ESTIMATING THE IMPACTS OF COMMUNITY USE OF THE MAVURADONHA WILDERNESS IN ZIMBABWE

by

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ABSTRACT Legislated wilderness, first created in the United States with the Wilderness Act of 1964, is being more widely established internationally. The Mavuradonha Wilderness Area in Zimbabwe is the first wilderness set up to be managed by the local community. Because of the importance of both conservation and rural development goals in this context, community use of the wilderness is a contentious issue in the development of a management strategy. The purpose of this study is to estimate the impacts of community use of the area. Measurements of several environmental variables were taken along random transects and cattle trails extending into the wilderness. Results indicate that a buffer zone of generally one kilometer is being lightly impacted, and the author suggests that allowing the community continued access to resources and cattle grazing in the area will result in little environmental impact and much local support of the wilderness.

INTRODUCTION

Though wild lands have always existed, the consideration of wilderness as a resource is relatively new. Towards the end of the nineteenth century, as human population increased and settlement continually expanded into rural, undeveloped regions, awareness grew in the United States and Europe that in order for wild lands to endure, active steps were needed to conserve them (Western and Wright, 1994). The first protected areas were established in the United States, starting with national parks geared towards the protection of national monuments, and extended to designated wilderness itself with the Wilderness Act of 1964. The ideology accompanying the establishment of protected areas was that wild lands were free from human influence, and should remain that way; people should only enter such areas in the capacity of visitors who would not interfere with the surroundings (Dasman, 1984).

The current wilderness allocation and management approach in the United States took years of development, and involved many compromises among various wilderness management philosophies. The first legislative step in the recognition of wilderness as a resource was the creation of the ability to allocate wilderness through the Wilderness Act (Weingart, 1989). The subsequent step, the ongoing nature of which is revealed through the evolving wilderness legislation over the past thirty years (Browning et al., 1989), was the determination of what the wilderness designation meant. The preservationist ideal for wilderness was laid out in the 1920's and 30's--that it would be an area designated and then left undeveloped. But in order to formulate a management approach acceptable to a wide variety of sectors in the American public, compromises with more utilitarian viewpoints were necessary (Hendee et al., 1990). Wilderness legislation which allows--with limits--grazing, mining, structures, and use of motorized and mechanical transport (Klein, 1982) to occur within wilderness boundaries in the United States demonstrates the compromises made between the opposing philosophies of preserving natural processes and maximizing human benefits from the wilderness.

Concurrent with the evolving wilderness legislation, consensus has been building that areas set aside with protected status in order to preserve their "naturalness," with the accompanying restrictions on usage of the area and its resources, most often have been impacted by humans during times past (Cubit, 1994; Dasman, 1984). This realization has had a clear influence on the way wilderness in the United States is allocated and managed. The Eastern Wilderness Act in 1975, for example, recognized that areas could have been heavily impacted in their past and as long as the impacts appeared 'substantially unnoticeable'--as per the requirement for wilderness laid out in the Wilderness Act of 1964, they were still eligible for wilderness designation. With the various past and current uses of wilderness areas in the United States, it is clear that different wilderness areas fall in different places on the continuum of human modification versus pristine nature (Klein, 1982) (Figure 1).

As protected areas were established in the United States, so, too, were they in other parts of the world, although the types of protected areas and the management philosophies that accompany them varied from the American model. While the movement to establish national parks spread to other industrialized countries and African colonies after the creation of the first national park in the United States in 1872, the protected area designation of wilderness has not spread widely from its origins: to date, only a handful of other countries have wilderness legislation (Martin, 1991). In European countries, by the time wilderness became valued as a resource, most land area had already been modified through urbanization or agriculture. Britain and Switzerland, for example, have national parks, but these tend to be much more lived in and are much less "natural" than they are in the United States. Due to these inherent differences in the land use situation, current movement in Europe towards wilderness protection is using as its basic concept a less pristine ideal than that of American wilderness (Stankey et al., 1990). Accompanying the different concepts of wilderness are different management strategies: in New Zealand, for example, which has wilderness legislation, there is a greater emphasis on protecting wilderness for the use of recreationists than for the purpose of allowing ecological processes to operate freely (Stankey et al., 1990). The conceptions of protected areas and wilderness, and associated management approaches, thus, vary among different countries.

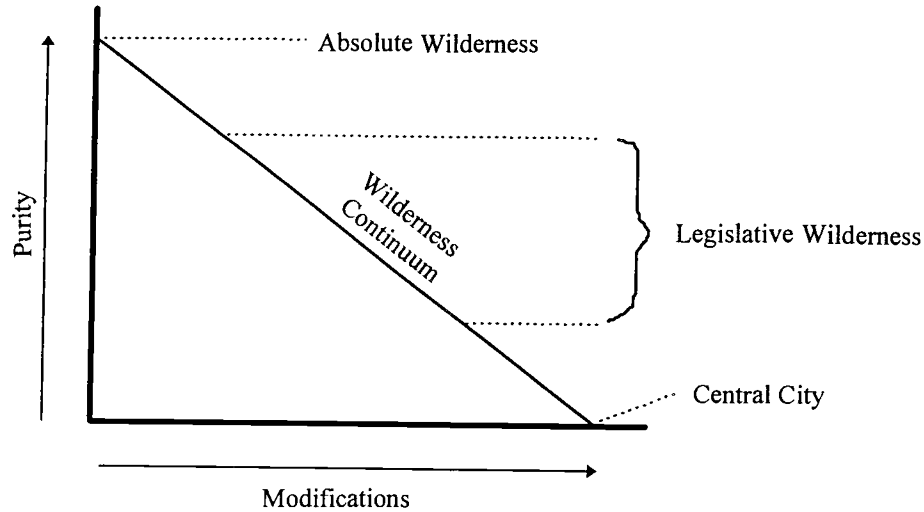

Figure 1. Continuum of human modification versus pristine nature. Modified from Klein (1982).

The management system accompanying the establishment of protected areas in colonial Africa was also based on the Western notion that people must be kept separated from wild lands. National parks and game reserves were gazetted, but the application of this management philosophy often resulted in the dispossession of rural people from their traditional lands, and restrictions on their access to the land or its resources (Wells and Brandon, 1992; Zube and Busch, 1990). The negative outcomes of this management approach were great. In the absence of being able to derive any benefits from the protected areas, while at the same time having to bear large costs of living next to the wildlands and wildlife, rural people had no incentive to promote the area's continued existence as an ecologically sustainable environment (Kiss, 1990). National strategies that set aside protected areas and ignored the needs of local people may have contributed to unsustainable resource utilization and persistent rural underdevelopment.

Recognition of the limitations of resource management at the national level has resulted in a reconsideration of local participation as a resource management strategy. Local participation can take many forms, with the local people having greatly varying degrees of involvement with the management of the resource (Pretty and Pimbert, 1995; Wells and Brandon, 1992; Oakley, 1991). This can range from distribution of the benefits gained through resource management, to inclusion of locals in the decision-making and implementation of management policies (Drijver, 1991; Zube and Busch, 1990). Consensus is clearly building that some amount of local participation may be necessary for resource management programs in less developed countries to promote conservation and rural development objectives.

