A Preliminary Report on Visitor use in Amboseli National Park

by

Wesley R. Henry

Working Paper No. 263

Institute for Development Studies,
University of Nairobi,
P.O.Box 30197,
Nairobi, Kenya.

March, 1976

Table of Contents

Summary

In Kenya, as in many other countries, tourism is beginning to have an adverse effect on national parks and reserves. Because of the ecological and economic importance of these areas, the interests of conservation and tourism need to be reconciled through a careful program of planning, research, and management. To off-set a critical lack of management information on visitors' and their use of wildlife areas, this study in Amboseli was designed to examine visitors' behaviour and use, temporal and spatial variations in use, and the impact of that use.

Results showed that there were very considerable daily, monthly, and seasonal visitor/vehicle entry rates which have the potential of greatly reducing the capacity of the park for tourist use and compounding other park problems. However, the fast turn-over of visitors greatly increased the capacity of the park; and because of the way the park was used on a daily basis; use was actually much less than might have been expected.

The very poor spatial distribution of vehicle use was largely the result of visitors' predator specific viewing pattern. Because of a limited number of lion and a decreasing number of cheetah, this pattern of use will probably be the most critical limiting factor on Amboseli's capacity for tourism.

The impact of vehicle use is not yet fully understood, but the study added much insight on the problem. Off-road driving very likely has a considerable impact on vegetation and soils. Half of Amboseli's visitors are exposed to high vehicle densities while viewing cheetah which may have an adverse effect on their viewing enjoyment. Of more immediate concern is the fact that the activity pattern of cheetah also appeared to be adversely affected.

The ecological and economic consequences of not solving the problem of vehicles concentrating around predators will be quite serious, but more information will be needed to design an effective tourist management plan.

INTRODUCTION

Tourism and recreation activities have had an adverse impact on National Parks and equivalent reserves in many countries around the world. In these countries, the growth of tourism and recreation use in natural areas has brought about an increased demand for facilities and services that threatens the very reason for which these areas were set aside in the first place -- the preservation of natural ecosystems and wild areas, unspoiled by man.

The preservation and use dilemma that afflicts so many parks and reserves was once thought to be a problem peculiar to North America and Europe, but it has now begun to affect parks in East Africa, especially Kenya. Parks at Nairobi, Nakuru, and Amboseli are seriously affected, and similar problems are developing in other wildlife areas.

The combination of a unique variety of wildlife and spectacular natural environments has resulted in the growth of a very substantial tourist industry in East Africa. The economic value of tourism makes a considerable contribution to the economies of the region and gives the parks and reserves more stability at a time when the demand for land is increasing dramatically. Thus, for ecological and economic reasons it is imperative that the naturalness of these areas is not adversely affected by tourist use.

But environmentally and aesthetically, the parks and reserves are suffering because of a laissez-faire attitude towards visitor use. Use is capable of damaging ecological features of these areas and decreasing their attractiveness

for tourism. Because the inevitable result of uncontrolled use will be a decline in both the conservation and economic values of the areas, tourist management must begin to constitute an integral part of the conservation and management of parks and reserves.

Purpose of Research

At a time when the growth in tourism and its economic value make it urgent that a proper balance be established between the interests of conservation and tourism, planning and management of East African parks and reserves is greatly hindered by the complete lack of information on visitor attitudes, behaviour, and impact. Accordingly, the purpose of this research was to study visitor use in one of East Africa's most heavily visited parks, Amboseli. Of particular concern were the fluctuations that occur in visitor flow over time and space, visitor behaviour, and the impact of visitor use. Information on these aspects of use are preliminary to any further research relating to tourist management in Amboseli, and will be most useful to other parks and game reserves facing similar problems.

Selection of Study Site

The conservation and economic values of this park, detailed in Development Plans for Amboseli (Western and Thresher, 1974) more than justify its selection as a site for this type of research. Moreover, the dramatic changes in the Amboseli ecosystem, studied in detail by Western (1973), make visitor management an even more urgent priority.

Several additional reasons also figured in the selection, Amboseli is more typical of East African parks and reserves than either of the heavily used parks at Nairobi or Nakuru because of its remoteness from population centre and its great diversity of wildlife. Yet its attractive setting near Kilimanjaro and its key location on the major tour circuits make it one of the most heavily visited parks in East Africa. It is also an area which is pre-disposed to the impact of visitor vehicles because of its extreme salinity, flat topography, and open terrain. Complicating this natural susceptibility is the lack of planned development in terms of roads, lodge sites, and other development.

METHODOLOGIES

A number of different techniques were used to examine visitor use in Amboseli:

Entry and Exit Gate Information

On four to six days for each month between October, 1973, and April, 1974, information from entry and exit books at each of the three gates (Namanga, Kimana, and Leme Boti) was recorded. Vehicle registration numbers, entry and exit times, and several other pieces of information were collected. By matching vehicle registration numbers on entry and exit, useful information was obtained on the amount of use, length of stay, and the entry-exit pattern of visitor vehicles.

Observation Hill: Visitor/Vehicle Use

Because of the vehicular mode of visitor use, the pattern of visitor use on these same four to six days was established by making counts of vehicle use in each square kilometer and in each of the main management zones of the park. These observations were taken at ten minute intervals between 0630-1100 and 1530-1820 hours from an observation hill where nearly ninety percent of the park was visible. Official vehicle entry information and counts of vehicles in overnight parking lots were also recorded so that comparisons would allow a more accurate picture of vehicle use in the park to be developed.

Visitor Behaviour: Game Viewing Drives

To add insight into how individual visitors and vehicles used the park, different types of visitor vehicles, ranging

from those owned by large tour companies to privately-owned vehicles, were followed on game viewing drives in the park. Each activity of the vehicles, such as driving on and off the road, or stopping to view wildlife, was recorded together with its location and the time and mileage incurred. In addition, the opinions of visitors in these vehicles were solicited on several aspects of visitor management in Amboseli.

Nearly forty dry-season game drives were examined using this technique. Although a small sample, it was quite representative since the variation in game viewing drives was very much reduced as a result of an information network between rangers and drivers on the location of viewing attractions and because as few as a thousand tour company vehicles account for nearly three quarters of total annual vehicle entries.

Depreciative Behaviour: Vehicle Impact on Environment

The predators, especially the cheetah, may be useful indicators of the extent to which vehicle use is causing both ecological damage and a reduction in visitors' viewing enjoyment. Although both lion and cheetah are attractive to visitors, the cheetah is a better indicator because it is a diurnal hunter that appears to be sensitive to vehicle pressure. At one time Amboseli was one of the few places in East Africa where visitors had a reasonable expectation of seeing this increasingly rare species. Yet over the past few years there has been a significant decrease in the number of daily cheetah sightings in the park, and it is quite possible that vehicle pressure is partly responsible.

In an effort to measure these factors, cheetah activity was recorded on a rank-order activity scale at five minute intervals together with observations on vehicle numbers, lengths of stay, and the extent to which they harassed the cheetah. Several sets of observations were made on a focal animal in each of the three groups of cheetah frequently seen in the park during the study period.

RESULTS

Fluctuations in Visitor/Vehicle Use Patterns

From the planning and management point of view there are important temporal and spatial variations in visitor flows which need to be documented. The seasonal and monthly differences in vehicle entries, for example, are quite large over the course of a year. The 1973 and 1974 vehicle entries illustrated in Figure 1 show that the average monthly entries during the five wet-season months (April, May, June, November, December) were about a third less than entries during the dry-season months. The differences between individual months was even greater since vehicle entries in April and May were two-thirds less than entries in August or February.

There was also a difference in the vehicle entry rate on different days of the week (see Table 1). Entries were about 20% above the average on Saturdays and Sundays indicating a sizeable number of weekend-only visitors. The high number of visitors on Tuesdays was probably a function of airline and tour schedules.

Figure 1: Vehicle Entries by Season

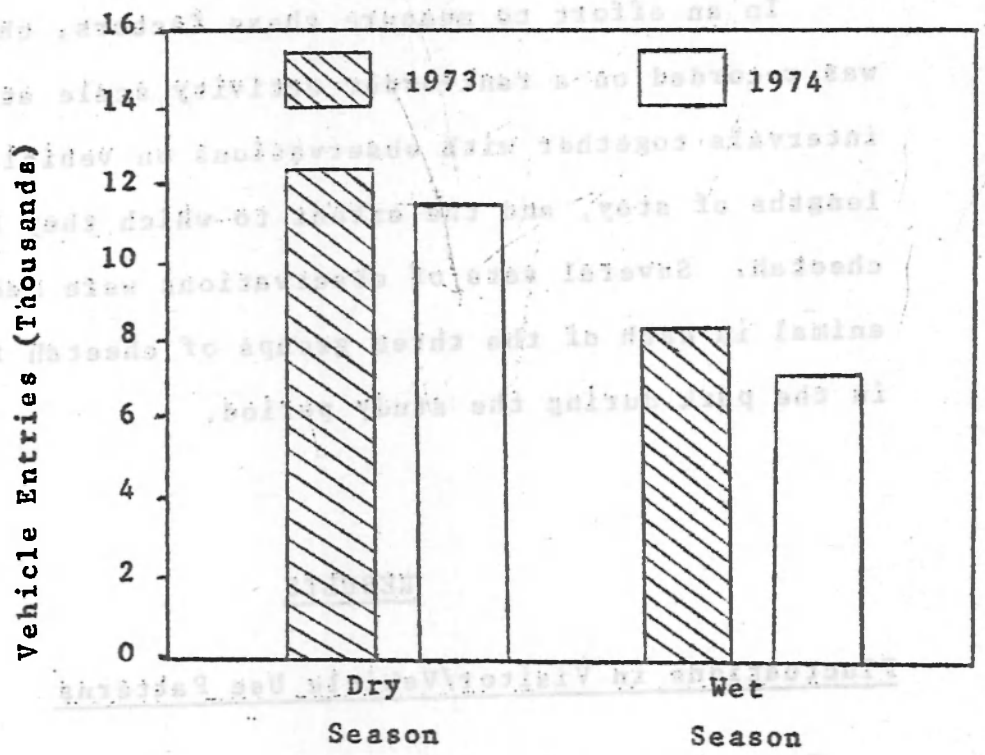


Table 1 Average vehicle entries per day

DAY	M	T	W	T	F	S	S
$\bar{X}$ ENTRIES	34	41	29	31	34	52	40

One of the most important variations in use resulted from the way in which the park was used on a daily basis. Vehicle counts from Observation Hill (Figure 2) indicated that there were three periods of intensive use (0630-0800, 0930-1100, and 1530-1815) which corresponded to the before-breakfast, after-breakfast, and afternoon game viewing drives. The bi-modal peak representing vehicle use in the park during morning hours resulted from a lack of distinct break between the two types of morning game viewing drives and from the substantial number of morning vehicle exits which tended to confuse the counts.

