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GREATEST NEGATIVE ENVIRONMENTAL IMPACT
ON ENVIRONMENTAL RESOURCE ATTRIBUTES IN
NATIONAL PARKS OF CENTRAL KENYA**

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Abstract

Purpose: Recreation sites and parks are exposed to degradation unless stringent conservation measures are undertaken. Recreational activities undertaken by visitors such as; camping, hiking and climbing, game driving, bird watching, bicycling, mountain biking, game viewing, and picnicking among others put huge pressure on the parks resources. The aim of the study is to determine the recreation activities that have the greatest negative environmental impact on environmental resource attributes in national parks of central Kenya.

Methodology: The descriptive survey research design was used. The study was conducted in the two designated national parks in Central Kenya region: Mt. Kenya and Aberdares. Stratified random sampling was used to ensure that the KWS and KFS officers in managerial, tour guide, maintenance, and security levels were represented.

Results: Two hundred and sixty three 263(79.9%) responded to the questionnaires by completely filling and returning them. Descriptive statistics that included frequencies and percentages were used to organize and summarize the data. Tables and bar charts were drawn to present the collected data. Independent Sample T-test was conducted to compare the mean of the visitors and staff on the perceived effect of recreation activities on environmental resource attributes. It is only on soil where the two groups were found to be significantly different ($\bar{X}_{(visitors)}=2.14$, $\bar{X}_{(staff)}=1.50$, $t=6.06$, $df=233$, $p<0.001$).

Unique contribution to theory, practice and policy: The study therefore concluded that parks environmental resource attributes are negatively affected by recreation activities in the national parks in the Central Kenya region. Through monitoring of conditions, managers will be able to more clearly identify when specific impacts have become so pronounced as to demand management attention.

Key words: *recreation activities, environmental impact, environmental resource, national parks*

Introduction

In Kenya, the national parks are built upon the colonial period of big game hunting. Big game hunting was a symbol of Western dominance, not only over the environment, but also cultural and class domination (Honey, 2005). The National Park Ordinance (NPO) No.9 of 1945 was the first piece of hunting legislation which was designed to protect wildlife from the indigenous people.

Visitation in the natural parks can cause substantial resource change in the national parks that can affect the parks' functionality (Akama 2000; Okello & Kirenge 2004). Recreational activities may lead to environmental impacts such as discharge into the sea, destruction of vegetation, invasive species, littering, overuse of resources, soil compaction, animal disturbance and animal killing within Kenyan parks (Okello & Kirenge, 2004; Well & Lauroth 2007). For instance, Cole and Marion (2004) noted that hiking, climbing, walking and camping are the most frequent and popular recreational activities conducted in natural areas such as forests, woods and parks. Hiking, climbing and walking have the potential to disturb wildlife and affect soil in a number of ways including trampling, littering, changing animal habitat or degrading soil through use of undesignated trail and trailside management (Ward & Berge, 2005). The magnitude of impact is a function of frequency of use, the type and behavior of use by visitors, season of use, environmental conditions, and the spatial distribution of use. Therefore, the primary management tools involve manipulation of these factors coupled with visitors' education programs that will ensure high quality recreation experience (Platts, 2004).

Eagle and McCool (2002) suggest that negative effects of tourism on park resource is less influenced by absolute number of visitors, and more influenced by weak tourism policy. Managers of the protected areas worldwide are faced with the challenge of conserving nature and cultural heritage for future generation. Parks managers most commonly address resource and experiential impact through site management actions, which include; enforcement of closures of recreation areas, relocation of recreation facilities, planning of recreation areas, design, construction and maintenance of recreation facilities, and relocation of recreation facilities (Manning, 2003). Environmental impact of visitors' use of the park and related areas is an important issue that deserves attention.

Objective of the study

The study sought to determine the recreation activities that have the greatest negative environmental impact on environmental resource attributes in national parks of central Kenya.

Methodology

The descriptive survey research design was used in the study because it did not involve manipulation of variables under investigation but sought to establish the status of the phenomena (Borge & Gall, 2002). The study was conducted in the two designated national parks in Central Kenya region: Mt. Kenya and Aberdares. In Mt. Kenya 3 out of 5 of game parks entry routes were used for study. The routes were: Sirimon route, Naro Moro, Marania. In Aberdares, 3 game park gates out of 6 from Nyeri route were used: Ruhumini gate, Kiandogoro, and Wandere. Also, 2 game park gates out of 4 from Nyahururu route were selected: Rhino gate, and Shamata.

The parks are managed by the KWS and the Kenya Forest Service (KFS) which have a memorandum of understanding on their operations (KWS, 2007). Hence, the subjects who were targeted to take part in the study were 103 KWS officers and 80 KFS from Mount Kenya National Park, 80 KWS and 84 KFS from Aberdares. This translates to a total of 183 KWS and 164 KFS officials making a total of 347 staff. Then the daily visitors' record at the entrance was used to target the park visitors in each park.