Out of this idea of local participation has come the paradigm of community based resource management. While "local participation" can mean any of a range of participatory activities, "community based resource management" implies that the local community has some aspect of control over the resource. This management philosophy draws upon the idea that by giving people a degree of control over their surrounding resources, they will have an incentive to manage sustainably. The community based resource management approach has been applied to many resources to date, including agriculture (Ramberg 1993), forests (McKean et al., 1993), aquaculture (Balakrishnan et al., 1993), and wildlife (Child, 1993) in several different countries throughout Africa, Asia, and Latin America. A prominent program within the community based resource management paradigm is CAMPFIRE (Communal Areas Management Programme for Indigenous Resources) in Zimbabwe, developed in 1984 by the Zimbabwe Department of National Parks and Wildlife Management. This program provides for the devolution of authority over wildlife from the central government to district councils that can demonstrate that they have an institutional framework set up to manage the wildlife (Murphree, 1990). While CAMPFIRE has thus far concentrated on wildlife, the eventual goal in implementation of the program is its extension to other resources. This study focuses on a case in Zimbabwe where the community management paradigm has been extended to the resource of wilderness.

RESOURCE USE IN A COMMUNITY WILDERNESS

In the community based context, there is an intrinsic need for local support of management policy. In the case of a community wilderness area, this support depends on the benefits people receive from the wilderness. These benefits can take many forms, such as income derived from tourism or hunting concessions. Additionally, wild resources collected in the protected area can provide food, medicines, household materials, food for livestock, and materials used for income generation (Makombe, 1994). Sheppard (1994) emphasizes that local support of protected areas is largely generated by the benefits that people derive from resource use.

Resource use in a wilderness area, however, presents managers with a dilemma. Community wilderness managers must balance the need for local support--and the accompanying types and amounts of resource use they will allow to generate this support--with conservation goals for the area. To strike this balance, managers need information about the amount of resource use occurring in the protected area, (e.g., McShane, 1990), and more specifically, the impacts this use has on the landscape.

This study looks at the impacts occurring in the Zimbabwean community wilderness from local usage of the area. It is designed to identify and quantify environmental impacts of community use. The objective is to estimate the spatial extent of physical impacts of resource collection and cattle grazing in the area.

THE STUDY AREA

The Mavuradonha Wilderness Area (MWA) in Zimbabwe is the first wilderness established in a developing country (Martin, 1992; Stankey et al., 1990). The 192 square mile (500 square kilometer) area, located on the Zambezi Escarpment, was established in 1988. The area is surrounded by communal lands, which are farmed by subsistence farmers, commercial farmlands, and state land (Figure 2). Before wilderness designation, the MWA was part of the communal lands. Due to the area's steep topography, settlement had only taken place along some of its margins. The communal land residents, as represented by the District Council, were approached with the idea to set this area aside as a wilderness, with the expectation that they would benefit through watershed protection and revenues from hunting and tourism. They agreed to this proposal and the MWA was established, and a management committee was created. The committee is composed of ten Councillors from the surrounding communal areas (one from each ward), three farmers from neighboring commercial farms, a representative from World Wide Fund for Nature, and a representative from the Zambezi Society, a wildlife conservation organization. Because the local, elected district government--which operates at approximately the same scale as the county government in the United States--has authority over the land that became the MWA, and because the majority of the management committee is comprised of local residents, the MWA can be considered a community managed wilderness.

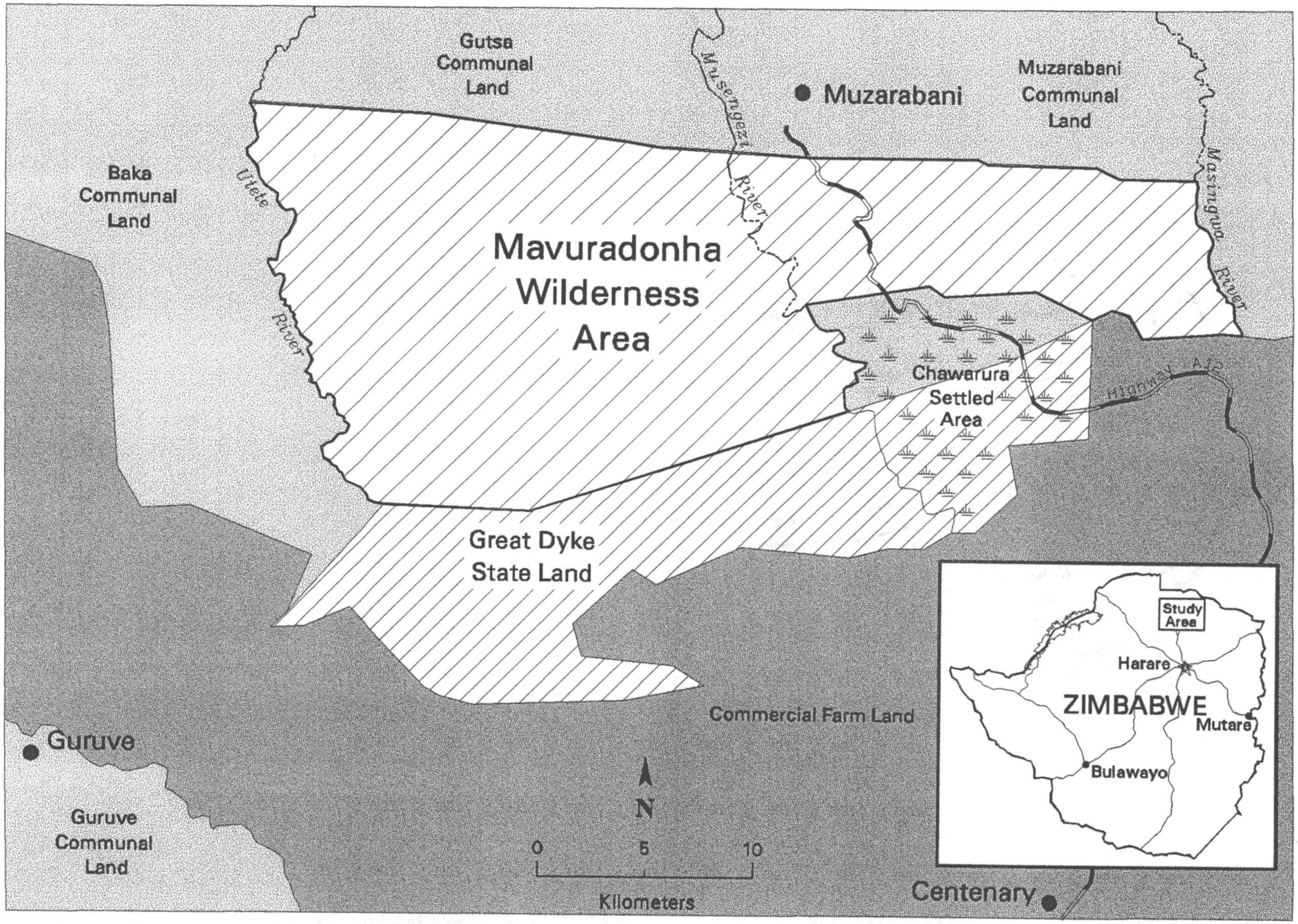

Figure 2. Mavuradonha Wilderness Area and surrounding lands.

Similar to the formulation of American wilderness management policy, the MWA's management approach started with the designation of wilderness, but it remains to be determined what this designation means. One aspect of management policy at issue is the amount of local usage of the wilderness that will be allowed. While a positive relationship between the wilderness and the people living in the areas surrounding it is critical, indications are that the current relationship is fraught with conflict (Rihoy et al., 1993), as MWA managers operating on Western notions of wilderness management attempt to restrict local people from their traditional uses of the area and its resources. This course of action, however, has been based on the acceptance of the idea that people's traditional uses of wilderness severely impacts it--an idea thus far untested in the MWA.

METHODS

The data in this study are measurements of variables in the landscape along transects that run perpendicular to the wilderness boundary. Three local secondary school graduates were hired and trained to take these measurements. Data were collected in July through September of 1993, and follow up data were collected in July 1994 in two places that had been inaccessible the previous year. These months are towards the end of this region's dry season.

