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Full Length Research Paper

Prevalence of human – elephant conflicts in Amboseli ecosystem, Kenya: Current opinions of local community

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Elephants capture the affection of people due to its size, social behavior and its flagship role in tourism. But it also elicits animosity because of the damages and insecurity it causes to local communities. This paper examined the current opinions of local community on human – elephant interactions in Amboseli Area. Results indicated that local community participation in elephant conservation was low. However, a majority (76%) of local community members indicated that elephant conservation was possible, and 70% said it was important. Most people (88%) believed that there was an overall increase in elephant numbers, and associated human – elephant conflicts in recent years. The majority (83%) blamed conflicts on human encroachment on elephant space, elephant crop raiding (82%), and indifference to the plight of local community by conservationists (78%), effects of drought and climate change (75%). Helping the local community bear the cost of elephant conservation by preventing damages, providing benefits, and being inclusive in elephant conservation process is a better strategy at elephant conservation.

Key words: Amboseli ecosystem, elephants, human – elephant conflicts, Kenya.

INTRODUCTION

Few wild animals elicit drastically different human emotions, as do elephants. They capture the imagination and unswerving affection of people worldwide but also inspire animosity and fear among those sharing their land with these mega-herbivores (Western 1989; Yaw and Lonneke 2008). Two factors have a large effect in determining the numbers and distribution of elephants in Kenya, and elsewhere in Africa. These are poaching or hunting, and competition for or conversion of land by people (Esikuri, 1998; Archie and Chiyo, 2012; Litoroh et al., 2012, Okello et al., 2009; Okello et al., 2010). There has therefore been a steady decrease in elephant habitats over many decades throughout Africa wherever human populations have increased (Spinage, 1990). Thus, Spinage (1990) established that there is a linear, negative relationship between human population size and elephant density. However, coexistence is possible at low human densities, while loss of habitat occurs at a critical threshold level of roughly 15 people per km^2 (Spinage, 1990). Field reports from across Africa describe local

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community antipathy to elephants beyond that expressed for any other wildlife species (Okello, 2005; Okello et al., 2010; Litoroh et al., 2012). Communities surrounding forest reserves and conservation areas engage in small-scale subsistence and cash-crop farming. Those farms close to the boundary are vulnerable to elephant crop damage, which is most intense during the food crop-harvesting season, but also occurs to a lesser extent throughout the year (Sitati et al., 2005). Elephants jeopardize communities' food security and livelihoods and communities' attitudes towards elephants are consequently and consistently negative. Resolving this conflict has become critical to the improvement of the livelihoods of rural communities co-existing with elephants and the conservation of the elephant populations (Yaw and Lonneke, 2008). The resolution of direct conflict between humans and elephants in Africa has become a serious local socio - political issue in recent years, and a continental conservation problem (Hoare, 1999; Sitati et al., 2005). Many studies have therefore shown that elephant causes diverse damage types including crop depredation, property damage and even threat to human life. Hoare (1999) states that 80% of the African elephant's range lies outside formally protected areas, and inadequate management of the conflicts with humans is frequently a pre- cursor to further decline in the numbers and distribution of elephants (Litoroh et al., 2012).

For decades, the relationship between the Maasai and wildlife found on their land has been described as "harmonious" and "tolerant." However, this situation has changed and intense conflicts and completion for space and resources like water and pasture characterizes Maasai land. Due to decline of suitable elephant habitat quality in Amboseli over the years (Esikuri, 1998), elephants frequently use areas outside the park leading to an escalation of human-elephant conflicts, with 489 elephant damage incidences recorded between June 1996 and July 1997 (Esikuri, 1998). Therefore degradation of elephant habitats outside Amboseli N. Park due to inappropriate human activities or as a result of climate change will give rise to higher prevalence of conflicts between elephants and local communities (Okello and Kioko, 2010).

Sitati et al. (2005) investigated susceptibility of farms to crop raiding by African elephants in Kenya. He noted that crop raiding by elephants eroded their tolerance by locals and impeded conservation efforts. He showed that within conflict zones, crop raiding was not distributed equally amongst farms due to variation in local physical or geographical factors, or in farmers' efforts to defend their fields. The application of enhanced early warning and guarding effort on previously raided farms reduced incidents of crop raiding by 89.6% over 2 years in comparison with a control group of farms. They therefore concluded that early detection of elephants approaching fields increased guarding effort, and the use of active deterrents could form the basis of an effective mitigation strategy regardless of location and the physical attributes of a farm (Sitati et al., 2005).

The importance of Amboseli area for elephant conservation in terms of stable populations, also the increasing human encroachment of elephant dispersal areas make human – elephant interactions persistently negative and desiring informed effort to containing the conflicts. From the foregoing synopsis of various aspects of the African elephant – human interactions, it is important to frequently assess and monitor the conflict types, the prevalence and severity of threats humans and elephants pose to each other. It is also critical to identify drivers of the conflicts and identify hotspots where they are more prevalent so that appropriate mitigation strategies borrowed from good practices reported in literature can be applied. This study sought to examine these aspects within the Amboseli Area.

Objectives

The overall objective of this research was to establish the opinions of the local community (both Maasai and other immigrants into the area) on human – elephant conflicts and drivers of such conflict. The specific objectives were to:

i) Evaluate threat types posed to elephants by humans, and posed to humans by elephants in Amboseli Area.
ii) Evaluate the prevalence and severity of threats to both elephants and humans based on perceptions of the local communities in Amboseli Area.
iii) Identify resources that are competed for between humans and elephants that fuel conflicts.

METHODS

This work was done in Amboseli Area between January and June 2013. Amboseli area covers over 5,000 km^2 with surrounding Maasai group ranches and privately owned lands 1). It involved interviews with local communities. Doing a study on the threats to elephants and what threats they pose to the local communities. Questionnaire interviews were administered by trained translators (using English, Kiswahili and local languages). The entire Amboselil ecosystem was covered in this study and included Kimana, Kuku, Rombo, Olgulului – Ooloorashi, Mbirikani group ranches, and private lands near the slopes of Mt. Kilimanjaro (Figure 1). Field data was obtained using a systematic sampling scheme of household leaders (one adult person per home) as a sampling unit in randomly chosen clusters of settlement in Rombo, Mbirikani, Kimana, Olgulului and Kuku group ranches as well as private farms especially around the cultivated areas in closer to Kilimanjaro area. Perceptions and views were collected questionnaire interviews. A total of 328 households (over 30% of household population) were interviewed in the entire ecosystem from about 900 total households in the study area.

