



Evaluation of nutritive values of most preferred forages eaten by different giraffes in the two seasons (wet and dry) in Sumu wildlife park of Bauchi State, Nigeria

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Abstract

The study identified different forage species most preferred by different Giraffes in Sumu Wildlife Park, Bauchi State, Nigeria. The Park was sub-divided into six sites; one plot of one hectare was randomly selected from each of the site. Direct observation and total count was used in noting the forage species consumed by giraffes. The most preferred forage species were obtained following the time spent on (5 to 10 minutes and 30 minutes to 1 hour) grazing/browsing on each forage species. Descriptive statistics, Pearson's product moment, correlation coefficient and t-test were used to compare the seasonal feeding behaviour, while proximate analysis was adopted in determination of feed quality. A total of 16 different forage species (11 trees and 5 grasses) belonging to 6 families were obtained seasonally. The result obtained showed that *Acacia albida* showed the highest dry matter (83.3%) value with lowest ether extract value (4.1%). *Balanites aegyptiaca* had the highest moisture content (60.1%) value compared with ether extract (1.4%) which had the lowest value. The proximate analysis of moisture content of *Pennisetum purpureum* is higher (75.9%) than that of *Mimosa asperata* (64.2%) but lower in ether extract (3.9%) than *Mimosa asperata* (4.7%). The results of the correlation coefficient between food availability and utilization by giraffes showed a direct relationship between food availability and utilization by giraffes during the wet and dry seasons. A test of significance of the r values showed ($p < 0.05$) a significant and none-significant correlation coefficient for wet and dry season respectively. Further research on the nutrient contents of other plants is recommended.

Keywords: forage species, giraffe animals, feeding behaviour

Introduction

The Giraffe has an enormously long neck which allows it to exploit the leaves and vegetation that are too high up for other animals to find. Despite their length, the neck of the Giraffe actually contains the same number of bones as numerous other hoofed mammals but they are simply longer in shape. The Giraffe's elongated neck leads into a short body, with long and thin, straight legs and a long tail that is tipped with a black tuft that helps to keep flies away. The Giraffe tends to be white in color with brown or reddish markings that cover its body (with the exception of their white lower legs). The markings of each Giraffes are not only unique to that individual but they also vary greatly between the different Giraffe species in size, color and the amount of white that surrounds them. All Giraffes though have large eyes that along with their height give them excellent vision, and small horn-like ossicones on the top of their heads. (Lorraine, 2002).

Giraffe occupy a wide range of environments across the African continent. However, the Namibia Desert is at their ecological limit. The northern Namibia Desert is characterized by extreme climatic conditions, including highly variable and patchy rainfall (<50 mm per annum) and a seasonal temperature range from 0C° to over 40C°. While rainfall is highly variable, precipitation in the form of fog is as much as three times more reliable and is an invaluable water source for flora and fauna. Within the Namibia Desert and throughout southern Africa, the behavioral ecology social organization of resident ungulates has been linked closely with precipitation and, consequently, with forage quality and quantity (Lorraine, 2002).

Giraffe (*Giraffa camelopardalis*) is one of the tallest land animal with an average height of up to 5.5m (males), 4 to 4.5m females to top of head 1100kg (800 to 1930), females 700kg (550 to 11800) for male and female respectively. Neck elongated, with a short, erect mane, shoulders much higher than croup but limbs of nearly equal length. It has a tail, Hock with long black terminal tuft and Horns: the pair is up to 13.5cm, borne by both sexes, the ends knobbed and hairless in adult males, thin and tufted in females and young; a median, lumpy horn and 4 or smaller bumps in males only. Coloration: ground color brown to dark chestnut (sometimes black), broken up into patches and blotches by a network of light-colored hair, the pattern individually unique; males darken with age. Scant glands: possible a pod -crane glands on eyelids, nose, adult males have a pungent odor (Richard, 1992; and Williams, 2011).

