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FIRE MANAGEMENT TECHNIQUES IN AND AROUND KANJI LAKE NATIONAL PARK (BORGU SECTOR) NIGERIA

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Abstract
Traditionally, fire has been used as a management tool to control vegetation structure and composition. Habitat management does not only include planting of a few trees and other crops, manipulating all necessary life forms round the year; but introducing control burning is a key to habitat management. Increase in the incidence of uncontrolled wildfires with the damaging effect on national parks, indigenous forests, forest plantation, rangelands communal grazing areas and agricultural lands have raised concerns to look into techniques in the management wildfire. Annual bush burning exercise at the Kainji Lake National park is usually characterized with prolonged smoke and displacement of wildlife species. Structured questionnaire were administered to both staff of Kainji Lake National park (KLNP) as well as 8-villages randomly selected around Borgu sector of the park to elicit information from people who have indicated their involvement with the use of fire one time or the other from the reconnaissance survey carried out. The results shows that male (55%) was more involve in the use fire than the female, youth ages 21-40 are the active respondents involve in the use accounting 80%. The results also show that the major culprit of wildfire associated incidences were those who uses fire for farming, honey harvesting and livestock keeper (28%, 24% and 23% respectively). Also the effect of the fire were more pronounced on farmland and disturbance to people especially respiratory associated ones (45% and 43% respectively). Base on this it is recommended that the community be sensitized often on the consequences of uncontrolled fire as well encourage them to participate in conserving the park.

Key Words: *Wildfire, National Park, Borgu, Controlled-fire, Farmland*

Introduction

Fire management is crude in many developing nation like Nigeria especially in the rural areas. The use of fire has both been traditionally and culturally employed in the management of vegetation structure and composition. It is a common phenomenon throughout the world especially in the savannas; it has been both beneficial as well as harmful to man. It has been used as a vital tool in natural resource management (SCBD; 2001, Russell-Smith *et al.,* 2003, Bond and Keeley, 2005). Farmers find the use of fire very important in land preparation especially at the onset of planting season just before the

first rain; it is equally employed in creating opening for crops (perennial crops). Fire has promoted wide variety of diverse plants associated with fire ecology, quantity of nutrients available in soils are usually increased due to the ash that is generated, this ash is made available immediately to the plant as opposed to the slow release of nutrients by decomposition (Pivello *et al.,* 2010). Traditionally, fire has been used as a management tool to control vegetation structure and composition, for hunting and to recycle nutrients locked in dead biomass and has continued even today particularly in savanna ecosystem in Africa (Raish *et al.,* 2005; Hoffman, 2013; Bush Heritage, 2020).

Habitat management does not only include planting of a few trees and other crops, manipulating all necessary life forms round the year; but introducing control burning is a key to habitat management. Controlled burning commonly called prescribed burning is the planned use of fire to achieve specific objectives. The timing of fire return interval and fire intensity of the burns play an important role in achieving a well management habitat. The timing of prescribed burns refers to what time of the year the burns took place. Early burning are used to reduce forest litter to help prevent forest fires, they are also used to stimulate growth of forbs, legumes and native grasses that are beneficial as food and cover for a variety of wildlife species. Prescribed fire affects wildlife in various ways. It can be positive, negative, neutral, short-term or long-term, and it does have varying degree of impact across its region of burnt. Whereas prescribed fire can create or maintain habitats for some species, it can also remove or alter conditions in ways that render it unsuitable for other species. Fire does not occur uniformly across a landscape, instead manifesting as a heterogeneous mosaic that provides habitats for different species, thereby influencing wildlife diversity (FAO, 1990; Block *et al.,* 2016; Krausman *et al.,* 2011; Bidwell *et al.,* 2020). Growing season burns take place at the on-set of the early rain (around March) to late rain (around late October), and is used to control choking undergrowth bush in a matured trees stand.

Nevertheless, the improper use of fire has at many occasions led to wildfire which became inferno that get out of control with its attending destruction spreading across wide area of both the forests and grassland; thereby resulting in loss of biodiversity as well as human life. Occurrence of wildfire in the tropical ecosystem of the sub-Saharan Africa is a regular phenomenon, and this has made Africa to be considered as the most fire-prone continent in the world and has been referred to as the "fire continent," chiefly because the once vast rich tropical vast landscape of both fire-prone savannas and fire-influenced woodlands have been tampered with, on the account of African involvement with fire over the past years. These have shaped the history of Africa's involvement with fire in the world (Bond *et al.,* 2003; Appiah, 2007; FANRD, 2010; Nyamadzawo *et al.,* 2013). Zimbabwe developed a fire protection system in the 1960s that monitors early detection, quick response, reaction and suppression of wildfire. They further put in place strategies to mitigate negative effects of wildfire which was more sustainable (Mudekwe, 2007; Nyamadzawo *et al.,* 2013). However, it is difficult to prevent wildfires; as such strategies to prevent the occurrence and limit it must be encouraged to preserve biodiversity.

In Zimbabwe, there has been increase in the incidence of uncontrolled wildfires with serious damaging effect on her national parks, indigenous forests, forest plantation, rangelands, communal grazing areas and agricultural lands. This has been attributed to settlement around the forested areas; it has therefore raised concerns to look into techniques in the management wildfire in order to maintain the balance ecosystem in the national park (EMA, 2011; Phiri *et al.,* 2011). Wildlife Conservation Society also reported that the Montane forests on the edge of Obudu plateau are gradually being degraded and destroyed due to grassland fires (WCS, 2020). Annual bush burning exercise at the Kainji Lake National park is usually characterized with prolonged smoke and displacement of wildlife species; because of this phenomenon, it is therefore imperative to examine the effect of bush burning at Borgu sector of Kainji Lake National Park and villages at its buffer with the view on the socio-economic impact. The study was done to identify causes of fire in Kainji Lake national park, highlight management practices and assess fire management methods in the study area.