Some of the key issues that were addressed during the interview discussions included types of threats that elephants face from

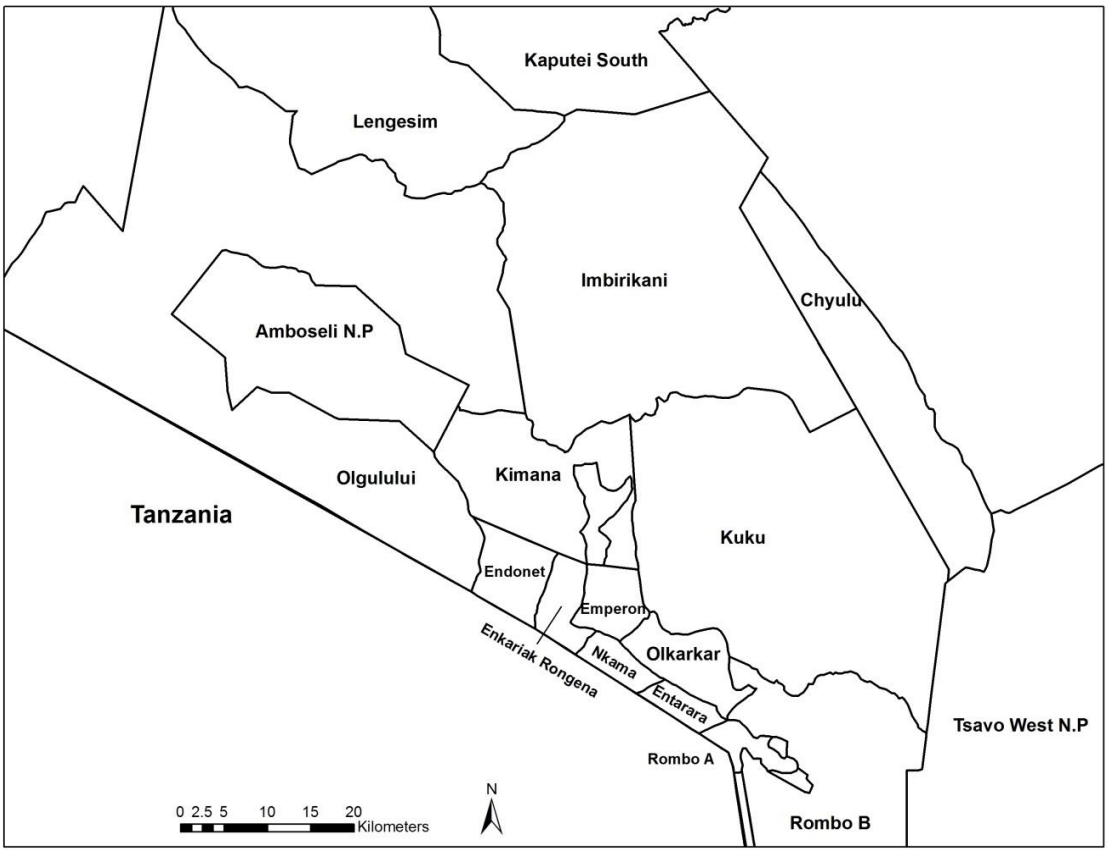

Figure 1. Amboseli and surrounding private and communal Maasai group ranches in Southern Kenya.

people, those that people face from elephants, key resources competed for, and reasons for that competition. Respondents were also requested to score on an ordinal scale of 1 (lowest) to 10 highest for both the prevalence and severity of the identified threats. The seasons and times of the year when conflicts were high, critical resources competed for by humans and elephants, drivers of human – elephant conflicts, locations (hotspots) where these conflicts mostly occurred, and places (hotspots) where these conflicts are most prevalent were also established. The kind of mitigation strategies the local community thought would work in containing the escalating human – elephant conflicts in the ecosystem were also examined.

Using the data collected, descriptive and inferential analysis was used to establish frequencies and means of responses (and their percentage) to the issues that were evaluated during the study. Where appropriate, Chi – square goodness of fit test was used to establish equality of frequencies of responses. Chi – square cross tabulations were also used to establish if there was a relationship between interviewee attributes and their responses (Zar, 1999), and the direction of the dependence, if any.

RESULTS

General community opinions on elephant conservation

Of the local community members interviewed, a majority (53%) had no formal education and very few had secondary and post – secondary education (Table 1). Local community participation in elephant conservation policies and strategies was low, with only 31% were involved. About half of the community members (51%) were willing to be involved in elephant conservation strategies, although 293% of the respondents were undecided on this (Table 1). A majority of community members (76%) were in indicated that elephant conservation was possible (76%) and important (69%) in the Amboseli region (Table 1). Opinions on whether the community was involved in elephant conservation in the Amboseli was dependent on location (χ^2 = 18.41, df = 10, p = 0.048: higher trends for proximity to wildlife parks and sanctuaries); and land use practiced (χ^2 = 18.29, df = 6, p = 0.006: highest where pastoralism was the main land use and lowest where agriculture was practiced). Further, willingness of the community to be involved in elephant conservation was dependent on the location they lived (χ^2 = 28.45 df = 15, p = 0.019: willing where conflicts were highest especially proximity to wildlife parks and sanctuaries, and where agriculture was practiced); and gender of the community member (χ^2 = 8.94, df = 3, p = 0.03: more females willing than men); and on the level of education (χ^2 = 27.55, df = 9, p = 0.001: more positive for

Table 1. Elephant conservation opinions of the local community and relationship in the Amboseli areas around Amboseli National Park, Kenya (n = 328).

