Strathmore University

Center for Biodiversity Information Development (BID-C)

LINK BETWEEN WILDFIRES OCCURRENCE AND HUMAN LIVELIHOOD ACTIVITIES IN TSAVO CONSERVATION AREA, KENYA.

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Abstract

Many countries experience massive environmental losses through Wildfires. Tsavo ecosystem in Kenya experienced serious Wildfires in the recent years and more specifically in 2020. Nevertheless, Information available on Wildfires in the area were speculative. This study aimed at establishing the linkages between Wildfires occurrence and of human activities in Tsavo. A social ecological survey was carried out in Tsavo Conservation Area from July to December 2022 to establish spatial distribution of Wildfires and identify human activities that could be linked to the Wildfires. The study sites included Chyulu Hills, Tsavo West and Tsavo East. Systematic sampling was used in choosing households issued with questionnaires. Key informant interviews was used to collect data from leaders. Area shape files and Wildfire attributes were obtained to develop area heat map. ANOVA and Kruskal-Wallis were used for testing differences in Wildfires frequencies and participant's opinion respectively. Findings for this study indicated Chyulu Hill area as the key Wildfire hotspot. Human activities linked to the Wildfires included poaching, honey harvesting, charcoal burning, bhang farming, khat harvesting, arsonist, pest management, farm clearance, disposal of cigarettes remnants and burning of elephant dung. The results would be useful in coming up with integrated approach in Wildfire management.

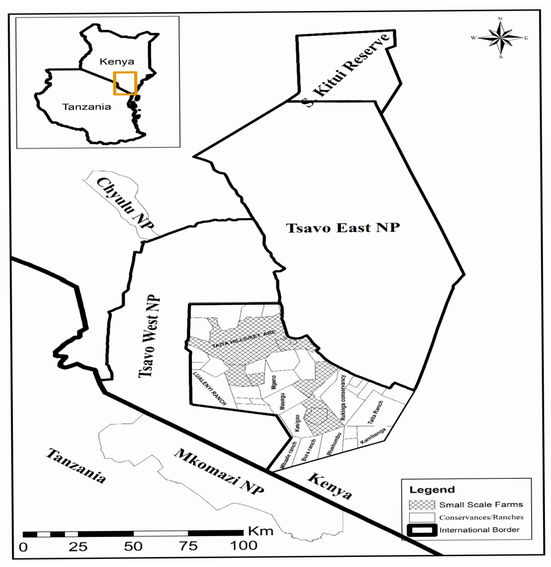
Introduction

Fire is an important component of many ecosystems. It is essential because it plays an important role in sustaining ecosystems processes and communities. However, some fires are very destructive to environment and mankind (Aponte et al., 2016). Wildfires are linked to either human activities or natural forces (Jhariya & Raj, 2014). Many countries experience massive and widespread environmental losses through wildfires. For instance, in Canada the wildfires between 1998 and 2021 led to the relocation of more than 125,000 people (Copes-Gerbitz et al., 2022). Tsavo Conservation Area (TCA) in Kenya, in specific experienced serious wildfire episodes in both protected and unprotected areas in the recent years (Sheldrick, 2015). Nevertheless, most information available on recent wildfire occurrences and distribution in TCA are speculative. A good example is the most recent serious wildfire that occurred in 2020. The fire lasted for close to 2 weeks and spread over 467,000 hectares of the TCA. This study aimed at establishing the linkages between Wildfires occurrence and human activities in TCA.

Photograph of Wildfire in August, 2022.