Measurements were taken along two sets of transects. One set was made up of transects that represent a systematic random sample. It was systematically decided to locate a transect every kilometer along the wilderness boundary, and randomly decided within each kilometer where to locate the transect (Figure 3).[1] These transects started 500 meters outside

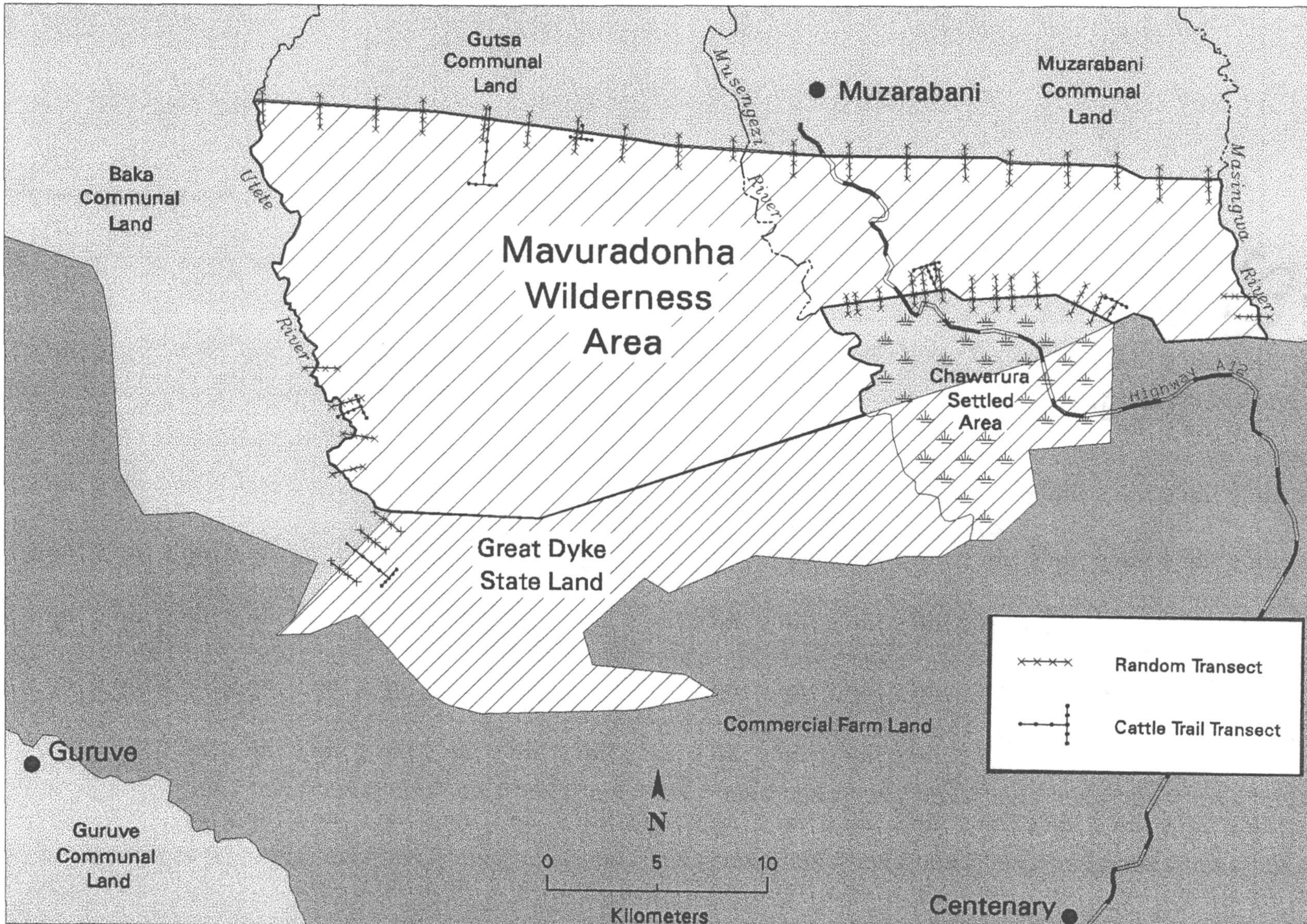

Figure 3. Location of random and cattle trail transects in the MWA.

the boundary, and extended one kilometer into the wilderness. Plots where measurements were taken were at 500 meter intervals along each transect (Figure 4). The other set of transects followed heavily used cattle trails. The rationale for their inclusion in the study is that these are the most heavily used areas in the MWA, and as such, represent the worst case scenario for physical impacts. All cattle trails with an entrance visible from the wilderness boundary were included. The cattle trail transects extended from outside the wilderness boundary to the furthest measurable use by cattle along each trail.[2] The shortest trail continued 900 meters into the wilderness, and the furthest went 3600 meters. Plots along these transects were at either 300 or 500 meter intervals (Figure 5).[3] In total, there were forty random transects and seven cattle trail transects. The number of plots at each location along both sets of transects is listed in Table 1. All of the locations were successfully surveyed with the exception of one plot along a random transect, where a cliff prevented the surveyor access.

The variables being measured fall into two main categories: cattle impacts and tree damage caused by humans and elephants. The impetus for measuring cattle impacts came from a previous study conducted by Matzke (1993), in which cattle herders were interviewed at diptanks near the MWA, and many reported going into the wilderness area to graze their cattle. The reason for measuring tree damage by humans is the importance of wood as a resource. Vermeulen (1994, p. 4) states that it is quantitatively the most important forest resource in Zimbabwe, in terms of both the number of people using it and the amount used per year. Additionally, results from the previously mentioned study by Matzke (1993) indicated that wood for use as firewood and poles was among the most commonly collected

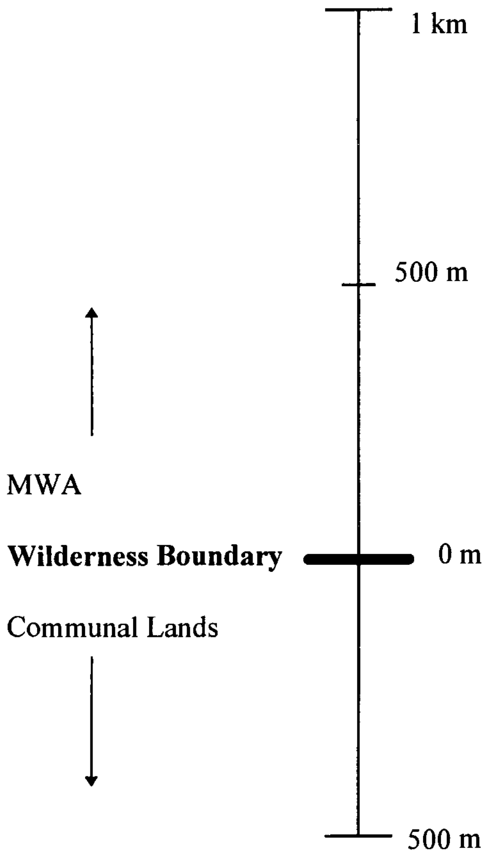

Figure 4: Random transect.

