Journal of Sustainable Development in Africa (Volume 10, No.3, 2008)

ISSN: 1520-5509

Clarion University of Pennsylvania, Clarion, Pennsylvania

THE IMPACT OF TOURISM ON SABLE ANTELOPE (Hippotragus niger) VIGILANCE BEHAVIOR AT ARTIFICIAL WATERHOLES DURING THE DRY SEASON IN HWANGE NATIONAL PARK

M. Kamanda, V. Ndiweni, V.E. Imbayarwo- Chikosi, and J. Muvengwi
Bindura University of Science Education

A. Musakwa
Hwange National Park

Abstract
The effect of tourism and herd size on the vigilant behavior of sables (Hippotragus niger) at artificial waterholes was determined during the dry season in Hwange National Park (HNP). Herds in Main Camp spent, on average, 23.5% of their time drinking, 31.6% moving, 21.4% on vigilance, 19.7% standing, and 3.8% urinating/defecating. Sable herds in Ngamo, an area less frequented by tourists, devoted, on average, 35.1% moving, 30.3% drinking, 16.9% standing, 14.5% on vigilance, and 3.2% urinating/defecating. Tourism had a significant effect ($P<0.05$) on time spent on vigilance by sables at waterholes in HNP. Time allocated to vigilance by the small herd was significantly ($P<0.05$) higher (22.5%) than that observed in a larger herd (9.6%). Tourism and herd size had a significant effect ($P<0.05$) on vigilant behavior of sables at waterholes in the HNP, although other factors could be involved.

Introduction

Hwange National Park (HNP), because of its rich wildlife biodiversity, is a major tourist attraction for both local and international visitors. However, the area used by tourists in HNP is very small and its utilization is perceived to be getting excessive in these limited areas, especially the Main Camp. The direct impacts of this concern include changes in animal behavior and distribution. However, it has been difficult to quantify these impacts because of the absence of baseline data.

Since 1930, the management of HNP had the objective to increase the populations of wild herbivores for tourism and the maintenance of biological diversity for genetic

conservation. Among the management activities is the extensive development of artificial water points to promote utilization of different habitats during the dry season for species dependant on water.

This research dealt with the daily visits of sables to artificial waterholes during the dry season in two different areas, one very frequented by tourists (Main Camp) and the other less frequented by tourists (Ngamo). It focused on the impact of tourism on the behavior of sables during the period they will be drinking water.

Vigilant behavior is thought to be largely controlled by the threat of predation on foragers, and has been shown to increase with increasing predation risk (Edmunds, 1974). In addition, an inverse relationship between group size and vigilance has been documented, and is known as the "group size effect" (Lima, 1995; Roberts, 1996).

Any disturbance preventing an animal from drinking properly leads to a cost, which has to be compensated for (Illius & Fitzgibbon, 1994). Pressure from tourists, at the time of drinking activity is one possible source of disturbance to animal behavior.

Vigilant behavior is directly correlated to detection of danger (Hunter & Skinner, 1998) and a cost directly linked to food and energy gain. In bovines, time spent feeding can vary between 2% and 95% (Underwood, 1982). However, vigilant behavior also depends on the environment in which animals live. Vigilance will be greater in an open area than in a closed habitat (Scheel, 1993; Molvar & Boyer, 1994). Herd size, often correlated to the type of habitat (Gerard *et al*., 1992), also has an influence on vigilance. The rate of vigilance decreases when herd size increases (Scheel, 1993; Bednekoff & Ritter, 1994; Hunter & Skinner, 1998).

Sables are regarded as one of the key species of the HNP due to its high sensitivity to environmental variations (Gourvennec, 1999); any disturbance in their drinking activity needs to be investigated. The sable was chosen because it is widely distributed in