Methodology

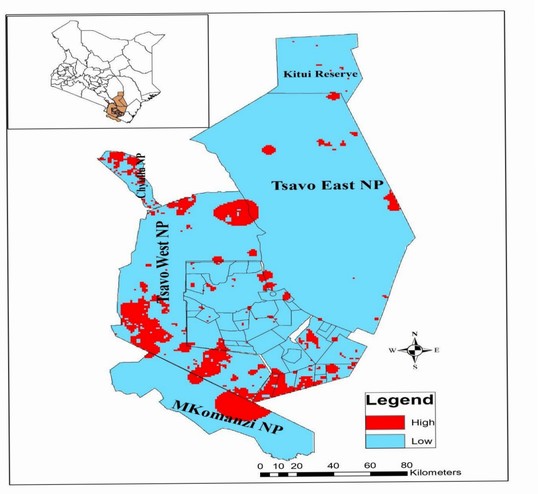
The study was carried out in Tsavo Conservation Area (TCA), Kenya. TCA lies within latitude $1^{0}59'$ S - $4^{0}8'$ S and longitude $37^{0}45'$ E - $39^{0}16'$ E (Lala et al., 2021). TCA is a protected area covering approximately over 21,000 Km^2. It is the largest area under protection in Kenya and covers over 4 % of the entire country land masses (Kenya Wildlife Service, 2018). Social ecological survey was carried out from July to December 2022 to establish spatial distribution of Wildfires and identify human activities that could be linked to the Wildfires. For the purpose of this study the entire TCA was divided into three regions: Chyulu Hill, Tsavo West and Tsavo East regions. This study involved both primary and secondary data. The primary data were obtained through questionnaires, interviews and focus group discussion method. Systematic sampling was applied in choosing households issued with questionnaires. Key informant interviews was used to collect data from leaders while Focus group discussion was useful in ranking human activities mentioned in other methods based on their link to wildfires. TCA Shape files were obtained from Wildlife Research and Training institute(WRTI). Wildfires attributes data were obtained online from NASA's Fire Information for Resource Management System (FIRMS) website. Both shape files and Wildfires attributes were obtained to develop area heat map. Finally, ANOVA and Kruskal-Wallis were used for testing differences in Wildfires frequencies and participant's opinion respectively.



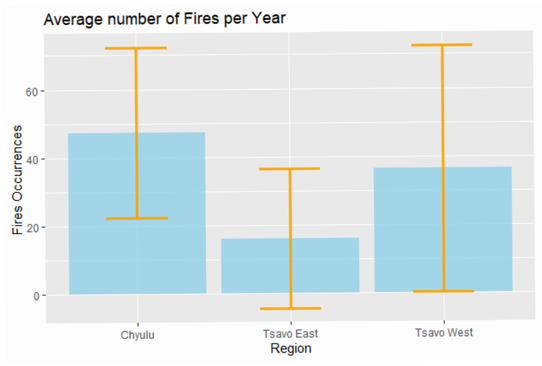
Map of Tsavo Conservation Area. The map shows conservation areas which include Tsavo West, Tsavo East and Chyulu Hill National Parks.

Result 1

- Wildfires were unevenly distributed in TCA. The proportion of red-shaded areas which-signify more wildfire detected, were more in Chyulu National Park Areas than other areas. The proportion of blue-shaded areas areas colour which signify low number of wildfire were more in Tsavo East National Park areas.
- Chyulu Hill region experienced more wildfires as compared to other two regions. The average number of wildfire detected per year for the period for Chyulu Hill, Tsavo East and Tsavo west National Park areas were 47.36, 16.09 and 36.062 respectively.
- ANOVA P value was less than 0.05; therefore rejecting the null hypothesis that the mean for wildfire occurrence in all regions were equal. The post Hoc analysis found that the mean value for wildfire occurrence was significantly different between Chyulu Hill area and Tsavo East only (Tukey's HSD p = 0.014, 95% C.I. = [6.94, -55.61])



Spatial distribution of wildfire in Tsavo Conservation Area for 11 years from 2010 to 2020. Chyulu Hill area received highest brightness (Fire).



Occurrence of wildfire in different regions of TCA from 2010-2020. Chyulu Hill region received the highest number of wildfire and Tsavo East received the least.