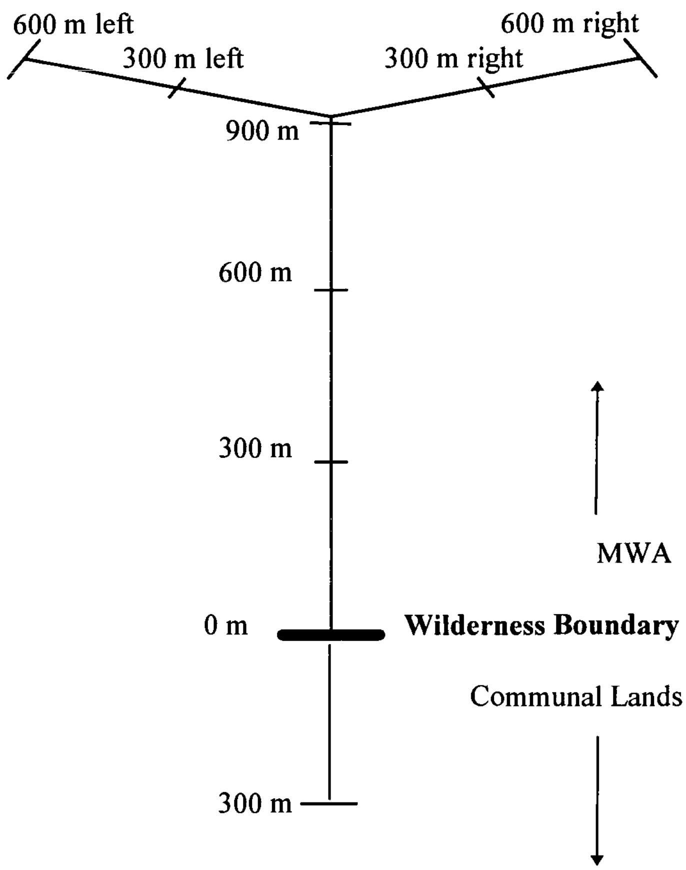

Figure 5: Sample cattle trail transect.

Table 1. Number of plots at each location along random transects and cattle trails.

	Random Transects	**Cattle Trails**
-500 m	40	4
Boundary	40	7
500 m	40	13
1000 m	36	14
1500 m	---	8
2000 m	---	4
2500 m	---	5
3500 m	---	4

resources in the MWA. The notion of measuring tree damage caused by elephants developed during the course of the study, when preliminary results showed that in some areas trees were being impacted not by people but by elephants. The elephant data was, thus, collected for comparison purposes to damage caused by people.

Cattle impacts were measured using four criteria: the percentage of bare ground, the percentage of grass eaten, the percentage of ground with manure, and the grass height. A plot where measurements were taken was a 20 by 20 meter area. These criteria were measured in five sample sites within each 20 by 20 meter plot. The sample sites were located systematically: one sample in the center of the plot, and the other four in each of the corners (Figure 6). Measurements were taken at each sample site by putting a one by one meter grid containing 100 cells on the ground. Data were collected by counting the number of squares in the one by one meter grid having bare ground, grass eaten, and manure; and measuring the grass height at the four corners of the grid (Figure 7).

Additionally, in each 20 by 20 meter plot, all trees were surveyed for damage. The tree damage surveying techniques were based on those used by Vermeulen (1994). Small trees--those under 15 centimeters in diameter--and large trees were recorded separately. Damage was broadly classified as resulting from elephants or humans. Trees showing evidence of elephant activity were more specifically classified as damaged or killed.

All of the measurements were input into a spreadsheet using the software MS Excel. Averages were calculated for the cattle impact measurements in two stages. First, by averaging the percentages for all five samples within a plot, a single value for each of the variables--bare ground, grass eaten, manure, and grass depth--was calculated for the plot.

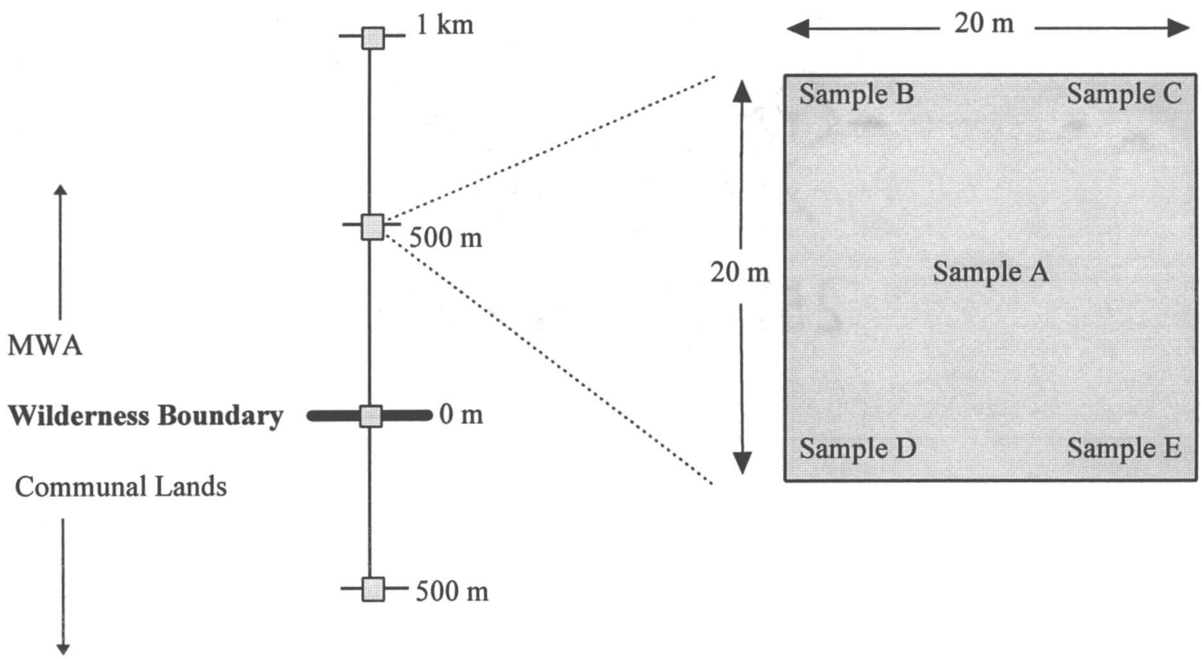

Figure 6: Plot layout.

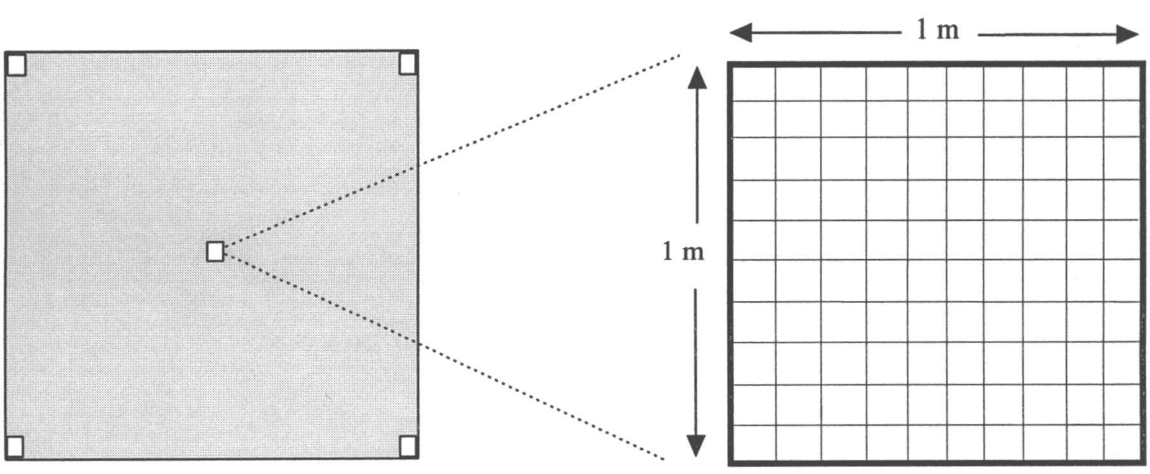

Figure 7: One by one meter wire grid laid on each sample site in the plot. Within each cell a hit was recorded when over half of the cell was bare ground, the cell contained any blades of grass that had been nipped off, or the cell contained any manure.

