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IN THE CENTRAL KENYA REGION**

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IMPACT OF RECREATION ACTIVITIES IN THE NATIONAL PARKS ON VEGETATION, SOIL, WATER AND WILD GAME IN THE CENTRAL KENYA REGION

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Abstract

Purpose: Outdoor recreationist are prone to selecting sites that have eye catching sceneries with nice weather and spectacular landscapes. However, visitation in the natural parks can cause substantial resource change in the national parks that can affect the parks' functionality. The aim of the study is to assess the impact of recreation activities in the national parks in the Central Kenya region on vegetation, soil, water and wild game.

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. 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. 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.

Results: Independent T-test was conducted to compare the perception mean rating between the visitors and staff on picnicking where visitors (\bar{X} = 1.82, SD=0.69) and staff (\bar{X} = 1.52,SD=0.69) the two group are not significantly different However, there is significant difference on Hiking/climbing/safari walk (\bar{X} =2.53,SD=0.76) and staff(\bar{X} =2.37,SD=0.87). The visitors rated Hiking/Climbing/Safari walk as the recreation activities that negatively affects environment followed by Bicycling/Mountain, biking/Game drive. The rating of hiking/Climbing/Safari walks both as recreation activity that was perceived to negatively affect environment and as the most preferred recreation activity is attributed to the visitors' perception that the more the use of a particular activity the more the impact on the environment.

Unique contribution to theory, practice and policy: 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.

Key words: recreation activities, national parks, vegetation, soil, water

Introduction

Over the years, national parks are set aside for the benefit of people. Their significance has been repeatedly emphasized by such landmark events as the London Convention of 1933 and more recently by criteria established through International Union for the Conservation of Nature (IUCN, 1997). The purposes of national parks mainly is protection of ecosystem and provision of various recreational activities to the visitor and the local community. The criteria were further expanded upon leading to more clear and defined benchmarks to evaluate a national park. These include: minimum size of 1000 hectares within zones in which protection of nature take precedence, statutory legal protection, budget and staff sufficient to provide adequate and effective protection and prohibition of exploitation of natural resources. National parks are latecomers to Protected Areas (PA) movements (IUCN, 1997).

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. Gradually the NPO created what is Kenya's National Park System (KNPS) (Whelan, 2007). According to Kenya Wildlife (2009), the KNPS have five regions. The five regions have 23 national parks, 28 national reserves, 4 marine national parks, 5 marine national reserves and 4 national sanctuaries. The regions span 17000 square miles or roughly 12% of Kenya's territory (Honey, 2005). The five regions of the national parks and reserves include central Kenya highlands and Rift Valley, Western Kenya, Northern Kenya, Southern Kenya and Coast.

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 (Akama 2000; Okello & Kirenge 2004). These 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). Thus the present study sought to evaluate the park staff and visitors' perceptions on the negative environmental effects of recreation activities with a view to making suggestions for improving the management of the recreation in national parks

Although neither the visitors nor the protected area management (staff) are really trained observers with respect to impact assessment, their opinion and input on usage and improvement

of park resources are important . Moreover, the visitors being the consumers of recreation products and the staff being the providers of the same are better placed to give their perception in assessing the impact of recreation product offered on the park environment. Furthermore, the use of visitors and staff perception on assessing the quality of recreation products is not entirely new. Hutchison (2009) used visitors and staff perception in understanding the relationship of quality, value, equity and satisfaction of Golfers. In Kenya southern part of Kakamega Forest a three-point Likert scale was designed to assess the perceptions of tourists on trail use impacts in Kakamega Forest where Spearman rank correlation between footpaths outside permitted trails and soil erosion along trails showed a positive, moderate correlation which was statistically significant (Kambona & Stadel 2006).