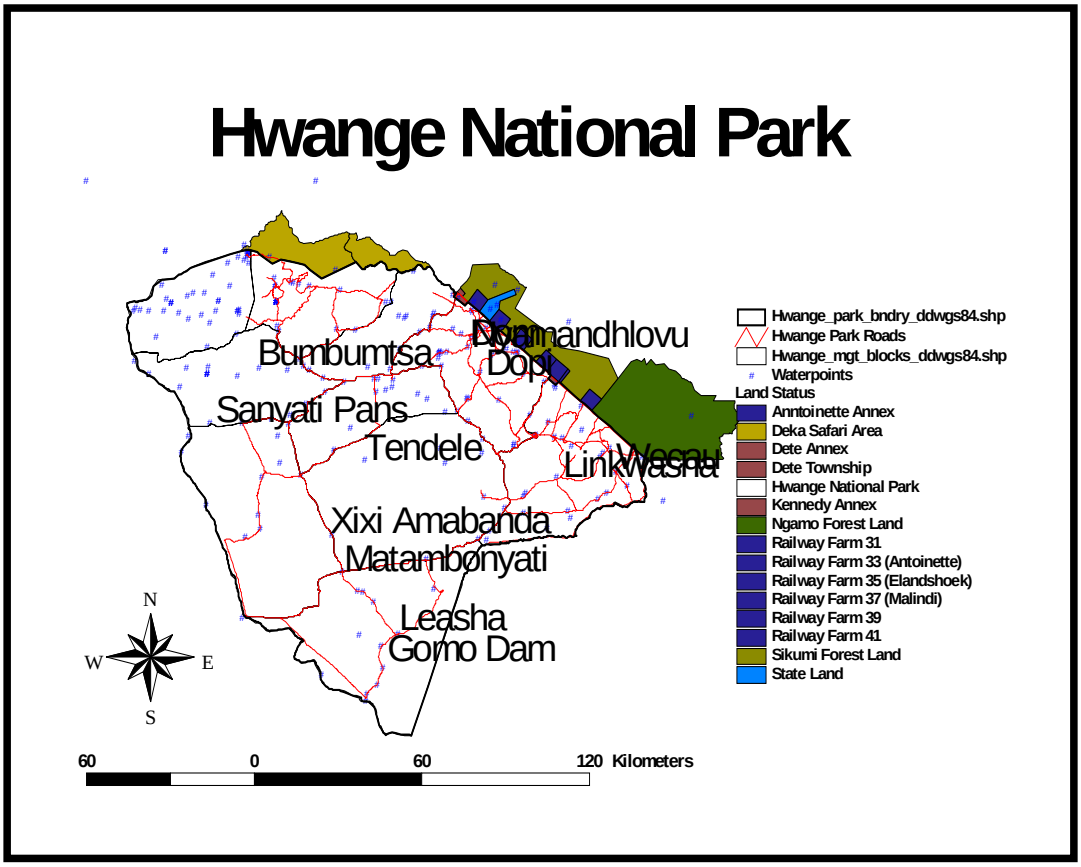
the HNP, with the densest population occurring around the Ngamo and Ngweshla areas. With the number of tourists visiting the park expected to increase (Park plan, 1999), there was a need to determine whether tourist presence at waterholes affects sable drinking behavior. This data is necessary in order to facilitate integration of this impact in the planning programs of HNP.

Moreover, there has been no study on the impact of tourism on vigilance behavior of sable at artificial water-points in Hwange National Park during the dry season.

Methodology

Study area. Below is a map which shows the study sites.

Figure 1: Hwange National Park



Hwange National Park is Zimbabwe's premier National Park. It covers an area of 14,651 km^2 and lies to the northwest of the country. Situated between latitudes $18^o30'$ and $19^o 50'$ south and longitudes $25^o 45'$ and $27^o 30'$ east (Rogers, 1993), at an altitude varying between 840m and 1,153 m, it is bordered to the west and southwest by Botswana and to the north by the Matetsi and Deka Safari Areas. The park has 105 mammals and 410 bird species and has nearly all of the protected species in Zimbabwe (Park plan, 1999). The area of HNP covered by this research extends northwards, from Dopi to Nyamandlovu pans. The most easterly waterholes are located in Ngamo (Figure 1). In Main Camp, annual rainfall varies considerably, but the average is 650 mm. The summer rainy season extends from October to March, with most rainfall being received during December to February. Total rainfall can vary from less than half to more than twice the annual average (Rogers, 1993). The remaining months of the year are normally dry. There are no rivers in the main study area and water is provided by a number of pumped and seasonal pans. Seasonal pans hold water to varying months in the dry season, depending on such factors as extent of the previous rainy season, the capacity of the pan, and its use by wildlife. The lowest minimum and highest maximum mean for monthly temperatures at Main Camp range from -3.5^oC to 35.1^oC, with October being the warmest month of the year and July the coldest (Rogers, 1993).