Previously found even in North Africa, today the remaining Giraffe populations are restricted to parts of sub-Saharan Africa with the largest concentrations being found in National Parks. Giraffes inhabit open woodlands

and savannah where using their height they are able to see for great distances around them to watch out for approaching danger. The nine different Giraffe species are found in varying countries on the continent, each exploiting their local ecological niche. Due to the fact that Giraffes feed on vegetation that is high in the trees but also too woody for the mouths of smaller herbivores, they are able to remain in areas where domestic grazing has obliterated the plant species close to the ground, forcing the species that feed on them to move on. Giraffes throughout Africa though have been drastically affected by the loss of vast regions of their natural habitat (Lorraine, 2002).

The large size of the Giraffe means that it must spend a great deal of time eating which it tends to do the most during the more tolerable heat of the morning and evening. During the hot midday sun, Giraffes rest in more shaded regions where they (like a number of their relatives) regurgitate their food known as cud, before then consuming it again. Small herds comprised of a number of females and their young spend both the day and night together to protect their offspring from predators, but male Giraffes are much more solitary often roaming over large areas in search of a fertile female. If, however they come into contact with a rival male, the two will begin to bump heads and interlock their necks as a way of establishing a dominance hierarchy, with the winner earning the right to mate with the local female (Lorraine, 2002).

Giraffes are known to eat up to 60 different species of plant throughout the year and do so by grabbing onto branches with their long, black tongue (that can grow up to 18 inches long) and using their tough prehensile lips and flattened, grooved teeth are able to strip the leaves off the branches. Giraffes most commonly eat from acacia trees but also browse for wild apricots, flowers, fruits and buds along with eating seeds and fresh grass just after the rains. Giraffes get 70% of their moisture from their food so need to drink very little but when they do come across clean water, they must splay their front legs (which are longer than the back) in order to get their head close enough to the ground to drink (Per-anders,2007).

Despite being the tallest land animal in the world, the Giraffe is actually preyed upon by a number of large carnivores that co-inhabit the dry savannah. Lions are the primary predators of the Giraffe that use the strength of the whole pride to catch their victim, but they are also preyed upon by Leopards and Hyenas. Giraffes rely on the vast open plains so that they can have the best view possible of their surroundings but if predators do get too close, Giraffes kick their attacker with their large, heavy feet to defend themselves. Young calves however, are much more vulnerable and rely on the protection of their mother and the herd. Sadly, though, around 50% of young Giraffes do not make it past the age of 6 months due to predation. All Giraffes are also threatened by hunting from humans with populations having completely disappeared from certain areas (David and Dorling, 2017).

1. Giraffe diet in the dry and wet Season

Hutchins *et al.*, (2003). observed that giraffes live in habitats where the available food varies throughout the year. During the dry season, giraffes eat evergreen leaves; However, once the rainy season begins, they switch to new leaves and stems that sprout on deciduous trees. Also, twigs and branches are pulled into the mouth of the giraffe with their long and dextrous tongues. In the wild giraffes can eat up to 66 kilograms of food daily. When there is a choice, male and female giraffes feed in different ways. Males concentrate on leaves from the highest branches, while the females arch their necks to eat closer to the ground. Because of this characteristic behavior, a giraffe can be identified as either male or female from a long distance, simply by its stance while eating. Male giraffes are also more inclined to wander into dense woodland, a habitat that females generally avoid. Giraffes drink large quantities of water and as a result, they can spend long periods of time in dry, arid areas. When searching for more food they will venture into areas with denser foliage. The giraffe has tough lips to ensure there is no damage to their mouths when chewing at trees and twigs such as thorns. Giraffes in captivity are generally fed on alfalfa hay and pellets, apples, carrots, bananas and browse (elm and alder are favorites).

Study Area

1. Location of the study area

Sumu Wildlife Park lies in the heart of Lame Burra Game Reserve along the Kano Federal Highway, barely 59 square kilometres from Bauchi town It lies between the latitudes 10⁰40' and 11⁰20', North longitudes and 10⁰09'East and 11⁰30'Eastward as shown in (Figure 1). It was created in 2006 and has been visited by Bill Clinton who attested to its potential. Although 82 sq km is allocated to the Reserve, only 12 square kilometres has been fenced off. Of which, 8 square kilometre belongs to Sumu Wildlife Park. It may seem as no remarkable feat to visit Sumu to see just six species of animals, but there are a few reasons why Sumu Wildlife park is worth the trip. One reason is you get to experience a drive through the Sudan Savannah to see Nature growing untamed and the animals roaming free; it is no secret that Bauchi State caters to both the Sudan and Sahel Savannah in its 46 thousand square kilometre mass of land. The road leading to Sumu Wildlife Park is untarred with nothing but grass-covered hills and scattered little farms by the friendly people of Kafin Madaki headquarters of Ganjuwa Local Government Area, Bauchi State., (Bauchi State Government Diary [BASGD] 2013) ^[7].