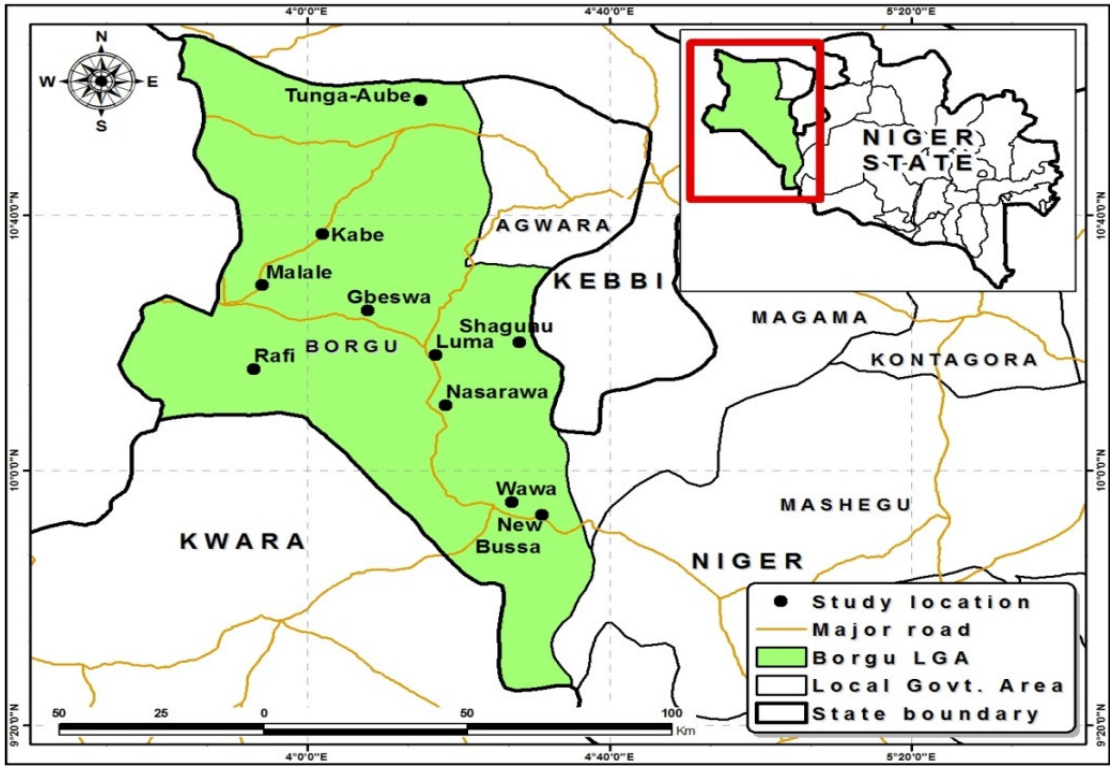

Fig. 1: Map of Borgu Local Government showing New Bussa and its environs
Source: (Ross, 1996)

Material and Method

Description of the Study Area

Kainji Lake National park is located between latitude 9° 40′ N and 10° 30′ N and longitudes 3° 30′E and 5°^{0} 50′ E. It lies at the extreme west of the wooded savannah region and in area generally referred to as the middle belt of Nigeria, characterized by relatively sparse population and abundant wild animals. It

is 560 km north of Lagos and 385 km northwest of Abuja, and covers a total area of 5340.82 km^2. It is made up of two non-contiguous sectors, the Borgu and Zugurma sectors. The Borgu sector lies between Borgu and Baruten local government area of Niger State and Kwara State respectively and covers an area of 3,970 km^2. Bordered in the east by the Kainji Lake and in the west by the Republic of Benin. Zugurma sector on the other hand covers a relatively smaller area 1,370.80 km^2, and in Mariga local government area of Niger State. This sector is bordered by Kontagora River on the northwest and by Manyara River on the north. The climate covers both wet and dry seasons from April –November and October-March respectively; with mean annual rain fall ranging from 1100 to 1200mm. temperature is between 10° and 30°C with 53% relative humidity (NPS, 2020).

Data Collection

Initial reconnaissance survey was carried out to map out villages with more respondents that make use of bush burning as one of their major economic activity. This further enhances administration of questionnaire later in the study area; the villages were mapped out in respect to the major objective of the study. Structured questionnaire were administered to both staff of Kainji Lake National park (KLNP) as well as villages around Borgu sector of the park. 20% out of 120 staff of KLNP were sampled, while eight out of the fifteen villages (Wawa, Gada/Olli, Malale/Doro, Lumma, Samsani/Shaganu, Kuble, Kemeji, Wuruma Koto/Tungamaje, Woro, Duruma, Baburasa, Knasare, Dekara, Gbeji and Leshigbe) around the sector were randomly selected for the study. Twenty (20) questionnaires each were distributed among the villages selected around the sector; the villages include Wawa, Lumma, Kameji, Wurumakoto, Woro, Duruma, Baburasa and Gbeji. This was done purposefully to elicit information from people who have indicated their involvement with the use of fire one time or the other from the reconnaissance survey carried out.

Data generated from the study were analyzed using descriptive statistics and results presented in frequency tables and bar chat.

Results and Discussion

Demographic of the Respondents from the Selected Villages

From table 1, the result showed that male (55%) were more than female (45%) who make use of bush burning in one form or the other. Respondents from the ages 31-40 (50%) was the active age group involved in using fire as economic activity in the study area; follow closely by ages 21-30 (30%) and ages 41-50 (20%). This only suggested that this kind of activity is domiciled with the youth than the elderly possibly because of their agility, strength and alertness to avert accident associated with fire accident. This further corroborate the work of Akosim *et al.,* (2010) who discovered that the productive age of the sampled population at Borgu sector lies between ages 21-45. The result further indicates that those who use bush burning as a major part of their economic process accounted for 60% of all the respondents, with only 10% among the civil servant.