The topography of the study area is flat. The major geological types in HNP include the vast areas of Kalahari sands, which cover two thirds of the park, the Batoka basalts, the Karoo sediments, and the Pre-Cambrian rocks.

The park's vegetation, mainly distributed on Kalahari sands, is composed of 64% savannah woodland, 32% savanna bushland, and only 4% savanna grassland. The major woody vegetation types found within the study area include the following genera: *Terminalia, Combretum, Acacia, Baikiaea* and *Pterocarpus* (Gourvennec, 1999).

Data Collection: Data was collected during the dry season when tourist visits were are at their peak. The animals' vigilance was selected as the principle factor to measure the impact. For the purpose of this study, only those pans that had artificially pumped watering holes, had significant populations of sable and with high tourist volumes (as indicated by the number of vehicles in the area) were considered. Study pans were selected from the Main Camp area (very frequented by tourists) and the Ngamo area in the extreme south-east of the park (scarcely frequented by tourists). This part of the park was, in fact, a concession used by two private operators (Bomani Safari Club and Wilderness Safaris). It was, therefore, scarcely frequented by tourists. Selected pans in Main Camp were Dopi and Nyamandlovu; and those in Ngamo area were Wexau and Ngamo Pan respectively (Figure 1).

A protocol to measure animal activity at waterholes in the two areas (Main Camp and Ngamo) was put in place. Sables were observed with 8 x 42 Bushnell binoculars within a radius of 100 m from the water pan in all directions. Time of arrival, time spent urinating/defecating, drinking, moving, vigilance, standing, departure time, and group composition was recorded in the two areas. Observations were conducted twice a day, in the morning (0600hrs-1000hrs) and late afternoon (1600hrs-2000hrs), during the peak of the dry season when the game animals were concentrated near the few waterholes which contained water. Most of these pans were supplied with water pumped from diesel engines. These were the normal drinking times of the sable in HNP.

Observers were either on a platform or in a vehicle at a distance from the pan and avoided unnecessary movement. Vigilance was defined as time spent by an animal(s) scanning its surroundings. Focal monitoring enabled individual behavior of sables in a herd to be studied. This consists of the longest possible observation of a single animal chosen at random from a herd, in this case for as long as the animal was within the 100 m

radius. These types of observation give the necessary information on the vigilance behavior of herd and individuals.

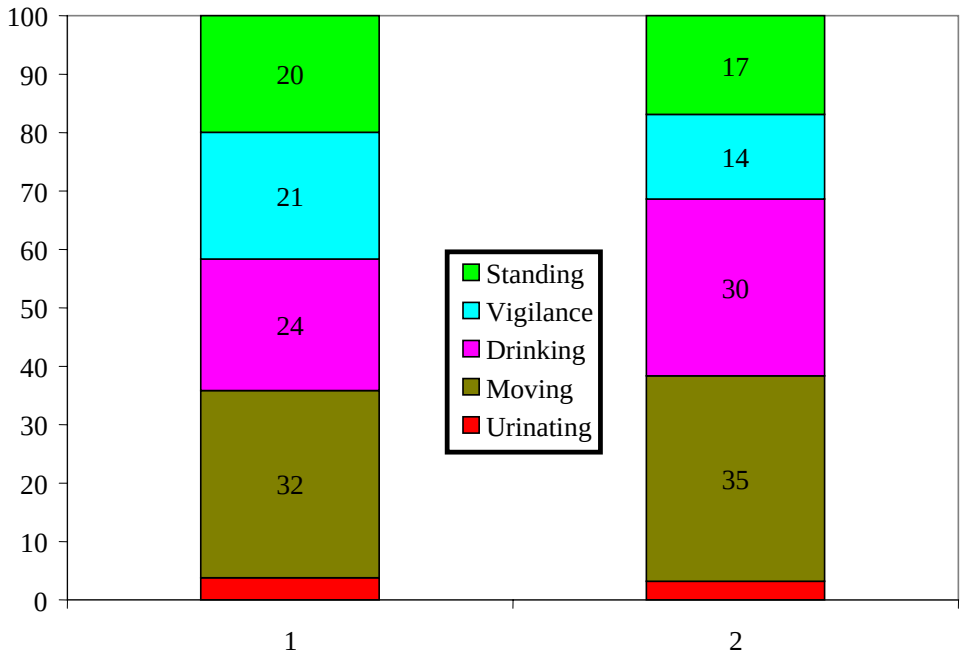
Data analysis: Since the data was purely categorical and percentages rarely follow a normal distribution, non-parametric tests were used to find the significance of the different factors (group size and tourism). Averages of percentages of time spent on the different activities by each of the herds observed were independent variables. The Mann-Whitney Test (variables independent in two variables/modalities) was selected to evaluate the effect of tourism (more or less frequented by tourists) and herd size (less than 5 individuals and more).