Statement of the Problem

Travel and Tourism is said to have generated US\$7.6 trillion (10% of global GDP) and 277 million jobs (1 in 11 jobs) for the global economy in 2014. International tourist arrivals are a catalyst for investment in other sectors, and it stimulates economic diversification across sectors. In Kenya, visitor exports generated KES160.1billion (18.3% of total exports) in 2014. This is forecast to grow by 1.4% in 2015, and grow by 5.1% per annum, from 2015-2025, and by 2025, international tourist arrivals are forecast to total 2,093,000, generating expenditure of KES265.9billion, an increase of 5.1% per annum (WTTC, 2012).

The parks in Central Kenya are recipients of a proportion of this large number of tourists and are subsequently bound to experience environmental conservation challenges. For instance, public campsites at Chinia Falls and at Queen Banda in Aberdares were closed in early 1990s due to trampling effect on vegetation and soil. The campsites were reportedly reopened in early 2000 (Western, 2000). Recreation resource impact is a valid management concern for both ecological and social reasons. Indeed, previous ecological research has demonstrated that recreational activities can make extensive local impact on soil, vegetation, water and wild game.

Recreation resource impacts have also been found to have undesirable social consequences such as visitors' conflict and overcrowding which may affect their recreation experience (Cole, 2001). Recreation experience can also be compromised by the existence of resource impact through their resource functionality, visitors' safety and aesthetic quality (Hammit & Cole, 2006). Also, there are few studies explaining the danger posed by increased tourism to conservation of natural resources in Kenya. Park managers have been striving for knowledge on the cause and nature of impact as well as to assess environmental impact of recreation activity. Hence, there is need for this study

Recreation impact is inevitable wherever recreation use is allowed and park management can only limit, not prevent it. Cumulative impacts in the parks may affect visitors' satisfaction due to unattractiveness or even closure of the recreational sites. This may have negative impact on Kenyan economy since nature based tourism is the largest component of tourism industry in Kenya which account to 70% of tourism earning and 20% of gross domestic product (Akama, 2000) .The industry was also identified as one of the six priority sectors in vision 2030 meant to drive economic growth of 10 percent. Recreation impact if not controlled will threaten the tourism which plays a vital role in Kenya's economy hence there is need for this study

Purpose of the Study

To assess impact of recreation activities in the national parks on vegetation, soil, water and wild game in the Central Kenya region.

Literature Review

Impact of Recreation Activities on Soils

The soils of Mt Kenya region are classified into the four broad categories; In the highest mountain area, above 4000m the soils are shallow and consist of very stony dark loams with high organic matter and low bulk density. They include Leptosols, Regosols and Greysols. The soils on the upper slopes between 2400m and 4000m have dark surface horizons and low bulk density, they are also rich in organic matter and are mainly formed from young pyroclastic rocks. They include; Regosols, Histosols and Andosols. The soil below 2600m is influenced by amount of rainfall. The soils are intensively red with considerable amount of clay. The main soil groups are Nitisols, Cambisols and Andosols. Finally, soils on the western plains and to the northwestern of the mountain are characterized by low rainfall, grassland zone with low rainfall. They have dark top horizons and high proportions of clay minerals. The main soil types are Phaeozems, Planosols and Vertisols (Wangila, 2000).

In Aberdares, the soils on the upper eastern slopes have inherent high fertility, being of basaltic origin. They are well drained, normally very deep, dark reddish brown, friable clays with a humid top- soil layer. Western boundary soils are of medium and high inherent fertility, but are more variable and interspersed with poorer draining soils and lower fertility. The soils of the moorlands are umbric andosols. They have a high content of organic matter and are very porous. The drainage and water retention capacity are good for plant production. Soils of the Northern Aberdare are rich in clay content (82.7%) and consist almost exclusively of kaolinite. Red kaolinite soils are dark grey and found on slopes. There are black cotton soils found in areas of impeded drainage. Southern soils are characterized by dark surface horizons and are rich in organic matter. Their bulk density is low and include; Leptosols, eutrophic and Gleysols (KWS, 2009).