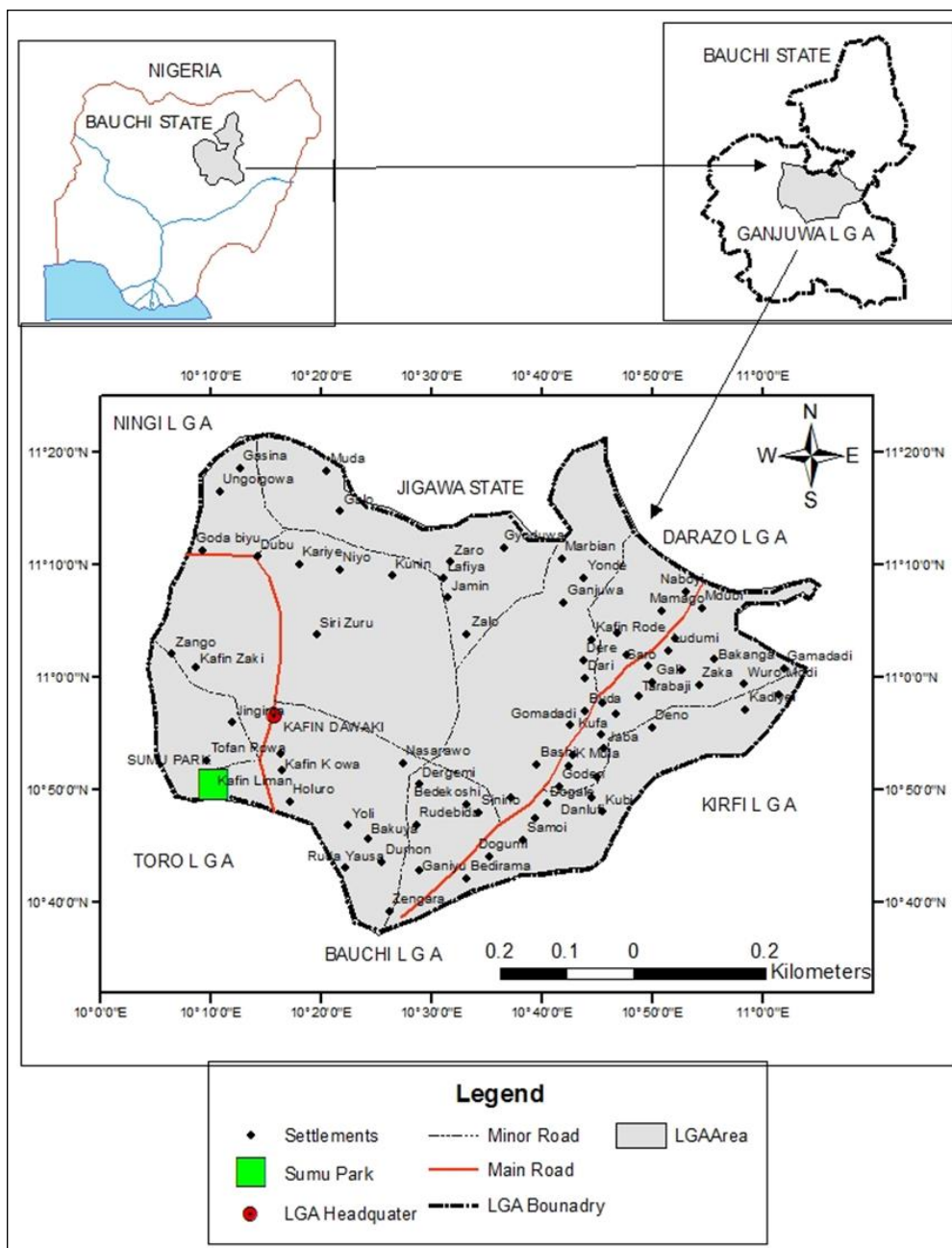
1.1 Climate

Ganjuwa has a Tropical Climatic condition. In wet/rainy season there is much more rainfall in the study area than is in the dry season. The average annual temperature is 26.8⁰C while the average annual rainfall is 1021mm. The driest month is December with zero rainfall. Most precipitation falls in August with an average of