Figure 2 Vehicle Use Activity Pattern

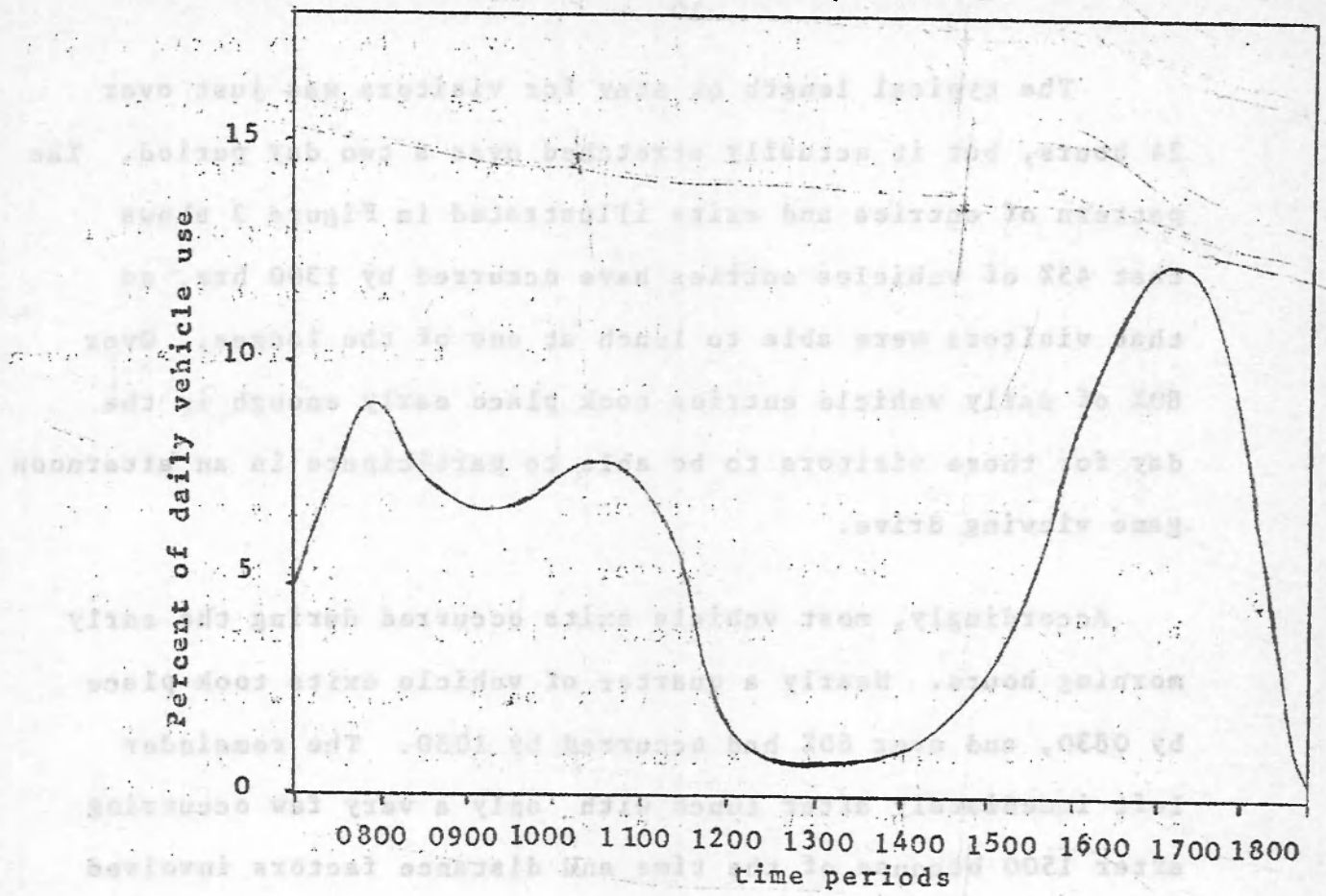
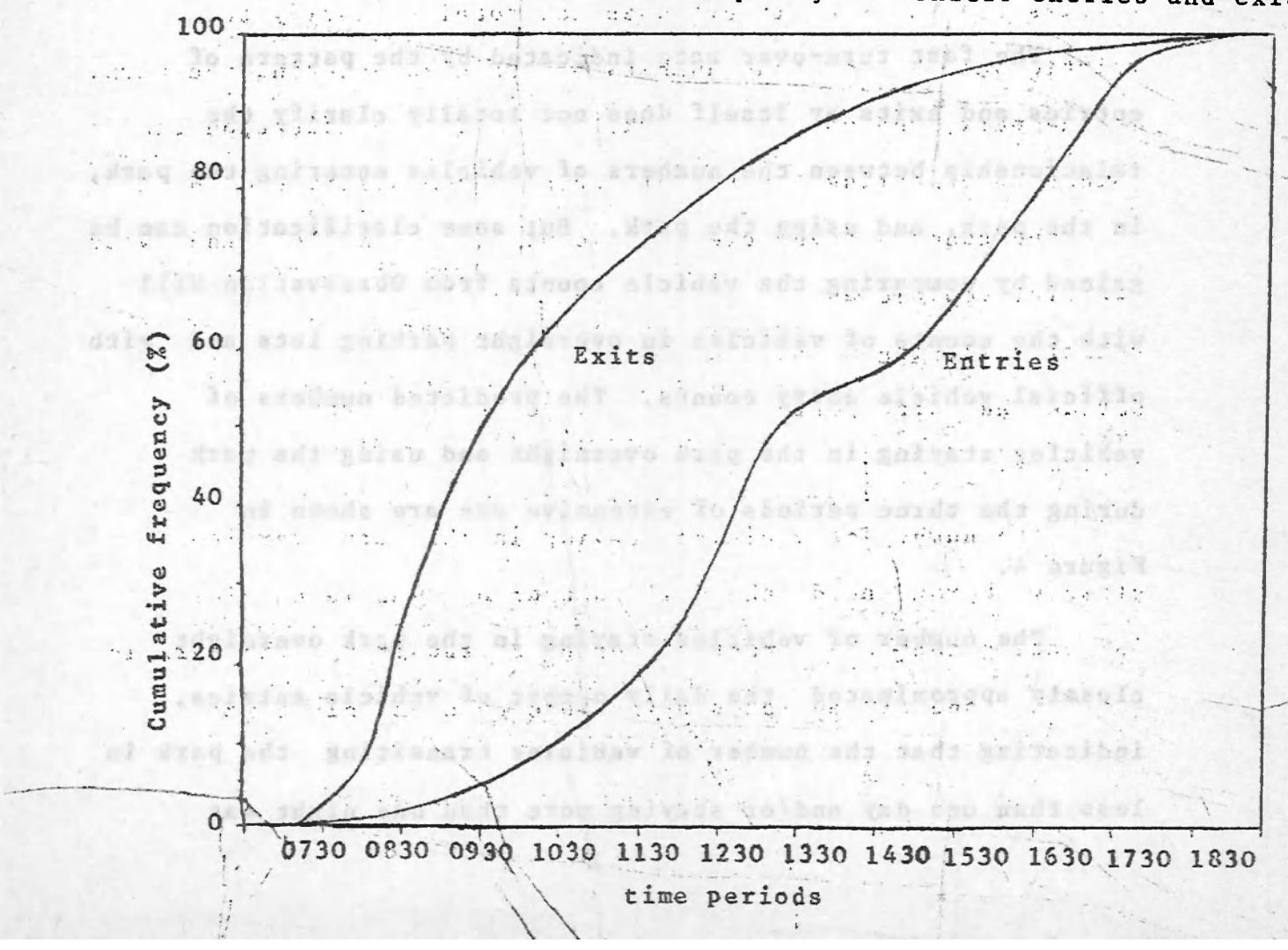


Figure 3 Cumulative frequency of vehicle entries and exits



The typical length of stay for visitors was just over 24 hours, but it actually stretched over a two day period. The pattern of entries and exits illustrated in Figure 3 shows that 45% of vehicles entries have occurred by 1300 hrs. so that visitors were able to lunch at one of the lodges. Over 80% of daily vehicle entries took place early enough in the day for those visitors to be able to participate in an afternoon game viewing drive.

Accordingly, most vehicle exits occurred during the early morning hours. Nearly a quarter of vehicle exits took place by 0830, and over 60% had occurred by 1030. The remainder left immediately after lunch with only a very few occurring after 1500 because of the time and distance factors involved in getting to the next destination.

The fast turn-over rate indicated by the pattern of entries and exits by itself does not totally clarify the relationship between the numbers of vehicles entering the park, in the park, and using the park. But some clarification can be gained by comparing the vehicle counts from Observation Hill with the counts of vehicles in overnight parking lots and with official vehicle entry counts. The predicted numbers of vehicles staying in the park overnight and using the park during the three periods of extensive use are shown in Figure 4.

The number of vehicles staying in the park overnight closely approximated the daily number of vehicle entries, indicating that the number of vehicles transiting the park in less than one day and/or staying more than one night was

Figure 4 Predicted vehicle use for Amboseli
(A=0630-0800, B=0930-1100, C=1530-1810, D=Overnight)

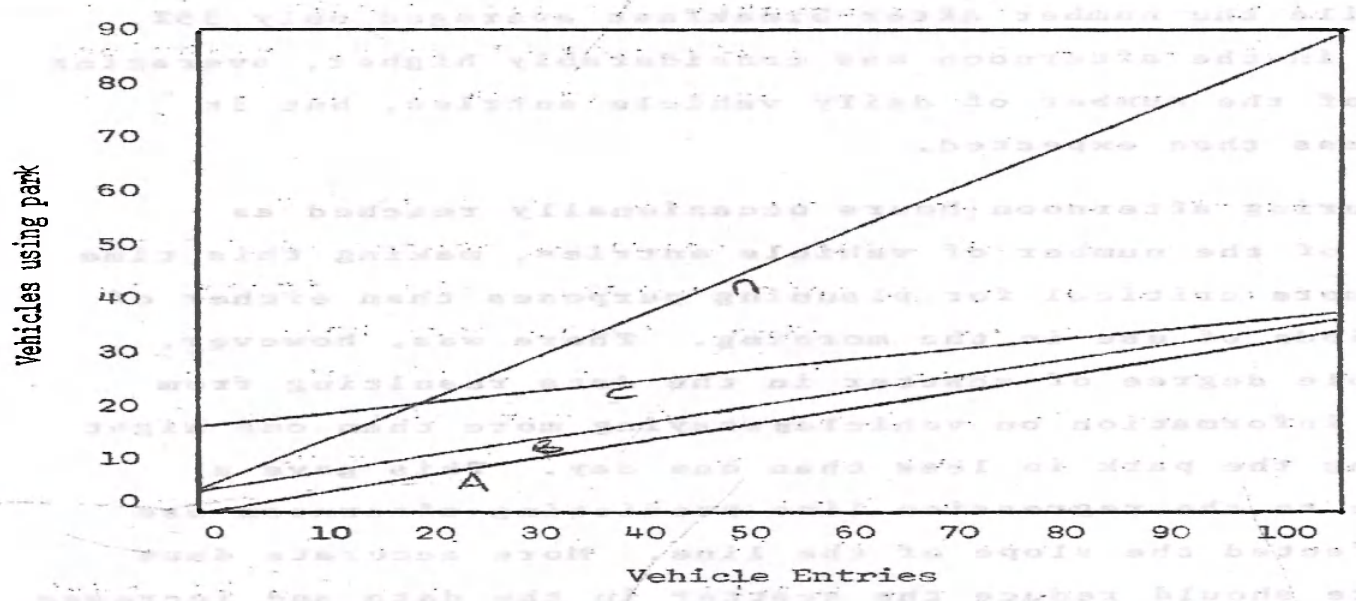
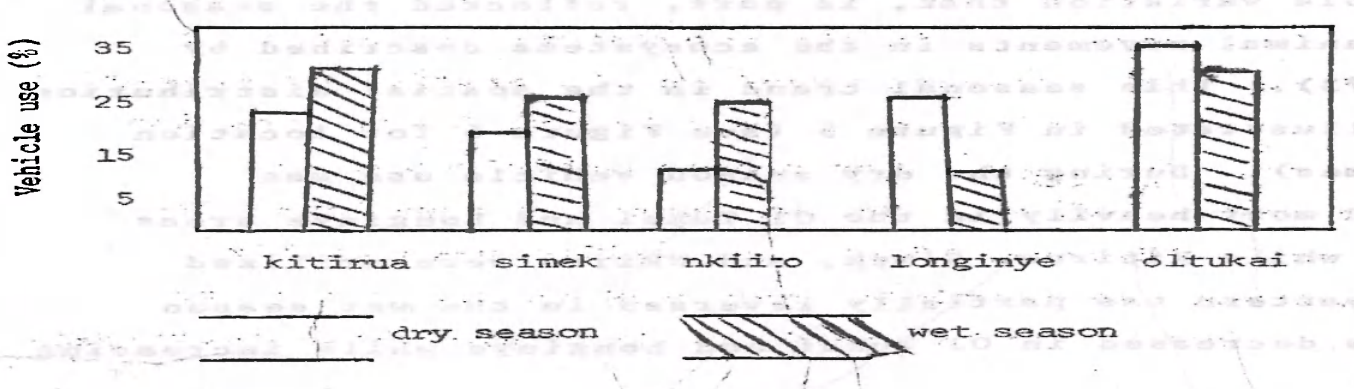


