ELSEVIER

0006-3207(94)00096-4

Biological Conservation **73** (1995) 23–26

0006-3207/95/$09.50+.00

ASIAN RHINOS *Rhinoceros unicornis* ON THE RUN? IMPACT OF TOURIST VISITS ON ONE POPULATION

Dale F. Lott

Department of Wildlife and Fisheries Biology, University of California, Davis, California 95616, USA

&

Michael McCoy

University Extension, University of California, Davis, California 95616, USA

(Received 6 May 1993; revised version received and accepted 26 July 1994)

Abstract

We evaluated the impact of tourist visits on Asian rhinos Rhinoceros unicornis *in Chitwan National Park, Nepal, by comparing the rhino's behavior during and after elephant-borne tourist visits to their behavior before visits. During the visits, the rhinos spent more time on alert and less time feeding. Close approaches (especially those under 10 m) were more disruptive, and frequently displaced the rhinos from the meadows where they preferred to feed. Visits were short (20·7 min average) and rhinos that were not driven out re-established their pre-visit pattern of behavior within 14 min of the tourists' departure. Moreover, these rhinos' home ranges overlapped extensively and individuals ranged widely so that each individual's encounters with tourists were usually several days apart. Eliminating close approaches would make these tourist visits relatively benign. However, this finding cannot necessarily be extended to other populations that might have different social systems.*

Keywords: Asian rhinoceros, tourist visits, foraging rates, behavioral indicators.

INTRODUCTION

Non-consumptive uses of wildlife are growing rapidly (see literature reviews and bibliographies in Hall & Deardon, 1984; Boyle & Samson, 1983; Boyle & Samson, 1985; Duffus & Dearden, 1990). These uses can have serious impacts on the species so used. Tourists disrupted nesting bald eagles *Haliaeetus leucocephalus* (Grubb & King,1991), foraging in ruddy shelducks *Tadorna ferruginea* (Hulbert, 1990), bighorn sheep *Ovis canadensis* (Stockwell *et al.*, 1991; Lott, 1988), mountain goats *Oreamnos americanus* (Lott, 1992) and whales (Duffus, 1988) among others.

Behavior has often been used as an indicator of disturbance. Bald eagles were flushed from nests and diverted from foraging by several types of human intrusion (Grubb & King, 1991). Foraging bighorn sheep were disturbed when helicopters carrying tourists in the Grand Canyon flew close to them (Stockwell *et al.*, 1991). Changes in resting and foraging indicated how much tourists in canoes disturbed ruddy shelducks (Hulbert, 1990). Since the basic behavioral patterns of Asian rhinos *Rhinoceros unicornis* have already been well described (Laurie, 1978), behavior seemed a good indicator of tourist visit impact on that species in Chitwan Park, Nepal.

SUBJECTS AND STUDY SITE

Chitwan Park (1295 km^2) lies along the southern border of Nepal with India at an elevation of 300 m and less. There are substantial areas of riparian habitat with grassy meadows where a grassland community flourishes. This community includes several species, collectively called elephant grass, standing up to 4 m tall (Gurung, 1983). Local Nepalese harvest this grass once a year with the park management's permission, then the meadows are set afire and the remaining grasses burned.

Asian rhinos graze in these meadows most of the year. The tourism at our study site is conducted via elephant-borne tours in which all the tourists ride elephants along a set of trails and through a set of meadows at a predictable time each day. Five to seven elephants travel in one group. Visits to a rhino in a meadow last 10–40 min. Towers approximately 8 m high are situated at the edge of each of the two largest meadows in the area. After the grasses have been burned, a rhino is observable in nearly any part of either meadow from these towers.

METHODS

We individually identified 14 of approximately 26 rhinos resident in the area via photographs and drawings.

The behavior was recorded by teams of volunteer research assistants. These assistants were trained to record rhino behaviors prior to their first data gathering session, and supervised during their first field session by an experienced observer. Each team arrived at

its tower at least an hour before the elephants, and remained in the tower until the elephants had been gone long enough to complete at least one checksheet (5 min). Observers were stationed at each tower on each of 17 study days.

