FOOD AND FEEDING HABITS OF THE FOREST BUFFALO(*Syncerus caffer nanus*) IN OKOMU NATIONAL PARK, EDO STATE

BY

OKOSODO EHI FRANCIS
FWL/99/3183

A DISSERTATION SUMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF AGRIC TECHNOLOGY (M. AGRIC. TECH)

TO THE

DEPARTMENT OF FISHERIES AND WILDLIFE MANAGEMENT, SCHOOL OF AGRICULTURE AND AGRICULTURAL TECHNOLOGY, FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE

DECEMBER, 2006

CERTIFICATION

I certify that this work was carried out by Mr. Okosodo Ehi Francis of the Department of Fisheries and Wildlife, Federal University of Technology, Akure, Ondo State, Nigeria.

.....
Dr. A.I. ADEYEMO
M.Sc., Ph.D (Ibadan)
(Major Supervisor)

20/8/07

.....
DR (MRS.) B.N.EJIDIKE
M.Sc., (Ib.) Ph.D (Akure)
Minor Supervisor

DEDICATION

With due gratitude and praise to the Almighty God, I hereby dedicate this project to Michael and Nosa Okosodo.

ACKNOWLEDGEMENT

I thank The Almighty God, the beginning and the end, the favour of whom I enjoyed, and the power of whom that sustained me during the project.

I wish to express my warmest and sincere appreciation to my Dr. A.I. Adeyemo and Dr. (mrs.) Ejidike for their efforts, understanding, tolerance and encouragement. Also, Dr. Ogunjemite for the painstaking and relentless manner in giving me the necessary materials needed for this project.

My indept appreciation goes to the following people, Mr. Yemi Gbadamosi, Micahel Popoola, Ojo Omotokiri, Aina Ojo, Mr. and Mrs. E.O. Adesoye for their moral and financial support.

My profound gratitude goes to the authorities of Okomu National Park for their kind support during the period of this study, Mr. Stephen Haruna, (Park Manager), Mr. Lawrence Osagie the Park Protection Manager, the rangers who assisted me in the collection of the data for this project and host of other staff who were very kind to me. God bless you all.

My wonderful thanks goes to the authority of Nigerian Conservation Foundation (NCF) for allowing me to use their library.

I also want to register my sincere thanks to all members of my family, my parents, my children and host of others too numerous to mention.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

ABSTRACT

This project investigated the food and feeding habits of the forest buffalo in Okomu National Park. The study covered three months during the wet season (July to October 2005) and three months in the dry season (December to February 2005). The specific objectives that were determined are the food preferences of the forest buffalo, the effects of seasonality on the food of this animal and nutrient quality of the food consumed by the forest buffalo.

Two hundred faecal outputs were collected and examined, i.e. ninety-six (96) during the wet season and one hundred and four (104) during the dry season. Samples from each season were carefully broken and sieved using 1mm wire mesh to reveal the microscopic contents of the faeces. Three weekly visits were made to the feeding sites of the forest buffalo, with the visits being made between 0600 hours and 1600 hours.

Data were collected of the plant species and the parts eaten by this animal. Samples of the undigested materials and plant species that could not be identified in the field were collected and preserved in 10% formalin specimen bottles for identification at the Department of Forestry, Federal University of Technology, Akure and later compared with standard herbarium. Samples of the dried faecal output and the plant species were used for proximate analysis according to the Association of Analytical Chemists (AOAC, 1990).

The results show that the forest buffalo feeds on both grass and browse species. It feedsmainly on grass species (84%) during the wet season but consumed higher percentage ofbrowse species (84%) during the dry season. The most preferred browse species is *oncocalamus spp*, the result of the proximate composition carried out show that they were highly nutritious

CHAPTER ONE

1.1 INTRODUCTION

The high rate of deforestation in Africa over the past two decades is causing a great concern among forest managers and conservationist. Deforestation may be defined as an act leading to removal or destruction of forest vegetation unaccompanied by deliberate effort at its replacement. Enabor (1986) described deforestation as not only the felling of trees but also removal of shrubs, lianas and other plants from the forest. He further stressed that it is a symptom of a widespread of poverty or the exploitative utilization practices of foreign capitalist or both.