2410mm. The warmest month of the year is April with an average temperature of 30.3°C. In December, the average temperature is 24.6°C. It is the lowest average temperature of the whole year (BASGD 2013) [7].

1.2 Vegetation

The vegetation of the Sumu wildlife park comprises of various types of forage species such as *Acacia seyal*, *Acacia senegalensis*, *Anona senegalensis*, *Combretum molle*, *Acacia hebeclada* etc. While herbaceous plants like *Andropogon spp*, *Imperata cylindrical*, *Aristida spp*, *Panicum maximum*, *Pennisetum purpureum*, among others. Grass species abundant in the Open Woodland included several species with a high grazing value such as *Andropogon gayanus*, *Panicum maximum* and *Digitaria eriantha* (Van Oudtshoorn 1999; Matthews *et al.*, 2001; Ibrahim, *et al.*, 2012; Sauer 1983). Growing tall gave the giraffes access to a 2m band of foliage beyond reach of all other large browsers but elephant aided by its 45mm tongue and a modified atlas-axis joint that enables the head to tilt to the vertical, a giraffe can be seen feeding on crowns of small trees. Big bulls can reach up to 5.8m, nearly a meter higher than cows. Where a choice exists between high and low browse, there is a clear ecological separation between the sexes, the bulls browse on the high trees, while females concentrate on regenerating trees and shrubs below 2m. The sexes of distant giraffes can usually be predicted by whether the animals are feeding high or bending low. Differences in feeding ecology as well as lower vulnerability to predators (based on size and absence of parental responsibility) allow males to enter taller and denser woodland more readily than females, leading also to measure



Source: BASGD, (2016)

Fig 1: Map of the Study Area

spatial separation of the sexes, (Richard,1992). Individual plants can exhibit a multitude of responses to herbivory. Among the most conspicuous of these strategies are. Induced responses may constitute an allocation cost, whereby resources that otherwise would be devoted to growth or reproduction are used to defend the individual from attack by herbivores. Where (and when) herbivores occur, it follows that induced responses should mitigate the negative effects of herbivory, if not provide a net benefit to individuals. By contrast, induced responses are unnecessary where herbivory is absent (Brown *et al.*,2007). The habitat of ungulates provides them with food, water and cover and the feeding styles of each species are therefore of primary importance in determining their preferred habitat (Van Rooyen 1990). The giraffe has suffered a major reduction in population size across its range primarily due to habitat loss, commercial overutilization, and severe poaching, and such decline continues unabated. The Federal Endangered Species Act has a duty to protect the iconic giraffe by listing the species as endangered under the Federal Endangered Species Act, which would meaningfully contribute to giraffe conservation by strictly regulating the import, export, and interstate commerce in giraffes and their parts and products. As mentioned earlier the giraffes nowadays are not as geographically widespread in Africa as they used to be.

Data collection techniques

Direct observation of the types of forage species eaten by giraffes seasonally was assessed in each of the selected plot. Data on quantity of herbaceous plants consumed were collected using quadrat of 1m x1m. The total count of the most preferred forage plant species eaten by the giraffes was adopted following Sutherland (1999) method. Data on the forage most preferred by the giraffes were obtained following the time spent on sighting the giraffe's browsing on each of the species among the individuals. Time spent browsing was measured between 5 to10 minutes, 30 minutes to 1 hour on a species preference and also the percentage availability was determined by dividing the mean number of each forage species in the six (6) plots by the total mean of all the species x 100.The food availability is assessed in terms of the density of each species relative to every other species as outlined by Mitchell and Skinner (2004).