Causes and Uses of Wildfires

In figure 1, the major sources of wildfire in the study originated from livestock keeper (26%), hunter (25%) and farmer (23%) that cleared the bush for farming activity during dry season, these accounted for 74% of the causes of

wildfire. This is similar to the report of Oates *et al.* (2004) which stated that fire among other things are threatening the Oban division of the Cross River National Park. Closely followed by these are fire generated by wild honey harvesting (18%), charcoal production (5%) and careless fire by smoker (3%).

Figure 2 shows that the major use of fire that resulted into forest wildfire in KLNP were from Farm clearing (28%), wild honey harvesting (24%), desire for fresh plant growth (23%) and game hunting (18%); while wildfire as a result of preventing the same was only 6%. This finding corroborate the 2019 annual report of Wildlife Conservation Society for Okwangwo division of the Cross River National Park; where it was reported that farming is one of the factors threatening the conservation status of the sector.

Consequences of Wildfire to Borgu Sector of KLNP

Figure 3 shows that, the effect of wildfire is pronounced in farmland destruction and respiratory disturbances among other things were the most disturbing issue for the people living close to the park (45% and 43% respectively). This is in line with the submission of Block *et al.* (2016) that smoke blowing into human communities is a health concern, especially for people with pre-existing respiratory conditions. The result shows only 9% property destruction and 7% disturbance to the park staffs. Animal species majorly affected by wildfire in the park as shown in figure 4 were Snails with 52%; this is because vegetation covers they need for their moist environment becomes destroyed during a wildfire coupled with the fact that they are slow locomotive animals. Other animals were Monitor lizards, snakes and Tortoise, 35%, 9% and 4% respectively. Smoke smoldering associated with fire do affect monitor lizards and snakes; tortoise on the other hand being a slow animal find it difficult to escape the inferno as fast as other animals. Being the least affected may suggest their low population density in the park. According to Steidl and Litt (2009), Fleishman *et al*. (2011) and Block *et al.* (2016); the interactive nature of fire, nonnative plants and other landscape changes on grassland plants as well as animals are largely unknown in the management of semi-desert grasslands like the one in KLNP. Therefore in this kind of condition, fire blazes beyond its natural range when farmers, hunters and livestock keeper–being the largest culprit in setting wildfire–set the bush on fire because of their needs (D'Antonio *et al*., 1999; Brooks *et al*., 2004; Block *et al.,* 2016). The combined effects of livestock keepers, hunters, farmers among other causes of wildfire may disturbed the balance distribution of species in Borgu sector of KLNP (Hobbs and Huenneke 1992; Paine *et al*., 1998; Block *et al.,* 2016).

Park Response to Fire Outbreak

Figure 5 shows that the initial response to a fire outbreak is to make a shout out (69%) by the staff that discovered it and then followed by the sounding of alarm (31%). This may be due to the nature of job, especially by the patrol team. Since the patrol team usually are the first to discover the wildfire and then make a shout out to the office to sound alarm. If it is possible to remotely sound an alarm by the patrol team that will save time and may help to reduce the magnitude of destruction. Figure 6 shows that mode of response by the people around the park, 28% of the time the they rush to see what is the level of fire associated, 60% of the time the response is to go with a bucket to

reduce the fire and only 12% of the time will a call be put to a fire fighter. This response may be due to the terrain of the park that makes it difficult for fire fighter truck to get into the park and farmlands except for built up areas surrounding the park. Table 2 shows that as at 2014 the local government fire fighter truck was not functional but by 2019, it has been put on standby. The other places where fire fighter can be connected at constant standby were the Air force base New Bussa and the management of the Kaniji Dam site.

Figure 7 shows that between December and January period (49%) fire incidence were recorded the most, between October to November and February to March there was a slight difference in the fire outbreak (26% and 24% respectively). While 1% of wildfire is only recorded between April and September, this is due to the fact that it falls in the rainy season in the study area.

Table 1: Respondent demographic among the villages selected

Variable	Percentage (%)
Sex	
Male	55
Female	45
Age	
21-30	30
31-40	50
41-50	20
50 and above	0
Occupation	
Farming	60
Trader/Artisan	20
Civil servant	10

Table 2: Fire fighters station Around Borgu sector

Organization	Location	Number of Tanker	Status	Source of water
Mainstream control room	Dam site New Bussa	2	functional and standby	Kainji Dam site
Nigeria airforce base	NAF base, New Bussa	2	functional and standby	Kainji Dam site
Borgu local Government Works department	Borgu Local Government secretariat	1	*Standby	*Borehole