Forest has been known since ages to provide certain amenities for the benefit of mankind; these include timber, poles, for furniture, pulp for paper and fuelwood, which account for large part of the household energy for rural people. It also provides a variety of other ethnobotanically important items like fruits, gums, medicinal plants etc. (Oguntala, 1995). The forest has always been recognized as the habitat for wildlife, as watershed protecting water supply and resort for recreational purposes (Afolayan, 1986). The most outstanding usefulness of the forest is the ability to protect the environment, soil, climate etc, (Adeola 1986).

FAO (1990) report indicad that while the forest area in most developed countries has stabilized and probably increased, the forest and savannah ecosystems in Africa and other tropical countries are being destroyed at an alarming rate. The report stressed further that although deforestation can be

ultimately useful to man; it is the most important agent of the forest disturbance and destruction. Okali (1995) stated that deforestation in West African countries would probably persist unless National planning in various countries is oriented towards giving the highest priority to agriculture not in theory but in practice.

Conservation include measures for the management, protection and rational utilization of land, water and wildlife resources of a country for the achievement of highest sustainable quality of living for mankind and the control or elimination of environmental pollution (Hardin 1965) and (Afolayan 1994).

Ajayi (1986) defined conservation as the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations. According to the Encyclopedia on Science Technology, conservation involves several processes such as preservation, restoration, beneficiation, maximization, reutilization or recycling, substitution, allocation and integration of natural resources. Examined briefly, preservation implies the protection of nature from commercial exploitation with the aim of prolonging its use for recreation, rational exploitation and scientific study. Adeyemo (1992) stated that wildlife conservation implies the wise sue of the game population.

The over riding objectives of conservation is to secure performance of benefits from natural resources (Ayodele, 1988). Afolayan (1992) stated that besides the objectives of ensuring permanent supplies of products, conservation particularly of vegetation has the objective of protecting the environment, such as the protection of the catchments areas to enhance water resources supply and at the

same time check soil erosion, protect grazing lands against desert encroachment and stabilization of coastal habitats. Ayodele (1985) stated that another important objective of conservation is the maintenance of the scientific values of the natural ecosystems.

The concept of conservation factors reveals that man at best disrupts the fundamental harmony and balance of nature including wildlife by his activities. The need therefore, is focused on restoring to the highest possible level and at the same time maintaining the state of productivity of their resources.

The main methods of conservation are as follows:

(a) In situ: This involves the conservation of wild animals in their original or natural habitats as we have in the National Parks, Game Reserves, Sanctuaries and Strict Nature reserve etc.

(b) Ex situ: This is the conservation of wild animals outside their original or natural environment or habitats as we have in the zoological gardens. There are about twenty-one zoological gardens in Nigeria (Ayodele *et al*, 1999).

Wildlife in form of bush meat constitutes a principal source of animal protein for the rural majority in Nigeria (Akegbejo - Samson, 1996). Research has shown that the available protein per capita per day in the developing countries is by far lower than that of the advanced countries (F.A.O. 1986). The report further stated that the protein per caput between 1980 and 1985 in United States of America was 80 grams per day while the protein intake in the developing countries was placed at 20 grams per capita per day. Fadeyi (1983) submitted that the

protein intake per capita per day in Nigeria was less than 10 grams. The low consumption of protein in the developing countries shows a corresponding adverse effect on the growth and the healthy condition of the people. The occurrence of various forms of protein/calorie malnutrition such as kwashiorkor, marasmus and mental deficiencies is an evidence of the low quality of nutrient consumption in the country. Ajayi (1978, 1986) and Afolayan (1980, 1982) have individually and collectively expressed the important roles played by bush meat in the diet of rural communities in Nigeria. Wildlife meat includes different species of insects, maggots, caterpillars, snakes, snails, and varieties of rodents, lizards, antelopes and a host of other small mammals.