Number	Issue being investigated	Outcomes of that issue	Count	Percent	Chi – square test for equality of frequencies
1.	Area location in the dispersal areas	Olgulului	114	34.8	$\chi2 = 133.7$, df = 5, $p < 0.001$
		Kimana	74	22.6	
		Mbirikani	68	20.7	
		Kuku	40	12.2	
		Rombo	20	6.1	
		Private farms	12	3.7	
2.	Land use types practiced	Agriculture	100	30.5	$\chi2 = 98.5$, df = 3, $p < 0.001$
		Agro – pastoralism	118	36.0	
		Pastoralism	105	32.0	
		Tourism	5	1.5	
3.	Gender	Male	185	56.4	$\chi 2 = 5.4$, df = 13, $p = 0.02$
		Female	143	43.6	
4.	Level of education	None (illiterate)	173	52.7	$\chi2 = 179.8$, df = 3, $p < 0.001$
		Primary school	98	29.9	
		Secondary school	44	13.4	
		Post-secondary	13	4.0	
5.	Trends in elephant – human conflicts over the recent past	Increased	230	70.1	$\chi2 = 412.4$, df = 3, $p < 0.001$
		Decreased	88	26.8	
		Same	8	2.4	
		Don't know	2	0.6	
6.	Currently involved in elephant conservation in the region	No	224	68.3	$\chi2 = 228.0$, df = 2, $p < 0.001$
		Yes	103	31.4	
		Don't know	1	0.3	
7.	Willingness to be involved in elephant conservation in the region	Yes	168	51.2	$\chi2= 51.9$, df = 2, $p < 0.001$
		No	64	19.5	
		Don't know	96	29.3	
8.	Opinion on whether elephant conservation is possible in the region	Yes	249	75.9	$\chi2 = 288.2$, df = 3, $p < 0.001$
		No	73	22.3	
		Don't know	6	1.8	
9.	Opinions on whether elephant conservation is important in the region	Yes	227	69.2	$\chi2 = 234.8$, df = 2, $p < 0.001$
		No	100	30.5	
		Don't know	1	0.3	
10.	Trends in the elephant numbers in the region in the recent past	Increasing	287	87.5	$\chi2 = 692.5$, df = 3, $p < 0.001$
		Decreasing	36	11.0	
		Don't know	4	1.2	
		Same	1	0.3	
11.	Most common time of human – elephant conflicts in the area	Night time	266	81.1	$\chi2 = 563.5$, df = 3, $p < 0.001$
		Day time	47	14.3	
		Both day and night	11	3.4	
		Don't know	4	1.2	
12.	The peak season when the human – elephant conflicts are at their worst	Dry season	181	55.2	$\chi2 = 264.5$, df = 3, $p < 0.001$
		Wet season	124	37.8	
		Both wet and dry	21	6.4	
		Don't know	2	6	

Table 2. Threats to people posed by elephants and their presence in the Amboseli areas around Amboseli national park, Kenya (n = 328).

Number	Issue being investigated	Response	Count	Percent	Chi – square test for frequencies
1.	Crop raiding	Yes	257	78.4	$\chi2 = 105.5$, df = 1, $p < 0.001$
		No	71	21.6	
2.	Destruction (non – crop and non – livestock) to property owned by community members	No	185	56.4	$\chi2 = 5.4$, df = 1, $p = 0.02$
		Yes	143	43.6	
3.	Environmental destruction (such as tree felling etc)	Yes	195	59.5	$\chi2 = 11.7$, df = 1, $p = 0.001$
		No	133	40.5	
4.	Cause of general insecurity in the area (fear of injury or death from elephants)	Yes	195	59.5	$\chi2 = 11.75$, df = 1, $p = 0.001$
		No	133	40.5	
5.	Killing and injuring livestock that belongs to the community	No	250	76.2	$\chi2 = 90.2$, df = 1, $p < 0.001$
		Yes	78	23.8	
6.	Killing and injuring people within the community	No	194	59.1	$\chi2 = 11.0$, df = 1, $p = 0.001$
		Yes	134	40.9	

the more educated than for less educated). However, opinion on whether elephant conservation in the Amboseli area was possible or not was independent of location of the area ($\chi^2 = 19.87$, df = 15, p = 0.17), land use types practiced ($\chi^2 = 15.74$, df = 9, p = 0.07), and gender of community members ($\chi^2 = 4.87$, df = 3, p = 0.18). But opinions on whether elephant conservation was possible or not was dependent on age of the people ($\chi^2 = 31.13$, df = 18, p = 0.028: positive among younger than older people); and the level of education attained ($\chi^2 = 17.18$, df = 9, p = 0.046: low for less educated than for highly educated).

Further, opinions on whether elephant conservation was important in the region was independent of the land use practiced ($\chi^2 = 4.2$, df = 6, p = 0.65), and the age of those interviewed ($\chi^2 = 19.51$, df = 12, p = 0.08). However, opinions on the importance of elephant conservation was influenced by the location ($\chi^2 = 30.94$, df = 10, p = 0.001: positive in places of less conflicts); gender of community members ($\chi^2 = 19.19$, df = 2, p < 0.001: positive for males than females); and the level of education attained ($\chi^2 = 15.93$, df = 6, p = 0.014: negative for those with low levels of education and positive for the educated).

Issues on elephant population trends and times of human – elephant conflicts

Overall, the elephant population in the region was perceived by the majority members (88%) to have increased (Table 1). However, perceptions on whether elephant numbers were increasing was independent of the age of the interviewees ($\chi^2 = 10.94$, df = 18, p = 0.90), gender ($\chi^2 = 2.63$, df = 3, p = 0.45), level of education attained ($\chi^2 = 7.66$, df = 9, p = 0.57), and land use practiced ($\chi^2 = 8.06$, df = 9, p = 0.53). However, opinions on whether elephant numbers were increasing were influenced by only the location of the community members ($\chi^2 = 29.59$, df = 15, p < 0.001: positive for areas closer to parks and sanctuaries). The majority of the community (71%) noted that trends in human – elephant conflicts in the recent years had increased in the area. However, opinions on conflict were dependent on the location of the community members ($\chi^2 = 41.78$, df = 15, p < 0.001: high for those close to parks and sanctuaries, and those practicing agriculture). Most conflicts occurred at night and during the dry season (Table 1). Opinions on which season most conflicts occurred were influenced by the location of respondents ($\chi^2 = 112.4$, df = 15, p < 0.001: more in wet season, close to parks and sanctuaries than far off; and more in dry season away from parks and sanctuaries), land use type practiced ($\chi^2 = 20.00$, df = 9, p = 0.018: more during wet season for agriculturalists); age of community member ($\chi^2 = 36.153$, df = 18, p = 0.007: split among young ages and more in wet for among older members).