The data was processed with Microsoft Excel software and analyzed with SPSS. The data was divided and percentages of time spent on different activities in Main Camp and Ngamo were processed and represented in graphs and pie charts.

Results: A total 415 animals were observed (98 male adults, 161 female adults, and 9 unclassified adults; 20 sub-adult males, 48 sub-adult females, and 9 unclassified sub-adults; 45 female juveniles and 25 male juveniles).

Tourist Effect: Sable herds in Main Camp, an area very frequented by tourists, devoted on average 23.5% of their time to drinking, 31.6% moving, 21.4% on vigilance, 19.7% standing, and 3.8% urinating/defecating (Figure 2). Sable herds in Ngamo, an area less frequented by tourists, devoted on average 30.3% to drinking, 35.1% moving, 14.5% on vigilance, 16.9% standing, and 3.2% urinating/defecating.

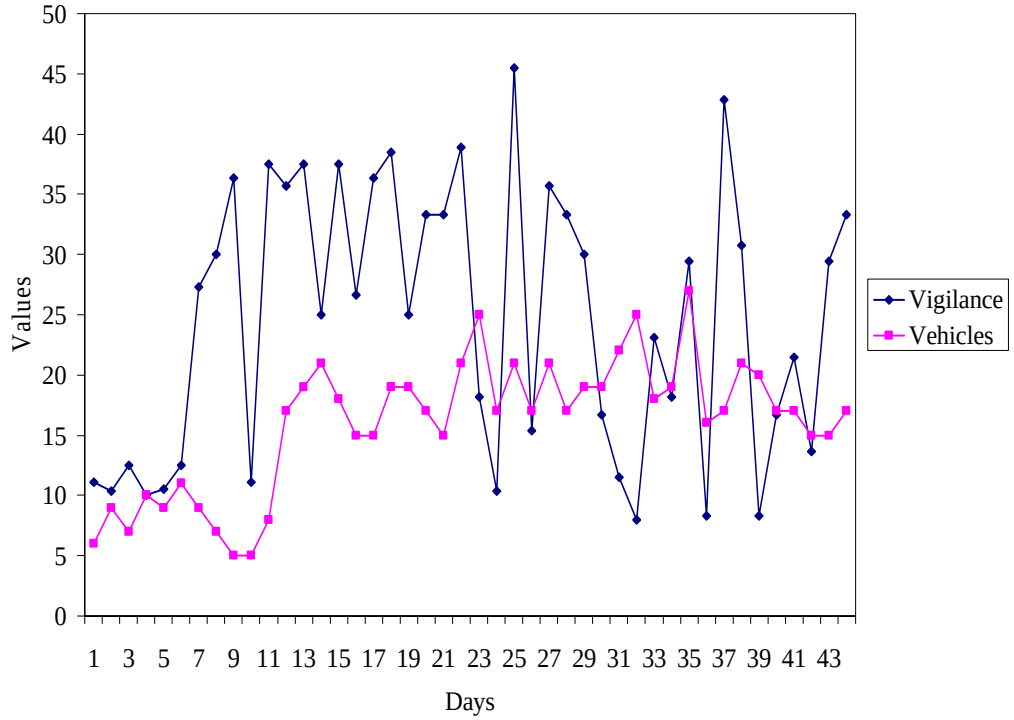
Figure 2: Average Time Spent (%) of Sable Herds on each Activity in Main Camp (1) and Ngamo (2)



Sables in Main Camp have significantly different vigilance percentages than those in Ngamo ($p<0.05$) (Figure 2). There was a significant effect of tourists that factored on time spent on vigilance by sables at waterholes in HNP. Moreover, there is a significant effect of tourism on time spent drinking ($p<0.05$) and moving ($p<0.05$) (Figure 2) by the sables. However, there was no significant effect of tourism on time spent by sables standing ($p>0.05$) and urinating/defecating ($p>0.05$) (Figure 2).