Figure 5 Vehicle use per management zone by season



probably not more than 5-10% of total use. However, vehicle use was very much less than expected during the three periods of peak use in the park. The number of vehicles using the park before breakfast averaged only 41% of the previous day's entries, while the number after breakfast averaged only 35%. Vehicle use in the afternoon was considerably higher, averaging nearly 60% of the number of daily vehicle entries, but it was still less than expected.

Use during afternoon hours occasionally reached as high as 80% of the number of vehicle entries, making this time period far more critical for planning purposes than either of the two periods of use in the morning. There was, however, a considerable degree of scatter in the data resulting from the lack of information on vehicles staying more than one night or transiting the park in less than one day. This gave a low r^2 value to the regression line predicting afternoon use and also affected the slope of the line. More accurate data in the future should reduce the scatter in the data and increase the slope of the regression line.

The spatial distribution of vehicle use in Amboseli showed a considerable variation that, in part, reflected the seasonal pattern of animal movements in the ecosystems described by Western (1973). This seasonal trend in the spatial distribution of use is illustrated in Figure 5 (see Figure 6 for location of place names). During the dry season vehicle use was concentrated most heavily in the Ol Tukai and Longinye areas of the park while Kitirua, Simek, and Nkiito were utilized less. The pattern was partially reversed in the wet season when use was decreased in Ol Tukai and Longinye while increasing

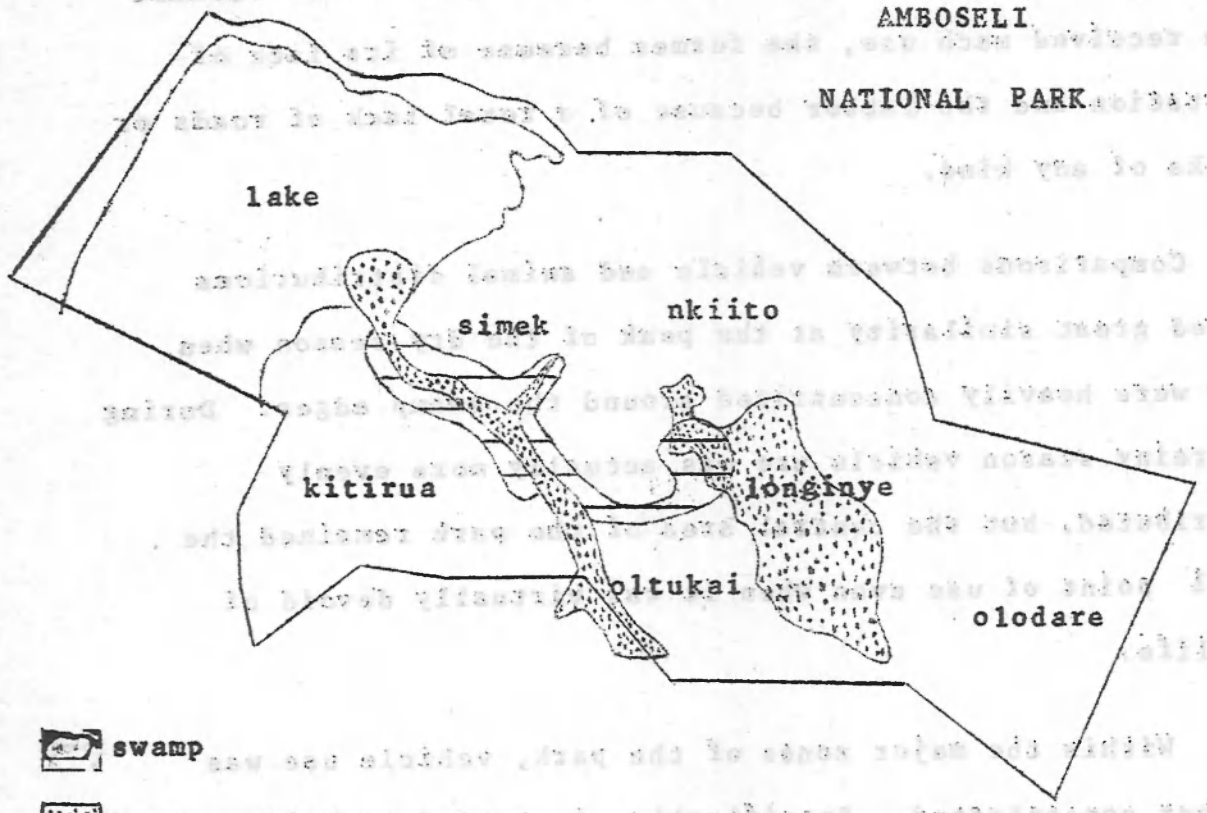
in the other three areas. Neither the dry lake nor Olodare area received much use, the former because of its lack of vegetation and the latter because of a total lack of roads or tracks of any kind.

Comparisons between vehicle and animal distributions showed great similarity at the peak of the dry season when both were heavily concentrated around the swamp edges. During the rainy season vehicle use was actually more evenly distributed, but the central area of the park remained the focal point of use even when it was virtually devoid of wildlife.

Within the major zones of the park, vehicle use was further concentrated. Specifically, it tended to be restricted to the edges of the two major swamps (Longinye and Enkongo Narok) and the wooded edge of Ol Tukai. This zone of concentration, illustrated in Figure 6 amounted to very little more than thirty square kilometers or about 10% of of the area of the National Park.

The concentration of vehicles both among the major zones of the park and within each of these areas was however, more than just a seasonal phenomena. It was rather, a predator-specific pattern of use, related in part to the herbivore migrations, but varying slightly. Concentrations of three or more vehicles and the cause of these concentrations were part of the information recorded during Observation Hill counts. An average of 12 concentrations were observed on each sample day with an average of 5.3 vehicles per group. Although it was often

Figure 6 Spatial concentration of vehicle use



not possible to verify first-hand the cause of many of these groupings, rangers and tourists later identified lion and cheetah as the cause of at least 75% of them.

Visitor Behaviour: Game Viewing Drives

Visitor game viewing drives in Amboseli averaged nearly two hours in length, the early morning drive being somewhat shorter and the afternoon drive being longer. The average mileage was 32.5 Km per game drive of which 5 Km was driven off-road. Each vehicle normally took two such game drives while in the park.

There was very little difference in viewing activities of the different types of vehicles that were followed. The few differences that did exist were largerly a function of visitors time constraints or a lack of information. Visitors on tented safaris who stayed in Amboseli three times longer than other visitors were under no time constraints, and the pace and tone of their viewing was more relaxed. In contrast, visitors in chauffered safari company vehicles who had much shorter lengths of stay spent much more time and mileage game viewing as drivers tried to maximize viewing success during the short time available to them in the park.

Visitors in privately-owned and rented vehicles showed the greatest degree of variability in their viewing activities. This was in part, the result of their lack of information on the park since maps and guide books were virtually non-existent and few took ranger-guides with them. The more inexperienced did not know where or how to look for wildlife.

On game viewing drives visitors spent 60% of their time driving and only 40% on viewing the various attractions in the park. The allocation of viewing time to different attractions is illustrated in Figure 7. Lion was by far the most popular, although cheetah, elephant, and rhino were strong secondary favorites. Over 70% of visitor viewing was spent on only six attractions -- lion, cheetah, elephant, rhino, Observation Hill, and giraffe. Other viewing attractions rated little more than a quick stop for photographic purposes.

Lion and cheetah were, in fact, the two species that visitors most frequently said they wanted to see in Amboseli. Kilimanjaro

