JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

How the use of backpack blowers can revolutionaries fire management in arid protected areas a case of Matetsi Safari Area, Zimbabwe

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Abstract: When it comes to suppressing dry season fires in arid protected areas, the experience can be a nightmare for protected area managers. Fire management is a critical management activity in protected areas, which if not undertaken may expose biodiversity to the negative impacts of dry season fires. The use of backpack blowers (leaf blowers) is an emerging tool for conducting fire management activities such as the construction of fireguards and suppressing dry season fires. We look at how the adoption of existing home tools can revolutionise fire management of protected areas with fewer cost implications while achieving area conservation goals. We demonstrate that the use of blowers has a huge impact on fire management activities in fire-prone protected areas.

Keywords: Wildfire**,** fire management, innovation, protected area

1. Introduction

Protected area managers and scientists are increasingly interested in cost-effective alternative ways of grassland biodiversity conservation (Valkó et al. 2014). Savannas constitute the most fire-prone biome in the world, due to the characteristic continuous grassy fuel layer that becomes increasingly flammable with the progression of the lengthy (5–8 month) dry season (Giglio et al., 2013; van der Werf et al., 2017). Fire is a key management tool in savanna ecosystems. Fires play an integral role in shaping ecosystem properties (Bond, Woodward & Midgley, 2005) and have widespread impacts on climate, biogeochemical cycles, and human well-being (Lelieveld et al., 2015). Recurrent fires are essential for maintaining savanna ecosystems (Scholes & Archer, 1997). The use or exclusion of fire from the landscape may lead to rapid shifts in vegetation structure and composition, carbon stocks, and biodiversity (Page et al., 2002).

Protected areas in North West Zimbabwe are particularly noteworthy for their high wildfire activity, which is associated with hot dry seasons and a variable precipitation regime, which promote heavy fuel production and rapid drying of fuels (Ndlovu and Mahakata, 2021). The most traditional means of fire management has therefore been the application of prescribed burning meant to reduce the fuel load. This method of fighting fire with fire (Jazebi, De Leon & Nelson, 2019) has had its success and limitations (Mapiye et al., 2008). Despite the huge

research in fire ecology, fire remains one of the threats to natural ecosystems. The lack of basic fire management training and tools is evident (Trollope, de Ronde & Geldenhuys, 2004). The other challenges included; a lack of proper firefighting equipment, poor volunteerism and poor implementation of policies and regulations (Nyamadzawo et al., 2017).

The use of backpack blowers in fighting veld fires in dry land is becoming a key tool in fire management because of its multiple advantages over conventional firefighting tools. The backpack blower (simply a blower) is a very popular and useful garden tool that has been in great use since the 1970s). The backpack blower works by propelling air out of it through a nozzle. The blower has a motor and a fan that has many blades. When the engine is turned on and the motor starts to run and spin the fan. When the fan inside the machine spins, it draws in outside air which builds up in the machine due to the centrifugal force and forces it out of the fan body through a long air tube. The effectiveness of a blower depends on the airspeed. The petrol (gasoline) models are powered by two-stroke or even four-stroke engines. The advantages of using the two-stroke engine blower are that the machine is lighter, easy to operate and carry; less expensive and offers optimum performance as it can work at any angle without problems.

Common tools and equipment for fire-fighting include shovels, fire beaters, knapsack sprays, racks and a wide range of related tools and equipment (Kilahama, 2011). The commonest tools used are fire beaters, which make it difficult to approach the intense fire. Fire beaters never suppress crown fire (Kilahama, 2011). The blower addresses most of these fire suppression challenges.

Figure 1: An example of a backpack blower

1.2 Study area

Matetsi Safari Area by designation according to the Parks and Wildlife Act Chapter 20:14 is 2 955 km^2 in extent. This area comprises seven (7) management known as units. The area has been managed as a hunting area since 1975. The study focuses on Units 1 to 5 which is 1 888km^2 in extent. The area shares a boundary with the Robins management sector of Hwange National Park, Kazuma Forest, Kazuma Pan National Park, Matetsi Environmental Conservation Area (ECA) and Pandamatenga farming area in Botswana. The Matetsi Safari Area is a unique ecological system. The Karoo basalt rock substrate dominates giving rise to basalt soils which are more productive unlike the Kalahari sand soils in most of the areas in the surrounding landscape. The annual rainfall ranges from 500 to above 700mm and the temperatures in the dry season are as high as 42°C. The area is dominated by vast wet and dry wooded grassland that produces a lot of fuel load (area dominated by tall thatch grass) giving rise to an elevated risk of wildland fires.