Threats to elephants, people and drivers for this conflict

The local people identified six threats posed by elephants to the local community as crop raiding, destruction of (other) property, environmental degradation, general fear and insecurity, killing and injuring livestock, and killing and injuring people (Table 2). Crop raiding was most frequently mentioned (by 78% of the community), followed

Table 3. Threats to elephants by people and their activities in the Amboseli areas around Amboseli National Park, Kenya (n = 328).

Number	Issue being investigated	Response	Count	Percent	Chi – square test for frequencies
1	Poaching of elephants for ivory	Yes	52	15.9	$\chi2 = 153.0$, df = 1, $p < 0.001$
		No	276	84.1	
2	Retaliatory killing by community members for various reasons of human – elephant conflicts	No	213	64.9	$\chi2 = 29.3$, df = 1, $p < 0.001$
		Yes	115	35.1	
3	Harassment by farmers and herders in the area for protection of property	Yes	78	23.8	$\chi2 = 90.2$, df = 1, $p < 0.001$
		No	250	76.2	
4	Habitat destruction and encroachment (clearing of vegetation for use and for agriculture)	Yes	16	4.9	$\chi2 = 267.1$, df = 1, $p < 0.001$
		No	312	95.1	
5	Blocking and conversion of elephant migratory corridors and dispersal routes	No	316	96.4	$\chi2 = 281.8$, df = 1, $p < 0.001$
		Yes	12	3.6	

by environmental degradation (60%), destruction to property (44%), injuring to people (41%), general insecurity (41%), and killing and injuring livestock (24%). Prevalence (frequency of occurrence) the threats elephants posed to local people were scored as low, moderate or high. Those scored as highly prevalent were crop raiding (mentioned by 71% of the community), followed by environmental degradation (51%). Threats scored as low in frequency were killing and injuring livestock (mentioned by 76%), killing and injuring people (76%), and general insecurity (36%), were scored to be of low prevalence by the community (Table 2). The community identified five threats posed to elephants by the local community as poaching for ivory; retaliatory killings; harassment by farmers and livestock herders; elephant habitat destruction; and conversion, and blocking and conversion of elephant migratory routes (Table 3). The commonly mentioned threat was retaliatory killing of elephants (by 35% of community members), followed by harassment of elephants by farmers and herders (mentioned by 24%), and poaching of elephants (16%). On prevalence (frequency of occurrence), the only two threats to elephants mentioned to be of high prevalence by the local community were habitat destruction and encroachment (mentioned by 71% of the community); and blocking and conversion of migration corridors (69%).

The community also identified drivers ranging from human population issues to climate change and competition for resources as drivers to the persistent human – elephant conflicts (Table 4). The most commonly mentioned drivers were human encroachment on elephant space (mentioned by 84%) elephant habituation to farms and human settlements (82%), indifference to local community plight by conservationists (78%), drought and climate change effects (75%), perceived elephant over–population (71%), general poverty and unemployment among the local community (65%), and blocking of elephant migration routes (61%). The community also identified five critical resources shared and competed for between elephants and the local community (Table 5) as woody plant vegetation (for elephant food, people shelter, fuel, medicinal plants for housing), water resources (for drinking and other uses), pasture (for grazing and construction), and general space (as home, for living, play and rest). The most competed mentioned resource was water (mentioned by 69% of community members), followed by pasture (mentioned by 43%) woody vegetation (36.0%), and space (7%).

Proposed interventions

The local community proposed eight interventions (Table 6) that can be used to address the persistent human – elephant conflicts in Amboseli area: provide thunder flushes and explosives to scare off elephants; provide benefits, economic opportunities and empowerment for the local community; lease land for elephant sanctuaries; provide compensation for elephant costs to the community; do more research and monitoring on elephants; provide more security for both elephants and the people; and provide more benefits from wildlife to the community (Table 6). The most frequently mentioned intervention was providing more security (suggested by 63%), followed by provision of explosive and thunder flushes for community to protect themselves and or scare away elephants (mentioned 32%).

DISCUSSION

From the demographics of the members interviewed, it

Table 4. Drivers of human elephant conflicts in the Amboseli areas around Amboseli National Park, Kenya (n = 327).

Number	Issue being investigated	Response	Count	Percent	Chi – square test for frequencies
1	Perceived elephant over – population in the area	Yes	34	10.4	$\chi^2 = 205.1$, df = 1, $p < 0.001$
		No	293	89.6	
2	General poverty and unemployment in the community	No	303	92.7	$\chi^2 = 238.1$, df = 1, $p < 0.001$
		Yes	24	7.3	
3	Human encroachment on elephant space	Yes	20	6.1	$\chi^2 = 251.9$, df = 1, $p < 0.001$
		No	307	93.9	
4	Drought and climate change effects on elephant range	Yes	250	76.5	$\chi^2 = 91.5$, df = 1, $p < 0.001$
		No	77	23.5	
5	Increasing human population in the area	No	317	96.9	$\chi^2 = 288.2$, df = 1, $p < 0.001$
		Yes	10	3.1	
6	Availability of lucrative black market for elephant ivory	No	310	94.8	$\chi^2 = 262.5$, df = 1, $p < 0.001$
		Yes	17	5.2	
7	Blocking elephant migration corridors in the area through human activities	No	289	88.4	$\chi^2 = 192.7$, df = 1, $p < 0.001$
		Yes	38	11.6	
8	Indifference by elephant conservationists on the plight of local communities	No	290	88.7	$\chi^2 = 195.7$, df = 1, $p < 0.001$
		Yes	37	11.3	
9	Elephant habituation to people and farms for crop raiding	No	229	70.0	$\chi^2 = 52.5$, df = 1, $p < 0.001$
		Yes	98	30.0	
10	Poor elephant conservation strategies, policies and laws	No	326	99.7	$\chi^2 = 320.1$, df = 1, $p < 0.001$
		Yes	2	0.3	

Table 5. Critical resources shared between the elephants and local community that leads to conflicts in the Amboseli areas around Amboseli National Park, Kenya (n = 328).