Time spent on vigilance in Main Camp was higher (21.4%) than that observed in Ngamo (14.5%). Although no other activity was significantly different, a look at the figures for percentages of time spent on movement shows a difference between the two areas. In Main Camp, sables spend 31.6% of their time at waterholes moving while in Ngamo they spend 35.1% (Figure 2).

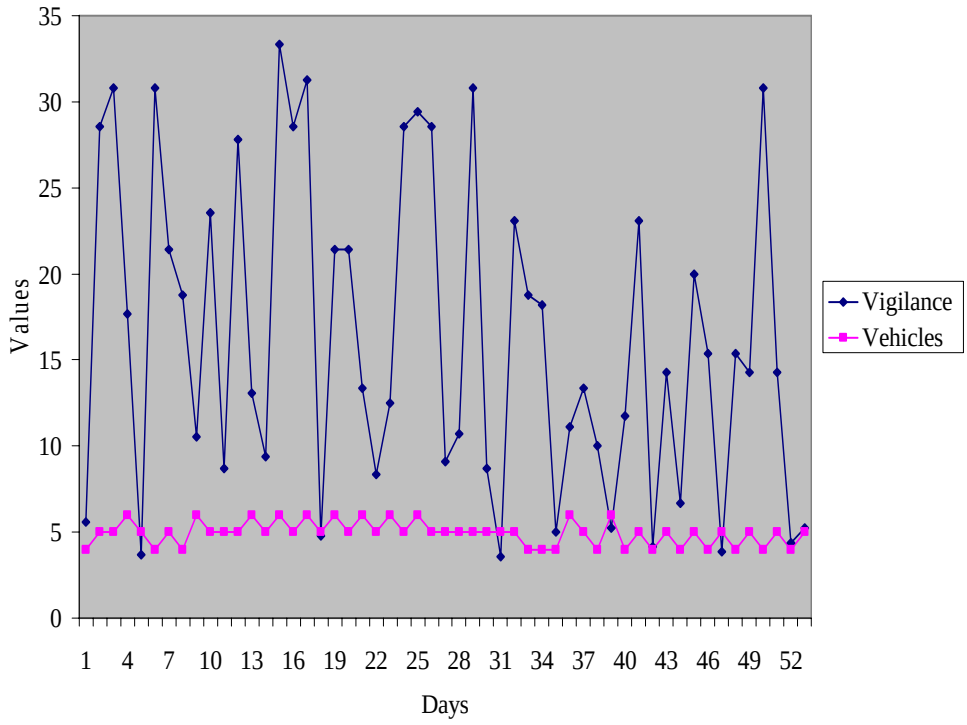
Fig 3: Number of Vehicles and Vigilance Percentages during the Period of Study in Main Camp



Based on Figure 3, vigilance increased with increasing vehicle volume. In the early days of the study (September), there were a few vehicles visiting the park; during the peak of the dry season (October) tourist volumes increased drastically, leading to a sharp increase in the vigilance of sables. A change in the number of vehicles led to a sharp increase or decrease in the vigilance of sables at waterholes in Main Camp area.

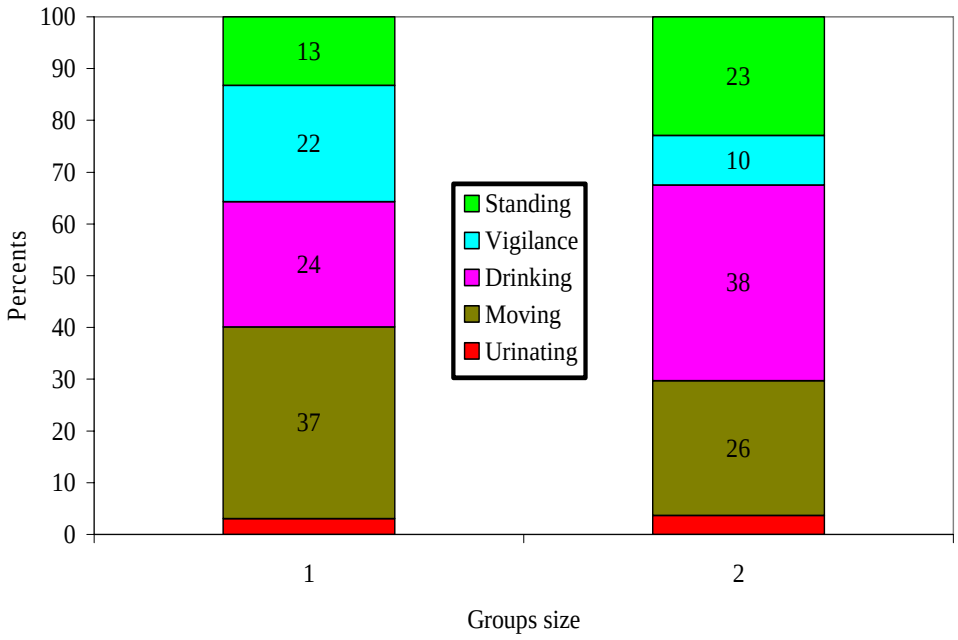
Looking at Figure 4 (below), vigilance of sables at waterholes in Ngamo fluctuated with time. The number of vehicles was constant for the rest of the study period, remaining above or below five at any given day.