Then, all of the values at a given location along the transects were averaged for each variable. For example, all of the percentages of bare ground at a location of 500 meters into the MWA were averaged together to end up with just one value. Averages for the tree damage measurements were calculated using only the second step, since all of the trees in a given plot were measured.[4]

RESULTS

The two sets of data collected in this study represent different levels of use of the wilderness area. The results show the environmental impacts in the general landscape, as represented by the random transects, to be less than those in the most heavily used areas of the wilderness, the cattle trails.

Cattle Impacts

For all of the cattle impact variables--bare ground, grass eaten, manure, and grass height--the values at each location along random transects (Table 2) are lower in impact terms than along the cattle trails (Table 3).[5] It is important to note when viewing these results that the survey was conducted towards the end of the dry season, when grass eaten, bare ground, and grass height are expected to reflect the highest levels of impact during the year.

The percentage of bare ground remains about the same along the random transects, varying only a few percent. Along the cattle trails, it generally decreases as one moves into the wilderness area (Figure 8).

Table 2. Cattle impacts along random transects.

	% Bare Ground	% Grass Eaten	% Manure	Grass Height (cm)
-500 m	14	18	2	29
Boundary	12	8	1	35
500 m	15	4	0	35
1000 m	13	3	0	35

Table 3. Cattle impacts along cattle trails.

	% Bare Ground	% Grass Eaten	% Manure	Grass Height (cm)
-500 m	28	27	9	7
Boundary	25	29	7	16
500 m	18	29	4	20
1000 m	14	26	1	19
1500 m	10	27	2	26
2000 m	18	19	2	31
2500 m	3	34	1	39
3500 m	9	66	6	23

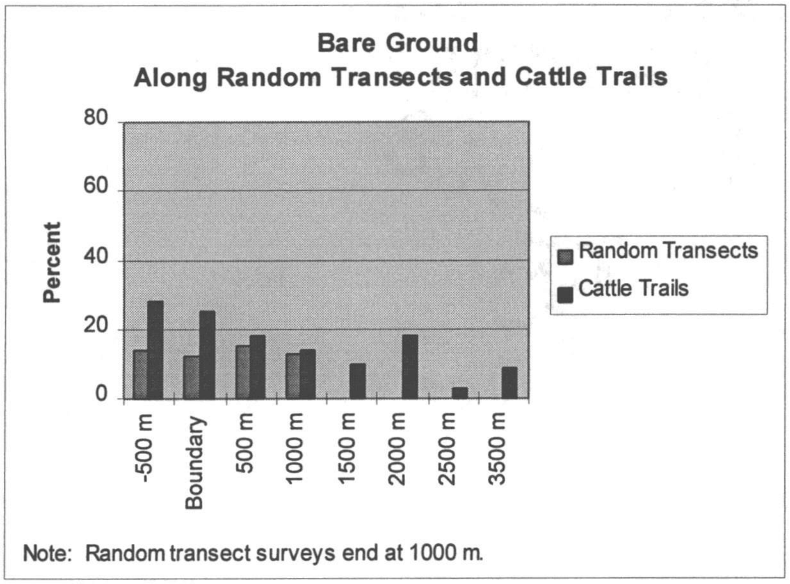

Figure 8. Percentage of bare ground along random transects and cattle trails.

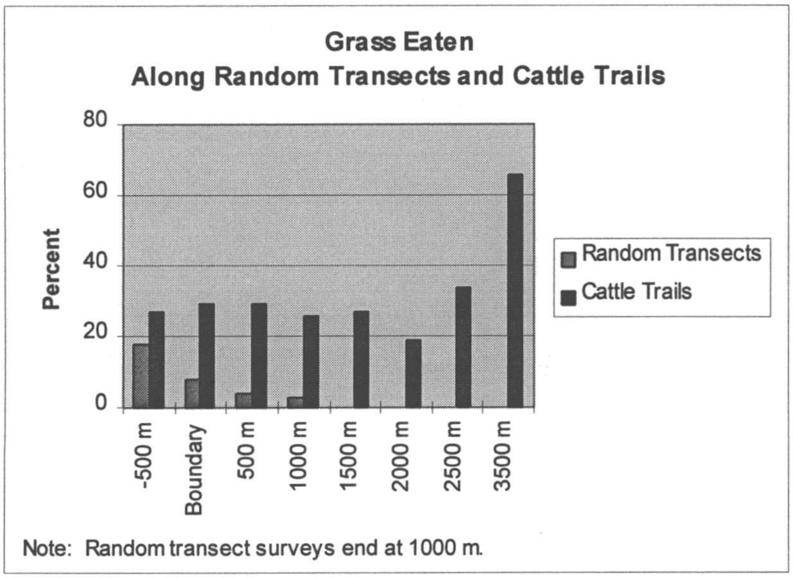

Figure 9. Percentage of grass eaten along random transects and cattle trails.

The percentage of grass eaten steadily declines along the random transects, exhibiting a distance decay effect. Along the cattle trails, it remains about the same between the -500 and 2000 meter locations (Figure 9). The plot locations of 2500 meters and 3500 meters are where the cattle trails end in wide grazing areas. This may account for the higher percentage of grass eaten at these sites.

One might expect the percentages of bare ground and grass eaten to closely match one another, if cattle grazing is the cause of the bare ground. A comparison between the percentages of bare ground and grass eaten, however, reveals that the patterns of these variables do not match each other. This indicates that other of several possible factors--such as the presence of rocks--are responsible for the bare ground; rather than just cattle grazing the ground bare.

The percentage of ground covered by manure is quite low along both sets of transects: the maximum value surveyed is nine percent, which occurs along a cattle trail at the location that is 500 meters inside the communal area (Figure 10). Since these values reflect a lower level of cattle use than do other variables, it is probable that manure decomposes too rapidly to be an all inclusive measure.

Grass height remains nearly the same along the random transects: it is 29 centimeters at the -500 meter location, and remains constant at 35 centimeters at the locations inside the wilderness. Along cattle trails, grass height increases slightly as one moves further into the wilderness area. The grass is almost twice as high along the random transects (Figure 11).

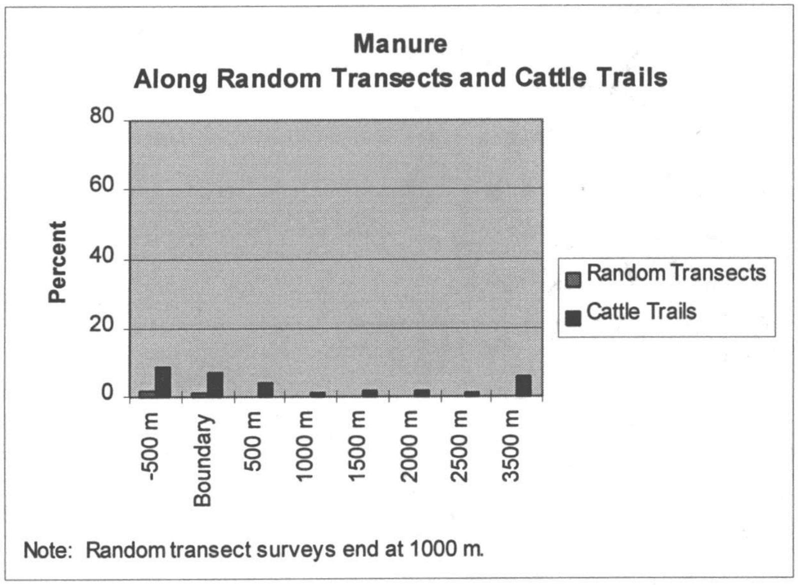

Figure 10. Percentage of manure along random transects and cattle trails.