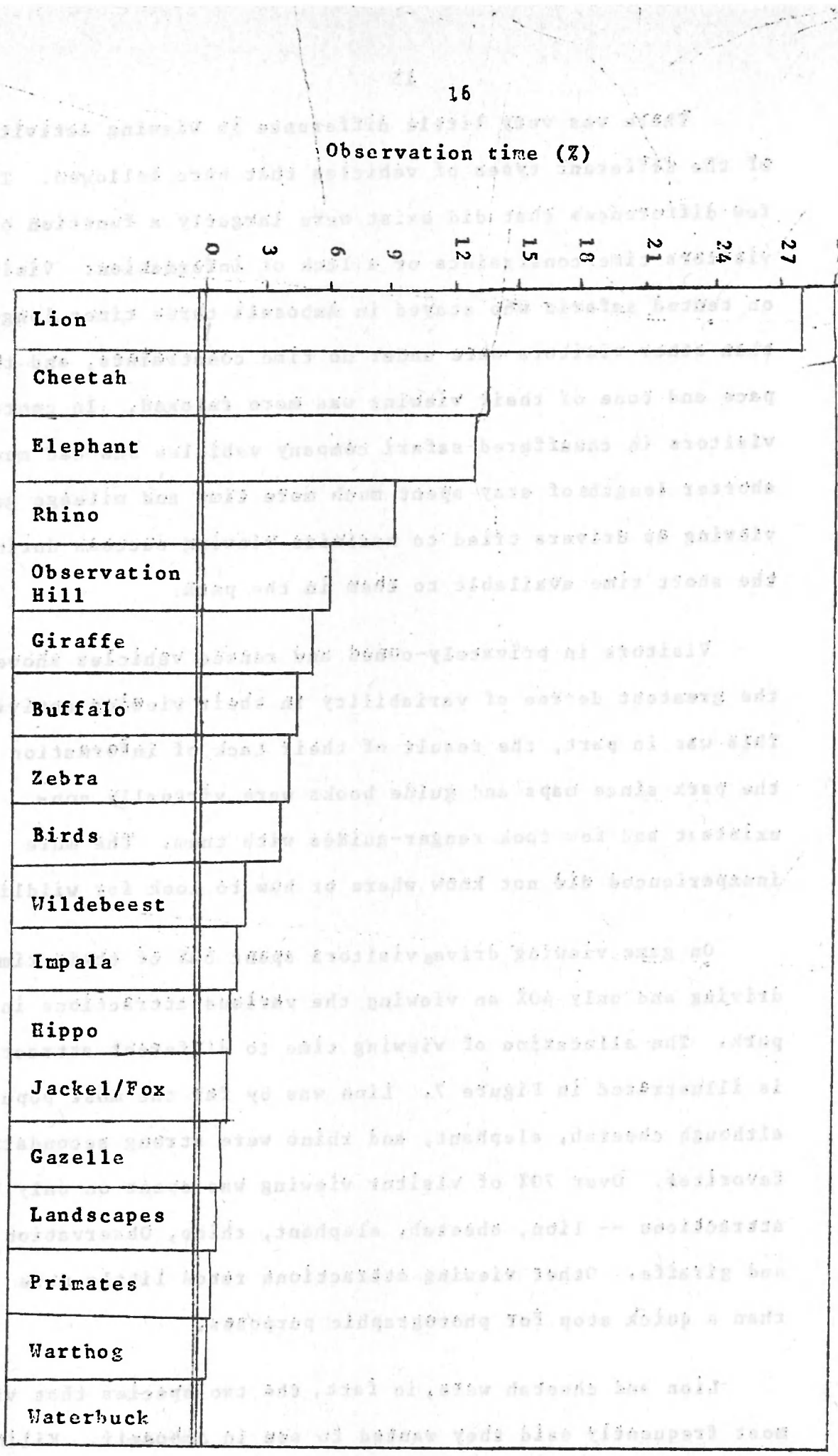


Figure 7 Allocation of visitor viewing time to park attractions

was of some interest, but as a photographic backdrop only.

Visitors indicated that information made a very important contribution to their enjoyment of visiting a park, adding that it was very inadequate for Amboseli. In the same vein, they also added that their driver's skill played an important role in contributing to their enjoyment. While not differentiating drivers on the basis of their skill, this did illustrate that a majority of visitors are quite dependent on their drivers for the quality of their experience in East Africa.

The quality of roads travelled was a marginal concern to most visitors, but they strongly indicated that they preferred to see unimproved road surfaces within the park. "Improved" carried the connotation of road systems seen in North American and South African parks, and they did not want to see these in Amboseli. Naturalness, they emphasized, was the most important quality of a park and shouldn't be impaired by the addition of a lot of improved roads. The response was, essentially, a reaction against over development and commercialization of the park.

Visitor response was almost equally split on the issue of a prohibition of off-road driving. Provided that they were allowed off-road to approach predators which were located some distance from the road, just over half the visitors said they had no objection to the basic restriction. Only 20% of the visitors had serious objections, and it was interesting that most of these visitors were on package tours that spent a very short time in Amboseli. The possibility of missing rare or unusual photographic opportunities was a very important consideration in visitors' response.

The importance of information was again evident when visitors said that they would be willing to pay an average of 25 shillings for an interpretive guide who could supply more detailed information on the park and the wildlife. This was more than twice the rate guides were paid at that time.

Depreciative Behaviour: Vehicle Impact on Environment

The full impact of vehicle use on Amboseli cannot be determined from the limited data that now exists, but there is ample room for concern. A conservative estimate of off-road driving in the park in 1974 is 150,000 Km (15,000 vehicles x 2 game viewing drives x 5 Km). Using a standard 15 cm tire track and assuming a 25% non-overlap of rear to front tires, off-road driving in 1974 could have resulted in nearly 60 Km^2 of tire tracks, an area of about 17% of the park. But since off-road driving is not equally distributed and the effects of superimposition of tracks is not known, this illustration will serve as a warning of the destructive potential of unregulated vehicle use.

Whatever the degree of damage being done by vehicles driving off-road, very little of it has any real justification. For a full 67% of the off-road driving done by the tourist vehicles which were followed in the course of this study there was no visible or apparent reason. It was simply aimless searching, cutting corners, or joy riding. Only 25% was done for lion or cheetah which were visible but located some distance off the road. All other viewing attractions combined accounted for the remaining few percent.

The contention that visitors are subjected to an inordinate degree of social interference while viewing predators is supported by study results. Visitors typically spent six to eight minutes viewing cheetah, and in the process half of them experienced concentrations of 6 or more vehicles (Figures 8 and 9). This is a telling statistic since photography becomes difficult after more than four vehicles are present.

Visitor lengths of stay for viewing cheetah were analyzed in relation to the density of vehicles which visitors experienced while doing this viewing, and for visitors in self-drive vehicles there was a density-dependent pattern of viewing. The pattern of a decreasing length of stay in respect to increasing density is illustrated in Figure 10. The slightly shorter lengths of stay at lower densities may be accounted for by either a social attraction factor or the fact that photography is easier and quicker at lower vehicle densities. But in either case, social interference became a more significant factor as density increased. Results did not show the same pattern for visitors in chauffered tour buses, so presumably it was masked by the presence of professional drivers, differences in the nationality and residence of the visitors, and differences in length of stay in Amboseli.

A density of 5-6 vehicles would appear to be a critical inflection point on the graph since length of stay steadily decreased after that density. It would appear that 50% of the visitors to Amboseli are already exposed to a level of social interference that may reduce their enjoyment of visiting the park.

The same data suggested that vehicle density had an effect on the activity pattern of these cheetah (Figures 11 and 12) which were observed in the central viewing area of the park between 0700 and 1100 hours or between 1500 and 1900 hours. Hunting, which comprised nearly a quarter of cheetah activity at low densities, ceased after densities of 6-7 vehicles were reached, and intensive or active hunting ceased after densities of only 2-3 vehicles. With eight or more vehicles present, cheetah had only two reactions -- lie down and out-wait their viewers, or try to walk away from them. The latter reaction made the situation worse since this was exactly what tourist with movie cameras had been hoping for.

These cheetah appeared to exhibit a rather different activity pattern from those observed by McLaughlin (1970) in Nairobi National Park. The cheetah he observed were more active and usually hunted between 0600 and 1000 hours. A less active or intensive hunting occurred through the hot mid-portion of the day interspersed with sleeping and resting. Activity picked up in the late afternoon and lasted until 1900 hrs. On the basis of this activity pattern, cheetah in Amboseli could have been expected to spend most of their time hunting during the periods that they were under observation. But in actual fact, over 80% of their time was spent inactive.

The cumulative frequency of vehicle avoidance behaviour graphed in Figure 12 showsit to be definitely related to an increasing vehicle density. But it can only be part of the explanation since 80% of this behaviour had occurred at densities of eight or less vehicles. Intended or unintended

Figure 8 Cumulative frequency (%) of visitors' length of stay for viewing cheetah

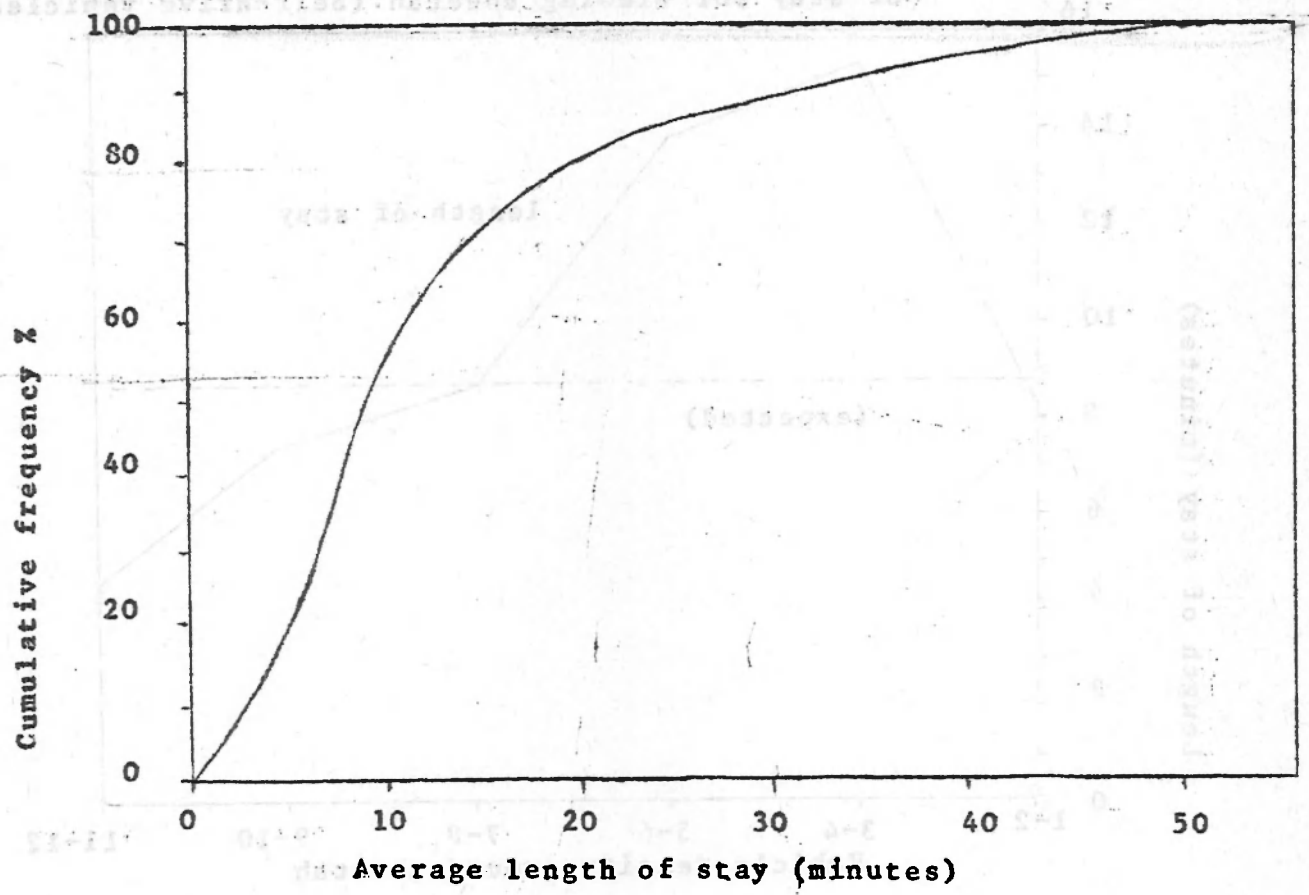


Figure 9 Cumulative frequency (%) of the size of vehicle concentration experienced by visitors while viewing cheetah in Amboseli Park