Figure 4: Number of Vehicles and Vigilance Percentages during the Period of Study in Ngamo



Group effect: Small herds had significantly different vigilance percentages than larger herds ($p<0.05$) (Figure 5). This indicates that there was a significant effect of group size on vigilant behavior of sables at waterholes in HNP. Furthermore, there was significant effect of group size on time spent by sables drinking ($p<0.05$), moving ($p<0.05$), and standing ($p<0.05$) (Figure 5). There was, however, no significant effect of group size on time spent by sables urinating/defecating at waterholes in HNP ($p>0.05$) (Figure 5).

Fig 5: Average time spent (%) by sable herds on different activities according to group size (1-less than 5; 2-five or more) in HNP



Time allocated to vigilance by a small herd (<5) was higher (22.5%) than that observed in a larger herd (9.6%). A look at the figures for percentages of time spent standing, drinking, and on movement also show a difference between the two group sizes. A small herd spends 13.2% of its time standing and 24.2% drinking, while a bigger herd uses 22.9% and 37.8%, respectively, of its time on the two activities. Smaller herds spend relatively more time moving (37.1%) as compared to larger herds (26.0%).

Discussion

Time spent by sables on vigilance is significantly higher in Main Camp, an area heavily frequented by tourists, than in Ngamo, an area which is less frequented by

tourists. Also, vigilance increased with increasing tourist volumes in Main Camp (Figure 2). In Ngamo, the vigilance percentages did not show a relationship with the number of vehicles as these were constant (Figure 4). In fact, vigilance seemed to fluctuate, which might possibly be due to other factors, such as predation. Another interesting observation was that the sables seemed to avoid drinking when there were many vehicles at the platform. These results suggest 'disturbance' to the animals due to pressure from humans.

The area of Main Camp, although overall it has the same predator pressure as that of Ngamo, does not harbor the same species and populations of predators. In particular, it has a significantly higher population of hyenas than Ngamo (Pers.comm, parks authority). Studies on vigilance (using flight distances) of plains antelopes, faced with different predators, showed that the hyena was amongst predators that caused the biggest flight distance, along with wild dogs, leopards, and lions (Walther, 1969).

In addition, Main Camp is open to different types of tourists - individuals with vehicles, safari operators, scientific researchers, school pupils on buses, *etc* - who make a lot of noise from door slams, engine sounds, talking, and so on. In Ngamo, tourists use only the safari vehicles provided by their operators, who only conduct morning and afternoon drives. The number of vehicles used at any given time depends on factors, such as the number of clients, vehicle carrying capacity, and client preferences among others. Normally, Bomani Safari Club uses two vehicles, and Wilderness Safaris usually has about five vehicles conducting drives at any given time in Ngamo (Pers.comm, Safari operators).

Moreover, the infrastructure in terms of tarred or graded roads and platforms act as a pull factor to tourists and boost tourist numbers in Main Camp area. These tourists, however, utilize a small portion of HNP. Morning and afternoon game drives are limited

to a few hours, and with stops at viewing platforms *etc*., almost all vehicles utilize only a small part of the road system in Main Camp.

