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VIGILANCE IN THE GREATER RHEA: EFFECTS OF VEGETATION HEIGHT AND GROUP SIZE

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Abstract.—Wild adult Greater Rheas (*Rhea americana*) were observed during most of the non-breeding season (May–July), while feeding alone or in groups in two different habitats: high vegetation (shrubs) and low vegetation (herbaceous). In both habitats an individual's percentage of time spent on vigilance behavior significantly declined as group size increased, but in high vegetation vigilance was lowest when group size was six and higher in larger groups. Vigilance was similar between sexes throughout the day. Vigilance was on average 11% greater in the high vegetation habitat. Vigilance increased from May to July.

VIGILANCIA EN EL ÑANDÚ: EFECTOS DE LA ALTURA DE LA VEGETACIÓN Y DEL TAMAÑO DE GRUPO

Sinopsis.—Durante la mayor parte de la estación no reproductiva (mayo–julio), se observaron ñandúes (*Rhea americana*) adultos en estado silvestre mientras se alimentaban solitariamente o en grupos, en dos ambientes diferentes: vegetación alta (matorrales) y vegetación baja (herbácea). En ambos ambientes el porcentaje de tiempo que un individuo pasa vigilando disminuyó significativamente a medida que el tamaño del grupo era mayor. No obstante, en la vegetación alta el valor mínimo de vigilancia se observó en los grupos de seis individuos, aumentando en los tamaños mayores. La vigilancia fue similar para ambos sexos a lo largo del día. La vigilancia fue 11% mayor en promedio en el ambiente de vegetación alta. La vigilancia aumentó de mayo a julio.

Greater Rheas (*Rhea americana*) are gregarious during the non-breeding season (March–August). Although seen alone, they are more commonly observed in flocks of 2–70 individuals (Bruning 1973; Martella and Navarro, pers. obs.). The adult rhea is omnivorous, but mainly herbivorous (Bruning 1974; Martella, unpubl. data). Like Ostriches (Bertram 1980), during their feeding, Greater Rheas drop their heads near the ground and raise them at intervals to look. An individual with its head down must not be very effective in detecting an approaching predator. Apparently looking around helps the rhea detect danger so it can run. Feeding and vigilance, therefore, are mutually exclusive, and studies about this trade off have shown that, based on the principle that many eyes are better than one (Lazarus 1978, 1979; Powell 1974), the amount

of time a bird allocates to these two activities may vary with group size (e.g., Bertram 1980, Burger and Gochfeld 1988, Pöysä 1987, Pulliam 1973). Several authors have shown that birds increase their vigilance with increasing distance to cover (e.g., Barnard 1980, Caraco et al. 1980) or in areas of less visibility (Metcalfe 1984). Some large herbivores such as antelopes also increase their vigilance in closed habitats (Underwood 1982).

Adult rheas have only two known predators: Pumas (*Felis concolor*) and humans. Despite legal protection in the last decades humans have become the main predator of rheas, persecuting and shooting them throughout their range. Therefore, the vigilance behavior of feeding rheas might be an adaptive response to puma predation, which has been generalized to humans as well.

The aim of this study was to explore the relationships between vigilance, flock size and vegetation type in wild Greater Rheas. We tested whether individual vigilance decreased as a function of group size and whether vigilance increased in taller vegetation.

STUDY AREA AND METHODS

We observed Greater Rheas during most of the non-breeding season (May–July) of 1989, in 640 ha of shrubs and grasslands at "El Coro" ranch (64°15'W, 30°15'S) near Villa María de Río Seco, province of Córdoba, Argentina. The mean annual rainfall in this area is about 560 mm.

We observed rheas in two vegetation types. In the high vegetation habitat, plants were on average 1 m tall. Vegetation was patchy, covering approximately 30% of the ground. Shrubs such as *Celtis* sp., *Acacia* spp., *Schinus* sp., *Condalia microphyla* and *Cassia aphyla* were prevalent. Beneath the shrubs, various species of herbs (e.g., *Oxalis* sp. and *Dichondra* sp.) covered 70% of the ground. In the low vegetation habitat, herbaceous plants with an average height of 0.1 m were common, and covered about 85% of the ground. The dominant plant species was *Brassica* sp., whereas herbs, *Oxalis* sp., vervains *Glandularia* sp. and dandelions *Taraxacum officinale* are also present.

We observed rheas from high trees or fence poles using binoculars at distances greater than 60 m. Birds at these distances showed no reaction to our presence. Observations were made between 0700 and 1900 hours on adult birds that were feeding alone or in groups. We considered rheas as part of a group if they were within 50 m of one another and moving together. We classified them as feeding if they were mainly static and pecking among the vegetation during the minute before the observation period began. During the observation period, we chose at random a rhea and recorded on tape each time this focal bird raised (vigilance behavior) or lowered its head. We proceeded to sample the majority of rheas per group, avoiding repeated observations of the same individual. We also recorded the sex of the focal bird, the group size to which it belonged, time of day and vegetation type (high or low). An observation period was momentarily stopped while the individual moved out of sight (behind

trees or large shrubs), or while the bird foraged on shrubs (because it did not lower its head). As many of our observation periods were interrupted for these reasons, their length ranged from 4 to 6 min (4.5 min on average). We discarded those samples in which rheas were disturbed by some obvious outside influence or when they raised their heads for more than 35 s at a time.

