AGRICULTURAL AND BIOLOGICAL SCIENCES

SEASONAL RESPONSES OF TWO FAUNAL TAXA TO FIRE TREATMENTS IN YANKARI GAME RESERVE, NIGERIA.

[1]Mwansat, G.S, [1]Da'an, S. A & [2]Nwabueze, E
[1]Department of Zoology, University of Jos, P.M.B 2084, Jos, Nigeria.
[2]Department of Animal and Environmental Biology,
Rivers State University of Science and Technology, Port Harcourt Nigeria.
Corresponding Email: ansamdaan@gmail.com

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ABSTRACT
The custom of using fire as a management tool in protected areas needs to be within a frame work of an understanding of the responses of biodiversity. This is to avoid or reduce the negative impacts of ecological disturbances in an ecosystem. More responses of floral than faunal components of biodiversity to fire have been studied and reported.This study was aimed at determining the faunal responses to fire in both wet and dry seasons at the Yankari Game Reserve (YGR)located in lat10° 30' E and long 9° 45' N. The birds and insects were used in the study to bridge the knowledge gap of fire ecology in Nigeria. Point transects treated with late burns during the wet season (April to June) and early burns during the dry season (November) were used to record birds and insects. Data was collected from 37 points in the wet season and from 45 points in the dry season. Results show that fire had a significant effect on insect abundance during the wet season and there was also a significant difference between mean insect diversity in wet and dry seasons and a higher bird and insect abundance and diversities was observed in wet than in dry season. The early burn fire regime is therefore, recommended as a fire treatment regime in the YGR. The need for conservation managers to maintain equilibrium between management practices and population dynamics in ecosystems is further highlighted.

Key Words: *Fire, abundance, diversity, insects, birds, Reserve*

INTRODUCTION

Fire has been used by hunters for thousands of years throughout the tropical and temperate zones to manipulate natural resources by creating grasslands for hunting, opening farmland for agriculture and driving game into traps (Meffe *et al*., 1994). Contemporary conservation managers now use a fire regime technique generally referred to as "prescribed burning" as a management tool to restore the ecological functions that were formerly provided by natural fires. However, fire does not only influence the total biomass of vegetation, it also markly influences their structure. Structural changes influence the microclimate and the distribution of resources such as nutrients and moisture (Ludwig *et al*., 2004). These changes in turn have cascading effects on biodiversity (Walker and Peet, 1983;Bigalke and William 1984) with some organisms responding to microclimate and resource availability. Fire is an example of abiotic ecological disturbance (Sutherland, 1998) and has key roles in the ecology of organisms.

Plants and animals respond differently to fire treatments. Burnt coniferous forest has been shown to support more bird species and larger species than unburnt forest presumably because of higher productivity of food supplies (Cody 1985;O'Reilly *et al.,* 2006). It has also been shown that mortality of dominant trees increased linearly with increasing fire intensity while grass layer vegetation was resilient with fire having no detectable effect on either the diversity or floristic composition. He was been reported that fire had greater effect on individual animal species than was indicated by group functional response(Alan *et al*., 2006).

Apart from the long history of bushfires in YGR(Green,1989; Birdlife International, 2007),fire is still being used as a management tool. However, very few fire studies have been conducted at the YGR (Da'an *et al*., 2015). Also,most fire studies have focused on only vegetation excluding the faunal component (Parr and Chown, 2003). Birds and insects species are sensitive to disturbance by fire and are known to be ecological indicators (Danks, 1992;McGeoch, 1998; Gregory *et al.*,2003).The studytherefore, determined the responses of birds and insects to fire treatments in dry and wet seasons.

MATERIALS AND METHODS

The study was carried out between April and November 2008 in YGR, Nigeria. The study site is located in the north east central part of Nigeria (10° 30' E, 9° 45' N), with an area of 2244 km square and 150-750 masl. The YGR is bisected by the Gaji River. The two major habitat types that occur within the reserve are dry savanna woodlands and riparian vegetation, which includes a large area of Fadama. Common woodland trees include *Afzelia africana, Burkea africana, Isoberlinia doka, Combretum glutinosum* and *Anogeissusleiocapus*. In the riparian forest, floral species such as *Khaya senegalensis, Vitex doniana, Acacia sieberiana, Tamarindus indica* among others are common (Geerling, 1973;Birdlife International, 2007).While there are very few records on insects, about 337 species of birds have been recorded in the study area with several other faunal taxa (Ezealor, 2002).