A tower team consisted of an observer who described the rhino's behavior aloud while the second member recorded the behavior using one-zero scoring at 15-s intervals on a check sheet (Martin & Bateson, 1986). A check sheet covered 5 min, or 20 intervals. The team recorded alert, walking and feeding — biologically important behavior patterns that are easily recognized by observers, and can be reliably scored after brief training. Elephant-borne spotters with the tourists and one of us (D.F.L.) identified the rhino, measured the distance between the elephants and the rhino with range finders, and radioed the information to the tower crew who recorded it on the data sheets.

The tower team completed at least one checksheet before the visit, at least one during it and at least one after the tourists departed (provided the rhino did not leave the meadow during the tourist visit). The post-intrusion session began shortly after the intrusion ended ($\bar{X}$ = 5·29 min, range = 0–11 min). It was quickly completed ($\bar{X}$ = 13·78 min, range — 5–25 min) because park rules required our arrival at home base by sundown, and the tourist visits we studied were in late afternoon.

Complete data sets (at least one check sheet before, during and after the visit) were obtained on 10 known individuals. We averaged the scores of each individual that was recorded more than once and represented that individual only once in the data set reported in Table 1.

The different responses of individuals to different proximity on different visits were revealing. Therefore each visit was treated as an observation for analysing the impact of proximity. Consequently, several individuals are represented more than once in the data set reported in Fig. 1, both in terms of behavior during a visit and the likelihood of leaving.

Table 1. Mean percent intervals during which behavior occurred, in the course of tourist visits to ten rhinos

Behavior	Before visit	During visit	After visit
Alert	7·98	33·04	4·38
Feed	83·17	51·64	85·27
Walk	38·07	32·66	37·59

RESULTS

The elephant-borne tourist visits lasted an average of 20·6 min (range 10–37 min) from the arrival of the first elephant in the meadow to the departure of the last. The reaction to the tourist visits and the degree of recovery during the period immediately afterward are reported in Table 1, which reveals that the percentage of 15 s intervals during which the rhinos fed declined while the percentage of intervals in which they were alert increased during visits. Both returned to about their previous values in the post-visit period. The statistical reliability of these changes was examined via a General Linear Models Procedure repeated measures analysis of variance. The rhinos spent significantly more time alert during the visit than before it (p = 0·0009) or after it (p = 0·0008). They spent significantly less time feeding during the visit than before it (p = 0·0018) or after it (p = 0·002). The change in walking was not statistically reliable ($p > 0·307$).

The effect during the visits is a function of how closely the tourists approached the rhinos. Figure 1 shows that when tourists came closer than 12 m the feeding rate was less than half as great as it was when the visitors stayed 12–23 m away and less than one-third as great as when the visitors stopped 30 m or more away. Thus the impact of closeness of approach seems to be a dose–response effect.

Distance also had another effect. A total of five rhinos left during very close visits (one of them left twice). The average closeness during these visits was 10·7 m,

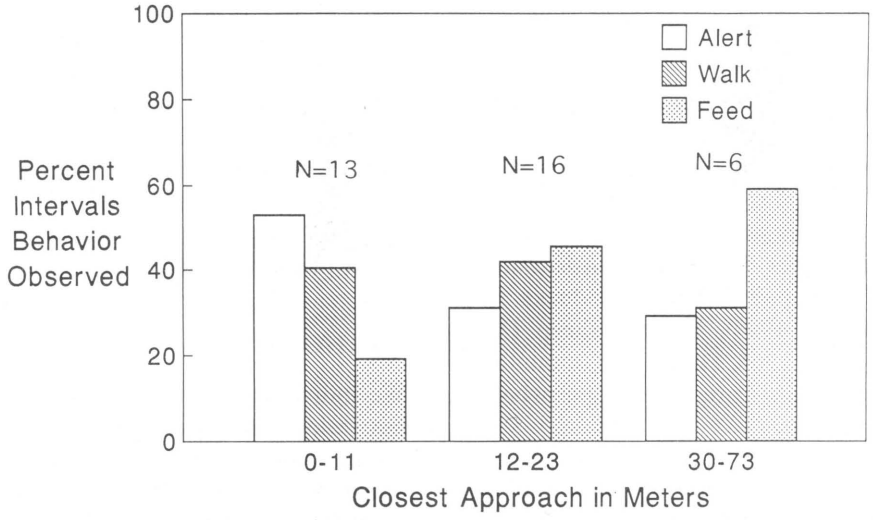

Fig. 1. The percentage of intervals in which being alert, walking, or feeding was observed as a function of the closest approach of the nearest elephant during a visit.