In the laboratory, we transcribed the tape and calculated the percentage of time each rhea spent with its head up (vigilance) during the observation period. We applied the angular transformation to percentages to perform ANOVA and Scheffe Tests (Sokal and Rohlf 1981). The normality and homoscedasticity of transformed data were confirmed through Kolmogorov-Smirnov goodness-of-fit and Bartlett's tests, respectively (Sokal and Rohlf 1981). As we did not find the same group sizes in both habitats for all months and times of day, we were restricted to performing two-way ANOVA. When we tested the effect of habitat type and group size on vigilance behavior, we compared only those group-size categories that were present in both habitats.

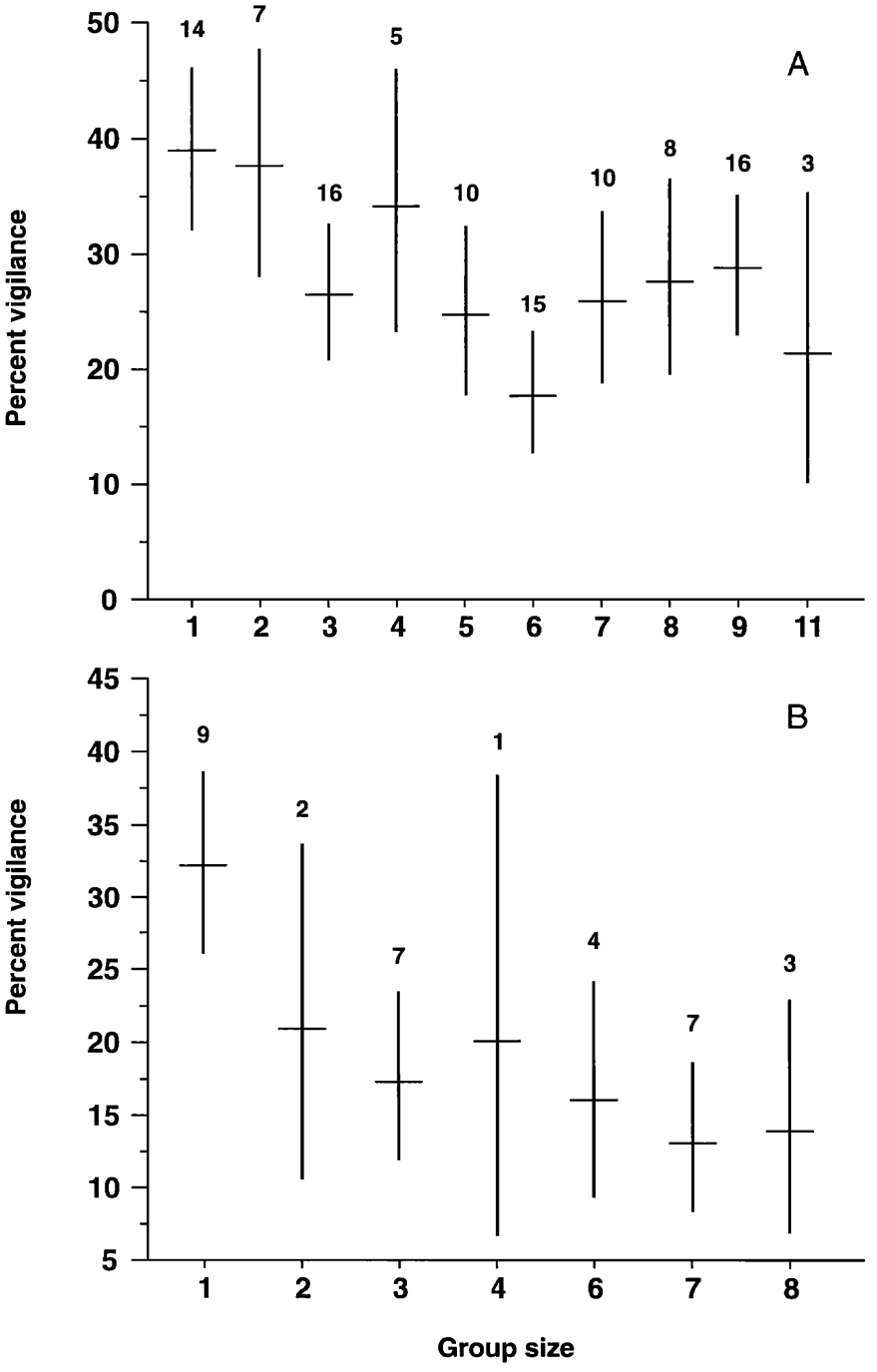
RESULTS

Either within or between habitats there were no significant differences either in the percentage of vigilance between sexes (two-way ANOVA; $F = 0.99$; df = 1, 133; $P = 0.333$), or the time of day (two-way ANOVA; $F = 0.71$; df = 8, 99; $P = 0.686$). In both habitats we found a weak but significant increase in percent vigilance from May to July (both habitats combined: Spearman rank $r_s = 0.322$, $n = 137$, $P < 0.001$). This trend was not related to group sizes, as they did not change significantly throughout the period studied (one-way ANOVA; $F = 1.185$; df = 2, 134; $P = 0.309$).