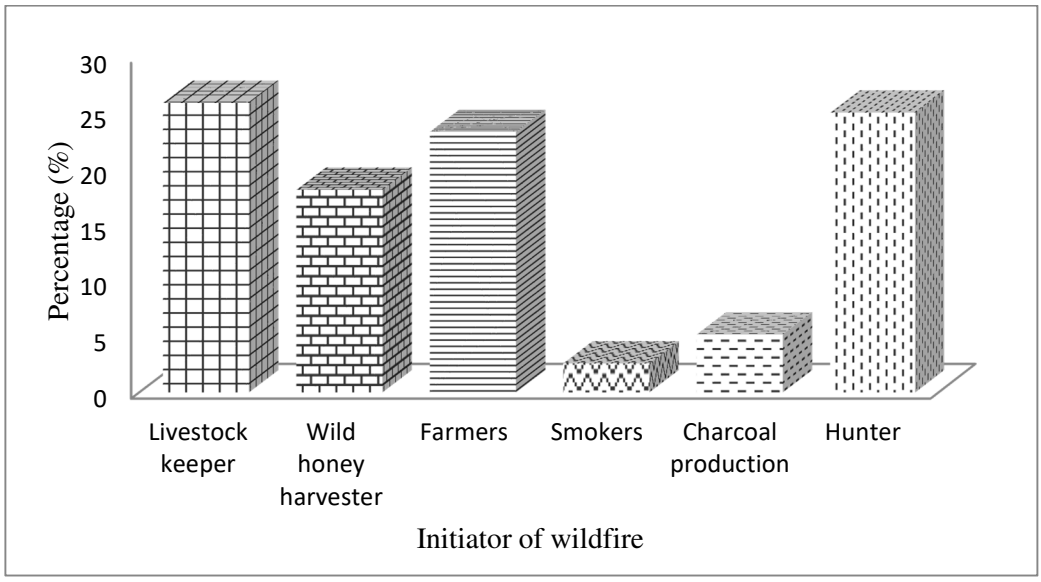

Fig. 2: Causes of wildfire at Borgu sector of KLNP

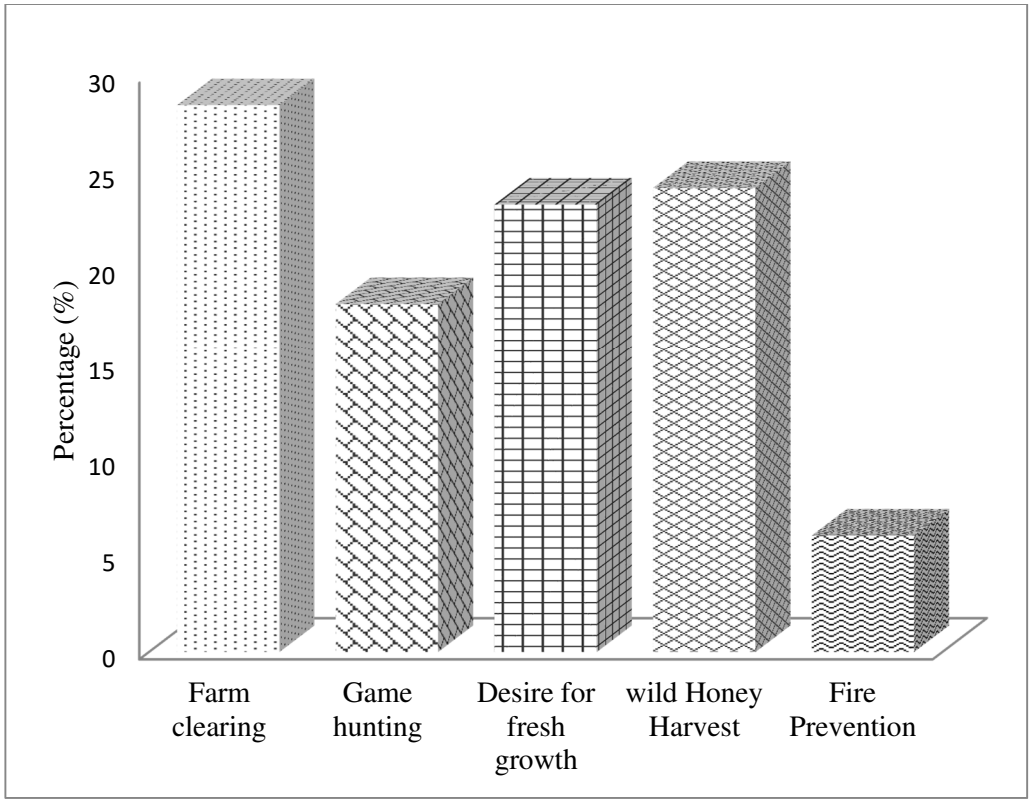

Fig. 3: Uses of wildfire at Borgu sectof KLNP

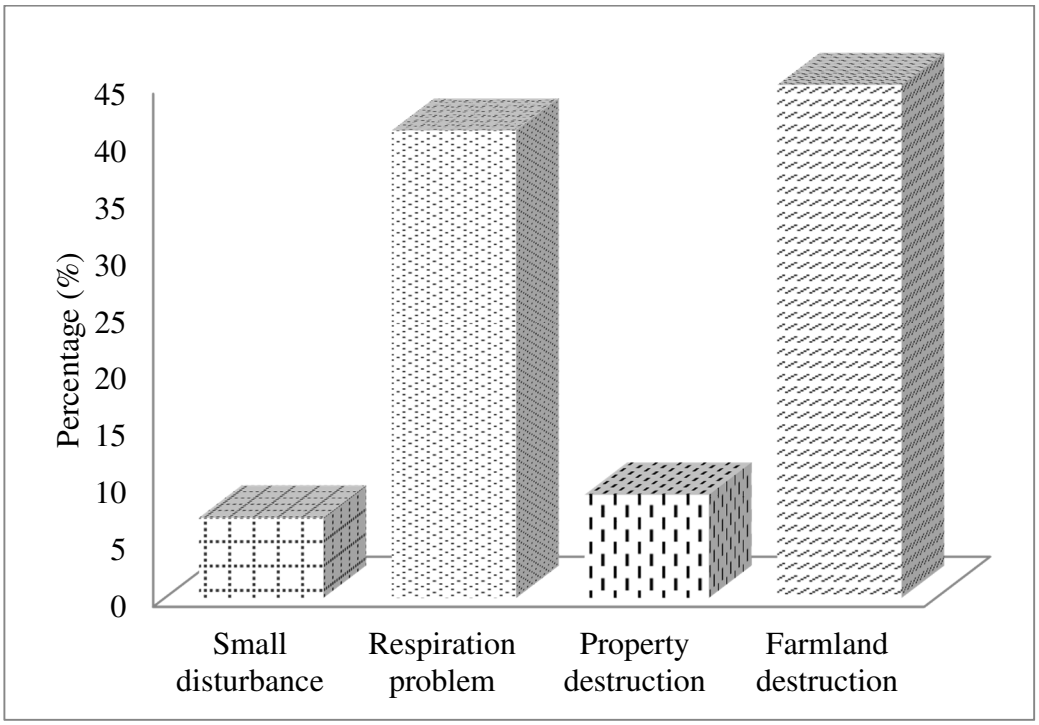

Fig. 4: Effect of wildfire in and around the park

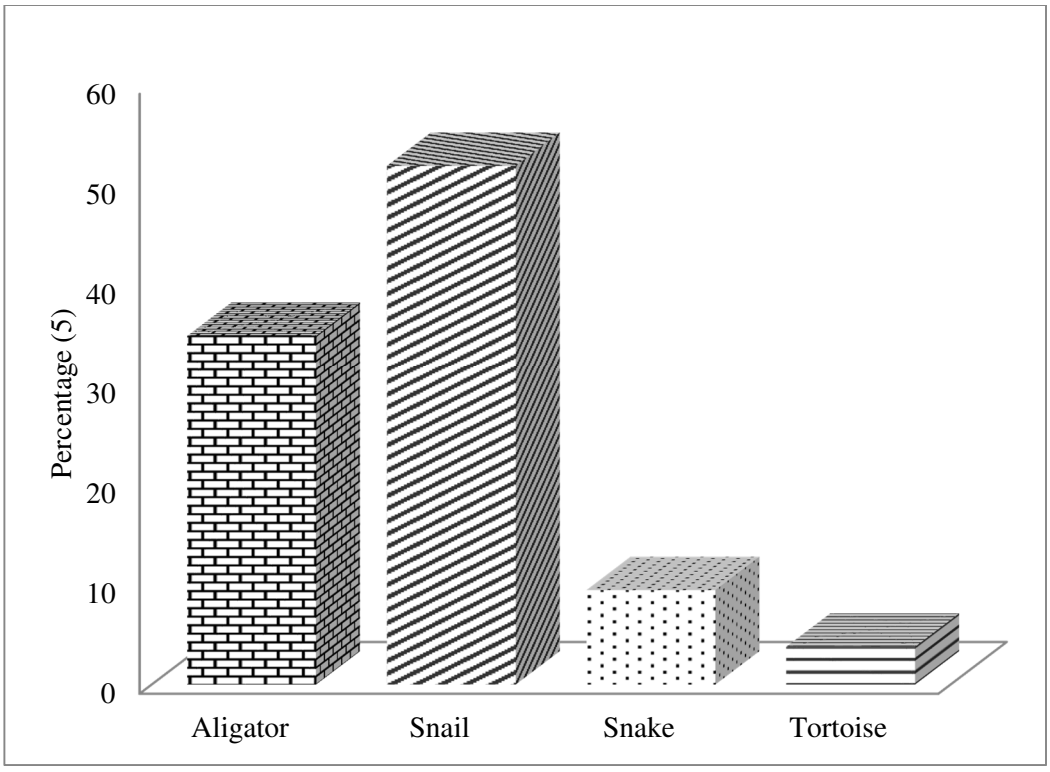

Fig. 5: Animals majorly affected by wildfire at Borgu Sector of KLNP

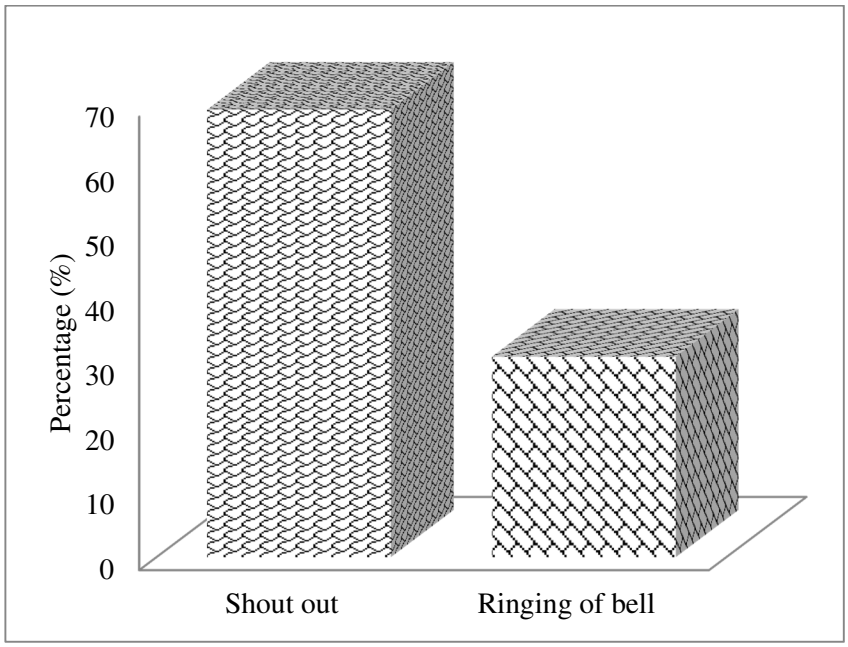

Fig. 6: First response to fire outbrake

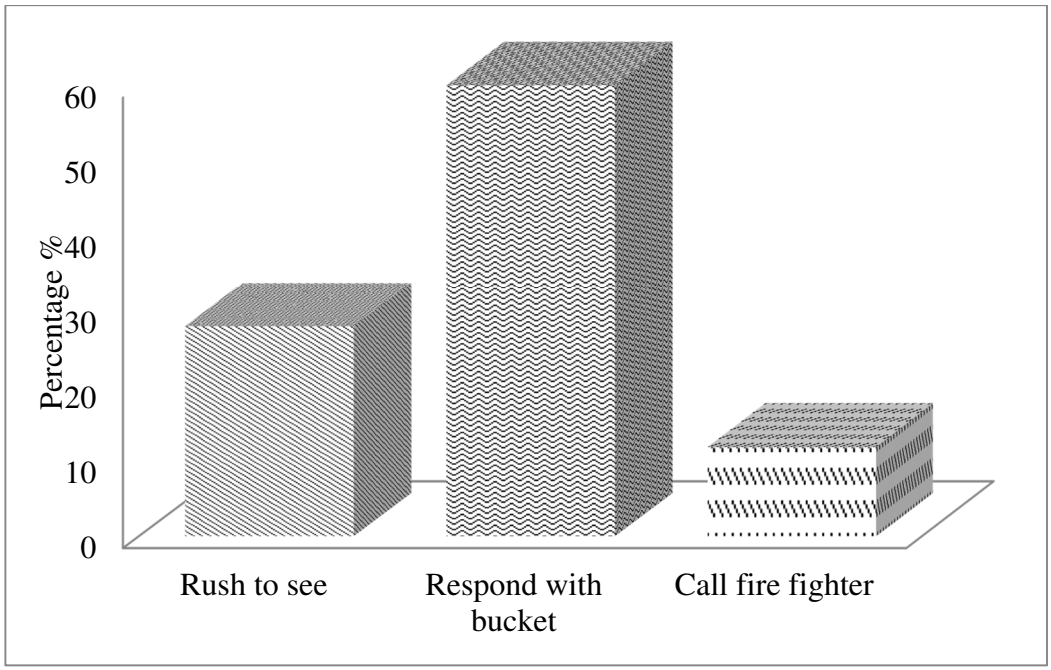

Fig. 7: Fire response mode

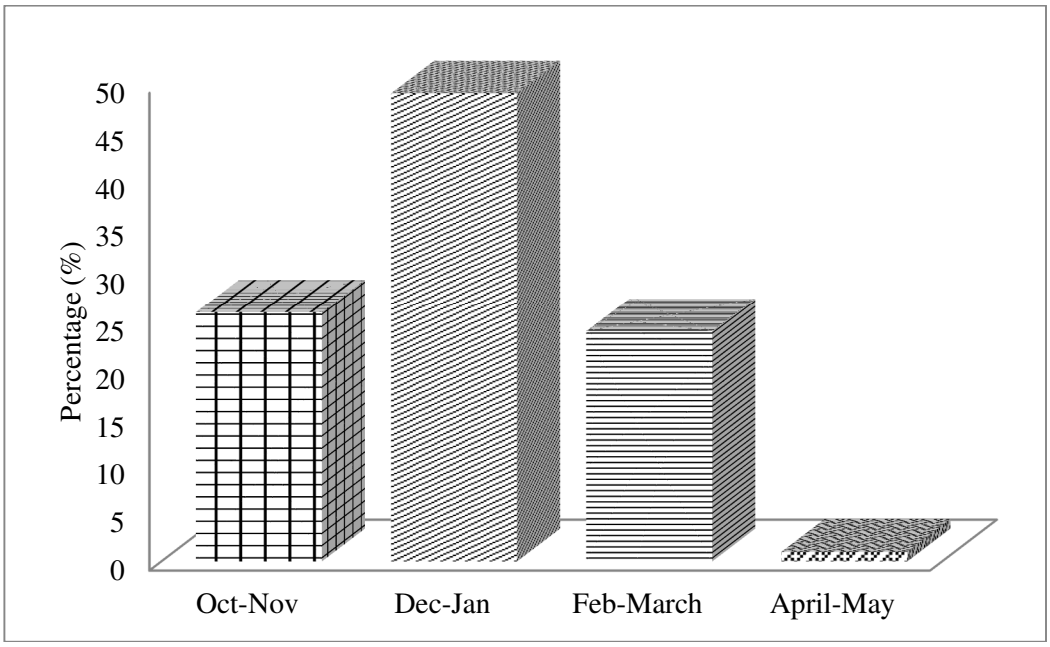

Fig. 8: Period of fire incidence in the park

Conclusion

The study reveal the uses of fire in Borgu sector of KLNP and information gathered will further enhance the management of fire in the sector. Educating the communities around the park of the consequences of wildfire by extension officers as well as possible damage to their property, will further encourage them to participate in both protecting the park as well as be involve in prescribed burns. The combined effects of uncontrolled fire to the wildlife species is