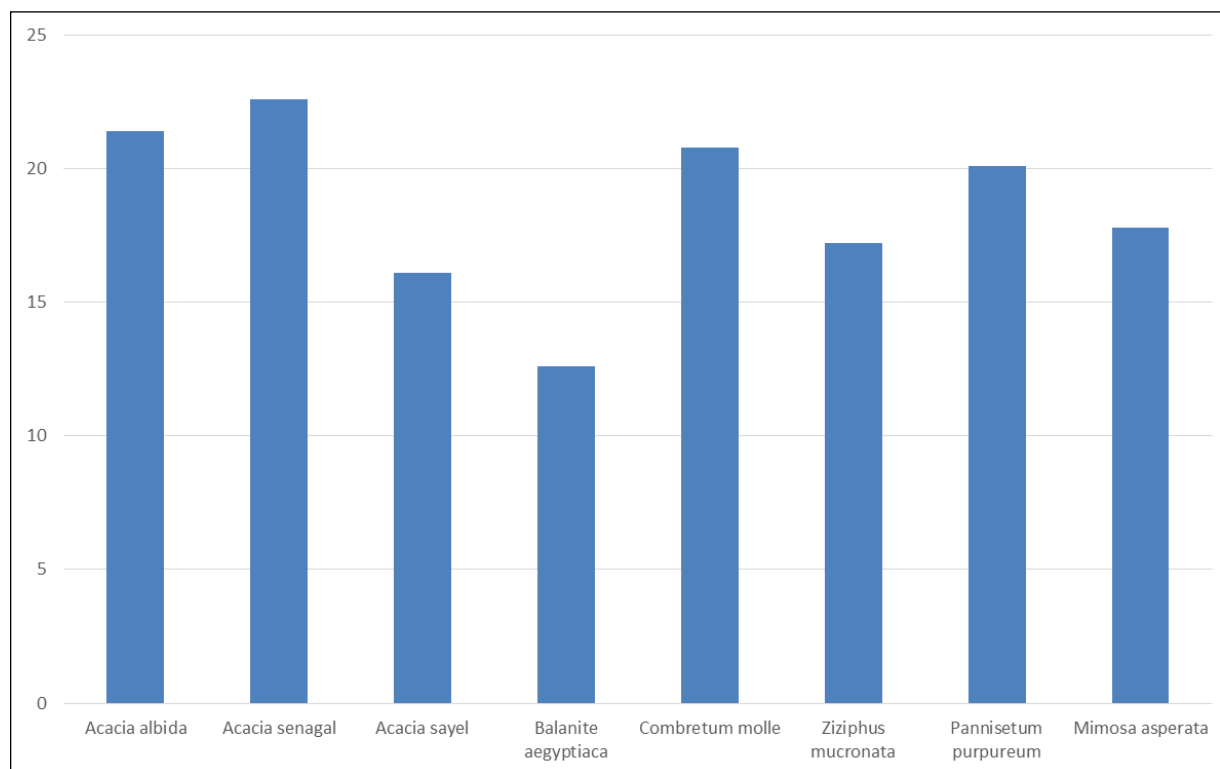


Fig 1: Percentage of crude protein content of the most preferred species.