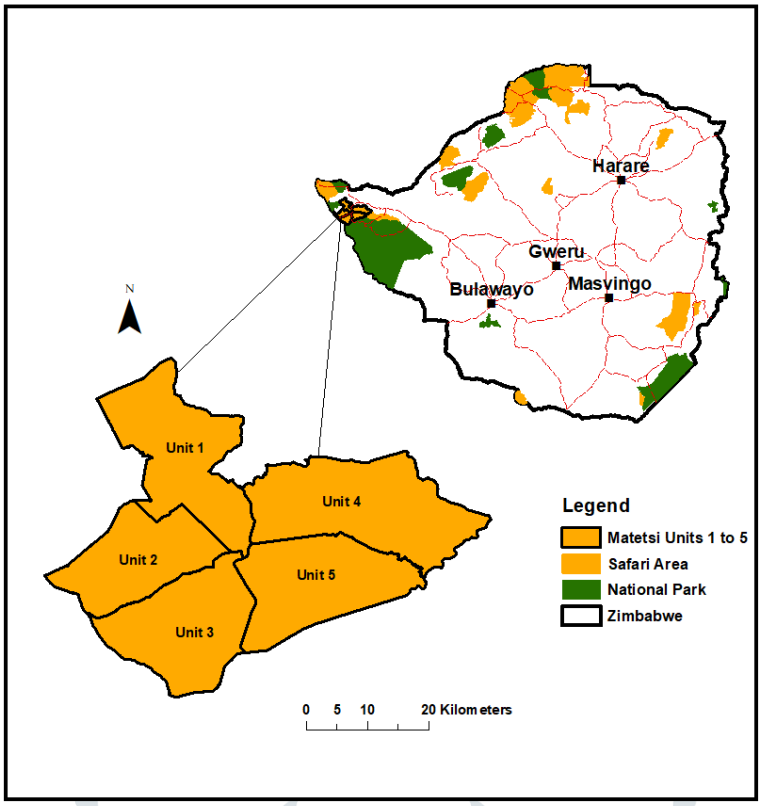

Figure 2: Map of Matetsi Safari Area Unit 1-5

1.3 Analysis of burnt area in MSA

The use of blowers was fully adopted in 2018 when 4 blowers were purchased for use in fighting veld fires. We used end-of-October (fire season ends on 31 October) satellite images covering the period 2013 to 2020 to map the area by supervised classification and calculate burnt in ESRI ArcGIS 10.7.1. The Landsat 8 Operational Land Imager and Thermal Infrared Sensor Collection 2 level 2 satellite images were obtained freely online thanks to United State Geological Survey (USGS) EarthExplorer (EarthExplorer (usgs.gov)).