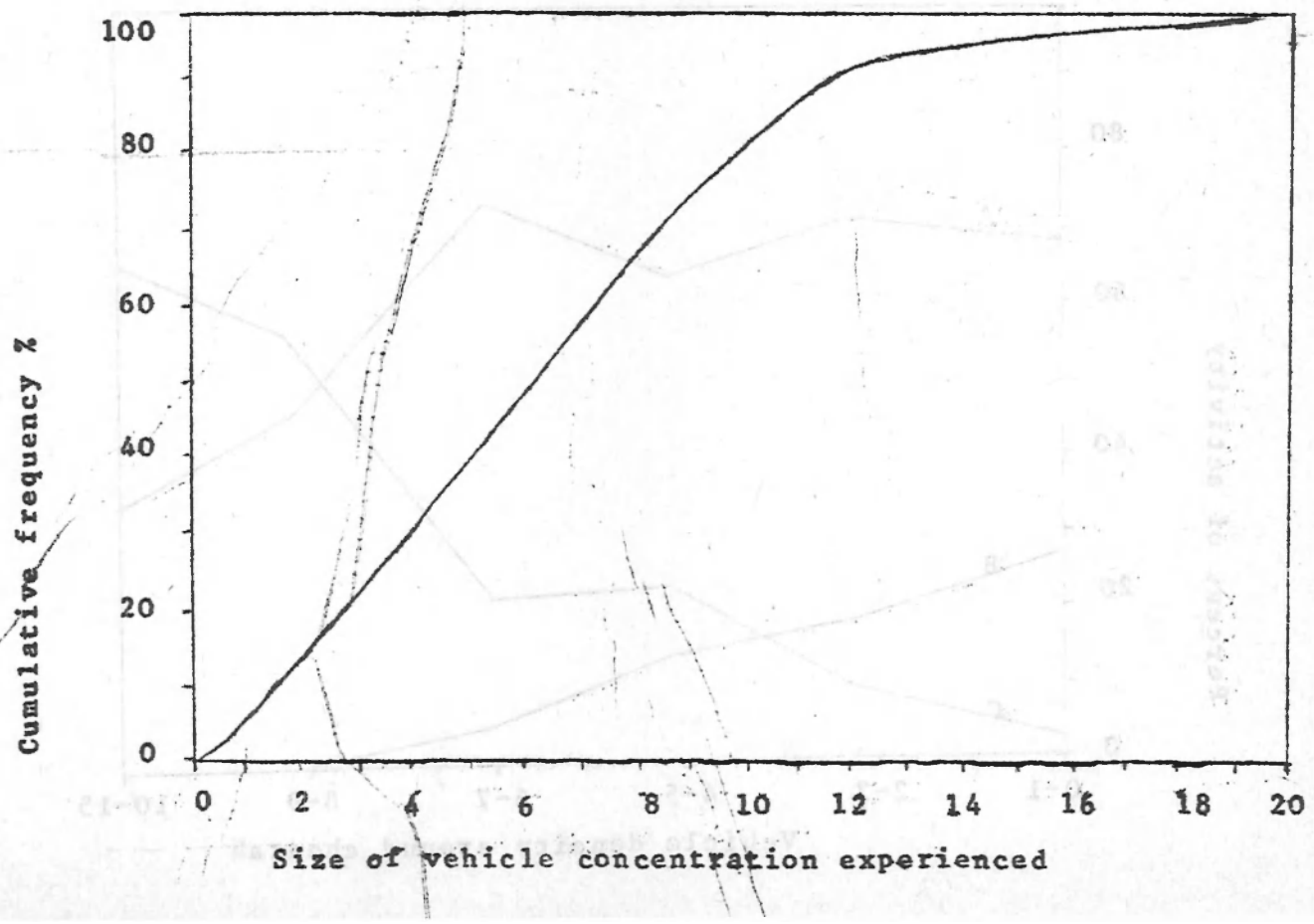


Figure 11 Effect of vehicle density on the activity pattern of cheetah in Amboseli. (A=low activity, B=high activity-hunting, C=vehicle avoidance)

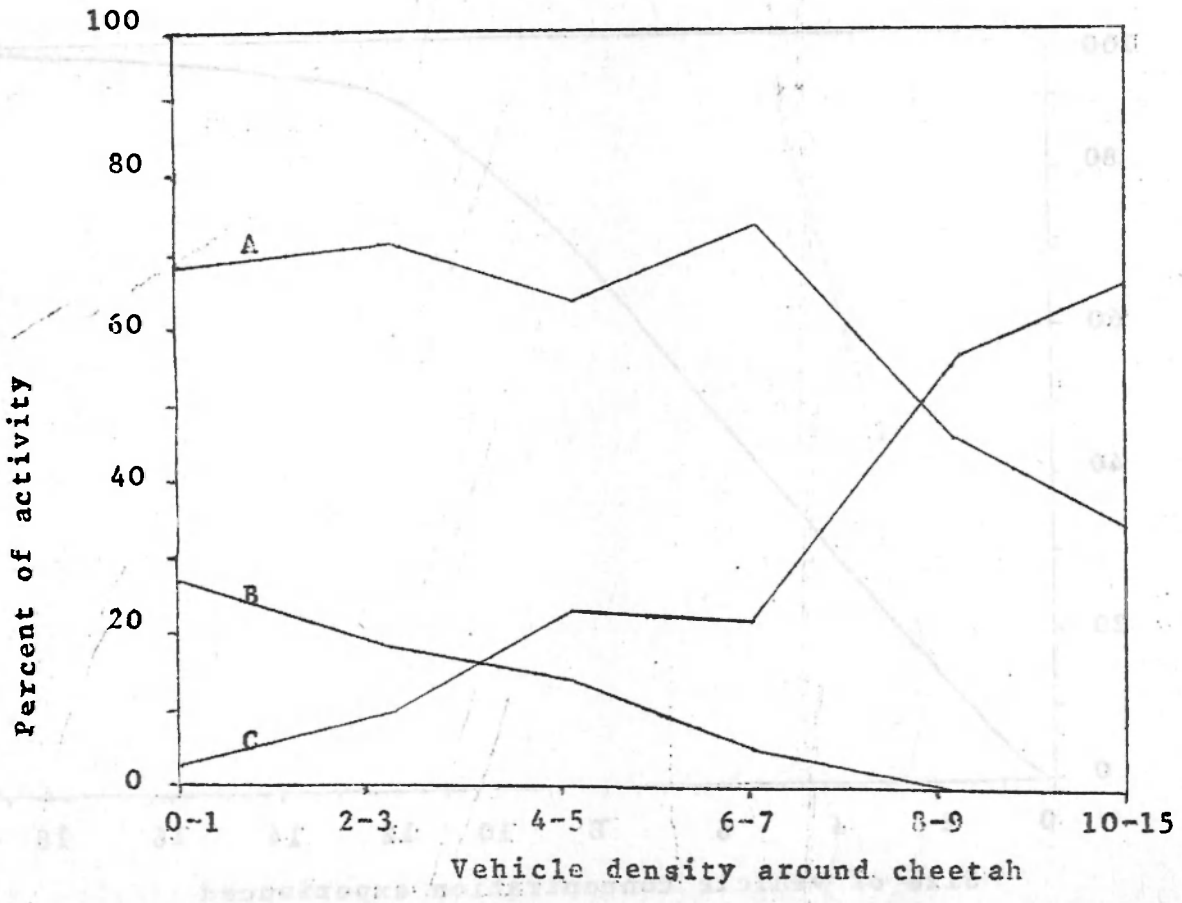


Figure 10 Effect of vehicle density on visitors' length of stay for viewing cheetah (Self-drive vehicles)