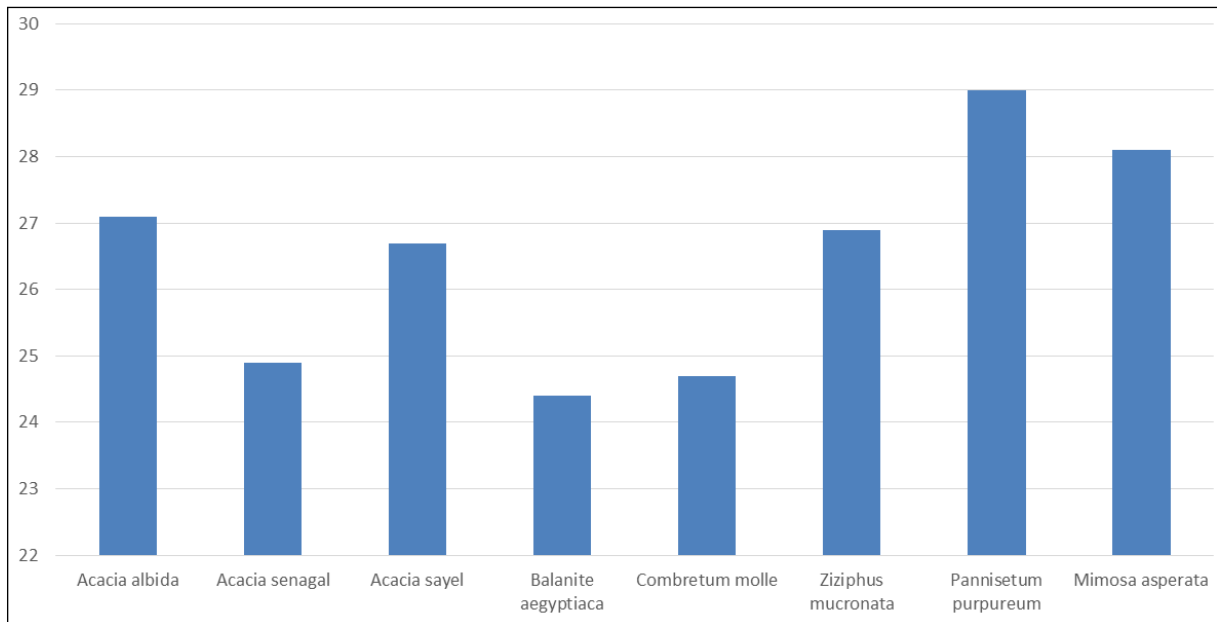


Fig 2: Percentage of crude fibre content of the most preferred species

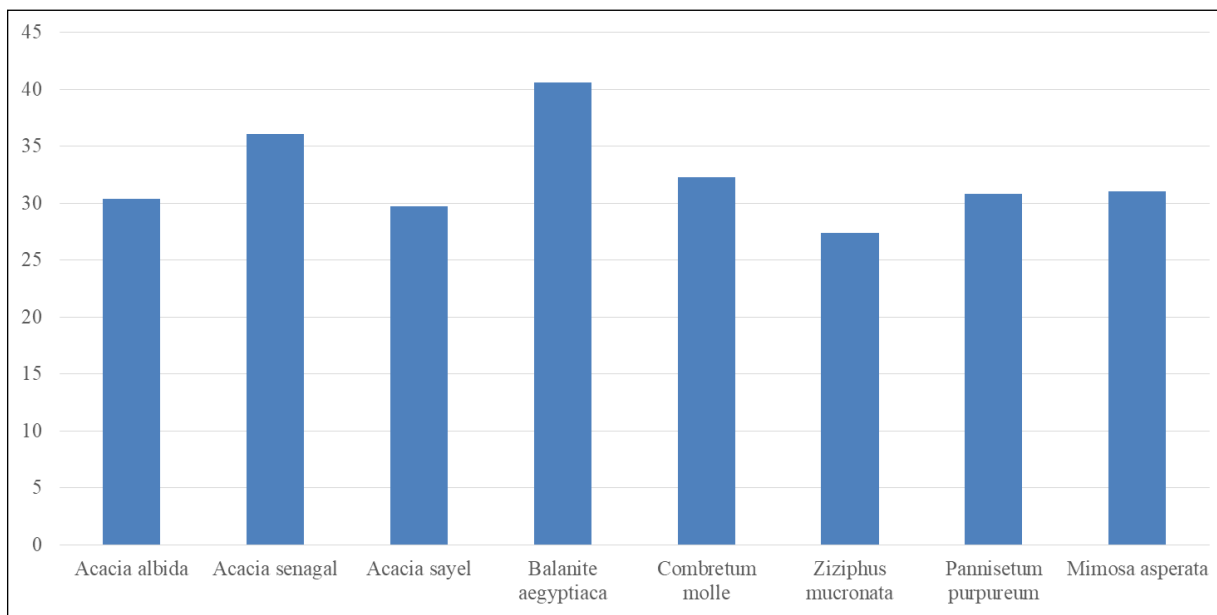


Fig 3: Percentage of Nitrogen free extract content of the most preferred species

Preference Ranking Values of Forage Plant Species Eaten by Giraffes in the Wet Season.