Stratified random sampling was used to ensure that the KWS and KFS officers in managerial, tour guide, maintenance, and security levels were represented. A proportion of 50% of the KWS officers out of 183 and 50% of KFS officers out of 164 in the two parks were randomly selected through balloting to take part in the study.

Out of the three hundred and twenty nine (329) questionnaires administered, two hundred and sixty three (263) (79.9%) responded to the questionnaires by completely filling and returning them. Data was coded and analyzed using the Statistical Package for Social Sciences (SPSS) software. Descriptive statistics that included frequencies and percentages were used to organize and summarize the data. Tables and bar charts were drawn to present the collected data. The hypotheses were tested using the independent sample T-test at 0.05 level of significance. The independent sample T-test is considered the appropriate statistical tool in this case because it was used to check whether there is statistical evidence that the population means are significantly different.

Findings

Table 1: Percentage of Environmental Resources Attributes perceived to have been Negatively Affected by Recreational Activities

Resource Attribute	Least Affected		Not Sure		Most affected		TOTAL	
	N	%	N	%	N	%	N	%
Water	78	30.2	64	24.8	116	45.0	258	100.0
Wild game	91	37.6	46	19.0	105	43.4	242	100.0
Vegetation	76	29.8	78	30.6	101	39.6	255	100.0
Soil	136	52.9	38	14.8	83	32.3	257	100.0

From the table 1, shows that 116 (45%), 105(43.4%) and 83(32.3%) of the respondents perceived water, wildlife and soil as the most affected environmental resource attributes. Table 4.18; shows the mean and the standard deviation of resource environmental attribute perceived to have been negatively affected by recreation activities.

Table 2: Mean and Standard Deviation of Resource Environmental Attribute Perceived to have been Negatively Affected by Recreation Activities

Resources Attribute	Category	N	Mean	Std. Deviation
Soil	Visitor	118	2.14	.91
	Staff	139	1.50	.78
Water	Visitor	118	1.93	.80
	Staff	140	2.33	.86
Vegetation	Visitor	118	2.44	.83
	Staff	137	1.80	.71
Wildlife	Visitor	103	2.22	.86
	Staff	139	1.94	.91

Table, 2, It is apparent that the visitors perceived; vegetation (\bar{X} =2.44, SD=0.83) as the most negatively affected by recreation activities followed by wildlife (\bar{X} =2.22, SD=0.86), and soil (\bar{X} =2.14, SD=0.91) respectively, while water (\bar{X} =1.93, SD=0.80) was perceived as the least affected. The staff from both KWS and KFS perceived, water (\bar{X} =2.33, SD=0.86), wildlife (\bar{X} =1.94, SD = 0.91), vegetation (\bar{X} =1.80, SD=0.71) and soil (\bar{X} =1.50, SD=0.78) respectively as environmental resource attributes that are affected by recreation activities.

Park Resources

Table 3: Shows the respondents' perception on whether the various resources at the parks needed to be improved or not.

Park Resources	Frequency	Percentage
Need to be improved	161	61.2
Need not to be improved	87	33.1
Missing	15	5.7
Total	263	100.0

From Table 3 it is evident that majority of the respondents 161(61.2%) perceived that there was need for the resources to be improved, whereas 87(33.1%) were of the perception that the park natural resources need not to be improved. Table 4.9.9 shows the mean and standard deviation of resource environmental attribute that are perceived to have been negatively affected by recreation activities.

Hypothesis 1: Ho₁ - Parks environmental resource attributes are not negatively affected by recreation activities in the national parks in the Central Kenya region.

Table 4: Independent Sample T-test on park resource attribute that are perceived to have been negatively affected by recreation activities

Effect on Resource attributes	T	Df	Sig2tailed	Mean difference
Soil	6.14	255	.000	.65
	6.06	232.76	.000	.65
Water	-3.80	256	.000	-.40
	-3.82	253.32	.000	-.40
Vegetation	6.62	253	.000	.64
	6.54	230.6	.000	.64
Wildlife	2.49	240	.014	.29
	2.51	226.1	.013	.29

Independent Sample T-test was conducted to compare the mean of the visitors and staff on the perceived effect of recreation activities on environmental resource attributes. It is only on soil where the two groups were found to be significantly different ($\bar{X}_{(visitors)}=2.14$, $\bar{X}_{(staff)}=1.50$, $t=6.06$, $df=233$, $p<0.001$).

Hypothesis 1: Ho₁ - Parks environmental resource attributes are not negatively affected by recreation activities in the national parks in the Central Kenya region was rejected.