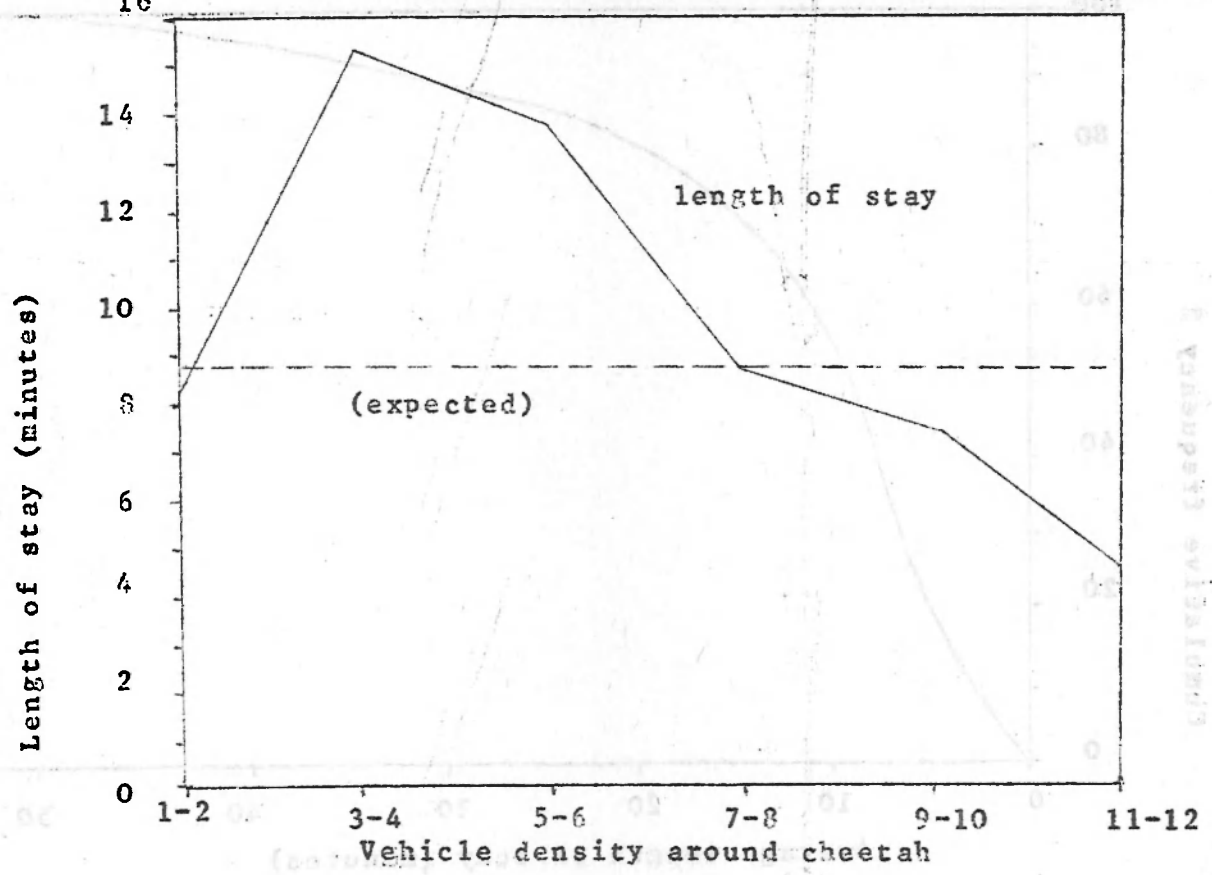


Figure 12 Cumulative frequency (%) of vehicle avoidance behaviour of cheetah

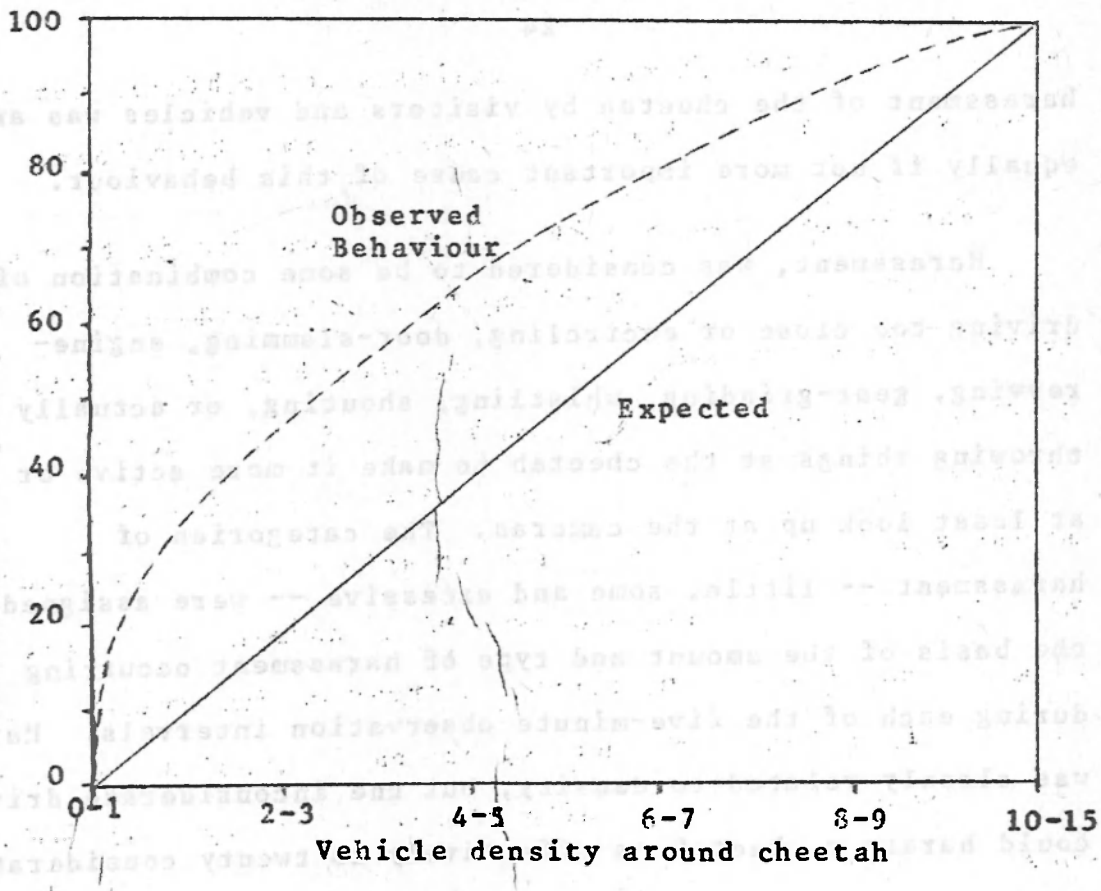
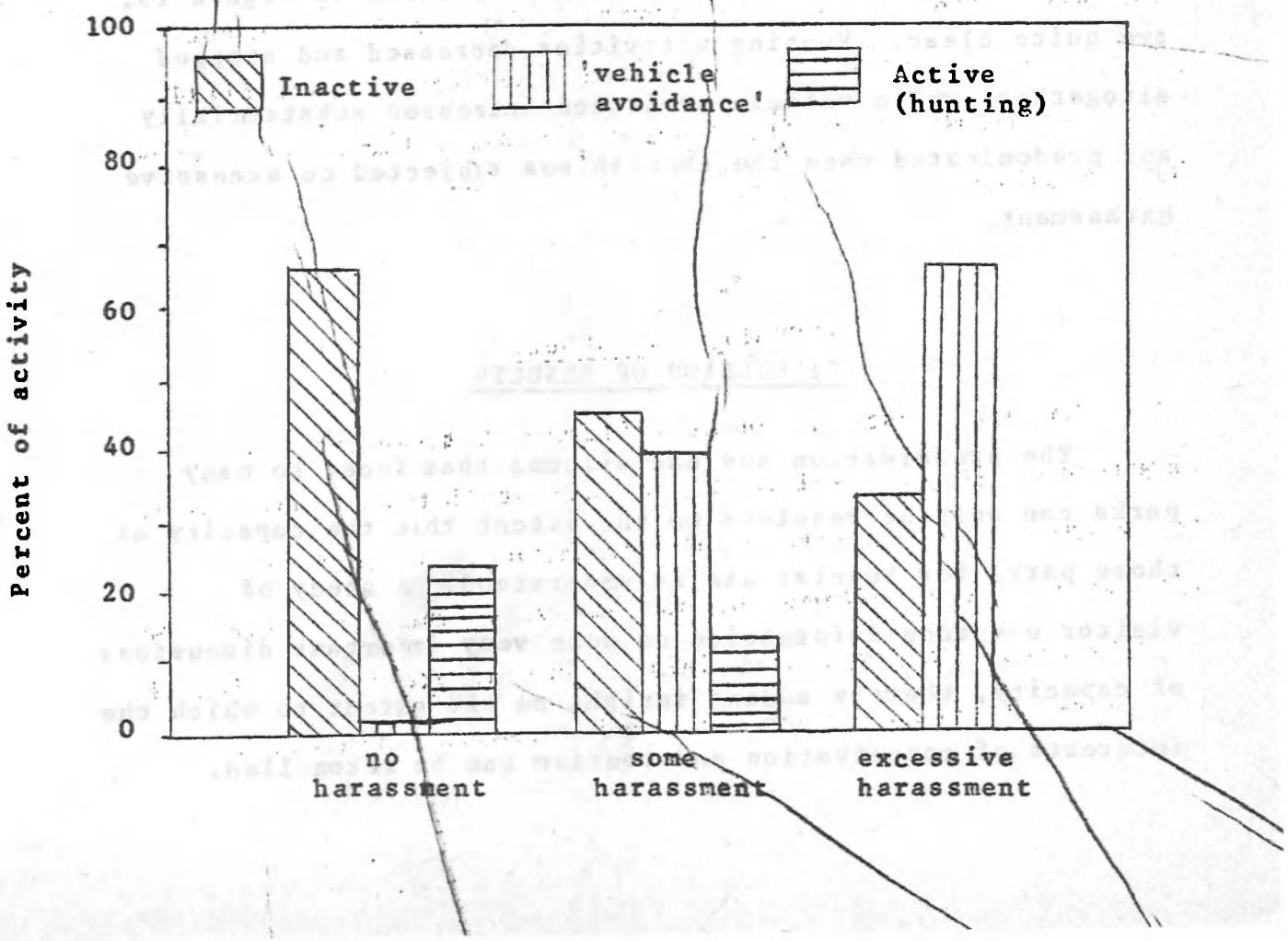


Figure 13 Effect of vehicle harassment on cheetah activity pattern



harassment of the cheetah by visitors and vehicles was an equally if not more important cause of this behaviour.

Harassment, was considered to be some combination of driving too close or encircling, door-slamming, engine-revving, gear-grinding, whistling, shouting, or actually throwing things at the cheetah to make it more active or at least look up at the cameras. The categories of harassment -- little, some and excessive -- were assigned on the basis of the amount and type of harassment occurring during each of the five-minute observation intervals. Harassment was closely related to density, but one inconsiderate driver could harass a cheetah as effectively as twenty considerate ones.

The effects of vehicle harassment, shown in Figure 13, are quite clear. Hunting activities decreased and stopped altogether, while vehicle avoidance increased substantially and predominated when the cheetah was subjected to excessive harassment.

DISCUSSION OF RESULTS

The preservation and use dilemma that faces so many parks can only be resolved to the extent that the capacity of those parks for tourist use is understood. A study of visitor use adds information on some very important dimensions of capacity, thereby adding insight on the extent to which the interests of conservation and tourism can be reconciled.

The seasonal, monthly, and weekly fluctuations in vehicle entry rates cannot be considered as serious problems at the present time, but they do contribute to other park problems and will make a very big difference in the capacity of the park for tourist use. As such, they need to be reduced. The pricing mechanism, whose use has been advocated in this situation (Western and Thresher, 1973) is probably the one management tool that will be really effective in adjusting these fluctuations.

The rainy season with its attendant problems of impassable roads and animal migrations which make visitor viewing success quite poor, is one of the primary causes of the fluctuations. But heavy dry season use and low wet season use need not be a fixed pattern. In Development Plans for Amboseli, Western and Thresher (1973) have argued for the extension of visitor viewing into the wet-season concentration areas on Masai group ranches adjoining the park. The importance of such arrangements has also been recognized in the sessional paper accompanying the 1976 Wildlife Management Bill, and this is significant since much of the future growth of tourism will depend on this type of arrangement.

Because of the comparatively longer time and mileage spent in game viewing by visitors to Amboseli, it may justifiably be called the second most heavily used park in Kenya. Visitor use in Amboseli far exceeds visitor use of Nakuru Park and even approaches that of the very heavily visited Nairobi Park (See Lee, 1973). Despite this use, results of this study suggest that the park is not nearly as heavily used as it might be. The number of vehicles

using the park for game viewing at any point in the day is considerably less than the number of daily vehicle entries or even the number of vehicles that are in the park. Even with the current fluctuations in tourist flows, the maximum vehicle use at any given time will not exceed sixty to eighty percent of the number of daily vehicle entries. Because of the implications of this, it is an aspect of use that needs to be more accurately verified and monitored over a long time period.

The poor spatial distribution of use is a more immediate problem which will be a very important limiting factor on visitor capacity. In addition to spreading visitor use into wet-season concentration areas on Maasai group ranches, it will be necessary to attain a more equitable distribution of vehicle use within the park. Figure 14 illustrates the discrepancy between the distributions of animals (Western, 1973) and vehicles in the park at the present time. Much of this problem is related to the easy wildlife viewing along the edges of the swamps and close to the lodges. If the location of one cheetah or one group of lions is known, no driver will search any further since viewing success is guaranteed.

To change this pattern will be exceedingly difficult. The concepts of zoning and one-way circuits suggested in Road Development Plans for Amboseli (Western, 1974) may have their desired effect in dissipating vehicle use, reducing vehicle concentrations and impacts on the environment, and even in increasing visitor viewing success, but present patterns of use emphasize the need to test these concepts as soon as possible. A small scale test preceeding full scale

implementation would ensure the best use of resources from both the conservationist's and the investor's point of view.

But an effective road system is not the entire answer to Amboseli's problems. In particular, the emphasis which visitors appear to place on seeing lion and cheetah to the exclusion of virtually everything else will not be that much affected by good road design. It would, therefore, be valuable to know if this pattern of use is the result of actual visitor demand or simply a lack of information on other animals and viewing attractions. More than any other single aspect of use, this will probably be the most important determining factor of Amboseli's capacity for tourist use.

If the provision of more information on the park and its diversity of wildlife can substantially alter the pattern of visitor wildlife viewing, there is sufficient justification for training the force of interpretative guides that has been proposed in the development plans (Western and Thresher, 1973). In addition to reducing the pressure on predators, such a force would have several other valuable side effects. It would be a way of ensuring that visitors had a more satisfying and enriching experience, a way of promoting tourism and Kenya's national image. Because a visit to parks and reserves is very much an educational experience, there should be Kenyans who can make it a really high quality experience.