The report of the Federal Office of Statistics showed that the annual total value of bush meat in Nigeria was about ₦60 million in 1963. In the southern states nearly 20% of all locally produced animal protein in 1979 came from wildlife. Charter (1970) reported that the value of bush meat consumed in southern Nigeria was ₦20 million while the total value for the entire country was put at ₦30 million. Afolayan (1982) valued the animal protein from wild animals and fresh water fish consumed annually as being well over ₦200 million. He further stated that the local hunters kill, eat or sell wild animals, the rich and affluent customers patronize the grass cutter, snails and host of other small mammals where they are roasted along road sides or hotels or restaurants.

In West Africa, 15.8 thousand kilogrammes of meat representing 13 wildlife species were sold over 17 months in Ghana, Republic of Benin, Ivory Coast, and Cameroon (Adeyemo, 1992).

There are about 36 wildlife reserves in Nigeria, only eight of these are up graded to National Parks and currently opened for game viewing and tourism. The Yankari and Kainji Lake National Park for example have been opened to visitors since 1962 and 1970 respectively. Falade (1996) reported that Yankari received over 20,000 visitors per annum and Kainji Lake received about half as much. Revenue collected from these visitors who came for game viewing is well over 60% of the total revenue of these parks.

Ajayi (1986) stated that tourist revenue begins with fares paid for international and local air transportation. This is followed by payment of hotel bills and hiring of vehicles for making local tours. In addition, tourist pay for such services as game guard and interpreters, purchase of locally made goods as souvenirs. Foreign exchange through tourism contributed to Kenyan economy to the level of about $36 million in 1973. $82 million in 1974 and $146 million in 1995. With a period of 3 years since opening tourism in the revenue has increased from zero to about 3,000 pounds per month during the peak of game viewing (Poak, 1995).

In Nigeria, such tourist income remains an asset for the future depending on the speed at which our National Parks are operated and developed. There are no physical barriers to Nigeria having parks quite as spectacular and as lucrative as the world famous National Parks of the East Africa. Wildlife and its habitats when elevated from mere existential nature to a management cum conservation stratum provides employment for both the rural communities and the experts. Management in most cases employs the local hunters for game patrols and as game

guards who act as anti-poaching groups. Where parks and game reserves are sited the junior cadre of management such as clerks, typists, drivers, game scouts are employed from such communities for effective management the local people are incorporated into the conservation and development of the reserves (Ayodele, 1988).

The numerous by-products of wild animals such as skins, feathers, beaks, horns, tails and ivory are used for different purposes in Nigeria. Ajayi (1979) stated that revenue derived from the sales of animal by-products amounted to N2 million in that year. In addition, many African countries derived substantial revenue from export of live wild animals and their by products. East African countries like Kenya, Tanzania and South Africa export tusk of elephants, skins of Leopard and hyena (Akegbejo - Samson, 1996).

Almost all our scientific advancement are built on the knowledge derived from nature. The conserved areas such as parks cannot be managed properly without adequate knowledge of what are to be protected (Adeyemo, 1992). Most of the advances in biological and medical fields are as a result of discoveries emerging from the studies of wildlife and their products (Ayodele, 1988). Some of those that are of immense importance to humanity include:

- the "rhesus" monkeys which revealed a new fact about human blood chemistry and prevention of diseases
- new drugs are first tested on primates because their physiological process are close to humans (Ajayi, 1974).
- the anthlers of deer are now used for measuring radioactive contamination of natural environments (Falade, 1996).

- various parts of animal such as feaces, bones livers and horns etc. are used for treating one ailment or another. This is stressed by (Afolayan, 1986).
- snails have been discovered to be capable of improving the singing tones of singers if taken regularly (Ayodele, 1988)

Various parts of plants – the roots, leaves and barks are useful in traditional medicine. Ayodele (1988) stated that different plant species preserved in the wild could be of much benefit to the people on the long run. The importance of these plants in West Africa have been reported by (Gbile 1985), and (Kio *et al* 1986). Most importantly, plants generally have been of tremendous use to humanity since the time of creation even till the present time. This is especially so with the people in local areas where they use them for food and treatment of local diseases.