Discussions

The respondents indicated soil and vegetation followed by wildlife and water respectively as the environmental resource attributes affected by recreation activities. In support of the finding on water as the most affected resource attribute, (Cilimburg, 2000) affirms that most management concern with water pollution has centered on the potential for transmission of disease by organisms present in water. Many different organisms are capable of causing illness in humans. The study indicated that, there are three prominent sources of water contamination: wildlife and pack stock; domestic livestock; and from the recreational user and his dogs. Even where animal contamination is absent, bacteria and other pathogens can be found in the soil, forest floor, and

stream sediment. Therefore, even so-called untouched areas receiving almost no recreational use at all can harbor organisms that are harmful to humans.

Studies carried in mountainous wilderness on water quality in the West Kings Canyon National Park have generally found very low levels of bacterial contamination even in areas of concentrated use. Coli form bacteria counts were usually low enough to allow drinking (Well & Laucroth 2007). This contradicts the findings of this study where respondents indicated water as the environmental resource attributes that is most affected by recreation activities. This was followed by wildlife.

This is attributed to the fact that visitors can impact wildlife through a variety of means either directly or indirectly. The most direct impact visitors have is death and injuries as a result of vehicle accident. Visitors can also impact wildlife indirectly through stress and behavior modification due to proximity, feeding, accidental fires, noise, traffic and harassment. Studies in Yellow Stone National Park suggested that 2% of the park's mule deer, elk mule and wolves are killed by visitors vehicles each year and in Yankari and Kainji National park in Nigeria; bushbuck, roan antelope and hartebeest are common road way fatalities. In these areas strict enforcement of speed limits and visitors' education are being used to reduce loss. Muthee (1992) has described a scene in Kenya where as many as 30 minibuses surrounded lions and leopards to allow close-up photo opportunity. In Mt. Kenya and Aberdares there are areas where vehicles are prohibited and speed limit enforced to reduce wildlife impact and wildlife feeding is also prohibited.

The impact on vegetation slightly exceeded that of soil. This was attributed to the fact that in case of trampling of vegetative area, the ground cover being the immediate recipient of the mechanical pressure of the ground bear the force first (Cole, 2001; McEwen, 2001) support that most studies found camping activities do generate substantial and usually localized vegetation and soil changes. High levels of groundcover loss and soil exposure even with modest use has been reported For example, in Prince William Sound of Alaska Park, low-use campsites lost 93% of their vegetation cover on gravel sites and 81% on organic soil sites (Cole, 2001).

McEwen (2001) showed that, one night of camping reduced relative vegetation height by 60% or more. The impact associated with three additional nights of camping was less substantial, further reducing relative cover to only 50%. Results from (McEwen 2001) study generally corroborate those of earlier studies (Cole, 2001) that demonstrate a non-linear use-impact relationship.

Hammitt and Cole (2003) demonstrate that soil tolerance is dependent on weather conditions at the time of trampling. Effect on soil is greater when soils are wet than when dry and that wildlife is more vulnerable to recreation impact at a certain time of the year, such as when giving birth, as well as certain time of the day, such as when feeding. Bowles (2004), state that trampling can compact the soil and damage surface litter, lichens and mosses. In British woodlands, heavy trampling severely reduced the population densities of soil, vegetation and litter dwelling invertebrates by up to 89% in path centers and by 57% at path margins when compared to undisturbed soil profiles.

Law (2000) asserts that it is not individual, but groups of environmental resources attribute that attract active recreation use and these groups often respond to recreation in complicated ways. Hammitt and Cole (2003) found that trampling, for instance, by hikers, walkers or climbers on

steep trails will likely cause direct impact on soil compaction and erosion. The erosion in turn may cause increased runoff and soil sedimentation that may damage vegetation and decrease water quality and to some extent affect quality of visitors' experience.

Independent sample t-test were used to examine mean differences between visitors and staff (H_{03})- Park environmental resource attributes are not negatively affected by recreation activity in national parks in Central Kenya region. Both the visitors and staff disagreed with the statement on number of resources; water, vegetation and wildlife, hence rejecting the hypothesis.

Conclusion

Hiking/Climbing/safari walk was rated as an activity with the greatest negative effect on the environment this is differed from non-traditional recreation activity like Mount biking, that is indicated to have greatest impact. Independent sample t-test were used to examine mean differences between visitors and staff- (H_{02}) and the hypothesis was rejected. Soil, vegetation, wildlife and water respectively were the most negatively affected environmental resource attributes by recreation activities. Independent sample t-test were used to examine mean differences between visitors and staff (H_{03}) and the hypothesis was rejected.

Recommendations

Since impact is inevitable wherever recreation use is allowed, it is imperative to set specific objectives and standards that will place a limit on impact. Then, through monitoring of conditions, managers will be able to more clearly identify when specific impacts have become so pronounced as to demand management attention. Since the demand for recreation is high than the supply, to minimize the impact, it is important to have information on the relationship between visitors numbers and activities and their impact on particular types of environmental resource. Research in these fields will therefore be critical for successful management of our parks.

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