In both habitats time spent in vigilance decreased as the number of birds in the group increased (Fig. 1). Vigilance of single rheas was highest (39%) in the high vegetation habitat, and it decreased as group size increased, reaching a minimum of 18% at a group size of six birds. Up to this group size, the relationship was significant ($r_s = -0.690$, $n = 67$, $P < 0.001$). Pairwise comparisons among group sizes revealed significant differences in vigilance between either single individuals or groups of two and groups of six birds (Scheffe Test, Fig. 1A). Although not significant, a further increase of vigilance was observed in larger groups in this habitat (Scheffe Test, Fig. 1A). Differences in vigilance between sexes at group sizes larger than six were not significant (one-way ANOVA; $F = 0.299$; df = 1, 35; $P = 0.594$).

Vigilance decreased as the group size increased in the low vegetation habitat ($r_s = -0.750$, $n = 33$, $P < 0.001$), and reached a minimum (13%) in groups of seven rheas (Fig. 1B). Pairwise comparisons showed significant differences in vigilance between single rheas and groups of three, six, seven or eight individuals (Scheffe Test, Fig. 1B).

Rheas were significantly more vigilant in the tall vegetation than in the low vegetation (two-way ANOVA; $F = 37.37$; df = 1, 94; $P < 0.001$). In


A
Percent vigilance
50
40
30
20
10
0
14
7
5
16
10
15
10
8
16
3
1
2
3
4
5
6
7
8
9
11
B
Percent vigilance
45
40
35
30
25
20
15
10
5
9
2
7
1
4
7
3
1
2
3
4
6
7
8
Group size

the high vegetation habitat, average percent vigilance was about 8% higher than in low vegetation and nearly 11% greater (on average) when comparing groups of the same size (Fig. 1).

DISCUSSION

Our data show that group size and vegetation height influence rheas' vigilance. Individuals were less vigilant in shorter vegetation and when they were in larger groups. A similar result was found in Ostriches by Burger and Gochfeld (1988) and also by Bertram (1980) who presented evidence about the same relationship between vigilance and group size. In high vegetation this trend was reversed at group size of more than six birds. Burger and Gochfeld (1988) found an analogous trend for the Ostrich males which they attributed to sexual competition. Competition among males, however, cannot explain the trend we found because we did not detect differences between sexes even at group sizes larger than six. Presumably, in high vegetation a group is more vulnerable because it becomes more conspicuous as group size increases. Therefore, the predator's ability to detect a rhea in this habitat increases with the size of the group, whereas in a low vegetation habitat, a solitary rhea may be as easy to discover as a group. Advantages of being in larger groups include increased feeding efficiency due to social facilitation (Krebs 1974) or a dilution effect on the predator's success (Bertram 1978). Nonetheless, this last could not always be true for predation by humans, because sometimes they can shoot a large proportion of birds in a group.

For all group sizes studied, levels of vigilance per individual are higher in the tall vegetation habitat. Probably, this is due to reduced visibility that leads to a decrease in ability to detect and escape from predators. Reduced visibility, however, seems not fully compensated with an increase in vigilance, as rheas react later to an approaching human in these types of habitat (Martella and M. Demaria, unpubl. data). Contrary to what happens in small birds who increase their vigilance with increasing distance to cover (high vegetation) (Barnard 1980, Caraco et al. 1980), rheas behave like antelopes (Underwood 1982) and shorebirds (Metcalfe 1984), which increase their vigilance in habitats with less visibility.

Lima and Dill (1990) suggested that birds should not use a habitat in which chances of escape are low and thus there is high risk of predation. Greater Rheas use a habitat in which they seem more vulnerable (i.e., with high vegetation) because, presumably, it has more dicot forbs, which are preferred by this species (Martella, unpubl. data). This higher profitability in terms of food may counterbalance the corresponding cost of an increase of vigilance.

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FIGURE 1. Percent vigilance (mean ± 95% Scheffe Intervals, represented in untransformed scale) for each group size observed in (A) high and (B) low vegetation habitats. Sample sizes are also shown.

The monthly changes in vigilance in both habitats cannot be explained easily, unless disturbance produced by humans or pumas shows a similar trend (e.g., increased hunting pressure or if alternative prey for pumas become scarce for some reason). This variable was not measured here and, therefore, future research should be focused on this question. In addition, as our results are limited to the non-breeding season, vigilance behavior in the breeding season deserves a detailed study. Observations we have made have confirmed what Bruning (1974) mentioned as regards the increase of aggressiveness among dominant males during the breeding season. Consequently, we believe that there could be important differences in vigilance rates between both periods.

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