1.2 Justification

Studies on food and feeding habits of an animal are very important in understanding its ecology and social behaviour. Different mammals exhibit varying traits in their food selection and feeding habits. The forest buffalo is a ruminant with a high requirement for food and space because of its body size.

Moreover, inspite of the immense importance of understanding food and feeding habits in animal ecology and ethnology, little studies have been carried out in this aspect on the animal in Okomu National Park, this potentials has to expose

to the outside world. These studies reveal the great potential of the park for research and ecotourism.

1.3 Aims and Objectives

The general objective is to determine the food and feeding habits of the forest buffalo in Okomu National Park, in order to achieve this, the following specific objectives were considered to determine

(i) the food preference of the Forest Buffalo in Okomu National Park

(ii) the effects of seasonality on the food of the forest buffalo in Okomu National Park.

(iii) nutrient quality of the food consumed by the forest buffalo

CHAPTER TWO

LITERATURE REVIEW

2.1 Distribution and Classification of Buffalos

Buffalo is one of the widely distributed ungulates in Africa, and is found throughout the continent south of 15°N but its distribution is limited by the 250mm isohyet. They are confined to areas where annual rainfall is higher than twice the potential annual evaporation (Grubb, 1986). According to Stewart and Stewart (1995) there is no buffalo in arid regions. Kingdom (1977) reported that in the past that buffalo inhabited most parts of Africa south of the Sahara from the East to the West Coast, that today there are forms of African buffalo in varying degrees of abundance in many countries in Africa.

The largest concentrations of West African savannah buffalo occur in the Ivory Coast, and Senegal. The Central African buffalo is abundant in Congo, Central African Republic and Tanzania. Today, the forest buffalo occurs mainly in Ivory Coast, Cameroon, Gabon and Central African Republic (Estes, 1991). Buffalo belongs to the family *bovidae* and genus *syncerus* (Wilson and Reeder 1993). There are four recognized sub species of buffalo according to the 1998 African Antelope Database of the IUCN/SSC Antelope special group. The four species are West African Savannah buffalo *Syncerus caffer brachyceros* Central African savanna buffalo *Syncerus aequinotalis* and the southern African buffalo *Syncerus caffer* often referred to as cape bufallo. The fourth species is the forest or dwarf buffalo *Syncerus caffer nanus*. It is physically quite different, distinct phenotypically and in its habitat.

According to Grubb (1986) buffalo has a great range of morphological variation, varying from small red brown to brown small individuals living in the forest to the more widely known large dark heavily built savanna buffalo with large horns. Numerous different sub species have been considered to characterize the intermediate forms; these were reviewed extensively by Kingdom (1977) and also listed by (Wilson and Reeder 1993).

Groves (1991) reviewed what is known of bovid specialization and placed the divergence of *syncerus* from boslike ancestors at about 4-5 million years ago. Kingdom (1977) listed synonymes for *Syncerus caffer* which include: *adamauae, adametzi, adolfifriederici, athiensis, azrakensis, beddington, bornouensis, bubuensis, centralis, corriculatus, cottoni, cubangensis, cunenesis, limpopoenensis, loma miensis, massaicus* and *mayi*. Taxonomy classifications of members of buffalos and subfamily bininae have been attempted by several authors. Kingdom (1997) classified buffalo as follows:

Kingdom	-	*Animalia*
Phylum	-	*Chordata*
Class	-	*Mammalia*
Order	-	*Artiodactyla*
Suborder	-	*Ruminata*
Family	-	*Bovidae*
Sub-family	-	*Bivinae*
Genus	-	*Syncerus*

2.2 Description of Buffalo

The African savanna buffalo is the largest of the African bovid, and one of the most successful African mammals in terms of geographical range, abundance and biomass. The average weight for male savanna buffalo is 800 kg and 240-340 cm long standing 135 – 170 cm at the shoulder height. The forest buffalo has small dimensions being about 220 cm long, standing 100-120 cm at the shoulder, with a weight of 320 kg (Foggin, 1999). The savanna buffalo are black or seal brown, whereas the forest buffalo are red-brown to brown. Both have heavy horns with a substantial boss (Sinclair, 1977).