Marion and Wimpey (2007) said that soil plays a vital ecological role. It is the medium for infiltration of precipitation and movement of groundwater to streams and ponds. Soil supplies nutrients and water to plants, and stores and recycles mineral nutrients and carbon. Soil provides habitat for a vast number of micro-organisms that mediate numerous ecological processes such as nutrient cycling. Tramping is a great cause of soil disharmony. It creates several types of disturbances, particularly removal of plants and plant litter, compaction, and misplacement. Compaction occurs on trails and campsites as the force of the feet of users, and tyres of bikes compress soil particles, eliminating voids between soil particles, and reducing soil volume. This condition degrades the habitat of soil organisms that recycle nutrients and support plant growth. Bare or compacted soils tend to shed precipitation, reducing the amount of precipitation that infiltrates into the soil (KWS, 2009).

Saturated areas with fine soils such as wetlands are key examples of locations that are highly susceptible to environmental impacts from recreational use (Schlichte, 2009). Riparian areas and

wetlands areas of the Kenyan parks are generally dependent on supplies of ground water as opposed to direct precipitation and can be impacted by increased surface runoff leading to changes in ground water recharge and availability. When compaction causes a trail to become an agent for runoff water, susceptibility to erosion increases (Marion & Wimpey 2007).

Marion (2002) states that impact of recreation on soils can be substantial. One study by National Park Service of the United States of America found that undesignated trails in general were over three times more eroded than designated trails. Jewel and Hammitt (2000) reported that erosion of trail surfaces caused by trail use is not an impact that the environment can recover from over time unless they are removed; the trail causes most of the environmental impact.

Studies have shown that environmental factors such as slope gradient and type of soil are important in determining ground incision and soil erosion than use-related factors such as the type of recreational use (Marion & Lecing, 2001). Location, rainfall intensities, and slope gradient are environmental factors that play a primary role in the amount of soil loss, while soil properties such as structure, texture and moisture content play secondary roles (Wilson & Seney, 2003). Aberdares and Mt. Kenya are sloppy areas with fine soil that do receive high rainfall. Then, if recreation activities are not well managed substantial damage may be caused onto the soil.

Camping can also have an impact on soils. The concentrated use of dispersed campsites where there is no well-defined boundary can result in the nutrient properties of soil being affected by people continually walking in and around an area (Zabinski, 2000). Soils near campsite can also be compacted due to continuous use, resulting in increased risk of erosion and runoff (Cole, 2001; Buckley, 2004).

Hiking, climbing and mountain cycling and game drive being most preferred recreation activities in national parks in central Kenya region can affect habitat through soil compaction, trampling of vegetation, damage to surface litter and vegetation, and erosion. Compacted soil is difficult to revegetate because the small roots of seedlings may not be able to penetrate the soil (Berge and Latin; 2000). Hence, Kenya parks managers should strive to balance any recreation ecological change with the requirement to conserve biological diversity in the parks..

Impact of Recreation Activity on Vegetation

Kenya's forests play many important roles: they trap and store rain water; regulate river flow and prevent flooding; help recharge ground water tables; improve soil fertility; reduce soil erosion and sediment load in river water; help regulate local climate conditions, they also serve as cultural, ceremonial and recreational sites (Schlichte, 2001). However, in recent times there has been marked loss of vegetation cover in national parks. The loss of natural vegetation in the parks in Kenya has been blamed on the increase in the numbers and mobility of tourists (Onyeanus, 1996).

Disturbance by recreational activities can have major impacts on flora and fauna at individual, population and community level in the short and long term. The use of campgrounds, trails and road by recreational users, for example, presents two potential environmental impacts to vegetation. One is the loss of vegetation and the other one is introduction of invasive species.

Vegetation loss varies greatly depending on the type of vegetation being impacted and, the type and amount of use (Cole & Trull, 2004; Cole, 2006).