The findings of forage species preference of giraffes in Sumu Wildlife Park during the wet seasons revealed that the most preferred forage species in the wet season include in the following decreasing order. *Acacia senegal*, *Acacia sayel*, *Acacia nilotica*, *Acacia sieberiana*, *Combretum molle*, *Pennisetum purpureum*, *Diospyrus mespiliformis*, *Combretum hypopilinum* and *Ziziphus mucronata* with preferences ranking values of availability of forage plant species consumed by giraffes in the study area during wet/raining season.

Preference Ranking Values of Forage Plant Species Eaten by Giraffes in the dry Season.

The findings of forage species preference of giraffes in Sumu Wildlife Park during the dry seasons revealed that the most preferred forage species in the dry season, the forage species consumed in decreasing order of preference were *Mimosa asperata*, *Panicum maximum*, *Mimosa pudica*, *Andropogon gayanus*, *Balanite aegyptiaca*, *Acacia hebeclada* and *Acacia albida* with preference ranking values of availability of forage plant species consumed by giraffes in the study area during dry season.

The trend of the preference shown for forage species by the giraffe may be attributed to the nature of the leaves that possess some defense mechanisms. To ensure the daily nutritional intake, which is crucial for surviving, the giraffe must continually modify its feeding behavior, for example by spending more time foraging when biomass and quality of the ingested food decline in the dry season this agrees with Lauren, (2003). The time giraffes spent on feeding during the dry season was twice the time spent during the rainy season this agrees with observation of (Ciofalo and Le-pendu 2002). The percentage utilization of the leaves of the different plant

species browsed by giraffes is mostly significantly correlated with the crude protein content in both the dry and wet samples. Compared to the other fractions.

However, this does not mean that the giraffes select the food plant species for their protein content. The giraffes seem to prefer new growing shoots when available as observed by Azim, *et al.*, (2011). These food parts may be more succulent and have a relatively high protein content, although chemical composition is only one of the selection criteria that may influence food selection by herbivores. Furthermore, of the of the species that showed a significant correlation between utilization and chemical composition a total of only eight (8) species out of the sampled, showed a significant correlation with the crude protein. In Sumu Wildlife Park which is a better habitat and where monthly data on utilization are available for a full year, percentage utilization correlate positively with changes in crude protein content and with moisture content. This is an indication that succulence of leaves may well be an important factor influencing selection of food plants by giraffes this observation agrees with Sauer, (1983); Wood and Weldon (2002); Baltimore, (1999) ^[5].

Browse plants, beside grasses, constitute one of the cheapest sources of feed for ruminants. The diversity and distribution of browse plants in Nigeria have received early attention in studies (Mohammed, *et al.*, 2014). One of such explanations is that most females in the study area were not lactating and did hence not need food to produce milk, although they might have been pregnant this agrees with the work of Du Toit (2005) ^[16] who compared four African browsers that differed widely in body size, including giraffe, and found that increasing body size was associated with increasing time spent on feeding and also moving at the cost of less resting. One might expect such a result as increased body mass leads to higher metabolic requirements which is also applicable within the species. The giraffe bulls are bigger than cows and naturally have a larger food bulk requirement. There are also sex-related differences regarding feeding adaptations. Both sexes spend over half their feeding time above two metres. This is in agreement with Du Toit (1990) who observed that giraffe bulls fed at an even higher level in the vegetation than cows, often with head and neck extended vertically. He observed that bulls benefit from this by gaining access to nutritious new shoots in the upper vegetation canopy. Though, in this posture they may suffer an increased predation risk due to reduced vigilance. The most intense feeding periods for a giraffe are the three-hour periods of post-dawn and pre-dusk. There is a marked decline in browsing activity during the midday period; reaching a minimum in the early afternoon when the ambient temperature is hottest. Ruminating diurnal behavior reaches its maximum during the hot midday period. Ruminating in giraffes is the most dominant nocturnal behavior. This research has seen a clear peak in the late afternoon in the amount of time spent foraging. It is likely that the giraffes ruminated more during the most demanding parts of the day because this is less energy-consuming than wandering and searching for food. Although the dominant food sources of the giraffe are trees and shrubs, *Acacias* species formed the major part of the diet of the giraffe population similar observation was made by (Parker 2005) in Arusha Park where he favor of, investigated and compared the botanical composition of the diet of giraffes and other ungulates (gazelles, wildebeest, zebra, buffalo and elephant) and in Masai Mara National Reserve by micro histological analyses of faeces, he found that the giraffes' diet was very dissimilar to the other ungulates.