and only one of the departures occurred when the visitors were more than 11.2 m from the rhinos that departed. However, the closely encountered rhinos that did not leave their meadow recovered much like the other visited rhinos. During post-visit observations, the closely encountered rhinos were alert in 7% of intervals (compared to 5%), walked in 35% (compared with 37%) and fed in 85% (compared with 74%). None of these differences approaches statistical significance. Recovery in the closely encountered rhinos that did not leave was no different from recovery after other visits, but those that left abandoned the foraging situation they had chosen, and stayed away for an unknown length of time.

DISCUSSION

The tourist visits disrupted the rhinos' behavior, especially by interrupting feeding (substantially through increasing a behavioral reciprocal — being alert). Feeding is significant since large herbivores must spend a high percentage of their day feeding to remain healthy (Stockwell *et al.*, 1991). However, two things make the impact of this disruption probably modest. The first is that recovery to normal behavior patterns is usually very quick. The second is that each individual rhino is visited only on occasional days because of their pattern of roaming over a large area even in the absence of heavy tourism (Laurie, 1978, 1982). Of course, this second point only applies to populations socially organized as these were, with large overlapping home ranges. If the rhinos were organized in territories, some individuals could bear a disproportionate share of the impact. Since social systems often vary intraspecifically (Lott, 1991) the impact of tourism cannot be fully determined without knowing which system a population expresses. Consequently, findings will be place- and population-specific, and cannot safely be generalized.

Avoiding too close an encounter should substantially reduce the disruptions that do occur. Visitors disrupted the rhinos most when they approached to less than 12 m, as they fairly often did. Such close approaches not only disrupted the rhinos' feeding, but about half the time displaced the rhinos from the feeding site they had chosen.

Increased disruption as a function of proximity reveals a possible dose–response impact of tourist visits. Dose–response relationships provide evidence for impact and can also point to strategies to reduce impact (Anderson, 1988). Tourists could be restricted to approaches no closer than a safe margin, say 15 m, and tour leaders could limit their approaches to easily disturbed individuals. A few tourists would object to this restriction, but interviews we conducted with visitors to this park indicated that the great majority would be content with such visits (McCoy & Lott, in prep.) and many would be pleased to know that their visit did the rhinos no harm.

The current program of two brief tourist visits per day is a function of current tourist demand. If increased demand were accommodated by more frequent visits, the program would disrupt the rhinos' feeding more, which could have a negative effect. However, we conclude that with proper precautions this population of Asian rhinos can tolerate tourist visits.

ACKNOWLEDGEMENTS

We thank Dwarika Shrestha, managing director of Chitwan Jungle Lodge, for his hospitality, the assistance of his naturalists and staff and the use of his elephants. Neil H. Willits advised us on the statistical analysis. Kris Timmerman coordinated research efforts and solved logistical problems. The members of our research team braved rhinos and sloth bears while traveling on foot to their posts, where they faithfully, and sometimes ingeniously, gathered the data. Our admiration and thanks to Gary Burleson, Helen Callbeck, Mary Connors, Mathew Connors, Robert Cowgill, Esther Dickens, John Dickens, Virginia Dingus, Betty Fairbank, William Fairbank, Naomi Haebler, Ben Hart, Lynette Hart, Mary Holley, Stan Holley, Stancil Johnson, Arlene Kruse, Kent Patrick, Laurel Patrick, Bonnie Pedersen, Larry Pedersen, Beryl Thompson, Ray Thompson, and Donald White. Daniel Anderson, Delia Owens and two anonymous reviewers made suggestions on an earlier draft. The study was partially supported by federal funds administered through the Agricultural Research Station as hatch project 3815.

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