Bird counts and insect collections were carried out along a total of 9 transects of 1 km each (distance was marked with a GPS 60) divided into 5 points 200 m apart cutting across burnt and unburntareas of the savanna woodland. Point count technique was used to record bird species (Bibby *et al.,* 2000); all birds seen and heard were recorded according to Borrow and Demey(2004).

Aerial insects were collected using sweep nets. Fifteen sweeps were made within a 10 m quadrat at each 200m point along the transects. Insects collected were sorted out and transferred into sample bottles containing 70% alcohol for identification in the laboratory according to Shattuck and Barnett (2001) and Castner (2000).

Analysis of Variance (ANOVA) was used to test the statistical significance of the effect of fire on treatments of bird and insect abundance in wet and dry seasons. Bird and insect diversity was calculated using Shannon Weiner diversity index. A one sample T-Test was used to compare mean bird and insect diversities in wet and dry seasons. Statistical analysis was carried out using the Statistical Package for Social Sciences Version 12.0 (SPSS 2003), Microsoft® Excel (2007) and Excel Add-in module Diversity.xla (The University of Reading)

RESULTS AND DISCUSSION

In this study, a total of 569 birds distributed in 75 species were recorded while a total of 532 insects distributed in 24 orders and 79 families were recorded. 275 birds distributed in 31 species were recorded in the wet season while a total of 294 birds distributed in 44 species were recorded in the dry season. Also, a total of 228 insects distributed in 12 orders and 40 families were recorded in the wet season while a total of 204 insects distributed in 12 orders and 39 families were recorded in the dry season (Tables 1 & 2, Figures 4 & 5). There was no significant difference between mean bird diversity in wet and dry seasons (One sample T-Test: $t=18.88$, $df=1$, $P>0.05$), however, there was a significant difference between mean insect diversity in wet and dry seasons (One sample T-Test: $t=4.653$, $df=1$, $P<0.05$)

Table 1: Effect of fire treatment on bird species abundance in wet and dry seasons

TAXON	SEASON	ABUNDANCE	MEAN ABUNDANCE	df	F	P
Bird	Wet	275	1.69±0.11	160	0.86	>0.05
	Dry	294	2.25±0.16	118	1.553	0.215

Table 2: Effect of fire treatment on insect species abundancein wet and dry seasons

TAXON	SEASON	ABUNDANCE	MEAN ABUNDANCE	df	F	P
Insect	Wet	228	1.41±0.06	160	4.043	<0.05
	Dry	204	1.70±0.15	118	0.001	0.957

Higher bird and insect diversities in wet than dry season may be indicative of more availability of food in the former as availability of food is one of the key factors that affect population dynamics in ecosystems (Raman *et al.,* 2002, Skowno and Bond, 2003, Ripple and Beschta, 2004, Ludwig *et al.*, 2004). Therefore, absence of resource(s) can limit populations that are dependent on it for survival. There was a significant effect of fire on insect abundance in the wet season and there was also a significant difference in mean diversity between wet and dry seasons.This agrees with O'Reilly *et al.*, (2006) who reported a similar trend in Kenya and Da'an *et al*.,(2015) who reported a significant effect of fire on the diversity and abundance of birds in YGR and recommended an early fire treatment to be used as a fire regime in YGR. Any management tool like fire should be used such as to maintain minimal ecological disturbance which is a prerequisite for getting ecological equilibrium as in the specific case of bird and insect interactions (Connell and Slatyer 1977, Sousa 1984, Begon *et al*., 1996, Maffe and Carrol, 1994). However, it is known that fire alone may not effectively account for the abundance of many wildlife species especially most birds and many invertebrates like insects because they are highly mobile (Elgood *et al.*,1994, David *et al.*, 2004). Therefore, more research is needed on the effects of fire on biodiversity in YGR. This is in view of the different important interactions in ecosystems asserted by Turshak (2010). While our study concentrated on the responses of bird and insects to fire treatments and suggests similarities in response by these faunal taxa, many other aspects were not studied such as the effect of fire on bird and insect interactions. We therefore, recommend that future research should aim to fill these gaps especially in terms of predator-prey feeding relationships of bird and insects respectively and other aspects of their ecology, effects of fire on vegetation and other faunal taxa like the large herbivorous mammals as well as their interactions with other forms of ecological disturbances.