The most substantial factor affecting vegetation loss is the durability of the type of vegetation, which is based on species resistance and resilience to disturbance and the ability to recover from trampling. At lowest levels of recreational use, some species of vegetation may recover from trampling and soil compaction in a short period of time. However, once recreational use meets or exceeds reasonable levels the impact to vegetation will be substantial and may take several years for recovery to occur (Cole & Trull, 2004).

In Kenya, at Masai Mara National park, off road driving by visitors is often perceived as a severe ecological problem. Vehicles can cause damage to; vegetation, cause soil compaction and erosion, alter the species composition and influence the recovery of grass species (Muthee, 1992). Annually, the park receives around 24,000 vehicles, that's average of 2.5 vehicles each day. A study in the 1980s found that there were conspicuous secondary tracks over extensive areas totaling 15.3 per cent of the reserve's area, and increased vehicle densities and speeds correlated with greater loss of vegetation cover and increased soil compaction on grasslands. Onyeausi (1996) found that at Treetops Lodge, in Aberdare National Park, Kenya, large quantities of salt are dumped just below the lodge windows, to lure animals into view. The salt leaches into the surrounding soil and has caused the vegetation around the nearby waterhole to die off.

The second concern relates to the spread of invasive species. Invasive species threaten the parks' biological richness and diversity and various industries for timber and agriculture. Invasive species can be highly adaptable to a variety of environments, spread easily and displace or eliminate native vegetation. Recreational trails and roads can serve as primary corridors for transportation of invasive species that threaten vegetation makeup of the forest (Well & Lauroth, 2007). Invasive species have been reported in some forest areas of Abardares national park particularly in open areas from forest fires and plantation backlogs. The common species include Lantana, Mauritius thorn, *Acacia melanoxylon*, *Acacia meansii* and *Rubus stendineri* species. (KFS, 2010).

In Mt Kenya, Some degraded sites have experienced invasive plant species; key of which include Mauritius thorn, (*Caesalpinia decapelata*), Jimsonweed (*Datura dothistroma*), Sodom's apple (*Solanum incanum*), Curse of India (*Lantana camara*) and (castor plant (*Resinus communis*). Mexican Green Ash (*Fraxinus pennysilvania*). Invasive plants are perceived to inhibit recovery of degraded or backlog forest sites. Areas affected are exotic plantation backlogs and indigenous forest sites namely Kangaita , Irangi and Chogoria, Meru forest, and Mucheene forest. Since Mt Kenya ecosystem is a continuum of habitats and considering that invasive species impact on agriculture, recreation and conservation, the issues require both direct and indirect management practices by all National Parks stakeholders (Mount Kenya Ecosystem, 2010).

Impact of Recreation Activities on Water Quality

Mt. Kenya ecosystem is of major economic and ecological importance in Kenya due to its value as a watershed and catchment area. The mountain is one of the five main water towers of Kenya.

It is the source of two of Kenya's largest rivers, the Tana and Ewaso Nyiro. The mountain contributes about 50% of the entire flow of the Tana River, the largest and most important river basin in Kenya. About 50% of Kenyans rely on water that originates from the mountain and it provides 70% of the country's hydroelectric power (Rhino Ark, 2011).

Like Mt Kenya, Aberdare also plays a critical role in water catchment for the country and is one of the five main "water towers" of Kenya together with, Mau Complex, Cherangani Hills and Mt. Elgon, all providing most of the nation's water. Major rivers from the Aberdare Forest are Tana and Athi which flow into the Indian Ocean, the semi-permanent Ewaso Nyiro which drains into Lorian swamp in northern Kenya and River Malewa that drains into Lake Naivasha. Aberdare range supplies all the water to Nairobi through Sasumua and Ndakaini dam. It also supplies water to the major towns in the neighboring counties (KWS, 2008).