Harris (1995) reported that buffalos are heavily built, thick set animals with large legs to support their heavy bodies, and in spite of their weight they are capable of moving at a speed of up to 55 km/ hr for a short distance. Stewart and Stewart (1995) reported that buffalos are heavy built member of the cow family with reddish brown coat (darker in subspecies), the neck is thick and the head carries two low curved horns with boss between them. Sinclair (1974) reported that savanna buffalo are large, heavily cow-like animals, he stressed further that they vary greatly not only in size but the shapes of their horns and colours. Adults are usually dark or black gray or black (or even look as if they have been wallowing in mud of that colour) and the young are often reddish brown. The forest buffalo maintains the red colour even as an adult.

Both male and female buffaloes ridged have heavy ridged horns that grow curved downward and then up. The horns are formidable weapons against predators jostling for space within the herd; the males use the horns in fights for dominance (Scarce 1986). The forest buffalo is gregarious but not territorial. They congregate in smaller herds generally from 8-12 individuals while the cape

buffalo generally form large herds of 50-150 individuals, sometimes 350 animals or more (Kingdom, 1977). Happold (1987) stated that the basic units of the buffalo herds are stable groups of presumably related cows that are in a linear dominance hierarchy to which is attached a number of adult bulls that are also ranked according to age and dominance status. He further submitted the young males may form loosely organized bachelor herds, while other bulls not associated with a herd may live a solitary existence.

Plate 1: The Forest Buffalo (*Symcerus caffer nanus*) in Okomu National park, Edo State, Nigeria.

Plate 2: The carcass of the forest buffalo (Syncerus caffer nansus) found around Lake 90 in Okomu National Park, Edo State, Nigeria.

Plate 3: Stale feacal droppings of a Forest Buffalo (Syncerus caffer nanus) in Okonu National park, Edo state, Nigeria.

2.3 Conservation Status of Buffalo

The 2000 IUCN Red Data list classifies the African savanna buffalo as lower risk and conservation dependent and the forest buffalo as low risk/threatened, this means that they are the focus of a continuing conservation programme that directly affect them. According to the 1998 African Antelope Database of the IUCN/SSC Antelope Specialist Group, there are approximately 830,000 cape buffalo, 27,000 West African savanna buffalo, 133,000 Central Africa savanna buffalo and approximately 60,000 of Forest buffalo in the wild. Wilson and Reeder (1993) reported that during the rainy seasons, buffalo numbers build up, only to decline during dry spells as they cannot adapt very well to dry conditions.

Grubb (1986) reported that the future status of all subspecies of African buffalo is closely linked to the future of protected areas and well managed hunting zones. Large, stable or increasing population of the southern savanna buffalo occur in many protected areas in southern and eastern Africa but the current trend of the West African and Central African forms of the savanna buffalo is towards near threatened or threatened. Stewart and Stewart (1995) reported that about 75% of the estimated total population of the forest buffalo occurs in nominally protected areas and the level of protection afforded this subspecies will determine its future conservation status.

2.4 Food and Feeding of the Forest Buffalo

The basic nutrients in animal diet are protein, carbohydrate, fats, vitamins, minerals and water (Baker, 2001). The amount and quality of nutrients required

for good health and efficient production vary according to species age, sex, gestation and lactation. Ruminants unlike monogarstic animals utilize microorganisms in the punch to break down fibrous feeds for energy and to synthesize amino acids from poor quality protein or non protein nitrogen compounds such as urea. Baker (2001) classified nutrients as being essential or non-essential. An essential amino acid cannot be synthesized by the body, on the other hand, non essential amino acids are those chemical elements or compounds required for growth and maintenance that can be synthesized in the animal body in sufficient quantities to meet daily requirements.