fully not understood by these communities, as reflected in their yearly practices in setting fire because of their faming activities, livestock as well as hunting both for honey and poaching.

Recommendation

Cultural view and belief the people have concerning the use of fire must be carefully managed by introducing schemes that will help them manage the use in such a way that the park is protected from uncontrolled fire. It is therefore recommended that quarterly and yearly sensitization on how to control fire in peoples farms as well as fire associated with livestock be carried out particularly at the onset of each dry season. Further study to determine the extent and impact on wildfire in the park to include the wetland, terrestrial animals and avian be conducted to have a holistic view on the impact of fire in the park.

References

Appiah, M. (2007). Fire: a necessary evil. In: Heikkilä, T., Grönqvist, R., Jurvélius, M. (eds) Wildland fire management handbook. Development Policy Information Unit, Ministry for Foreign Affairs of Finland, Helsinki, pp 238–245, Available from:[http://www.fire.uni-freiburg.de/literature/Fire-Management.htm]

Bidwell, T.G., Masters, R.E., Weir, J.R. and David, M.E. (2020). Fire Effects in Native Plant Communities.

Oklahoma Cooperative Extension Fact Sheets; Division of Agricultural Sciences and Natural Resources. Oklahoma State University. Available on our website at: http://osufacts.okstate.edu. Retrieved August 31, 2020, from https://extension.okstate.edu/county/woodward/media/docs/agriculture/fire-effects-on-native-range.pdf

Block, W.M., Conner, L.M., Brewer, P.A., Ford, P., Haufler, J., Litt, A., Masters, R.E., Mitchell, L.R. and Park, J. (2016). Effects of Prescribed Fire on Wildlife and Wildlife Habitat in Selected Ecosystems of North America. The Wildlife Society Technical Review 16-01. The Wildlife Society, Bethesda, Maryland, USA. Pp 69

Bond, W.J. and Keeley, J.E. (2005). Fire as a global 'herbivore': the ecology and evolution of flammable ecosystem. *Trends Ecol. Evol.* 20(7): 387–393.

Bond, W.J., Midgley, G.F. and Woodward, F.I. (2003). What controls South African vegetation - climate or fire? *S. Afr. J. Bot.* 69(1): 79–91.