Hunter and Green (2000) note that most recreation activities can severely impact water supplies in an area. Of concern is the unregulated discharge of sewage which can have severe implications for the ecology of tourist areas, as well as for the health of both tourists and locals who use contaminated water for drinking, bathing and cooking. When discharged into enclosed inland water bodies, sewage can result in excessive algal growth. Similarly, sewage released into the sea may have implications for coral reefs if algae grow to such an extent as to cover large sections of the reef and prevent the corals from obtaining light and essential nutrients.

Cole (2006) points out that, tourism industries do overuse water resources for hotels, swimming pools, golf courses and personal use. This results to water shortage and degradation of water supplies, as well as generating a greater volume of waste water. Golf courses, for example, require a huge amount of water every day and this can result to water shortage. If the water comes from a well, over-pumping can cause salty intrusion into groundwater (Moor, 2003). Construction of hotels, recreation and other facilities often lead to increased sewage pollution. Waste water pollutes seas, lakes and rivers surrounding tourist attractions and damaging the flora and fauna.

Hammit and Cole (2003) affirm that water quality and quantity is a major concern, but apparently not a prevalent impact in recreation areas since there is conflicting evidence regarding the effect of recreation on water. The connection between human waste from outdoor recreation and its ultimate effects on aquatic systems are poorly understood and probably highly variable. Research done so far, indicates little threat to water quality from human waste as a result of outdoor recreation, with the exception of recreational facilities receiving high levels of use (from boating, fishing and swimming) during peak seasons (Cilimburg, 2000).

Recreation Activities and Wildlife in Parks

Kenya's distinctive landscape supports bountiful and diverse wildlife of scientific, intrinsic, and economic value and has a considerable expanse of wildlife habitat. The recreational satisfaction of wildlife can either be non-consumptive or consumptive (GOK 2007; KWS 2008; Western 2000). According to Rhino Ark (2011), wildlife tourism encompasses a range of activities, including wildlife watching, walking safaris. Investigations into the effects of recreation on wildlife have been less systematic than those of vegetation and soils. Recreation activities can impact animals in four different ways. Animals can be indirectly affected through habitat

modification or through pollution (particularly through leaving trash). They can be directly affected through exploitation--hunting, fishing, trapping or collecting. Finally, they can be directly disturbed either intentionally or unintentionally. Impact to wildlife caused by recreation may be far-reaching than those experienced by plants and soils, due to the fact that wildlife are able to migrate and to pass learned responses to their offspring (Cole, 2006). Indirect impacts, like habitat modification, can affect an animal's ability to get food, and as a result, the entire food chain of which that animal is a part can be affected (Knight & Cole, 2001). A key factor in determining the degree to which wildlife are disturbed by recreational use relates to location in which the disturbance occurs. Studies have shown that wildlife appear more disturbed by recreational users in areas where humans are less common, such as off-trails (Knight, 2000; Kenny, 2004).

Honey (2005) observes that in Kenya at Amboseli National Park which is a small and heavily visited park, provides good visibility and allows as many as 30 vehicles to crowd around a single group of cheetahs. A study carried out in the early 1970s revealed significant disturbance to the daily activity patterns of cheetahs (Honey, 2000). Some routine activities only occurred when vehicles were absent or fewer than six in number. Cheetahs appeared to actively avoid vehicles, and delayed hunting in their presence.

In East Africa, balloon safaris are a now a feature of wildlife tourism in certain protected areas, and appear to cause considerable distress to particular species, notably buffalo and lion (Sindiyo & Pertet, 1994). As a result, keeping human recreational activities focused to discrete areas can be important in reducing the degree of any disturbance. Wildlife is more susceptible to the stress caused by disturbance during certain periods of time such as during the winter, migration or pregnancy (Joslim & Youmans, 2000). Continuous stress placed on wildlife as a result of recreation during periods of heightened susceptibility may eventually cause illness or death, including an increased potential for pregnant wildlife to abort (Anderson, 2004). Wildlife is also affected by habitat modification. As a result, any impacts that compromise a habitat may also compromise the wildlife that relies on that habitat.