Number	Issue being investigated	Outcomes of that issue	Count	Percent	Chi – square test for frequencies
1.	Woody vegetation (for shelter, food, medicinal plants, fuel, housing etc)	No	210	64.0	$\chi^2 = 25.8$, df = 1, $p < 0.001$
		Yes	118	36.0	
2.	Water (for drinking, washing, watering livestock, irrigation agriculture etc)	No	101	30.8	$\chi^2 = 49.0$, df = 1, $p < 0.001$
		Yes	228	69.2	
3.	Pasture (for elephant and livestock grazing)	No	188	57.3	$\chi^2 = 7.0$, df = 1, $p = 0.008$
		Yes	140	42.7	
4.	Space (for living, rest, play and home)	No	304	92.7	$\chi^2 = 239.0$, df = 1, $p < 0.001$
		Yes	24	7.3	
5.	No resource competition whatsoever between the local community and elephants	No	326	99.4	$\chi^2 = 320.0$, df = 1, $p < 0.001$
		Yes	2	0.6	

was evident that generally the community has a low level of education. This is an issue of concern because appreciation of the importance of natural resources including elephants can best be comprehended with a good level of education. Education in Africa is also a ticket to an empowered economic empowerment that provides alternative opportunities to benefit from natural resources. Therefore, the understanding and discourse of

Table 6. Proposed interventions to address human – elephant conflicts in the Amboseli areas around Amboseli National Park, Kenya (n = 328).

Number	Issue being investigated	Response	Count	Percent	Chi – square test for frequencies
1.	Provide explosives and thunder flushes to local game scouts and farmers in the Problem Animal Control strategy	No	224	68.3	$\chi2 = 43.9$, df = 1, $p < 0.001$
		Yes	104	31.7	
2.	Provide economic opportunities and empowerment through employment of local community to address poverty	No	279	85.1	$\chi2 = 161.3$, df = 1, $p < 0.001$
		Yes	49	14.9	
3.	Lease land for conservation and encourage establishment of conservancies so as to secure more space and migration corridors for elephants	No	309	94.2	$\chi2 = 256.4$, df = 1, $p < 0.001$
		Yes	19	5.8	
4.	Provide compensation for elephant damages and costs to the local community	No	306	93.3	$\chi2 = 245.9$, df = 1, $p < 0.001$
		Yes	22	6.7	
5.	Do more research and monitoring of elephants	No	239	72.9	$\chi2 = 68.6$, df = 1, $p < 0.001$
		Yes	89	27.1	
6.	Provide more security for both elephants and people	No	123	37.5	$\chi2 = 20.5$, df = 1, $p < 0.001$
		Yes	205	62.5	
7.	Provide more benefits from elephants such as education bursary scholarships, hospitals and infrastructure	No	321	97.9	$\chi2 = 300.6$, df = 1, $p < 0.001$
		Yes	7	2.1	
8.	Provide veterinary services to the elephants to improve their health	No	303	92.4	$\chi2 = 235.6$, df = 1, $p < 0.001$
		Yes	25	7.6	

conservation in the Amboseli area can be improved by investing in schools, education programs and encouraging parents to take their children to school. In Kenya, this is no longer a privilege, but a universal right provided for by the new constitution and children rights laws that provide for free access and right to education. An improved level of education will also improve understanding of conservation and natural resource laws much better. Education level and lack of policies to involve local community in elephant conservation issues may explain why a few of the local community were involved in elephant conservation issues, even as it clearly showed the majority were interested to participate, they stated that elephant conservation in the ecosystem was possible, and that generally elephant conservation was important. If the level of education is addressed together with exploring economic benefits and incentives for the local community and striving to involve them in elephant conservation at the grass root level, this will go a long way not only in providing tolerance for elephants, but change negative perceptions both of the elephants and those who advocate for its conservation in the area (researchers, conservation organizations, the KWS and the government).

In the new devolved system of government in Kenya, the Olkejuado County government is also expecting that conservation of resources and associated benefits (tourism revenue) will help provide services and goods needed to alleviate poverty and transform the lives of the local community. If economic benefits, collaboration in elephant management and improvement of conservation understanding are not addressed in the area, a growing number will still regard elephant conservation in the Amboseli as not important or even necessary. It is common that farmers will not tolerate elephants because of huge costs incurred to crop raiding, and especially because these costs are not compensated by neither the government nor the conservation agencies. Therefore, support in these aspects will depend on location in terms of its land use with more pastoral land uses being more tolerant that agricultural ones. In terms of age, young people, especially if exposed to an education and positive interaction with elephants, were likely to support it than older generations who had predominantly negative

interactions with elephants over the years. Gender can be an issue where partitioning of household duties brings them more into conflict with elephants. Women provide more for families and seek natural resources from the environment (water, pasture, plants for fuel and construction of houses) are likely to resent elephants more because of this competition than men.

The predominant perceptions about elephant numbers is that they were increasing, but this was more for areas around parks and sanctuaries, and in farming areas. It is true that generally the population of Amboseli elephants is about 1,400 that utilize the park and Maasai group ranches around it, and that this population is increasing by about 4% annually (Amboseli Trust for Elephants records, 2012). Given the huge size, greater space use and needs, and greater use of resources (water, pasture, woody plant resources), any increase in the number of elephants further leads to intensified resource competition and incidences of crop raiding. However, it is also true that there is a great part of the group ranch dispersal areas that are not used by elephants and opening up those ranges by providing water, security, and benefits to the land owners will distribute better elephant use of range in the Amboseli area. There is also a perception that elephant numbers may be increasing when in certain areas, elephant use of that space and numbers are declining. The perception of increase of numbers may be informed by a high rate of encounter or incidences which can also be explained by unsuitable land use changes (like agriculture expansion) that attract elephants to use certain areas primarily for crop raiding, or even general encroachment of people on traditional elephant range they use as a result of increasing human population rather than increasing elephant population. Where there is human and elephant population increase, the inevitable result will be escalating conflicts as each seeks its own welfare and as competition for critical resources intensify. So trends in elephant conflicts, though perceived to be increasing, can be similarly explained.