Sauer, (1983) also observed that the most preferred plant by the giraffes were *Acacia* spp. (70 %) and *Acacia* (20 %) in the dry season and *Hibiscus* spp. (17%), *Acacia* spp. (14%), *Grewia* spp. (13%) and *Olea* spp. (10%) in the wet season. The leaf protein content of the *Combretum* species remains more or less constant during this period but the protein content decreases in the leaves of the *Acacia* species. Taking availability into account, the utilization of these preferred food plants by giraffes correlates positively with the protein content of the leaves throughout the year, while during the wet season the succulence of the leaves may be important. There is significant correlation between utilization and succulence in specific *Acacia* species this agrees with (Sauer, 1983).

The Nutritive Values of Preferred Forage Plant Species eaten by the Giraffe in Sumu Wildlife Park

The moisture content of the most preferred forage plants species by giraffes was generally high ranging from 80% to 16.2%. The highest value of 81.2% was obtained in *Acacia senegal* and continued in this order: *Pennisetum purpureum* (75.9%), *Ziziphus mucronata* (73.2%); *Mimosa aesperata* (64.2%); *Balanites aegyptiaca* (60.1%); *Combretum molle* (18.7%).

The findings of proximate analysis of the nutritive values of preferred forage plant species consumed by Giraffes in Sumuz Wildlife Park indicated that *Acacia albida* had the highest dry matter (83.3%) with ether extract (4.1%) having the lowest value. This agrees with Lukhele, *et al.*, (2003) who reported that dry matter content constituted 20% to 30% of most plant parts, the rest being water which makes up to 70% to 80%. In this situation therefore, the dry matter content of giraffe feeds which ranges from (18.8%) for *Acacia senegal* and the least value from *Balanites aegyptiaca* (39.9%). The rumen degradability of dry matter in this study was substantially higher than that of Nitrogen. This agree with the results of Lukhele, *et al.*, 2003) working on Ghanaian browse plants, found that the Nitrogen degradability was equal and even higher than the dry matter degradability. They concluded that the browse species they had evaluated, contained low concentrations of compounds that would inhibit N digestion. In many investigations leaves from trees and shrubs are proclaimed as suitable supplements to graminaceous fodder and crop by-products containing low protein and fermentable energy levels. This corroborates with the findings of this study.



Fig 4

Conclusion

The findings of this study indicated that giraffes forage resources in the study area is presently adequate in terms of diversity, variability and availability, and nutritional content distribution. Sixteen forage species were identified which are available either in the wet or dry seasons. The density and the percentages of the important forage species is adequate. Therefore, feed abundance may be attained in the study area if the available trees are protected from fire and indiscriminate cutting by fuelwood collectors. However, regeneration or enrichment planting should be encouraged in the study area. This in turn will increase the carrying capacity of the habitat with the attendant increase in giraffe's population. Thereby increasing tourism potentials of the Sumu Wildlife Park.

Recommendations

In view of the findings from this study the following recommendation are made:

1. Judging from the number of available forage species, the study area is moderately species rich. However, indiscriminate cutting of trees and shrubs in the area should be checked to prevent the depletion of these resources.
2. Further research on the nutrient content of all the forage species eaten by giraffe in the study area could be done, especially on the carbohydrate, potassium and phosphorus.
3. Therefore, further data on the concentration of micronutrients in the plants eaten should be of great interest to draw conclusions on the functions of browsing/grazing in giraffes in Sumu Wildlife Park.
4. Enrichment planting of the forage plant species most preferred by giraffe in the study area should be encouraged.
5. More food supplementation should be sustained during the drought periods and salt licks should also be provided. This is presently being done in Sumu Wildlife Park.

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