CONCLUSION

The current study has shown that fire had no statistically significant effect on bird species abundance in wet and dry seasons and there is no significant difference between bird diversity in wet and dry seasons but the direct opposite is the case for the insect species. However, the abundance and diversity indices of both species were higher in wet than dry seasons. We therefore, recommend that early fire treatment can be used as a fire regime in YGR.

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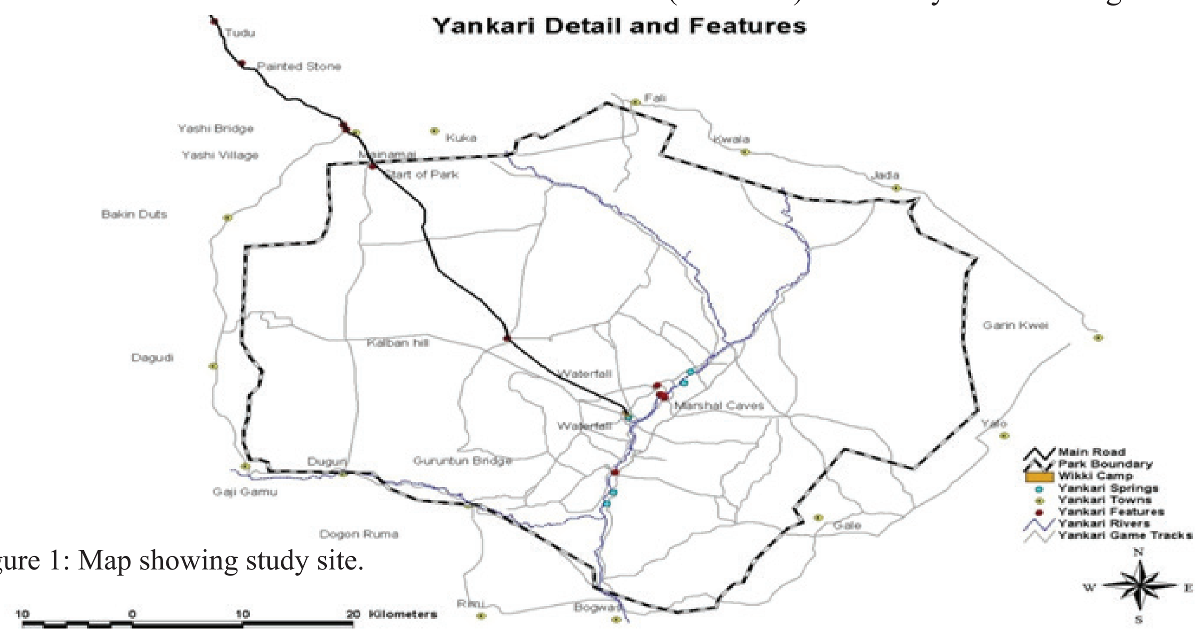

Figure 1: Map showing study site.