The local community identified night time as the most common time for human – elephant conflicts. This makes sense because elephants will freely move during the night after retiring to safer places during the day to avoid interactions with people (reference). At night when human presence and activities reduce or stop all together, they have freedom to graze, get water and even go for crop raiding. Elephants are catholic foragers who spend long times foraging and continuously, and therefore since they are non – ruminants, they can eat continuously without taking time to ruminate (Estes, 1991). They are therefore likely to be active better times of early night and early morning and therefore do more damages to crops and property at night. It is common in Amboseli Park to see herds and families of elephants coming inside the park during the morning (to water, rest and escape conflicts with people), and then also head out in evening to dispersal areas. This diurnal movement pattern can be best explained in terms of foraging needs in a safe environment devoid of conflicts with people, but also a possible of elephant strategy to head out when people are less active to raid crops or use other areas where they compete for resources (pasture, water, woody plants) with people and livestock.

Local opinions were split over whether more conflicts occurred during the dry or wet season. Slight majorities indicated the dry season, and this could be informed by the fact that during dry season, there is more intense conflict for critical resources with people. In the dry season, water, pasture and green woody plants become less abundant and available and so conflict over use and access may be informing the position that dry season time has the highest and intense conflicts with elephants. Further, during the dry season, wildlife tends to be concentrated in areas of water and pasture. Residence time in or around such areas increase and when both people and livestock meet in these hub areas of resource availability, conflicts can be intense and persistence. Since there are fewer such oases (Amboseli Park, Kimana Sanctuary, Osoit Pus swamp etc) of water, pasture and green woody plants, competition not only takes a resource specific dimension, but become localized and intense especially when such localized oases of resources can be very few and limited in number and distribution.

However, even though relatively fewer local perceptions were that conflicts with elephants occur more in wet season, it seems to make sense as well. When water and resources are available everywhere, elephants can roam many places and have increased encounter with livestock and people, sometimes leading to negative conflicts. However, when resources are abundance and available, home ranges become small and species inter – specific and intra – specific competition for critical resources decline. That is, why is most likely that human – elephant conflicts were less in the wet season. Other areas like those closer to parks and sanctuaries have conflicts throughout irrespective of time and season. These incur higher costs than other places.

The African Trust for Elephants (ATE) has been running a long standing consolation scheme for livestock killed by elephants outside the parks (Amboseli Trust for Elephants documents, 2012). This has received wide support and appreciation in the community not because of the less than market value that is offered, but because it is a consolation (not compensation which was outlawed by Kenyan laws in 1971), and that it goes a long way in helping people deal with wildlife costs and therefore highly accepted by the local community. There is need for more of such initiatives that address concerns and plight of the people who are themselves poor and impoverished, as a way of increasing tolerance and acceptance of wildlife as other land uses. But more in terms of tourism revenue, employment and direct benefits from the hotel

industry and other beneficiaries is expected in form of social responsibility to the local community who bear and shoulder the cost of conservation.

From the results, most common threats elephants pose to people were crop raiding, environmental degradation and general insecurity. These top three threats touch on ability of people to feed themselves and make money from agriculture, destruction of basic critical resources supported by the environment that they rely on for basic needs and general insecurity. These are issues that touch the economic, safety and livelihood of the local community and if compromised, will lead resentment, intolerance of elephants and determination and attempt to limit both their movements and ranging. This will be compounded if livestock and people are either injured or killed, a fact that will lead to stronger and lasting resentment that cannot be corrected even by benefits and tokens to the community. That is why retaliatory killings and harassment and poaching of elephants are the leading threats people pose to elephants. This is mostly an attempt for the community to shield themselves from elephant attacks and also prevent further loss of property and life. It is also an attempt to restrict their ranging as well as counter their numbers. This is a serious threat to elephant viability and human – elephant conflicts should be viewed as a leading threat to existence of elephants as a species.

Mitigation strategies and innovations to address this must be multidimensional and diverse in targets and expected outcomes (Sitati et al., 2005). This includes examination of human encroachment to elephant habits and guidance in acceptable land uses that will not escalate conflicts with elephants; to attempts to make elephant presence benefit the Maasai and become an asset rather than a liability through ecotourism investments, innovations and direct and significant benefits to local landowners who let elephants roam freely on their land. The emergent of privately owned sanctuaries in Amboseli area where land owners are converting their land to ecotourism and conservation should be supported and encouraged as one way to turn around elephants from being a liability to an asset to local land owners. Addressing the multiple drivers of the conflict will be another useful approach to containing human – elephant conflicts, particularly socio – economic welfare of the people and incorporation of local members in elephant conservation policies and strategies as important stakeholders. The local communities proposed several approaches to militate against - human elephant conflicts. These ranged from providing them with items that would scare away elephants to direct benefits from elephant conservation. Others are to lease land for elephants. Most of these recommendations are concerned about allowing elephant conservation benefit people through paying for space (lease programs) and also ecotourism investments. These will increase economic benefits for local people. People will not yield their land or space for elephant use outside the national parks if there is no compensation for that. It is therefore critical for stakeholders to consider leasing space for elephant dispersal to compensate the Maasai and other land owners for their space and resource use and competition from elephants. Without this, there is likely to see further agriculture expansion, human encroachment and retaliatory killings increase (Sitati et al., 2005).