In a practical sense, these guides would be a management force in position to prevent specific abuses such as off-road driving, harassment of cheetah, etc. It would cost the park nothing to field this force, and visitors have expressed the willingness to pay for this type of guide.

The issue of off-road driving is a complex one. A better road system will reduce the need for off-road driving, but will not eliminate it since wildlife is not likely to stay within instamatic camera range of roads. There is an urgent need to find out the levels of impact on vegetation and soils for different amounts of use so that management decision-making will be possible. A total prohibition would be one solution, but considering the reasons for the occurance of off-road driving and the cost of enforcing the prohibition, a total ban on this type of use may not prove to be necessary.

Even less is known about the closely related problem of dust emission by vehicles, but it may well be proved that the powdery dust has a negative affect on older tourists as well as on the photosynthetic efficiency of vegetation in the park.

The results of this study suggest that the concentrations of vehicles around predators is the problem that most needs a solution. Like its effect on the distribution of vehicle use, the most direct effects of concentrations on visitors and predators need to be remedied. Figure 15 illustrates what may happen to visitors and cheetah if the same pattern of use persists along with increasing visitor numbers. With only a hundred vehicles using the park, visitors would be experiencing an average concentration of 12 vehicles as they viewed the cheetah, the cheetah would have to attempt hunting with an average of more than 3 vehicles present, and visitor and cheetah alike would suffer momentary concentrations of 30 or more vehicles. It is doubtful whether visitors or cheetah would tolerate this situation, and so it would seem likely that social interference and environmental damage will act to check the growth of

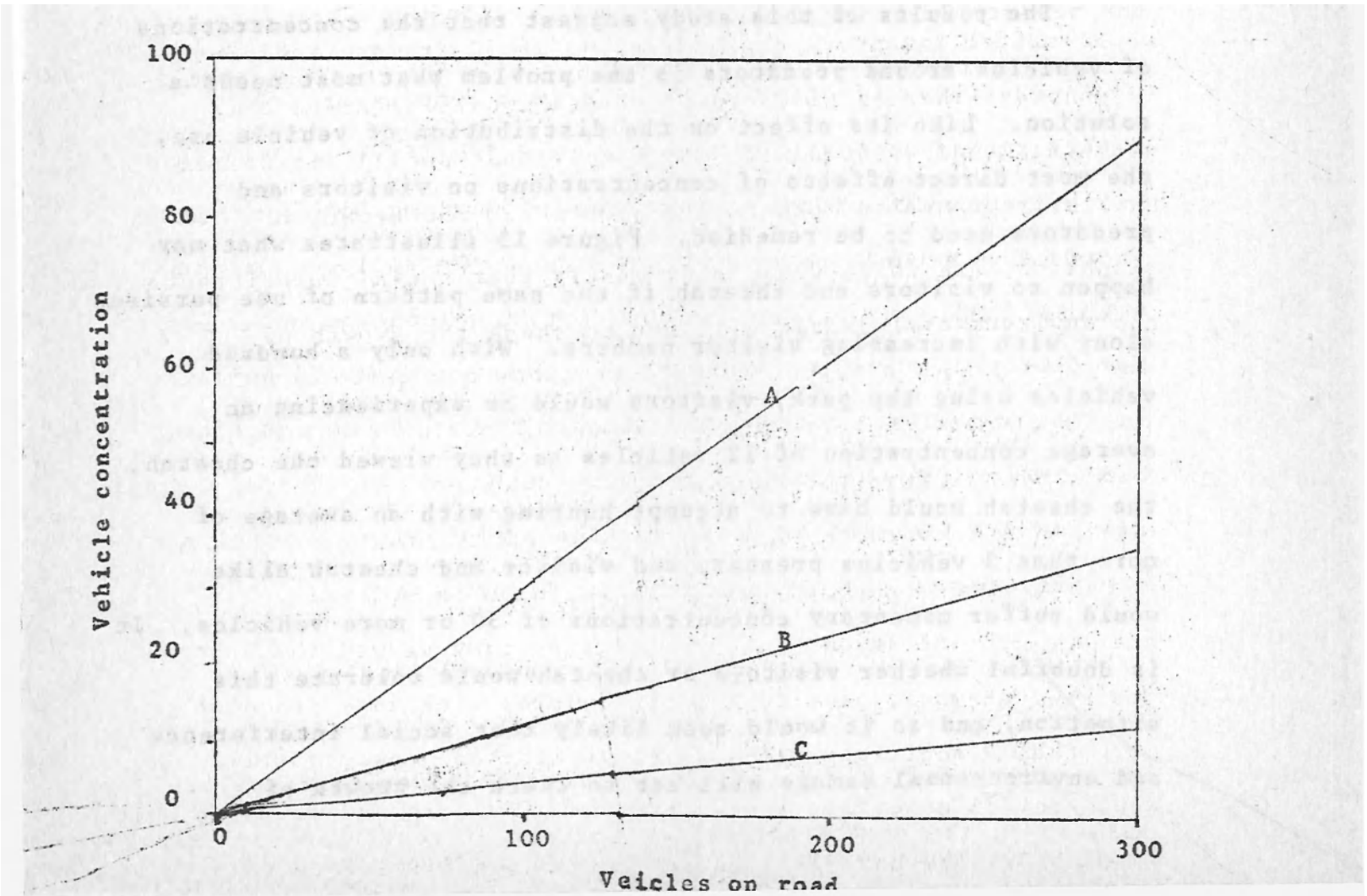

100
80
60
40
20
0
Vehicle concentration
A
B
C
0
100
200
300
Veicles on road

Figure 14 Cumulative frequency distribution of animal and vehicle distribution in Amboseli

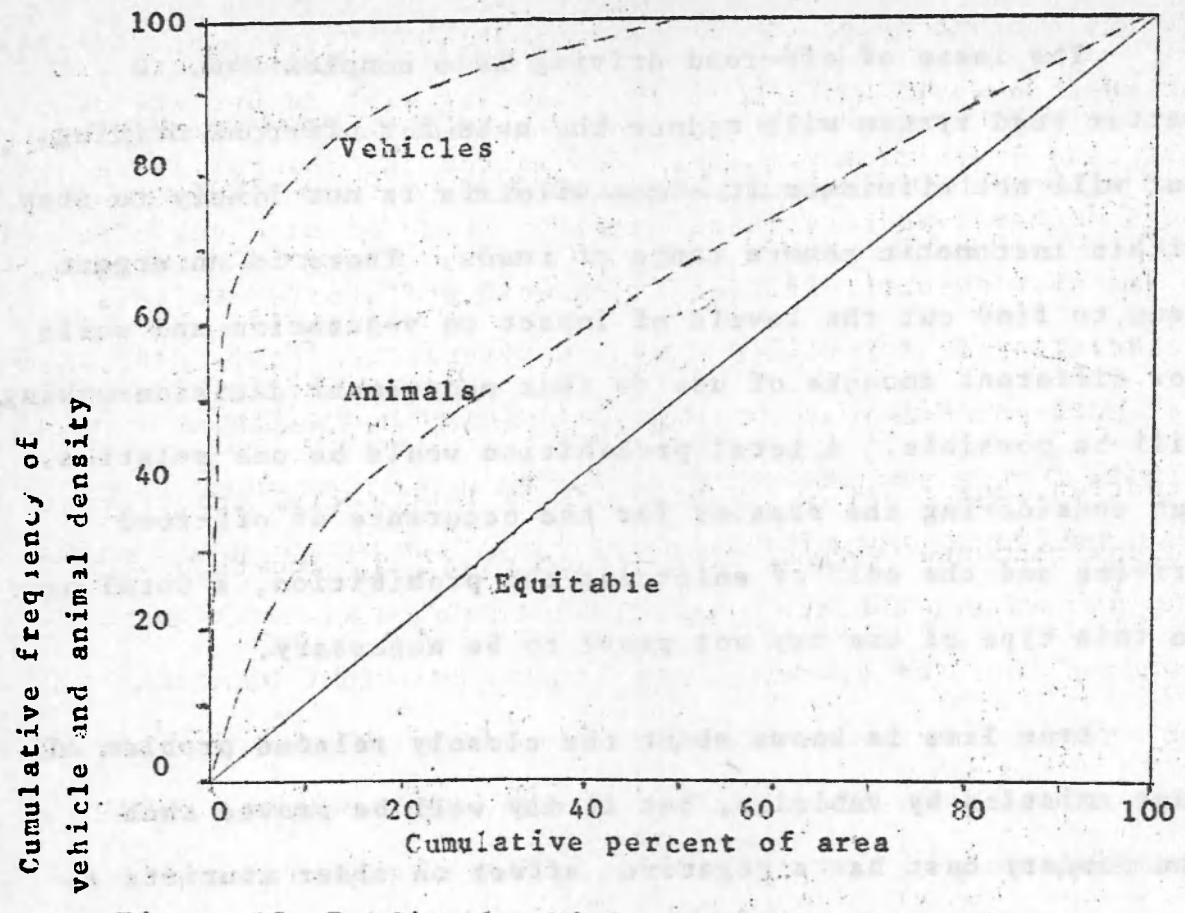


Figure 15 Predicted vehicle concentrations A= peak concentration experienced by visitors and cheetah, B=average concentration experienced by visitor, and C=average concentration experienced by cheetah.

tourism should present management conditions continue to prevail.

The density-dependent viewing pattern of visitors in self-drive vehicles may also be predictive of future events, but since its seriousness cannot be evaluated without more detailed information on visitors, its present usefulness is in spurring a search for solutions to the problem.

The decrease in the number and frequency of cheetah sightings in the central viewing area of the park should be alarming to both conservationists and the tourist industry. The presence of an average of 2 vehicles around cheetah during the entire period of observation is indicative of the pressure these diurnal hunters are subjected to. If, as the results of this study suggest, the cheetah's activity pattern, especially hunting, is adversely affected by increasing vehicle use, the problem is in even more urgent need of solution.

The harassment of cheetah is avoidable, but it will be difficult to counteract owing to a seemingly total ignorance of cheetah behaviour by visitors, drivers, and rangers alike. It is indeed unfortunate and ironic that visitors who would very much like to see a cheetah hunt are prevented from doing so by their own behaviour, while cheetah are harassed and may have their opportunities to hunt curtailed in an area set aside for their protection.

Some added insight on the problem can be gained by considering the viewing pattern of visitors watching for cheetah on an afternoon in February, 1974. The pattern is

graphically illustrated in Figure 16. Over seventy vehicles stopped to view the cheetah on that afternoon when the total number of vehicle entries was only between sixty and seventy. This high usage means that every vehicle using the park on that afternoon stopped to view the cheetah and some even came twice. The number of vehicles present, recorded at five minute intervals, shows that the highest single count was 20 vehicles, a concentration rate of about 30% of vehicle entries. As a percentage of vehicles actually using the park during this time period, this rate could actually be as high as 50%. However, this high concentration lasted only a small percentage of the time, and during the remainder of the time the rate was little more than 5%. The concentration rate during pre and post peak viewing times (before 1600 hrs and after 1730 hrs) was even lower as is illustrated in Figure 17.