Figure 2: Bird species diversity with fire treatments in dry and wet seasons

Figure 3: Insect species diversity with fire treatments in dry and wet seasons

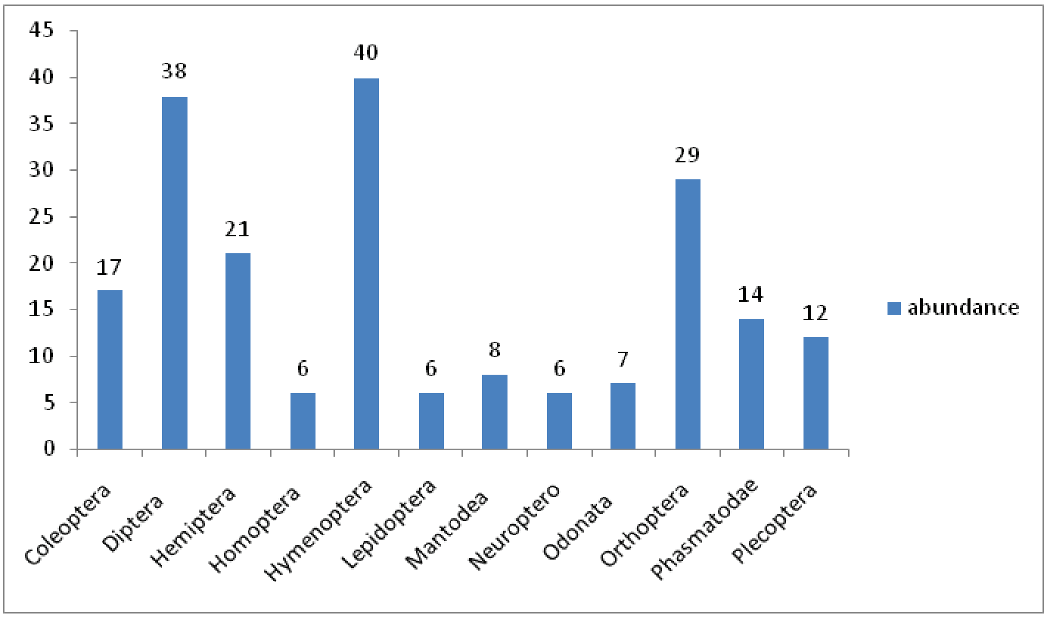

Figure 4: Insect Order abundance in the dry season

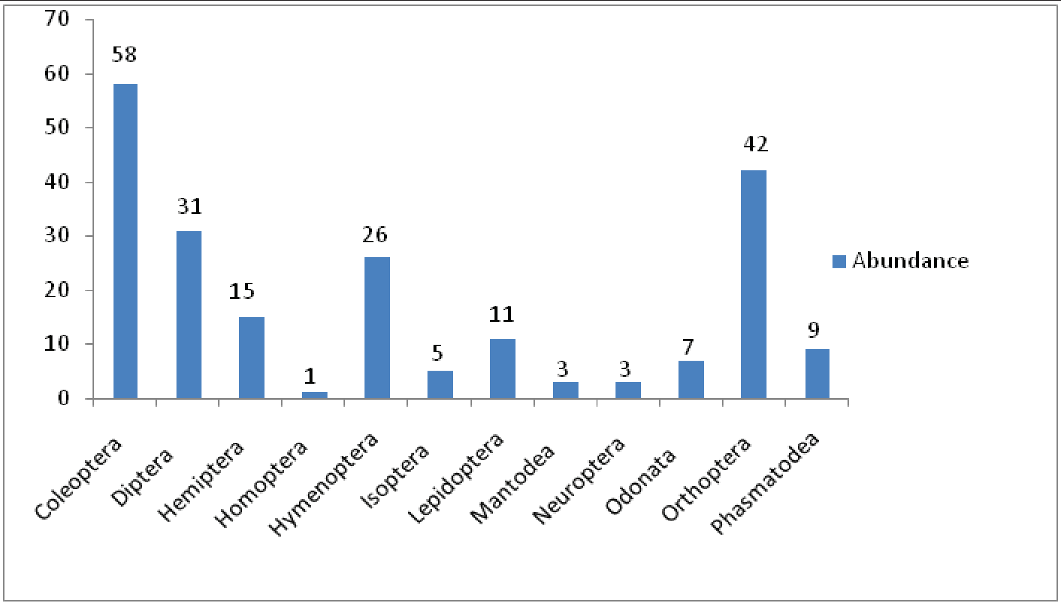

Figure 5: Insect Order abundance in the wet season

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