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 shows analysis of rating of recreational activities that perceived to negatively affects the environment.

Table 1: Rating of Recreational Activities that Perceived to Negatively Affects Environment

Recreation Activity	Least effect		Not sure		Most affected			TOTAL	
	N	%	N	%	N	%	Rank	N	%
Hiking/Climbing/ Safari walk	55	21.5	33	12.9	168	65.6	1	256	100.0
Bicycling/Mt. Biking/Game drive	100	38.9	47	18.3	110	42.8	2	257	100.0
Camping	133	51.8	30	11.7	94	36.6	3	257	100.0
Game Viewing/ Bird watching	132	51.6	67	26.2	57	22.3	4	256	100.0
Picnicking	123	48.2	98	38.4	34	13.3	5	255	100.0

From the Table 1 the staff and the visitors rated hiking/ climbing/safari walk at 168(65.6%) and cycling/Mt biking/game drive 110(42.8%) respectively as the recreation activities that are perceived to have most negative impact on the environment in the Parks. They also rated game viewing 132(51.6%) and picnicking 123(48.2%) respectively as recreation activities that are perceived to have least negative impact on the environment in the parks. The mean and standard deviations for visitors and staff on perceived rating of recreation activity is shown on table 2

Table 2: Mean and Standard Deviation for Visitors and Staff on Perceived Rating of Recreation Activity

Rating of Recreation				
Activity	Category	N	\bar{X}	SD
Camping	Visitor	115	1.77	.93
	Staff	142	1.91	.93
Hiking/climbing/ safari walk	Visitor	115	2.53	.76
	Staff	141	2.37	.87
Cycling/mountain biking/ Game drive	Visitor	115	1.67	.83
	Staff	142	2.34	.85
Game viewing/Bird watching	Visitor	115	1.87	.80
	Staff	141	1.57	.79
Picnicking	Visitor	114	1.82	.69
	Staff	141	1.52	.69

Table 2 shows that: among the visitors, hiking/climbing/safari walk had the highest Mean (\bar{X} =2.53,SD=0.76), followed by game viewing/Bird watching (\bar{X} =1.87,SD=0.80), and picnicking (\bar{X} =1.82, SD=0.69). While among the staff the mean and standard deviation were as follows hiking/climbing/safari walk (\bar{X} =2.37,SD=0.87), cycling/Mt biking (\bar{X} =2.34, SD=0.85), camping (\bar{X} =1.91,SD=0.93). On the other hand, from the staff picnicking (\bar{X} =1.52, SD=0.69) and game viewing/Bird watching (\bar{X} =1.57, SD=0.79) had the least mean. Table 3 shows independent sample T-test on rating of recreational activities that have most negatively affected environment

Table 3: Independent Sample T-test on Perceived Rating of Recreational Activities that have Most Negatively Affected Environment

	T	df	Sig(2tailed)
Camping	-1.16	255	.25
	-1.16	244.20	.25
Hiking/climbing/ safari walk	1.57	254	.12
	1.59	252.35	.11
Cycling/ mountain biking/ Game drive	-6.32	255	.00
	-6.33	245.70	.00
	2.95	254	.00
Game viewing/Bird Watching	2.94	243.09	.00
Picnicking	3.43	253	.00
	3.44	242.94	.00

Hypothesis 2: Ho₂-There is no single recreation activity that has high rating of impact on the environment in national parks in Central Kenya region.

Independent T-test was conducted to compare the perception mean rating between the visitors and staff on picnicking where visitors (\bar{X} = 1.82, SD=0.69) and staff (\bar{X} = 1.52,SD=0.69) the two group are not significantly different However, there is significant difference on.Hiking/climbing/safari walk (\bar{X} =2.53,SD=0.76) and staff(\bar{X} =2.37,SD=0.87)

Hypothesis 2: Ho₂ was rejected.

