregating into same-sex groups, mixed groups are often necessary in sexually segregating species at low densities in order to obtain larger group sizes (Meldrum and Ruckstuhl, 2009).

As mentioned previously synchrony has been widely reported in many species of ungulates. The main goal of this paper was to determine if two species of ungulates, caribou (*Rangifer tarandus*) and domestic Yak (*Bos grunniens*), displayed synchrony. The second aim of this paper was to determine if synchrony was higher in a same-sex group compared to a mixed-sex group. This paper explores the hypotheses that (1) both groups would show a significant degree of synchrony and (2) that the same-sex group would have a higher degree of synchrony than the mixed sex group.

Methods

Data collection

The study took place at the Riverview Park and Zoo in Peterborough, Ontario. Data was collected during four sampling periods in March of 2010. Sampling periods took place at either 12:00pm or 1:00pm. The weather was consistently warm with no precipitation during sampling periods. The first study group consisted of four domestic yaks; one adult male, two adult females and one juvenile individual. The Yaks were housed alone in an outdoor exhibit which included a shelter. The second study group consisted of two adult female caribou. The caribou were housed in an outdoor exhibit along with a female Sika deer (*Cervus nippon*) and a group of wild turkeys (*Meleagris gallopavo*). The individuals in each group were given names in order to distinguish individuals in the observation notes. It was important to differentiate between the adult male and the adult females in the yak study group.

Data was collected using the scan sampling method outlined by Altmann (1974). Ten behaviours were originally categorized, but were condensed to five categories during data analysis. The five behavioural categories used were: standing, lying, moving, eating and other. Ten second scans of the groups were performed, in which the behaviour of each individual was recorded. Scans took place approximately every five minutes for an hour at a time. Duration between scans varied slightly due to variation in the time it took to walk between exhibits.

Data analysis

To get an overview of the degree of synchrony of each group the percentage of time spent synchronous was calculated. To get a better measurement of the degree of synchrony we followed Rook and Penning (1991) and calculated the k coefficient of agreement (Siegel and Castellan 1988). The k statistic ranges from 0 to 1, with higher values indicating greater synchrony (Siegel and Castellan 1988). K was obtained using all five behavioural categories and the significance was tested using the z statistic (Rook and Penning 1991; Siegel and Castellan 1988). The k value of the yaks without the male or juvenile was also tested to determine if there was a difference in synchrony when the group consisted of only females.

Results

The mean percent of time that the caribou were synchronous was found to be 71.97% with a standard deviation of 23.8 %. The k value for the caribou was found to be 0.6036 ($p=0.05$) which indicates substantial synchrony.

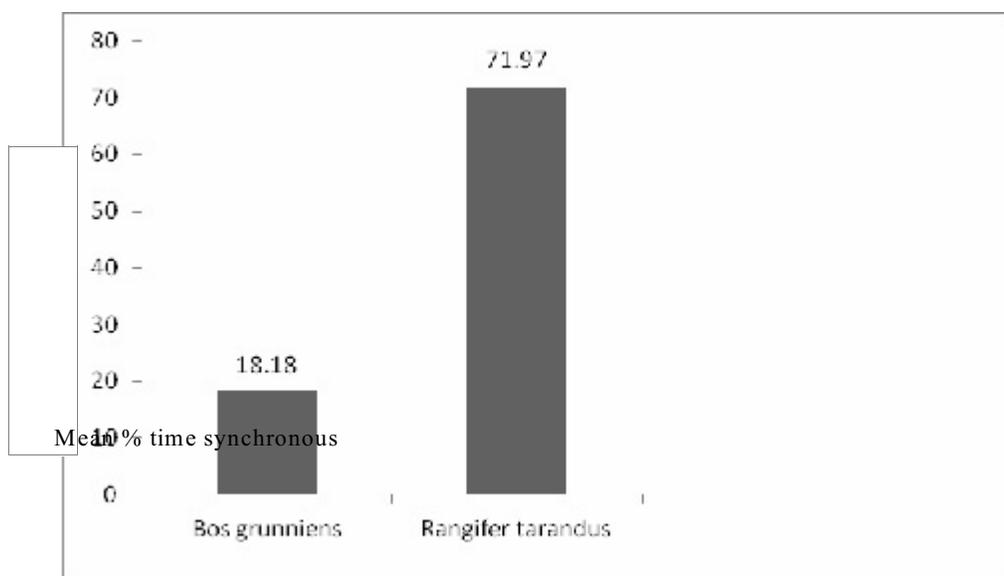


Figure 1: mean percent of time each group spent synchronous

The yaks were found to be synchronous an average of 18.18 percent of the time with a standard deviation of 36.4%. The k value of the yaks was 0.0279. The z value that was calculated failed to reach significance in this case indicating that there was not significant synchrony in the group.