Brooks, M.L., D'Antonio, C.M., Richardson, D.M., Grace, J.B., Keeley, J.E., DiTomaso, J.M., Hobbs, R.J., Pellant, M. and Pyke, D. (2004). Effects of invasive alien plants on fire regimes. *BioScience,* 54: 677-688.

D'Antonio, C.M., Dudley, T.I. and Mack, M. (1999). Disturbance and biological invasions: direct effect and feedbacks. Pages 143-152 In: L.R. Walker. (ed). Ecosystems of disturbed ground. Elsevier, Amsterdam, Netherlands

Bush Heritage (2020). Fire management. Retrieved August 31, 2020, from https://www.bushheritage.org.au/what-we-do/landscape-management/fire

EMA (2011). Environmental Management Authority (EMA) fire assessment report. 2011. Environmental Management Agency (EMA), Benaby Printing and Publishing, Harare

FANRD (2010). Food, Agriculture and Natural Resources Directorate. SADC regional fire management programme document, Draft proposal, June 2010. SADC, Gaborone, Available from: [http://www.fire.uni-freiburg.de/GlobalNetworks/Africa/SADC%20Regional%20Fire%20Management%20Programme%20Document-Final-6.pdf]. Accessed 30 August 2012

Fleishman, E., Blockstein, D.E., Hall, J.A., Mascia, M.B., Rudd, M.A., Scott, J.M., Sutherland, W.J., Bartuska, A.M., Brown, A.G., Christen, C.A., Clement, J.R., Dellasala, D., Duke, C.S., Eaton, M., Fiske, S.J., Gosnell, H., Haney, J.C., Hutchins, M., Klein, M.L., Marqusee, J., Noon, B.R., Nordgren, J.R., Orbuch, P.M., Powell, J., Quarles, S.P., Saterson, K.A., Savitt, C.C., Stein, B.A., Webster, M.S. and Vedder, A. (2011). Top 40 priorities for science to inform US Conservation and Management Policy. *BioScience* 61:290-300.

Food and Agricultural Organization (1990). Fire as a forest management tool: Prescribed burning in the southern United States. By D.D.

Wade and J. Lundsford. *Unasylva* - No. 162 – Fire. *An international journal of forestry and forest industries* - Vol. 41 - 1990/3. Retrieved August 31, 2020, from http://www.fao.org/3/t9500e07.htm #

Hobbs, R.J. and Huenneke, L.F. (1992). Disturbances, diversity, and invasion: implications for conservation. *Conservation Biology* 6: 324-337. https://gfmc.online/wp-content/uploads/SADC-Regional-Fire-Management-Programme-Document-Final-6.pdf accessed 8 September 2020

Huffman, M. (2013). The Many Elements of Traditional Fire Knowledge: Synthesis, Classification, and Aids to Cross-cultural Problem Solving in Fire-dependent Systems Around the World. *Ecology and Society,* 18(4). Retrieved August 31, 2020, from http://www.jstor.org/stable/26269435

Krausman, P.R.., Bleich, V.C., Block, W.M., Naugle, D.E. and Wallace, M.C. (2011). An assessment of rangeland activities on wildlife populations and habitats. Pages 253-290 in D. D. Briske, editor. Conservation benefits of rangeland practices: assessment, recommendations, and knowledge gaps. U.S. Natural Resources Conservation Service, Allen Press, Lawrence, Kansas, USA

Mudekwe, J. (2007). Management Practices for the Protection of Forest Reserves The Case of Kalahari Sand Teak Forest Reserves in Western Zimbabwe. FAO, Rome, Available from: [http://www.fao.org/docrep/010/j9533e/J9533E00.htm#]. Accessed 8 September 2020

Nyamadzawo, G., Gwenzi, W., Kanda, A., Kundhlande, A. and Masona, C. (2013). Understanding the causes, socio-economic and environmental impacts, and management of veld fires in tropical Zimbabwe. *Fire Science Reviews*, 2:2. Available at http://www.firesciencereviews.com/content/2/1/2. doi:10.1186/2193-0414-2-2.

Oates, J.F., Bergl, R.A. and Linder, J.M. (2004). Africa's Gulf of Guinea Forests: Biodiversity Patterns and Conservation Priorities. Advances in Applied Biodiversity Science, Volume 6. New York: Wildlife Conservation Society (WCS), and Washington, D.C.: Center for Applied Biodiversity Science (CABS), Conservation International.

Paine, R.T., Tegner, M.J. and Johnson, E.A. (1998). Compounded perturbations yield ecological surprises. *Ecosystems* 1: 535-545.

Phiri, M., Zingwena, S. and Mahamba, S.M. (2011). Community-based fire management; experiences from the FAO funded project in the provinces of Manicaland and Matebeleland North, Zimbabwe. In: FAO, Integrated fire approach: From global monitoring to natural fire management, Fire management working paper FM/27/E. FAO, Rome, pp 51–60. doi:10.1071/WF03015

Ross, C. (1996). Conditionality and logging reform in the tropics. In: Institutions of Environmental Aid: Problems and prospects, Eds. Kohane, R.O. and Leve, M.A. Pp.

167-197. MIT Press, Cambridge Massachussets.

Russell-Smith, J., Yates, C., Edwards, A., Allan, G.E., Cook, G.D., Cooke P., Craig, R. and Heath, B. (2003). Contemporary fire regimes of northern Australia, 1997–2001: change since Aboriginal occupancy, challenges for sustainable management. *Int. J. Wildland Fire,* 12: 283–297. doi:10.1071/WF03015

SCBD (2001). Secretariat of the Convention on Biological Diversity (SCBD). Impacts of human-caused fires on biodiversity and ecosystem functioning, and their causes in tropical, temperate and boreal forest biomes. SCBD Technical Series no. 5. SCBD, Montreal, p 42

Steidl, R.J. and Litt, A.R. (2009). Do plant invasions change the effects of fire on animals? *Fire Ecology,* 5:56-66.