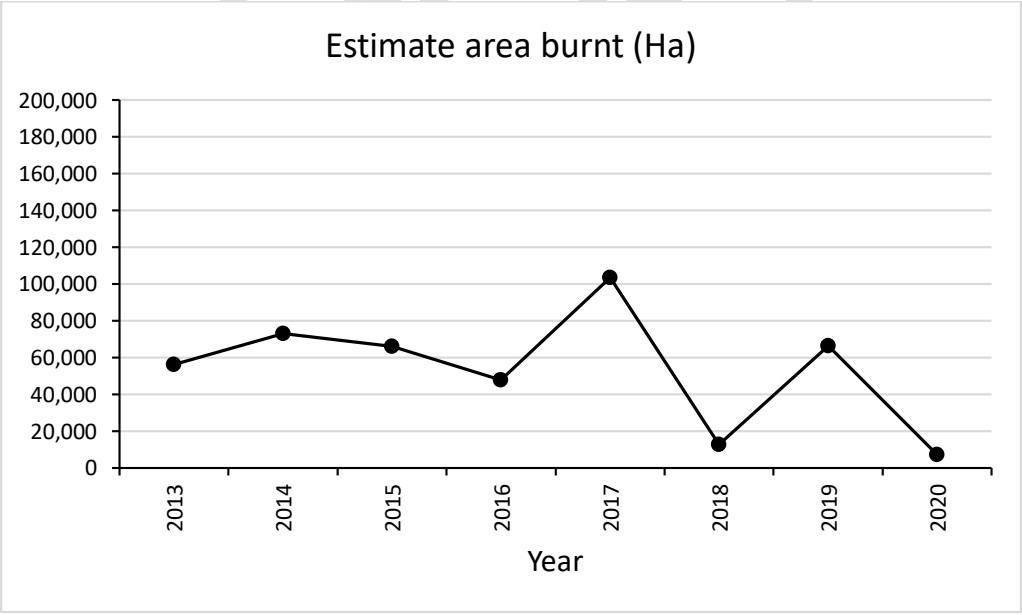

Figure 3: Estimated area burnt by dry season fires in Matetsi Unit 1-5. There was a dramatic decline in fire-affected areas in 2018 and 2020 following the use of backpack blowers.