When only the adult female yaks were considered the k value increased to 0.041 but still failed to reach statistical significance.

Table 1: synchrony of caribou and yaks

Group	k value
Caribou	0.6036
All yaks	0.0279
Female yaks	0.041

Discussion

Although synchrony has been found in a variety of ungulate species the results from this study suggest that synchronization may not occur in all ungulate species. By applying the kappa statistic it was found that the caribou demonstrated significant synchrony and the yaks did not. The hypothesis that both groups would show some degree of synchrony was not supported. The hypothesis that there would be greater synchrony in the same-sex group was supported when looking at both species, but not supported when looking only at the yaks.

Group composition has a known effect on synchrony, with mixed sex groups being less synchronous than same- sex groups (Meldrum and Ruckstuhl, 2009). The caribou group was made up of two females and was found to be much more synchronous than the mixed-sex yak group. The caribou had a k value of 0.6036, which approaches 1, meaning that the group is synchronous. The yaks had a k value of 0.0279, which is approaching 0, meaning that the group is asynchronous.

Côté et al. (1997) found that male muskoxen (*Ovibus moschatus*) were less synchronous in mixed-sex groups than in bachelor herds. The fact that the yaks were in a mixed sex group may explain the lack of synchrony in the group. Meldrum and Ruckstuhl (2009) found that male big horn sheep (*Ovis canadensis*) spent more time resting then the females, due to longer rumen retention time. In our observations it was noted that the male did spend a greater amount of time resting then the other individuals. That being said, when the male and the juvenile were removed from the analysis, the group remained asynchronous, indicating that there is likely another reason for the lack of synchrony.

An alternate explanation of the asymmetry seen in this study, is the setting in which it was performed. Research on synchrony is predominantly done on wild populations whereas this study

was performed on captive populations. In the wild ruminants have to deal with predation pressures as well as foraging pressures. In a zoo setting the individuals do not have either of those concerns. It has been widely postulated that social groups form in order to avoid predation and to optimize foraging (Côté et al., 1997; Gautrais et al. 2007). Synchrony is thought to be the key to group cohesion and to allow the formation of such large groups (Searle et al., 2010; Gautrias et al., 2007). If the risk of predation is removed and there is an abundance of food, there may not be a need for synchrony in the group.

The yaks were housed in an enclosure with no other species, whereas the caribou were housed with a sika deer and wild turkeys. The caribou enclosure may emulate the natural condition more closely than the yak enclosure, which may explain the increased synchrony seen in the caribou. Further research into the difference in synchrony between captive and wild populations is needed in order to gain an understanding of the differences.

The difference in synchrony between the groups may simply be due to the differences in the species. This explanation however, is unlikely due to the fact that synchrony has been reported for similar species such as muskoxen and bison (Côté et al., 1997).

In this study behavioural data was obtained using the scan sampling method. In this method scans should occur at precise intervals. The duration between scans in our study varied slightly depending upon the time it took to walk between enclosures. Having scans at precise intervals may result in more accurate data. Another confounding variable is that two of the sampling periods occurred during March break, resulting in a large increase in the number of visitors to the zoo and more noise and disturbance to the animals. The noise and commotion of the patrons may have affected the behaviour of the animals.

Synchrony may be a common trait among ruminants, but it is not seen in all species. In this study it was found that same-sex groups of caribou show a high degree of synchrony. The mixed-sex group of yaks in this study did not show synchrony, nor did the two female yaks when analyzed with only each other. Further research on these species, in the wild and in captivity is needed to understand the degree of synchrony seen in this study. There is no one hypothesis that can account for the varying degree of synchrony across ungulate species, it is likely that there are many factors that affect the degree of synchrony seen in each species.

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