Other strategies are to counter the economic popularity of agriculture in the area by supporting local land - owners who choose to make wildlife sanctuaries of their land to benefit from tourism investment and activities. This is possible in large parcels of land space still available that has not been converted to agriculture and or is unsuitable for it. Critical immigration corridors should be earmarked for leasing programs (as being done by IFAW for Kitenden corridor in Olgulului / Ololorashi Group Ranch arouond Amboseli Park, and AWF for community sanctuaries (Elerai, Kimana and Osupuko) as well as economic consolation programs for elephant damage of property (as being done by ATE and Big Life conservation organizations). Awareness of how to best protect crops and formation of vigilant groups, use of chilli farms, use of diesel rope repellant and enhanced KWS Problem Animal Control (PAC) units and patrols will in combination form effective mitigation strategies for human – elephant conflicts. Critical to all these effort is scientific research on effectiveness of these or combination of strategies, elephant ranging and ecology, and habit use and preference by elephants in response to changing human landscapes (Sitati et al., 2005).

Several studies have proposed and explored these and several other mitigation measure to reduce human – elephant and human – wildlife conflicts in general. These strategies have revolved around economic rewards and empowerment (Norton – Griffiths, 2000; Erwin et al., 2006) collaborative vigilance by farmers (Sitati et al., 2005;Jackson et al., 2008; Joana, 2009), expansion of space through establishment of private wildlife sanctuaries (Okello, 2005, Okello et al., 2008), provision of water and other resources to limit competition with man (Western, 1975; De Beer et al., 2006; Grainger et al., 2005; De Beer and Van Aarde, 2008), control of elephant population numbers (Kerley and Shrader, 2007; Lotter et al., 2008) expanding economic benefits from elephants from ecotourism (Ogutu, 2002), fencing in agriculture and associated issues (Thoules and Sakwa, 1995;. Loarrie et al., 2009), land use zoning and planning (Prinns, 1987; Shauna and Mwangi, 2007; Western et al. 2009), and addressing people's livelihood issues (Okello et al., 2009).

Conclusion

Key insights have been obtained from this study that will help KWS Elephant Program plan and manage conflicts and elephant conservation in the Amboseli ecosystem. A proactive education campaign and involvement of local

people in elephant people as envisaged in the current elephant conservation strategy should be implemented without further delay. This will act as a mechanism to have people understand elephant needs more, tolerate them, and participate in community simple and safe strategies to reduce loss to elephant damages. Awareness of appropriate land uses, benefits that can accrue to ecotourism ventures and importance of elephants in tourism will help create more tolerance and community participation in elephant conservation. Changing elephants from a liability to an asset for local community should guide this strategy, which includes changing people's negative attitudes to elephants and creating tolerance and appreciation.

The KWS PAC personnel should be trained on simple and consistent entry of field incidences in elephant – human conflicts because they form important data for understanding prevalence and severity of conflicts and hotspots for these. Further, KWS should deploy enough personnel in PAC units in Rombo, Oloitoktok and Park headquarters to deal with human – wildlife conflicts control. Information showed that in some situations, KWS PAC did not take any action on reported cases because they were on other assignments or engaged elsewhere. This will remove the impression that they respond when elephants are harmed by people, and not when elephants harm people or destroy their property. The newly enacted the Wildlife (2013) Act should be quickly implemented so as to address the great costs local people shoulder to conserve elephants by providing adequate and timely compensation to reported and verified cases to forestall the negative perceptions and increasing intolerance of locals to elephants and wildlife in general. Costs such as injury and death to people and livestock, crop raiding, destruction of property and general insecurity affects the economic and freedom of people and therefore entrenches poverty and undermines their social rights. Compensation from the government to supplement *consolation schemes* given by some NGO's in the area, (and which are very popular with the local community) will help local community bear the cost of conservation.

Elephant hotspots (areas with high prevalence and severity of conflicts) identified in this study should receive more protection from elephant damages, as well as elephants protected from persecution and retaliation such as poaching in some of the hotspots like Rombo. More research effort should do further mapping prevalence and severity of conflicts and risk assessment (to people from elephants, and elephants from people) so that to take a proactive action in controlling these damages and conflicts.

Conflict of interests

The authors have not declared any conflict of interests.

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REFERENCES

Archie EA, Chiyo PI (2012). Elephant behaviour and conservation: social relationships, the effects of poaching, and genetic tools for management. Mol. Ecol. 21:765-778

Barnes RFW, Barnes KL, Kapela EB (1994). The long term impact of elephant browsing on baobab trees at Msembe, Ruaha National Park, Tanzania. Afr. J. Ecol. 32:177-184.

Chiyo PI, Lee P, Moss CJ, Archie EA, Hollister – Smith JA, Alberts SC (2011). No risk, no gain: effects of crop raiding and genetic diversity on body size in male elephants Behavioral Ecology 22:552-558

De Beer Y, Kilian W, Versfeld W, Van Aarde RJ (2006). Elephants and low rainfall alter woody vegetation in Etosha National Park, Namibia. J. Arid Environ. 64: 412-421.

Erwin HB, Randall BB, Randy S, Philip KT (2006). Wildlife conservation in Amboseli, Kenya: Paying for nonuse values. Roles of Agriculture Project Environment Service, December 2006, Agricultural and Development Economics Division (ESA) Food and Agriculture Organization of the United Nations

Esikuri EE (1998). Spatio-Temporal effects of land use changes in a Savanna wildlife area of Kenya. Dissertation submitted to the Faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Fisheries and Wildlife Sciences

Hoare RE (1999). Determinants of human elephant conflict in a land-use mosaic. J. Appl. Ecol., 36: 689-700

Jackson TP, Mosojane S, Ferreira SM, Van Aarde RJ (2008). Solutions For Elephant *Loxodonta Africana* Crop Raiding In Northern Botswana: Moving Away From Symptomatic Approaches. *Oryx* 42: 83-91.

Litoroh M, Omondi P, Kock R, Amin R (eds). (2012). Conservation and management strategy for the elephants in Kenya. 2012-2021. The Kenya Wildlife Service (KWS). Nairobi, Kenya.