Sinclair (1977) reported that ungulates might die of starvation during the period of food scarcity. Owen-Smith (1999) submitted that herbivores use their body reserves to bridge periods of food scarcity. Tyler (1992) reported that feeding time of the ungulates depend on the animals requirements of energy and nutrients, the amount of digestive food that is available and the rate at which food can be ingested which is influenced by the distribution of the food. Prins (1993) reported that flexibility to adjust to its time budget in periods of food scarcity may help the buffalo to obtain nutrient requirements, he stressed further that this is because buffalo spend considerable proportion of its time on feeding.

Stobbs (1999) stressed that as a result of unfavourable vegetation their bite will be reduced hence their intake will not be able to meet their requirements. Welch and Smithers (1995) reported that the bite rate and bite size of the forest buffalo depend on the structure of the seaward and morphology of the animals mouth, they also stated that increasing more time is lost due to coarseness of the

grass and buffalo changes its grazing technique during the dry season from plucking with their mouth to cutting with incisors which results in smaller bite during this period. Skinner (1994) reported that buffalo shows a seasonal movement in the wet seasons they use large areas and in the dry season they concentrate in permanently wet areas. Vessey-Fitzgerald (1984), Bligh and Harthoom (1985) reported that the poor ability of the buffalo to regulate their body temperature resulted in low levels of grazing and movement during the hot periods. Hoffman (1985), Vansoest (1996) reported that buffalo is water dependent and non selective grazer of fresh grasses. Ponnycuick (1990) reported that buffalo spends more time feeding during the dry season.

Bell (1991) reported that buffalo changes their diet during the dry season. Ayodele (1985) reported that ungulates migrate during the dry season only to return when the condition is favourable. Field (1991) submitted that buffalo has the most efficient digestive system for digesting fibrous food, than any of the ruminants, while they feed on fresh, new flush grasses such as occurs in freshly burnt areas. They readily eat old grasses and effectively utilize them regularly. He stressed further that this habit of feeding on old grasses and trampling on them helps to open up those areas to other species by enabling new growth.

Dott (1989) submitted that buffalo is sensitive to heat and move to shade during the heat of the day and sometimes wallow in the mud. Sinclair (1977) reported that the bulls often wallow in mud which not only helps them cool down their body temperature but it is good in controlling biting insects. He further stated that buffalo drinks water twice a day. They even wade into the water up to their

bellies when drinking. Harris (1995) reported that buffalo are active at dawn, dusk and during the night. Grasses are the major food of the forest buffalo, it also feed on browse plants where little grasses are available (Foggin 1999). Buffalo is a bulk grazer consuming grasses that are often too coarse for other animals.

2.5 Breeding in Buffalo

According to Smitters (1995) breeding can take place at any time but birth tend to peak during the rainy season. Grubb (1986) stated that peak mating times occur in the rainy season when the animals are in the best condition, he further stressed that a female may mate with a succession of males and that she only becomes pregnant by one of the males. According to Wild (1996) breeding during the rainy season is to ensure that she has plenty of food to produce milk for the growing offsprings. Lasson (1999) reported that there is competition between the bulls, and this may lead to social unrest in the herd during the breeding season. Phole (2002) submitted that reproduction commence between the ages of 4-5 years. Buffalo are gregarious but not territorial, but male reproductive success is based on dominance over other males not over a particular site, this place a direct premium on size and power (Happold, 1987).

Grimsdell (1993) reported that the reproduction history of *synceruss show* that the length of the gestational period is between 300 and 345 days, but Sinclair (1977) in his lengthy study, described the gestation period as being on average of 340 days. Grubb (1986) gives 11.2 months as the gestation period. Mossman (1987) was emphatic that in all the bovid that he had examined, including the forest buffalo, implantation of the umbilical cord occurs mesometrially in a

midcornulocation. This indicates that this is the place where the blastocyst comes to for elongation and implantation. He also describes in considerable details the development of cotyledons and of the uterine charades.