These different factors certainly make the animals more suspicious in Main Camp than in Ngamo; although it has been suggested that animals seem to adapt to the presence of tourists (Gourvennec, 1999), they can still suffer from stress. Studies on the heartbeat of wild ungulates have shown that even without any apparent reaction, they sometimes react emotionally (McArthur *et al*., 1979). This stress can represent a cost in terms of population dynamics, and can also lead to change in the time budget. Results on time allocated to drinking and vigilance, at artificial waterholes in Main Camp and Ngamo areas during the dry season, show clearly an increase in the rate of vigilance at the expense of drinking in the area frequented by tourists (Figure 2).

In arid and semi-arid savannas, as the dry season progresses, surface-water resources become scarce, resulting in high levels of animal aggregation near water sources. In HNP, where surface water is scarce and elephant numbers are high, there have been suggestions that elephants, through their presence, abundance (passive interference) or behavior (aggressive interaction), influence water access by other herbivores (the sable included). However, studies by Valeix (2002), showed that the presence, abundance, or behavior of elephants at waterholes; i) did not shorten the time spent by other herbivores in contact with water, i.e., their potential drinking time; ii) influenced the time spent by other herbivores to approach the water, for only impala, kudu, and zebra by only a few minutes; and iii) influenced the decision to drink for only two species: the giraffe and roan. Therefore, no direct mechanism could be identified to explain a negative effect of elephants on other herbivores regarding access to water.

Small herds, of less than five individuals, spend significantly more time on vigilance than larger herds, of at least five individuals. Group size did affect the length of

scan bouts. This was in line with the predictions of the group size effect, as scan bout length (vigilance) increased with decreasing group size. The data suggest that more animals implies there are more eyes available for detecting predators, and any one individual may benefit by spending less time scanning and more time drinking. Pulliam (1973) advanced the hypothesis that animals benefit by flocking because the vigilance of flock-mates leads to an increase in the probability of detecting a predator within the time it takes to attack. This has been referred to as a 'many eyes effect' (Powell 1974), as a 'collective detection effect' (Lima, 1995) and as a 'detection effect' (Dehn, 1990, but not as in Lima, 1995). It states that individuals in larger groups can enjoy the same or improved predator detection rate, while scanning less frequently, and having more time to feed/drink (Pulliam, 1973).

While reduced vigilance for predators in larger groups is a logical hypothesis, the presence of larger groups also may mean reduced opportunities to drink, hence, more time spent at the waterhole. Scanning was relatively constant in smaller group sizes, suggesting that when scanning does occur, it is primarily associated with tourist avoidance.

Conclusion

The impossibility of having energy input and surveillance simultaneously shows that vigilance has a cost (Underwood, 1982). This cost can be estimated in additional time necessary to compensate for the decrease in ingestion/drinking (Illius & Fitzgibbon, 1994). Animals will have to compensate at another times of day for the lack of drinking/foraging, resulting from vigilance time taken out of drinking/feeding time because of tourism.

Group size contributes greatly to limiting dangers, in view of the fact that formation of herds, for example, leads to decrease of predation, while also limiting the individual level of vigilance (Scheel, 1993; Bednekoff & Ritter, 1994; Hunter & Skinner, 1998). Thus, a small solitary antelope needs to pay much attention to different dangers existing, tourism being a possible one. Although the time necessary for vigilance is inversely proportional to the size of species, cost of vigilance is higher in large species, which have to devote more time looking for and taking food/water (Underwood, 1982). Whilst vigilance can be a result of other factors, this study also showed that group size and tourism contribute significantly towards vigilance behavior. Tourism should further (not counteract) the objectives of conservation and possible strategies to ameliorate impact of tourism, including construction of new hides and platforms in areas, which are remote from the main roads and development areas, so that visitors are spread over a larger area, there by minimizing visitors pressure on animals at waterholes.

References

Bednekoff, P.A and Ritter, R. (1994). Vigilance in Nxai Pan Springbok, *Antidorcas marsupials. Behavior,* **129**: 1-2.

Burger, J. and Gochfeld, M. (1994). Vigilance in African mammals: differences among mothers, other females and males. *Behavior*, **129**: 10-23.

Dehn, M.M. (1990) Vigilance for predators—detection and dilution Effects. Behav. Ecol. Sociobiol; **26**:337–342.

Department of National Parks and Wildlife Management (1999). Hwange National Park. Management Plan 1999-2003. Research Unit, DNPWM, Harare.