Wildlife Conservation Society https://nigeria.wcs.org/wild-places/cross-river-np-okwangwo.aspx Accessed August 2020

Nigeria Park Service (2020). http://nigeriaparkservice.org/?p=148 Accessed 2020

Pivello, V.R., Oliveras, I., Miranda, H.S., Haridasan, M., Sato, M.N. and Meirelles, S.T. (2010). Effect of fires on soil nutrient availability in an open savanna in Central Brazil. *Plant Soil,* 337: 111–123. https://doi.org/10.1007/s11104-010-0508-x

Raisha, C., Gonza´lez-Caba´n, A. and Condiec, C.J. (2005). The importance of traditional fire use and management practices for contemporary land managers in the American Southwest. *Environmental Hazards,* 6(2005): 115–122. doi:10.1016/j.hazards.2005.10.004 Retrieved August 31, 2020, from https://www.fs.fed.us/rm/pubs_other/rmrs_2005_raish_c001.pdf

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FALL ARMYWORM, *Spodoptera frugiperda* OUTBREAK IN NIGERIA: IMPACTS AND MANAGEMENT ON MAIZE FIELDS - A REVIEW

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Abstract
The recent invasion of fall armyworm (FAW, Spodoptera frugiperda) on maize in Africa has threatened food security in Nigeria and across African region. The arrival of fall armyworm in Nigeria since 2016 has significantly affected maize production and caused severe economic losses to farmers in the country. The spread of FAW in Nigeria cut across the 36 states of the country in 2018 incurring more damages due to the invasive nature of this pest. At the onset of the FAW attack between 2017 and 2018 farmers adopted chemical control method which proved ineffective against the pest. The current management approach for FAW in Nigeria is integrated pest management (IPM) which comprises combination of chemical application, cultural practices and botanicals from neem plants. The IPM program adopted by farmers have not yet achieve appreciable success in FAW eradication in the country. This paper therefore reviews the status, impacts and current management of the fall armyworm to provide useful information to scientists and relevant stakeholders on the need to intensify efforts in conducting relevant research to improve FAW management or possible eradication in Nigeria and West Africa to enhance food security in the region.

Key Words: *Maize, Invasive species, Biology, Control, Spread, Damage, Nigeria*

Introduction

Insect pest outbreak is a function of population dynamics. The population of insect is controlled by their ability to increase and this is greatly determined by both biotic and abiotic factors. According to Hasting (2004), an outbreak is when an insect reaches a very high population which is far above the normal. From an ecological point of view 'an outbreak is an explosive increase in the abundance of a particular species that occurs over a relatively short period of time (Singh and Satyanarayana, 2009). There is a general consensus that insect pest outbreak is more frequent and do more damage in host plant in large and continuous host stands; that is a vegetation where one or a few plant species are dominant, abundant or aggregated (Carson *et al*., 2008). Fall Armyworm (FAW) *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera:

Noctuidae) is an invasive and highly significant economic pest native to the Americas (Nagoshi *et al*., 2012). The FAW was first confirmed in the rainforest zone of Southwestern Nigeria in maize fields at the International Institute of Tropical Agriculture (IITA) and Institute of Agricultural Research and Training (IAR&T) at Ibadan and Ikenne in 2016 and later spread to other parts of African countries. (Goergen *et al*., 2016; IAR&T, 2016; Cock *et al*., 2017). The invasion of FAW caused massive destruction of several hectares of maize field resulting in huge economic loss to majority of the farmers (Odeyemi *et al*., 2020)

The invasion of the pest is indeed of a great concern, because, aside the fact that maize is an important raw material for most agro-based industries used in the production of animal feed and breakfast, it also forms major components of the diet of more than 180 million people of Nigeria. The outbreak of the pest in Nigeria is still of a great concern, because it constitutes threat to the food security of the nation as well as farmers' livelihood. The caterpillar of FAW is ravaging maize field at an alarming rate. It is a well-known pest of agricultural crops in the western Hemisphere and endemic to some part of United States such as Florida , Texas and Columbia (Sparks, 1979; Clark *et al*., 2007 Garcia *et al*., 2002;).

The pest host range include; grasses, maize, sorghum, sweet corn, cotton, rice, peanut, cowpea, soybean, vegetables, broadleaf plants and others (Sparks 1979; Andrew 1980; Scott 1991; Santos *et al*., 2003). The pest is known to be capable of causing severe damage by feeding on the foliage of suitable crop, leading to heavy skelotonization/defoliation. Leaves of heavily infested maize usually appear ragged. Maize tassels and cobs are also attacked under severe infestation. The activity of this pest is so insidious to the farmers, which makes its presence unnoticed until havoc is done. Armyworms are strong fliers and can migrate across thousands of kilometres of land. Rain shower after a long dry spell is one of the possible factors that could lead to a pest outbreak. Similar armyworm outbreaks have been reported in the past in some Africa countries like Tanzania, part of South Africa, Ethiopia (Goergen *et al*., 2016).

Nigeria is one of the very first country that reported the presence of fall armyworm in Africa, however, there is no clear evidence on the source of introduction of the pest to Nigeria (IART, 2016, Goergen *et al*., 2016). There is high possibility that the pest could be introduced across the borders, moth migration by flight, wind dispersal or through imported maize materials as a result of international trades (Dent, 2000). The major infestation of FAW in Nigeria since its introduction is mostly on maize crop, though it has been recorded in other crops but the damage on maize in more severe than in other crops. A quick survey conducted in the year 2016 revealed that fall armyworm is present in most of the farms visited. In some areas as high as 90% of visited farms were infested by fall armyworm with varied levels of severity (Odeyemi *et al*., 2020). Till present, fall armyworm constitute a great threat to successful maize production in Nigeria. This pest problem if not address urgently, will further widen the maize supply gap, especially in the phase of the current COVID- 19 pandemic, maize importation ban and farmer-herdsman situations.