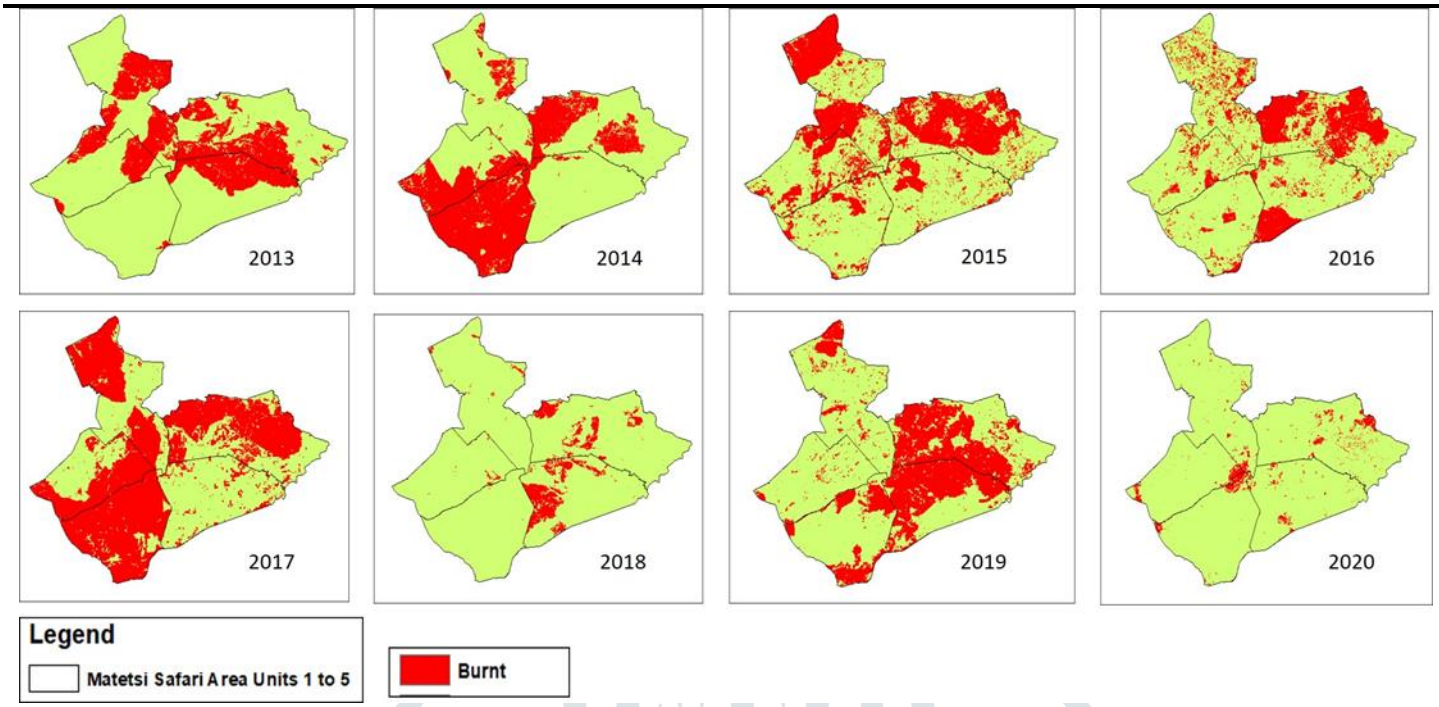

Figure 4: Spatial extent of dry season fires in Matetsi units 1-5 from 2013 to 202.

2. Discussion

Natural and anthropogenic fires in the savanna ecosystem account for the vast majority of burned areas (Singh et al., 2018). The main causes and sources of fire include; bush meat poaching, illegal honey harvesting, lightning incidences, negligent smokers, faulty electrical lines, arson, fire encroachment from illegal charcoal production outside the safari area, land preparation, burning to stimulate green flush for livestock and sometimes cross border fires (Gandiwa and Kativhu, 2009; Nyamadzawo et al., 2017; Mpakairi et al., 2016). The drivers of veld fires include air temperature, NDVI and human population density (Mpakairi et al., 2016). Monitoring of fire incidences in MSA is done through the use of remote sensing technology particularly fire alerts from Fire Information and Resource Monitoring System (FIRMS) and visual detection by rangers. The study area is well known for the prevalence of dry-season veld fires. Despite this, the use of backpack blowers has significantly reduced the area affected by dry-season fires.

2.1 Cost-effectiveness

The initial cost of purchasing backpack blowers ranges between US$ 1 000 to US$1 500 depending on machine specifications and capabilities. The fuel cost is very economical too. Petrol and two-stroke oil are the main fuel and oils needed which are mixed. One major challenge for the use of backpack blowers has been the difficulty in finding repair spares. This challenge is anticipated to become less and less as the availability of machines for home and industrial use increases.

2.2 Health and safety issues

In terms of safety, because the machines use highly flammable petrol, there is an inherently high risk of the operators being burnt during fire firefighting. Despite this risk, well-trained staff can use this machine without exposing them to much danger.

2.3 Conservation implications

The use of backpack blowers is key in contributing to Sustainable Development Goal (SDG) number 8, "Promote, restore and promote sustainable use of terrestrial ecosystem, sustainably managed forest, combat desertification, halt and reverse land degradation and halt biodiversity loss. The use of backpack blowers utilised a small team of firefighters. This has effectively helped to free up the rangers to attend to other pressing conservation calls even if there is a fire outbreak. Only a few rangers are then required to offer security and area navigation services

during fire suppression. The overall spread of veld fire is reduced as fire is contained quickly. Despite these advantages, fire suppression relies on early detection capabilities, and the availability of vehicles to attend swiftly and in time to fire incidences.

2.4 Conclusion and recommendations

The use of backpack blowers has to a greater extent reduced the area affected by dry-season wildfires in MSA. Fire management is critical in helping achieve the 2030 Sustainable Development Goal (SDG) number 15, "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss" which is one of the 17 SDGs adopted by the United Nations parties in 2015. We recommend the investment in backpack blowers as fire management equipment for protected and conserved areas to protect sensitive habitats from destructive late dry season fires. While fire suppression is ideal, the net effect of this fire suppression on biodiversity has not been assessed, this needs to be researched to inform fire management activities.

Funding

We received no funding for this work.

Acknowledgements

The author is very thankful to the Director General Zimbabwe Parks and Wildlife Management Authority for the opportunity to share this experience. Our special thanks go to the Matetsi Safari Area management staff and rangers for their information contribution.

References

[1] Bond, W. J., Woodward, F. I., & Midgley, G. F. (2005). The global distribution of ecosystems in a world without fire. *New phytologist*, *165*(2), 525-538.

[2] Gandiwa, E. & Kativu, S. 2009. Influence of fi re frequency on Colophospermum mopane and Combretum apiculatum woodland structure and composition in northern Gonarezhou National Park, Zimbabwe. Koedoe, 51(1), Art. #685, 13 pages. DOI: 10.4102/Koedoe. v51i1.685.