Okello MM, Kioko JM (2010). Contraction of wildlife dispersal area in Olgulului – Ololorashi GroupRanch around Amboseli National Park, Kenya. The Open Conserv. Biol. J. 4:34-45

Okello MM, Kiringe JW (2004). Threats to Biodiversity and the Implications in Protected and adjacent dispersal areas of Kenya. J. Sustainable Tourism 12(1):55-69

Okello MM (2005). Land Use Changes and Human - Wildlife Conflicts in the Amboseli Area, Kenya. Human Dimensions Wildlife 10(1):19-28

Okello MM, Seno SK, Nthiga RW (2009). Reconciling peoples' livelihoods and environmental conservation in the rural landscapes in Kenya: Opportunities and challenges in the Amboseli landscapes. Nat. Res. Forum 33:123-133.

Okello MM, Buthmann E, Mapinu B, Kahi C (2010). Community Opinions on Wildlife, Resource Use and Livelihood Competition in Kimana Group Ranch near Amboseli, Kenya. Open Conserv. Biol. J. 4:34-45.

Prinns HHT (1987). Nature conservation as an integral part of optimal

land use in East Africa: the case of the Massai Ecosystem of Northern Tanzania. Biol. Conserv. 40:141-161

Sitati N, Walpole MJ, Leader-Williams N (2005). Factors affecting the susceptibility of the farms to crop raiding by African elephants: Using a predictive model to mitigate conflicts. J. Appl. Ecol. 42:1175 - 1182

Thouless CR, Sakwa J (1995). Shocking elephants: Fences and crop raiders in Laikipia District, Kenya. Biol. Conserv. 72:99-107.

Spinage CA (1990). Botswana's problem elephants. *Pachyderm* 13:14-19.

Western D (1975). Water availability and its influence on the structure and dynamics of a savanna large mammal community. East African Wildlife J. 13:265-286.

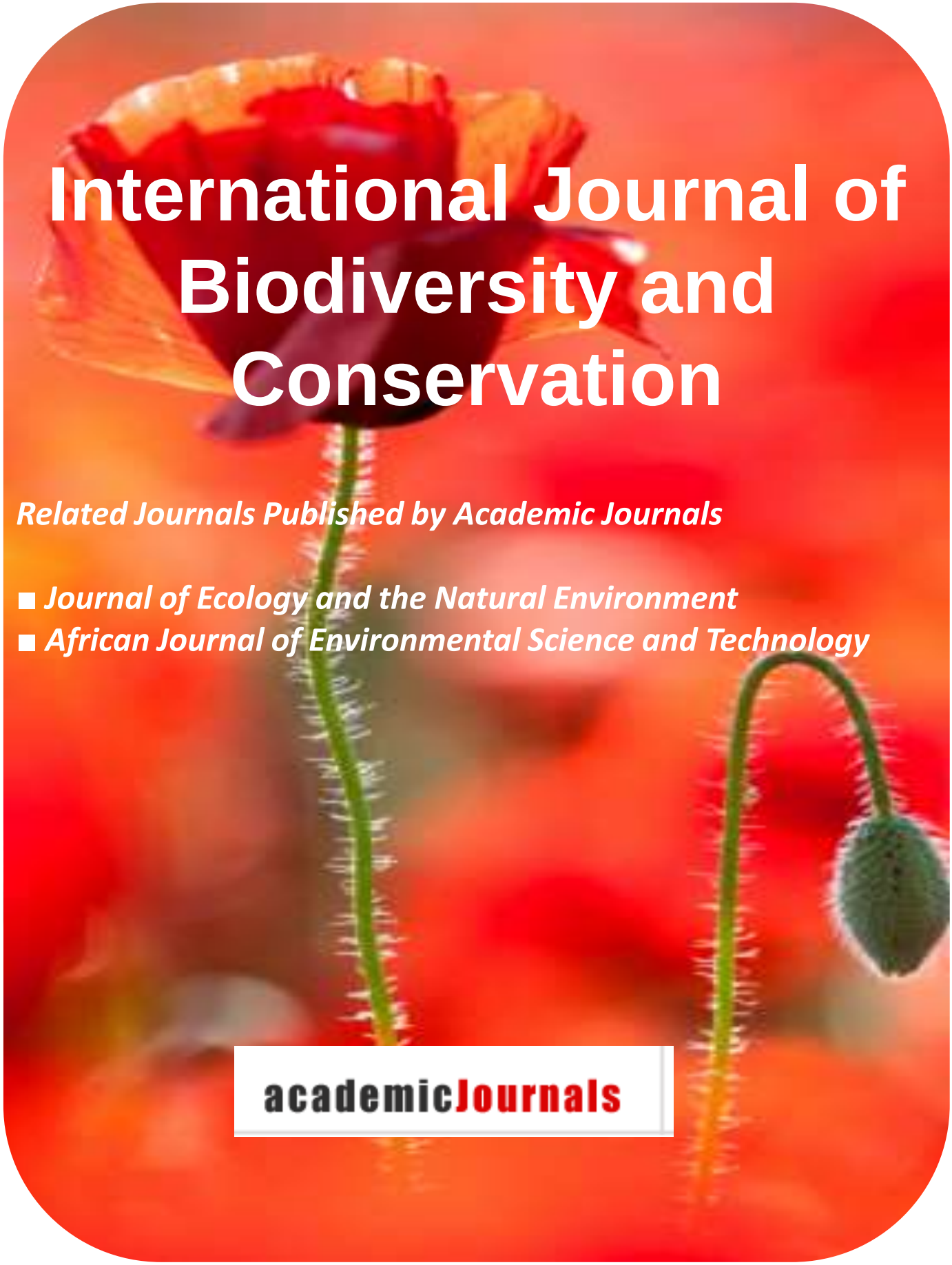
Western, D. (1989). The ecological role of elephants in Africa. *Pachyderm* 12:43-46.

Western, D. (2007). A half century of habitat change in Amboseli National Park, Kenya. Afr. J. Ecol. 45:302-310.

Western D, Groom R, Walpoole J (2009). The impact of subdivision and sedentarization of pastoral lands on wildlife in an African savanna ecosystem. Biol. Conserv. 142:2538-2546

Yaw Osei-Owusu, Lonnek B (2008)**.** Human-wildlife conflict: Elephant Technical Manual. Wildlife Management Working Paper, Lagos Nigeria.

Zar JH (1999). Biostatistical Analysis.Fourth ed. Prentice Hall, Inc. Upper Saddle River, New Jersey.



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