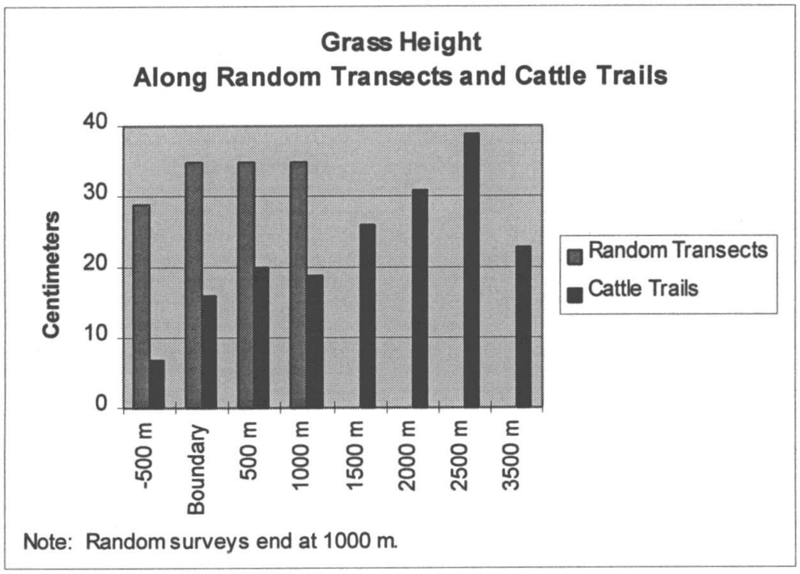

Figure 11. Grass height along random transects and cattle trails.

Tree Cutting by People

Both small and large trees reflect the same pattern of cutting along random transects (Table 4) and cattle trails (Table 5). The percentage of small trees cut steadily declines from nine percent to zero percent along random transects, and from eleven to zero percent along cattle trails (Figure 12). The percentage of large trees cut declines from fifty to zero percent along random transects, and from seventy to zero percent along cattle trails (Figure 13). Tree cutting activity exhibits a sharp distance decay effect, with nearly all cutting activity absent at one kilometer into the wilderness. It is important to note that the first location is 500 meters into the communal areas, and so in some places is in the middle of people's fields. Large trees, since they have been around longer than small trees, are more likely to have sustained damage at some point in the past; hence, the percentages of large trees that have been cut are higher than those of small trees. Lastly, because of the steep topography throughout much of the MWA, there are limited areas where the wilderness can be readily accessed. Cattle trails are located in the more easily accessed areas, which likely accounts for the higher percentages of trees cut along cattle trails than along random transects.

Tree Damage by Elephants

While tree cutting activity by people decreases into the MWA, tree damage from elephants increases in both small trees (Figure 14) and large trees (Figure 15) along random transects and cattle trails. The percentages of small trees killed or damaged by elephants steadily increases from four percent to thirteen percent along random transects, and the percentages of large trees steadily increases from nine to twenty-six percent (Table 6). Along

Table 4. Percent of small and large trees cut by people along random transects.

	% Small Trees	% Large Trees
-500 m	9	50
Boundary	6	23
500 m	1	5
1000 m	0	0

Table 5. Percent of small and large trees cut by people along cattle trails.

	% Small Trees	% Large Trees
-500 m	11	70
Boundary	2	45
500 m	1	10
1000 m	0	2
1500 m	0	5
2000 m	0	0
2500 m	0	0
3500 m	0	0

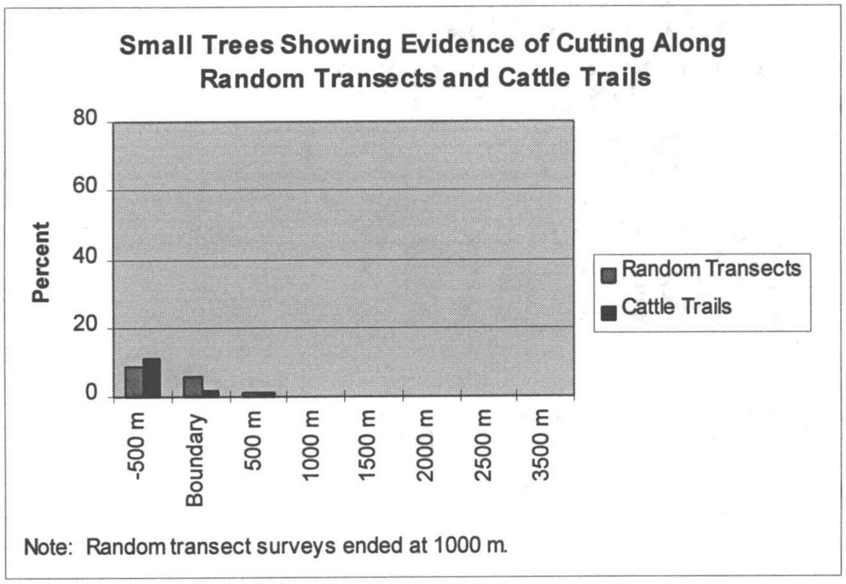

Figure 12. Small trees showing evidence of cutting along random transects and cattle trails.

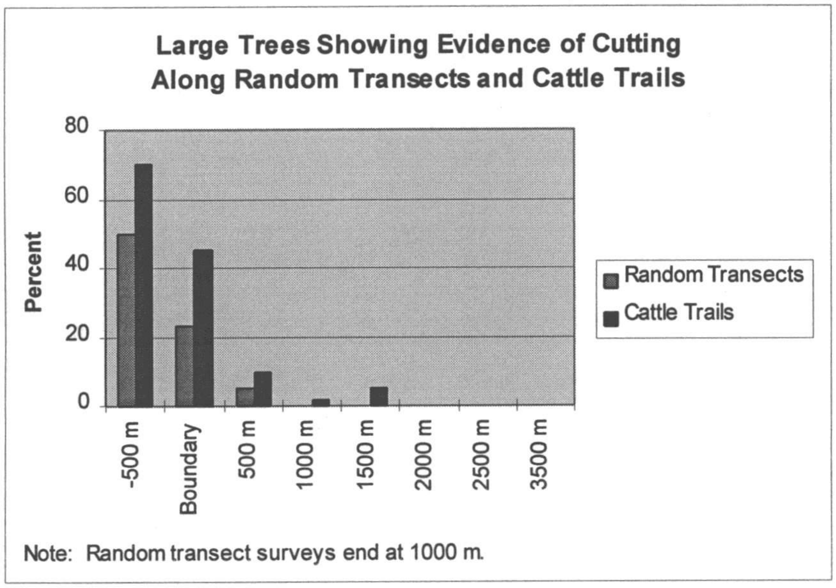

Figure 13. Large trees showing evidence of cutting along random transects and cattle trails.

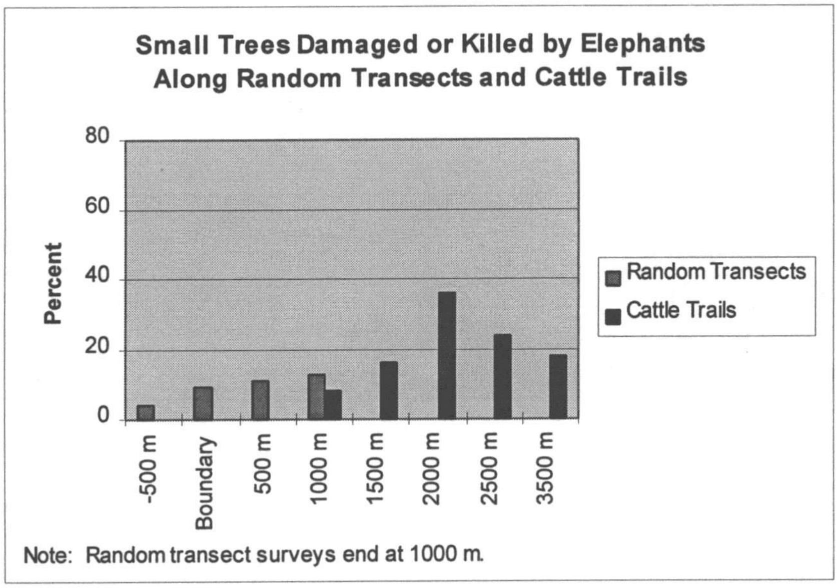

Figure 14. Small trees damaged or killed by elephants along random transects and cattle trails.