[3] Jazebi, S., De Leon, F., & Nelson, A. (2019). *Review of Wildfire Management Techniques-Part I: Causes, Prevention, Detection, Suppression, and Data Analytics. IEEE Transactions on Power Delivery, 1–1.* doi:10.1109/tpwrd.2019.2930055.

[4] Kilahama, F. (2011). Integrated fire management and reduced emissions through deforestation and degradation program (REDD PLUS). In *FAO at the Vth International Wildland Fire Conference* (pp. 13-26).

[5] Kudzai S. Mpakairi, Paradzayi Tagwireyi, Henry Ndaimani & Hilary T. Madiri (2018): Distribution of wildland fires and possible hotspots for the Zimbabwean component of Kavango-Zambezi Transfrontier Conservation Area, South African Geographical Journal; https://doi.org/10.1080/03736245.2018.1541023.

[6] Lelieveld, J., Evans, J. S., Fnais, M., Giannadaki, D., & Pozzer, A. (2015). The contribution of outdoor air pollution sources to premature mortality on a global scale. *Nature*, *525*(7569), 367-371.

[7] Mapiye, C., Mwale, M., Chikumba, N., Chimonyo., M. (2008). Fire as a rangeland management tool in the savannas of Southern Africa: a review. *Tropical and Subtropical Agroecosystems*, 8(2), 115-124: https://www.redalyc.org/articulo.oa?id=93980201.

[8] Mukululi N., Innocent M. (2021), An Analysis of the Influence of Annual Rainfall Fluctuations on Wildfire Occurrence in Protected Areas in the Northwest of Zimbabwe. African Journal of Environment and Natural Science Research 4(3), 93- 107. DOI: 10.52589/AJENSRDEYOLNL5.

[9] Nyamadzawo, G., Mapurazi, S., Mukutirwa, P., & Mupotsa, M. (2017). Challenges faced in controlling wildland fires in Mazowe A1 resettlement farming areas of Zimbabwe. *Southern Africa Journal of Education, Science and Technology*, *4*(1), 51-62. http://dx.doi.org/10.4314/sajest.v4i1.39815.

[10] Page, S. E., Siegert, F., Rieley, J. O., Boehm, H. D. V., Jaya, A., & Limin, S. (2002). The amount of carbon released from peat and forest fires in Indonesia during 1997. *Nature*, *420*(6911), 61-65.

[11] Scholes, R. J., & Archer, S. R. (1997). Tree-grass interactions in savannas. *Annual review of Ecology and Systematics*, 517-544.

[12] Singh, J., S. R. Levick, M. Guderle, C. Schmullius, and S. E. Trumbore. 2018. Variability in fire-induced change to vegetation physiognomy and biomass in a semi-arid savanna. Ecosphere 9(12): e02514. 10.1002/ecs2.2514.

[13] Trollope, W.S.W. (1984). Fire in Savanna. In: de Booysen, P.V., Tainton, N.M. (eds) Ecological Effects of Fire in South African Ecosystems. Ecological Studies, vol 48. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-69805-7_7.

[14] Trollope, W. S. W., de Ronde, C., & Geldenhuys, C. J. (2004). Fire behaviour In Wildland fire management: Handbook for Sub-Sahara Africa. *Goldammer, JG, de Ronde, C., Eds*, 27-59.

[15] Valkó, O., Török, P., Deák, B., & Tóthmérész, B. (2014). Prospects and limitations of prescribed burning as a management tool in European grasslands. *Basic and applied Ecology*, *15*(1), 26-33, https://doi.org/10.1016/j.baae.2013.11.002.

[16] Van Der Werf, G. R., Randerson, J. T., Giglio, L., Van Leeuwen, T. T., Chen, Y., Rogers, B. M., Mu, M., van Marle, E. J. M., Morton, C. D., Collatz, J. G., Yokelson, J. R. & Kasibhatla, P. S. (2017). Global fire emissions estimates during 1997–2016. *Earth System Science Data*, *9*(2), 697-720. https://doi.org/10.5194/essd-9-697-2017.