It is clear that effective management intervention could easily reduce those peak periods of use and produce a low vehicle concentration rate around the cheetah. What is not so clear is whether this would enable the cheetah to resume a more normal pattern of activity. More information will be needed before it can be decided whether a low concentration rate over a long period is better or worse than a high concentration rate over a short period of time. In addition, some type of spatial zonation may be needed around the cheetah to negate the harassment factor. As with the problem of off-road driving, this is a situation where the interests of conservation must take precedence over the interests of tourism.

Figure 16 Numbers of visitor vehicles viewing cheetah

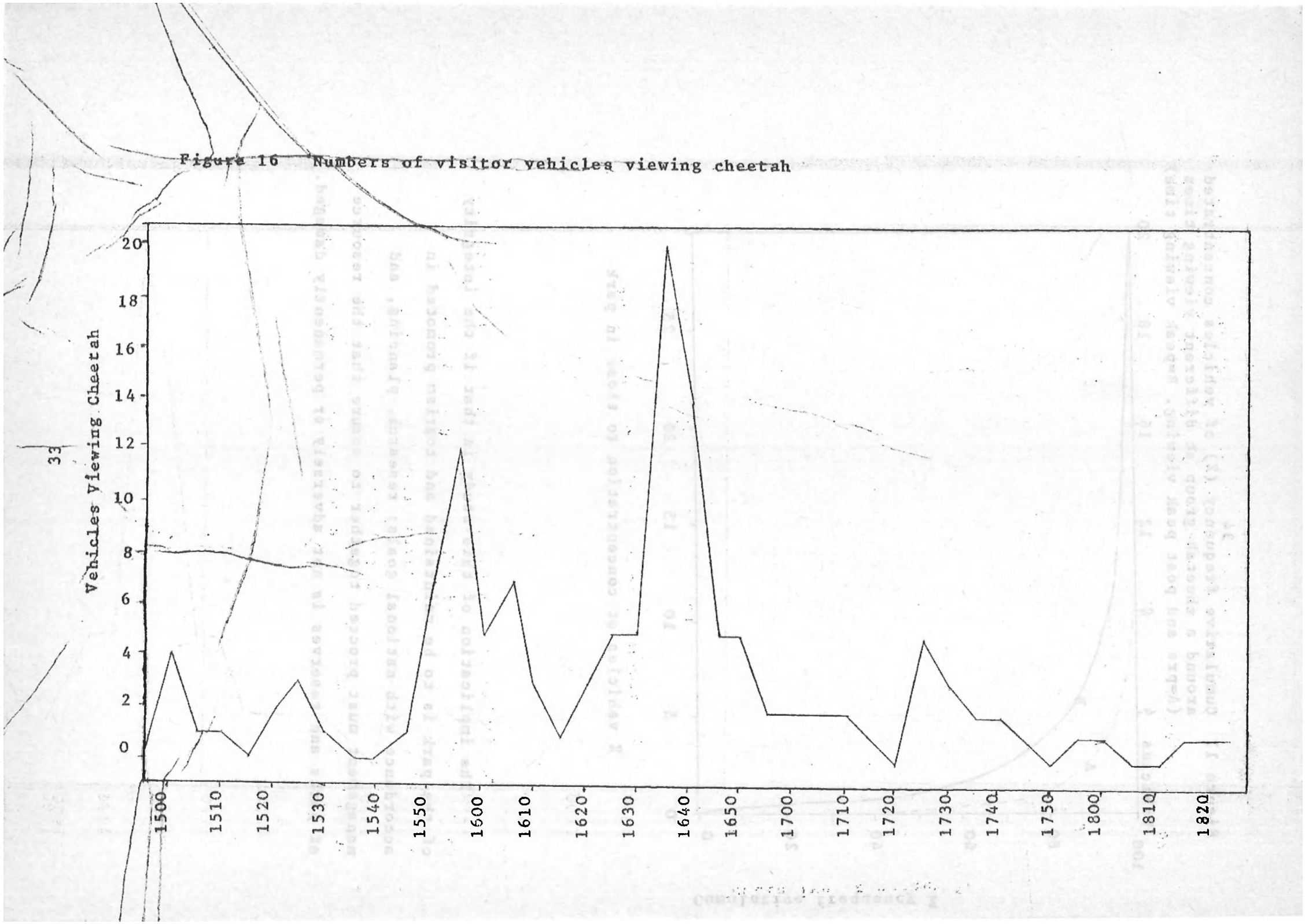
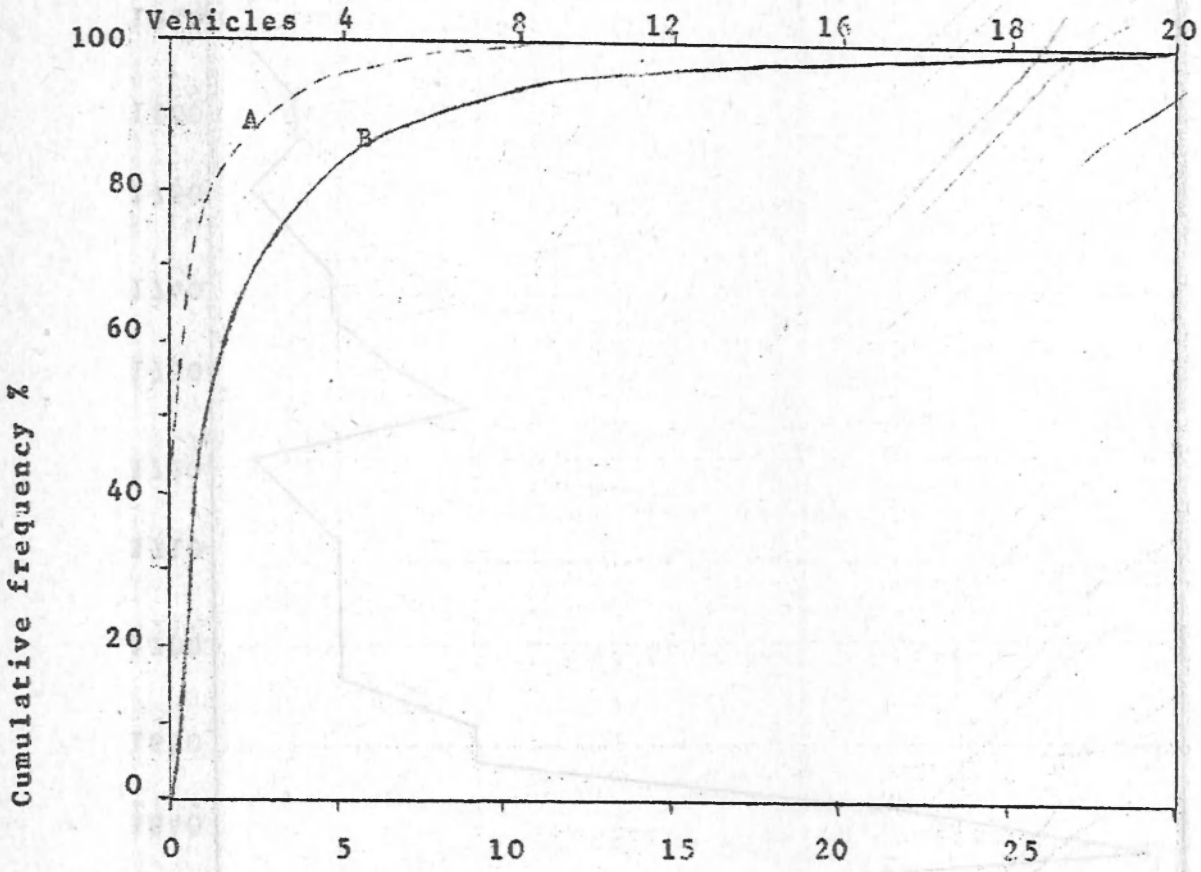


Figure 17 Cumulative frequency (%) of vehicles concentrated around a cheetah group at different viewing times (A=pre and post peak viewing. B=peak viewing time)



The implication of this study is that if the integrity of the park is to be maintained and tourism promoted in accordance with national goals; research, planning, and management must proceed together to ensure that the resource of parks and reserves is not adversely or permanently damaged.

Appendix 1: Game Viewing Patterns of Amboseli Visitors

ATTRACTION	(A) Average Time Viewed Per stop	(B) Average Number of stops	(C) Average Time Viewed (Minutes)	(D) Percent of Viewing time	(E) Rank Order
Lion	8.1	1.42	11.50	26.83	1
Cheetah	4.7	1.21	5.69	13.27	2
Elephant	4.6	1.18	5.43	12.67	3
Rhino	5.1	0.76	3.88	9.05	4
Look-out Hill	19.6	0.13	2.55	5.95	5
Giraffe	2.2	1.00	2.20	5.13	6
Buffalo	3.0	0.63	1.89	4.41	7
Zebra	2.8	0.66	1.85	4.32	8
Birds	1.8	0.02	1.66	3.87	9
Wildebeeste	1.8	0.58	1.04	2.43	10
Impala	2.2	0.34	0.75	1.75	11
Hippo	8.3	0.08	0.66	1.53	12
Gazelle	1.6	0.32	0.51	1.19	13
Jackel	2.5	0.16	0.40	0.93	14
Landscapes	1.3	0.21	0.27	0.63	15
Primates	1.5	0.11	0.17	0.40	16
Warthog	2.5	0.05	0.13	0.30	17
Waterbuck	1.0	0.05	0.05	0.12	18
Miscellaneous	2.0	0.13	2.24	5.22	19
Hyaena*	-	-	-	-	-
Ostrich*	-	-	-	-	-
Kongoni*	-	--	-	-	-
Gerenuk*	-	-	-	-	-
Oryx*	-	-	-	-	-
Totals		10.94	42.87	100	

(A) = Mean time that vehicles which stop will spend on that attraction.

(B) = Average number of stops that vehicles make at each type of attraction during a game viewing drive.

(C) = Average number of minutes that each vehicle spends at each attraction per game viewing drive (i.e. A x B = C).

(D & E) Self Explanatory

* = Animals rarely seen in central viewing area.

References

Lee, H., 1973. Human Pressures on The National Parks of Kenya, with special Emphasis on the problem of vehicle pressure: A Preliminary Study of Nairobi and Nakuru National Parks. Mimeo, Kenya National Parks.

McLaughlin, R.T., 1970. Aspects of the biology of cheetahs, Acinonyx jubatus, in Nairobi National Park. Master's Thesis, University of Nairobi.

Western, D., 1973. The Structure, dynamics and changes of the Amboseli Ecosystem. Ph.D. Thesis, University of Nairobi.

Western, D., and Thresher, P., 1973. Development Plans for Amboseli, mainly wildlife viewing in the ecosystem. Mimeo IBRD, Nairobi, Kenya.

Western, D., 1974. Road Development Plans For Amboseli. Mimeo IBRD, Nairobi, Kenya.

Acknowledgements

I would like to thank Rotary International for a graduate scholarship to the University of Nairobi which enabled this study to be completed. The assistance of the Zoology Department at the University of Nairobi and the National Parks is also gratefully acknowledged. A special thanks goes to Dr. David Western and Philip Thresher for their advice and encouragement of the project.