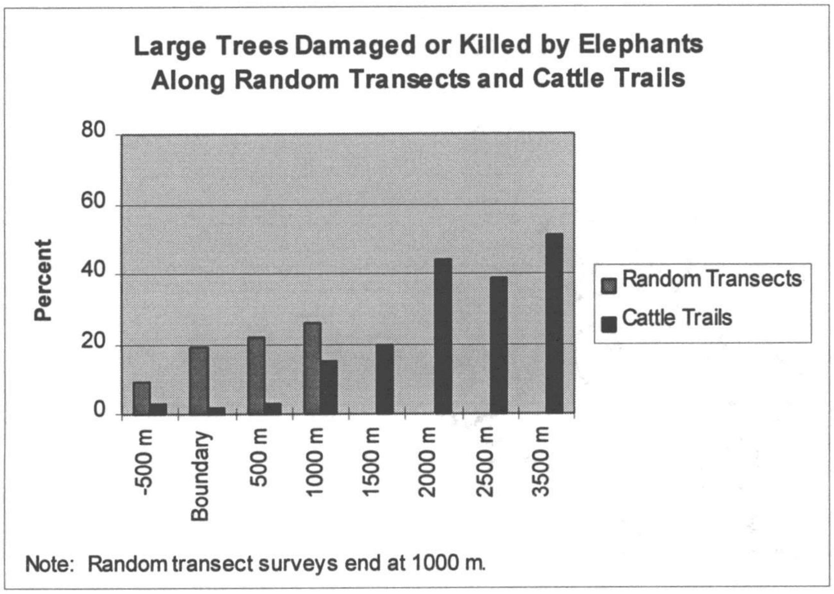

Figure 15. Large trees damaged or killed by elephants along random transects and cattle trails.

Table 6. Small and large trees damaged or killed by elephants along random transects.

	% Small Trees	% Large Trees
-500 m	4	9
Boundary	9	19
500 m	11	22
1000 m	13	26

Table 7. Small and large trees damaged or killed by elephants along cattle trails.

	% Small Trees	% Large Trees
-500 m	0	3
Boundary	0	2
500 m	0	3
1000 m	8	15
1500 m	16	20
2000 m	36	44
2500 m	24	39
3500 m	18	51

cattle trail transects, elephant damage to small and large trees generally increases farther into the wilderness, with a jump between the 500 and 1000 meter locations in the percentages of trees damaged (Table 7). It is interesting to note that in the case of small trees along cattle trail transects, the elephant damage begins at the 1000 meter location, right where human tree cutting activity ceased.

DISCUSSION

The results of this study suggest that the Mavuradonha Wilderness Area is not being severely impacted by human use of the area. With most of the variables measured in this study, evidence of human use declines from outside the wilderness boundary on the way into the wilderness, and is very sparse or non-existent by one kilometer into the area. Some exceptions are found in the cattle trail results, when the trails extend farther than one kilometer.

These results indicate that the measured usage pattern by the local people is confined to the MWA border area. This area acts as a buffer zone, a concept widely discussed in the literature (e.g., Cubit, 1994; McDermott et al., 1992). A buffer zone is generally thought of as a strip of land surrounding a protected area, where, within limits, resource use is allowed (Sayer, 1991). Its purpose is to enhance the conservation of an area, while permitting local people usage of the area and its resources. Activities typically associated with buffer zones around protected areas are hunting or fishing using traditional methods, collecting dead wood, gathering fruit, seasonal grazing of herds, and cutting rattan, bamboo, or grasses (Wells and Brandon, 1993).

Wells and Brandon (1993) report that although much is written on the buffer zone concept and much enthusiasm exists for it, some researchers have concluded that there are few, and possibly no, actual working models. The authors theorize that this is due in part to a major problem with the buffer zone concept--the expectation that the benefits that local people derive through regulated access to the buffer zone are large enough to change their resource use practices in a way that will enhance the conservation of the protected area. This perceived obstacle to the successful implementation of a buffer zone rests on the notion that people's traditional uses severely degrade the protected area.

The data in this study indicate, in contrast, that community resource use in the Mavuradonha Wilderness is causing light environmental impacts, and that throughout much of the wilderness, evidence of human use is nearly or completely absent. Furthermore, current indications in the case of the Mavuradonha Wilderness are that the local community has a desire to protect their wilderness resource into the future, and are taking active steps towards increased conservation. After the wilderness designation, people in one community surrounding the MWA who had begun to settle in the more erodible lands on the wilderness boundary, voluntarily moved their homes farther into the communal lands, away from the wilderness. Additionally, since this study was conducted, a wildlife fence with cattle gates was built, as the local community had been requesting. After the fence construction, residents decided to eliminate one of their proposed gate sites. Once they were given the decision-making power themselves, rather than moving in the direction of destroying the resource as traditional Western thought might dictate, they chose a more preservationist course of action.

The measurements of elephant damage to trees provide an interesting comparison to those of tree cutting by people. When MWA managers determine acceptable levels and types of resource use within the wilderness, they will look to the conservation goals and values for the area for guidance. The data in this study show that elephants, at one kilometer into the wilderness, are causing far more damage to the trees than people are causing. If undamaged trees are valued as intrinsic to a wilderness experience, elephants are a larger problem than people.

The environmental impacts to the Mavuradonha Wilderness from resource use must be balanced with the intrinsic importance of local support for a community managed wilderness. Stankey states that "...with public support, wilderness can be protected; without public support, it can't, regardless of the protective mechanisms in force" (1993, p. 36). If people are allowed continued use of the Mavuradonha Wilderness Area, community goodwill towards the area will result. As the results of this study suggest, this use may compromise little in terms of conservation of the wilderness. Conversely, if community use of the wilderness is denied, it is likely that public support will erode and the wilderness will be turned into an alternative land use.

CONCLUSION

As the precedent for a community wilderness area, the MWA's management approach will be looked to as a model for community wilderness. A critical issue in the formulation of a wilderness management strategy for the MWA is the determination of the amount local people are allowed to retain their traditional uses of the landscape, an issue Martin considers to be "...the greatest challenge in the adoption of wilderness areas internationally" (1992, p. 22). Data on environmental impacts of community use of a wilderness are critical to the formulation of a well advised management policy regarding restrictions on resource use. The results presented in this paper run counter to the traditional idea that people must be kept separated from wilderness or they will ruin it. As in the case of the Mavuradonha Wilderness, data on the impacts of community use of a wilderness may point managers towards a policy where traditional uses can coincide with wilderness conservation goals.

NOTES

1. Most of the southern boundary was excluded because where the wilderness abuts unsettled State Land, local people do not access the area.
2. The cattle trail transects started either 300 or 500 meters outside the wilderness boundary.
3. The decision to use both 300 and 500 meter intervals along cattle trail transects was made by the field assistants, and was not part of the original study design. These plot locations were standardized during analysis by grouping plots at 300 meter intervals with the closest locations at 500 meter intervals.
4. When averages were calculated for all the plots at a given location, such as 500 meters into the wilderness area, each plot was weighted equally, despite the differences in the total number of trees present in the plot. This way, a plot with a particularly large number of trees would not dominate the results.
5. The location along the transects at 500 meters outside the wilderness boundary, which is 500 meters into the communal areas, is referred to in figures and tables as negative 500 meters.