Table 4: Perceived Negative Effect of Recreational Activities on Vegetation, Soil, Water and Wild game

Recreation Activity	Soil Compaction		Littering		Water overuse/ Waste		Water Pollution		Animal Disturbance		Animal Killing		Reduced Vegetation		Total.	
	N	%	n	%	N	%	n	%	N	%	n	%	n	%	N	%
Camping	25	21.9	4 3	37.7	13	11.4	5	4.4	7	6.1	5	4.4	16	14.0	114	100.0
Hiking/ Climbing/ Safari walk	36	32.4	5	4.5	21	18.9	22	19.8	7	6.3	3	2.7	17	15.3	112	100.0
Cycling/Mt. Biking/Game drive	68	60.7	6	5.4	5	4.5	2	1.8	6	5.4	1	.9	24	21.4	112	100.0
Game Viewing/ Bird watching	2	1.8	7	6.2	25	22.3	9	8.0	59	52.7	3	2.7	7	6.2	113	100.0
Picnicking	7	6.2	5 1	45.1	9	8.0	5	4.4	28	24.8	12	10.6	1	.9	114	100.0

Table 4 shows that: cycling/Mt. biking/game drive and hiking/climbing/safari walk were perceived by 68(60.7%) and 36(32.4%) respondents respectively to have the greatest effect on soil compaction. Picnicking and camping at 51(45.1%) and 43(37.7%) respectively were perceived to have the greatest causes of littering. hiking/climbing/safari walk 22(19.%) were perceived as a great cause of water pollution. Game viewing/bird watching/picnicking at 59(52.7%) and 28(24.8%) respectively were perceived as leading causes for animal disturbance. Picnicking 12(10.6%) was perceived as the greatest causes of animal killing. Cycling/Mt biking/Game drive at 29(25.7%) were perceived to cause reduced vegetation on the environment. Mean and standard deviation for visitors and staff on perceived rating of recreation activities that negatively affect environment are represented on table 5.

Table 5: Mean and Standard Deviation for visitors and staff on perceived rating of recreation activities that negatively affect Environment.

Category	N	\bar{X}	SD
Camping negative impact	114	3.04	2.05
Hiking/climbing/safari walk	111	3.32	2.10
Cycling/Mt biking/Game drive	112	2.74	2.49
Game viewing/Bird watching	112	4.37	1.31
Picnicking	113	3.32	1.66

Result in Table 5 show that game viewing/bird watching has (\bar{X} =4.37, SD=1.31), followed by swimming (\bar{X} =4.35, SD=1.28). These two activities were perceived to have highest mean in affecting the parks environment negatively. While cycling/Mt biking/game drive (\bar{X} =2.74, SD=2.49), camping (\bar{X} =3.04, SD=2.05) and hiking/climbing/safari walk (\bar{X} =3.32, SD=2.10) were perceived to have the lowest mean in affecting the parks environment negatively

Discussions

The visitors rated Hiking/Climbing/Safari walk as the recreation activities that negatively affects environment followed by Bicycling/Mountain, biking/Game drive. The rating of hiking/Climbing/Safari walks both as recreation activity that was perceived to negatively affect environment and as the most preferred recreation activity is attributed to the visitors' perception that the more the use of a particular activity the more the impact on the environment. Coupled with the key generalization regarding walking and hiking is that impact is one inevitable with repetitive use. According to Watson *et al*, (2010) walking and hiking is the most frequent and popular activities conducted in natural areas such as forest and park wilderness. This then, support that the magnitude of impact is a function of frequency of use and the type and behavior of use. The season of use, environmental conditions, and the spatial distribution of use are factors that affect impact.

The rating of bicycling/mountain biking/game drive followed by hiking/Climbing/Safari walks as activities that are perceived to negatively affect environment is attributed to the fact that the visitors use heavy fuel machines to penetrate deep into the parks. A mountain-biking study

conducted in the UK by Schlichte, (2001), contradict this finding. Where the study compared the perceptions of mountain bikers, hikers and horse riders on the impact these recreational groups have on the countryside. The three user groups were represented in the study and most believed that the, other recreational groups caused more damage to trails than their own recreational activity. For example, horse riders were aware that horses' hooves might cause trail damage but they believed that mountain biking 'behavior' and the fact that mountain bikers tend to concentrate in one area would have a greater impact on the environment.