Elgar, M. **(**1989). Predator vigilance and group size in mammals and birds: a critical review of the empirical evidence. *Biological Review*, **64**: 13–33.

Elgar, M. A.; Burren, P. J.; Posen, M. (1984). Vigilance and perception of flock size in foraging house sparrows (*Passer domesticus* L.). *Behavior*, **90**: 215–223.

Elgar, M. A. and Catterall, C. P. **(**1981). Flocking and predator surveillance in house sparrows: test of a hypothesis. *Animal Behavior*, **29**: 868–872.

Gerard, J.F.; Poulle, M.L.; Bideau, E.; Maublanc, M.L.; Vincent, J.P. (1992). Influence of season and habitat openness on European Roe Deer (*Capreolus capreolus)* group size. *Eco-Ethology: "Ongules"/Ungulates*, **91**: 279-281.

Gourvennec, G. (1999). Impact of tourism on impalas *(Aepyceros melampus)*: adaptation but vigilance. Unpublished project report to the DNPWM, Harare.

Grimsdell, J.J.R. and Field, C.R. (1976). Grazing patterns of buffalos in the Ruwenzori

National Park, Uganda. *East African Wildlife Journal,* **14**: 339-344.

Hunter, L.T.B. & Skinner, J.D. (1998) – Vigilance behavior in African ungulates: the role of predation pressure. *Behavior*, **135**: 195-211.

Illius, A.W. and Fitzgibbon, C. (1994). Costs of vigilance in foraging ungulates. *Animal Behavior,* **47**: 481-484.

Lima, S. L. **(**1995). Back to the basics of anti-predatory vigilance: the group size effect.

Animal Behavior, **49**: 11–20.

McArthur, R.A.; Johnston, R.H.; Geist, V. (1979). Factors influencing heart rate in free- ranging bighorn sheep: a physiological approach to the study of wildlife harassment. *Canadian Journal Zoology*. **57**: 2010- 2021.

Molvar, E.M. and Bowyer, R.T. (1994). Costs and benefits of group living in a recently social ungulate: the Alaskan moose. *Journal of Mammals,* **75(3)**: 621-630.

Papouchis, C.M.; Singer, F.J.; Sloan, W.B. (2001). Responses of desert bighorn sheep to increased human recreation. *Journal of Wildlife Management*. **65**: 573-582.

Peres, C.A. & Lake, I.R. (2003). Extent of non timber resource extraction in tropical forests: accessibility to game vertebrates by hunters in the Amazon basin. *Conservation Biology*. **17**: 521- 535.

Powell, G. V. N. **(**1974). Experimental analysis of the social value of flocking by starlings (*Sturnus vulgaris*) in relation to predation and foraging. *Animal Behavior*, **22**: 501–505.

Pulliam, H. R. **(**1973). On the advantages of flocking. *Journal of Theoretical Biology*, **38**: 419–422.

Roberts, G. **(**1996). Why individual vigilance declines as group size increases. *Animal*

Behavior, **51**: 1077–1086.

Rogers, C.M.L. (1993). A Woody Vegetation Survey of Hwange National Park. Department of National Parks and Wild Life Management, Harare, Zimbabwe.

Scheel, D. (1993). Watching for lions in the grass: the usefulness of scanning and its effects during hunts. *Animals Behavior*, **46**: 695-704.

Tyler, N.J.C. (1991). Short-term behavioral responses of Svalbard reindeer Rangier *Tarandus platyrhynchus* to direct provocation by a snowmobile. *Conservation Biology*, **56**: 179-194.

Underwood, R. (1982). Vigilance behavior in grazing African antelopes. *Behavior*, **79**: 79-107.

Valeix, M. (2002). Structure of ungulate communities: A test for the role of megaherbivores in interspecific competition. Masters thesis, Universite Pierre and Marie Curie, Paris.

Vesey-Fitzgerald, D.F. (1960). Grazing succession among East African game animals. *Journal of Mammals*, **41(2)**: 161-172.

Vickery, W. L.; Giraldeau, L-A.; Templeton, J. J.; Kramer, D. L.; Chapman, C. A. (1991). Producers, scroungers and group foraging. *American Naturalist*, **137**: 847–863.

Wilson, V.J. (1975). Mammals of the Wankie National Park, Rhodesia. Museum Memoir No. 5. Trustees of the National Museums and Monuments of Rhodesia.