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APPENDIX I: SURVEY FORM

0. NEAREST DIPTANK LOCATION
______(1) Negomo School (Guruve District)
______(2) Kanhukamwe (Centerary District)
______(3) Kapatamukombe (Centenary District)

MAVURADONHA WILDERNESS BOUNDARY DATA

______1. TRANSECT NUMBER

2. LOCATION ALONG TRANSECT
______(1) 0 Metres (500 metres into communal area)
______(2) 500 Metres (Fence line)
______(3) 1,000 Metres
______(4) 1,500 Metres
______(5) 2,000 Metres
______(6) 2,500 Metres
______(7) 3,000 Metres
______(8) 3,500 Metres
______(9) 4,000 Metres
______(10) 4,500 Metres
______(11) 5,000 Metres
______(12) Other Metres______________.

3. SINCE THE LAST PLOT HAS THERE BEEN EVIDENCE OF:
______3 a. SOAPSTONE DIGGING:
______3 b. THATCH GRASS CUTTING
______3 c. BROOM GRASS CUTTING
______3 d. CATTLE MANURE
______3 e. OBVIOUS CATTLE TRAIL
______3 e. OTHER____

4. CULTIVATION HISTORY.
______(1) Cultivated last year.
______(2) Formerly cultivated location.
______(3) Never cultivated.
______(4) Other:__________________________

5. DIP (SLOPE DIRECTION IN COMPASS DEGREES)

______(1) 0 - 45
______(2) 45 - 90
______(3) 91 - 135
______(4) 136 - 180
______(5) 181 - 225
______(6) 226 - 270
______(7) 271 - 315
______(8) 316 - 360

6. SLOPE (CENTIMETRES DROPPED IN 5 METRES)
______(1) 0-20
______(2) 21-50
______(3) 51-100
______(4) 101-150
______(5) 200-300
______(6) 400-500
______(7) 500+

2
TALLY SHEET - SMALL TREES-LESS THAN 15 CMS.

_______________ 7.SMALL TREES NOT DAMAGED (NUMBER 15 CMS. SMALLER)

_______________ 8a. SMALL TREES DAMAGED BY ELEPHANTS

_______________ 8b. SMALL TREES DAMAGED BY HUMANS

_______________ (1) MAIN STEMS CUT OFF BELOW 50 CENTIMETRES
- _______________ a. side branches cut (lopping)
- _______________ b. bark stripped
- _______________ c. cut marks (incomplete cut)
- _______________ d. other evidence of human caused damage
- _______________ e. new stems cut (coppicing)

_______________ (2) MAIN STEMS CUT OFF ABOVE 50 CENTIMETRES
- _______________ a. side branches cut (lopping)
- _______________ b. bark stripped
- _______________ c. cut marks (incomplete cut)
- _______________ d. other evidence of human caused damage
- _______________ e. new stems cut (coppicing)

_______________ (3) MAIN STEM NOT CUT OFF
- _______________ a. side branches cut (lopping)
- _______________ b. bark stripped
- _______________ c. cut marks (incomplete cut)
- _______________ d. other evidence of human caused damage

TALLY SHEET -LARGE TREES MORE THAN 15 CMS.

_______________ 9. LARGE TREES NOT DAMAGED

_______________ 10A. LARGE TREES DAMAGED BY ELEPHANTS

_______________ 10b. LARGE TREES DAMAGED BY HUMANS

_______________ (1) MAIN STEMS CUT OFF BELOW 50 CENTIMETRES
- _______________ a. side branches cut (lopping)
- _______________ b. bark stripped
- _______________ c. cut marks (incomplete cut)
- _______________ d. other evidence of human caused damage
- _______________ e. new stems cut (coppicing)

_______________ (2) MAIN STEMS CUT OFF ABOVE 50 CENTIMETRES
- _______________ a. side branches cut (lopping)
- _______________ b. bark stripped
- _______________ c. cut marks (incomplete cut)
- _______________ d. other evidence of human caused damage
- _______________ e. new stems cut (coppicing)

_______________ (3) MAIN STEM NOT CUT OFF
- _______________ a. side branches cut (lopping)
- _______________ b. bark stripped
- _______________ c. cut marks (incomplete cut)
- _______________ d. other evidence of human caused damage

3 TREE MEASUREMENTS (20 X 20 METRE PLOT)

SMALL TREES-LESS THAN 15 CENTIMETRES

_____7. SMALL TREES NOT DAMAGED (NUMBER 15 CENTIMETRES & SMALLER)

_____8a. SMALL TREES DAMAGED BY ELEPHANTS

_____8b. SMALL TREES DAMAGED BY HUMANS

_____8(1) NUMBER OF MAIN STEMS CUT OFF BELOW 50 CENTIMETRES
- _____8(1) a. side branches cut (lopping)
- _____8(1) b. bark stripped
- _____8(1) c. cut marks (incomplete cut)
- _____8(1) d. other evidence of human caused damage
- _____8(1) e. new stems cut (coppicing)

_____(2) NUMBER OF MAIN STEMS CUT OFF ABOVE 50 CENTIMETRES
- _____8(2) a. side branches cut (lopping)
- _____8(2) b. bark stripped
- _____8(2) c. cut marks (incomplete cut)
- _____8(2) d. other evidence of human caused damage
- _____8(2) e. new stems cut (coppicing)

_____(3) MAIN STEM NOT CUT OFF
- _____8(3) a. side branches cut (lopping)
- _____8(3) b. bark stripped
- _____8(3) c. cut marks (incomplete cut)
- _____8(3) d. other evidence of human caused damage

LARGE TREES- DIAMETRE MORE THAN 15 CMS.

_____9. LARGE TREES NOT DAMAGED (MORE THAN 15 CENTIMETRES)

_____10a. LARGE TREES DAMAGED BY ELEPHANTS

_____10b. LARGE TREES DAMAGED BY HUMANS

_____10(1) NUMBER OF MAIN STEMS CUT OFF BELOW 50 CENTIMETRES
- _____10(1) a. side branches cut (lopping)
- _____10(1) b. bark stripped
- _____10(1) c. cut marks (incomplete cut)
- _____10(1) d. other evidence of human caused damage
- _____10(1) e. new stems cut (coppicing)

_____(2) NUMBER OF MAIN STEMS CUT OFF ABOVE 50 CENTIMETRES
- _____10(2) a. side branches cut (lopping)
- _____10(2) b. bark stripped
- _____10(2) c. cut marks (incomplete cut)
- _____10(2) d. other evidence of human caused d
- _____10(2) e. new stems cut (coppicing)

_____(3) MAIN STEM NOT CUT OFF
- _____10(3) a. side branches cut (lopping)
- _____10(3) b. bark stripped
- _____10(3) c. cut marks (incomplete cut)
- _____10(3) d. other evidence of human caused e

4 GRID PLOTS: B C
A
D E

PLOT A 1 2 3 4 5 6 7 8 9 10 TOTAL

______11. BARE GROUND

______12. GRASS EATEN

______13. MANURE

______14. GRASS DEPTH

PLOT B

______15. BARE GROUND

______16. GRASS EATEN

______17. MANURE

______18. GRASS DEPTH

PLOT C

______19. BARE GROUND

______20. GRASS EATEN

______21. MANURE

______22. GRASS DEPTH

PLOT D

______23. BARE GROUND

______24. GRASS EATEN

______25. MANURE

______26. GRASS DEPTH

PLOT E

______27. BARE GROUND

______28. GRASS EATEN

______29. MANURE

______30. GRASS DEPTH