According to Moor (2003), mount biking and horseback riding have the most impact on trails. Most impacts are related in some way to amount of recreation use although the relationship is curvilinear, most damage to soil and vegetation at recreation sites occurs after relatively few groups of use. After the initial impact, additional groups cause less damage per group (Cole, 2001). On the impact of specific activities, Hall and Whyte (2007) reported that, some like, Mountain cycling and game drive cause more or faster impact than others. So it is good to remember that all recreation activities have impacts on the environment, especially on soil, vegetation and panorama. This depends on numerous factors of the study area, notably: ground slope, materials and moisture; levels and persistence of use. The weight, speed and technology of users; and remedial management actions are other factors of the study area.

Cycling/Mt biking/ game drive and hiking/climbing/safari walk were perceived to have the greatest effect on soil compaction.. Most compaction occurs as a result of trampling. Trampling either by visitors or recreational stock is the fundamental impact force applied to trails and campsites, directly affecting vegetation and soil within trampled zones.

According to Cottrell & Graefe (2000) the activity most done in Marshall Mesa and East Boulder Gunbarrel parks was hiking (n=256; 20.6%), followed by biking (n = 193; 15.5%), walking (n = 179; 14.4%), and walking dog(s) (n = 144; 11.6%). The study support this. Picnicking and camping were perceived to have the greatest cause of littering. This is attributed to the fact that, visitors spend considerable time on campsites. Their activities can disrupt normal wildlife activities, attract animals or alter wildlife habitat through vegetation and soil impacts through solid littering. Hence wildlife that avoids areas with campsites can be displaced from vital riparian vegetation and water sources, a particularly critical impact in desert environments (Hammitt and Cole 2003).

To minimize or limit these impacts it is good to appreciate and respect the seven Leave No Trace principles of the outdoors. This includes; Plan ahead and prepare, travel and camp on durable surfaces and dispose of waste properly. Others include Leave what you find. Minimize campfire impacts and respect wildlife and be considerate of other visitors.

Marion (2002) and Cole (2004) affirmed that the impact of visitors on the ground can have significant trampling effects in the park natural environment. These can include vegetation damage/ abrasion, reduced plant/vegetation cover, reduced plant species density, decreased leaf litter biomass, organic soil removal and compaction, reduced plant genetic and species diversity, and increased trail width and depth.

Independent sample t-test were used to examine mean differences between visitors and staff perceptions (H_0); There is no recreation activity that has high rating of impact on the

environment in national parks in Central Kenya region. Both the visitors and staff disagreed with the statement on number of recreation activities for instance Hiking/Climbing/Safari walk, hence rejecting the above hypothesis

Conclusion

The study revealed that the staff and visitors perceived camping to have most effect on littering while Hiking/climbing/safari walk was perceived to have most effect on soil compaction while cycling/Mt. Biking/Game drive was perceived to have most effect on soil compaction. Game Viewing/Bird Watching was perceived to have most effect on animal disturbance, while picnicking was perceived to have most effect on littering

The study also revealed that water, wild game and vegetation were perceived to be the most affected resource attributes. Soil was perceived to be the least affected. Majority of the both staff and visitor were of the perception that the parks resources needed to be improved. The most preferred recreation activity was Hiking/climbing/safari walk, which is a traditional non-consumptive recreation activity that requires no specific learned skill. However, none of the recreation activity recorded non preference. The respondents' perception was measured on a 3-scale. 1= minimum preferred 3=maximum. Independent sample t-test were used to examine mean differences between visitors and staff- (H_{01}) and the hypothesis was rejected.

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.

Recommendation for Policy and Practice

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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