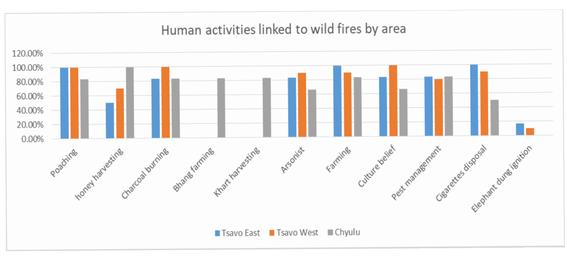
ANOVA and Post hoc test for ANOVA results using Tukey's HSD test. Significant difference (P<0.05) in means was only between Chyulu Hill and Tsavo East.

Multiple Comparisons for ANOVA Results: F(2)=3.55, Sig, 0.041

(I) Area	(J) Area	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Chyulu	Tsavo East	31.273	11.91	0.01	6.94	55.61
Chyulu	Tsavo West	10.909	11.91	0.37	-13.42	35.24
Tsavo East	Tsavo West	-20.364	11.91	0.1	-44.7	3.97

Result 2: Eleven human livelihood activities were linked to Wildfires in TCA

- Poaching, honey harvesting, charcoal burning, bhang farming, khat harvesting, arsonist, pest management, farm clearance, disposal of cigarette remnants, burning of elephant dung and Cultural belief of smoke being the source of rain
- Bhang farming and Wild Khat harvesting was peculiar to Chyulu Hill region.



Percentage of key informants who linked specific human activity to wildfire.

Illegal charcoal burning within a community conservancy of Lumo detected by rangers

Bee keeping farming observed in Chyulu Hill park neighbouh hood.

Results 3: Ranking of specific human activities in order of their strength in the way they are linked to wildfire.

Poaching was highly ranked among the mentioned human livelihood activities and charcoal burning was the second ranked human activity that was linked to wildfire

- *"Poachers burn to divert attention of rangers, to make them busy in putting off the fire".*
- *"Others burn to direct wild animals they are targeting towards their traps"*
- *"While others burn to encourage regrowth of fresh grass and shoots to attract small herbivores of their interest"*

Focus group discussion with Manager at Voi, Tsavo East region

Focus Group discussion with Managers at Voi, Tsavo East region

Focus group discussion with village elders in Tsavo West region (Mwakitau Village)

Human activities ranked in order of strength in being linked to wildfire. More human activities were linked to wildfire in Chyulu Hill area than the others.

S. No.	Chyulu Hill area	Tsavo West Park area	Tsavo East Park Area
1	Poaching	Poaching	Poaching
2	Honey harvesting	Charcoal burning	Charcoal burning
3	Charcoal burning	Farm land clearance	Arsonist (Pastoralist)
4	Bhang farming	Arsonist (Pastoralist)	disposal of cigarettes puff
5	Wild Khat harvesting	burning elephant dung	honey harvesting
6	Arsonist (Pastoralist)	honey harvesting	use of fire to manage pest
7	Farm land clearance	use of fire to manage pest	Smoke attract rain
8	Smoke attract rain	disposal of cigarettes puff	Farm land clearance
9	use of fire to manage pest	Smoke attract rain	Burning of elephant dung
10	disposal of cigarettes puff		

Conclusion

The study established heat map that clearly showed how different regions wildfire in term of brightness were recorded by remote sensing images. The map could be a useful tool to show variation in Wildfire distribution across TCA. The study also identified Chyulu regions as the region most susceptible to wildfire; Out of 1095 Wildfire frequencies recorded in the three regions, 521 were from Chyulu Hill. In addition, 11 specific human activities were linked to wildfire and poaching was top ranked as a factor linked to wildfire. The information Obtained from the study would be very useful in Wildfire management. Land managers, researchers, policy makers and other stakeholders will utilize the findings to determine where more attention should be directed in wildfire management. The results could also help in coming up with well guided policy in wildfire management

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