A single calf is born and the youngster remain hidden in vegetation for three weeks, being nursed occasionally by the mother, before joining the protective herd where they are held in the centre of the herd for safety (Sinclair 1977). The bond between mother and calf is very strong and they communicate via croaking calls from the mother and bleating by the calf (Lasson 1999). Calves continue to suck until they are about 15 months old, and can remain with their mother until they are about 2 years and calf mortality is fairly high as they are targeted by predators (Wild, 1996).

The female and her offspring have an unusually intense and prolong relatsionship, suckling for as long as a year makes them to be dependent on their mother. Female offspring usually stay in the natal herd but may leave when they are about 3 years (Grimsdell, 1993). The distribution of animals in relation to their environment is essentially in game management and range utilization control. Afolayan (1986) reported that the distribution and movement of wild animals are usually affected by the availability of water, food, cover and bush burning particularly during the early part of the dry season. The impact of fire on the habitats resources which range from changes in vegetation types, depletion of food reserve in plants, destruction of cover, promotion of soil erosion to killing of soil micro-organism and production of herbage have been studied and reported by Ayeni (1989). Sinclair (1977) studying the activities and grazing habits of the

African buffalo in Knuger National Park in South Africa pointed out that grasses, weeds and browse plants of high nutritive value were most preferred and these animals were selective during the rainy season, inferior ones which were deserted in times of plenty were used readily during dry season.

Milligan *et al*, (1986) observed that the utilization of forage by large mammals in Kainji Lake National Park reduced with increased distance from water points particularly streams and rivers. Pelink (1994) noted from aerial survey of the Kainji Lake National Park that elephants often moved to unburnt areas at the beginning of the dry season and only return to the burnt areas when the new leaves are coming up on the trees. Kearney and Gilbert (1984) stated that deer and moose utilized habitats with good food supply and shelter but utilization was poor when temperatures were low and considered climate as the major limiting requirements. Heady and Heady (1982) recognized that in East Africa, though wild beast and zebra migrate each year in lengthen routes following rains and green grasses, they always return to the serengeti plains were they have enough space and good terrain to breed and rear young ones, strong enough before repeating their migrating pattern. Lofi *et al* (1986) noted that wild animals used the meadow riparian areas in California during summer for fawning and fawn breeding due to available cover, water and food for the fawn.

Surring and Vohs (1993) found out that the combined availability of cover and forage influenced habitat use by Columbian white-tail deer. This accounted for their differential in their seasonal use of habitat. This fact was testified by poor utilization of improved pasture of cover. Allden and Whitter (1995) reported

that, wild animals in Africa thrive on poor natural grazing fields and can be managed so as to produce a high meat yield without destroying the natural vegetation..

Afolayan (1980) reported that observed in Yankari National Park wildlife concentrated along the rivers and warm spring during the dry season due to the availability of salt licks, water, cover and fresh flush of grasses. He further reported that the animals look much widely dispersed during the rainy season when food, water became randomly available. Brincihman and Pradual (1979) reported that seasonal changes in herbage nutritive content and concluded that there is no easy remedy to poor quality of most grasses herbage in the dry season, except through elimination of the tree cover with heavy equipment and converting the savanna into sown legumes grass pasture. Ayodele (1985) stated that in maintaining healthy population of wildlife food quality is as important as quality in both rainy and dry seasons.

2.6 Domestication and Economic Value

African buffalo has not been domesticated although attempts are being made in Zimbabwe to train them to the yoke. Wild buffalos are currently being exploited in various countries for meat and hides. In Nigeria, the forest buffalo has almost been hunted to extinction due to its meat. South Africa in particular has a cropping scheme in Kruger National Park and Mozambique had a major scheme at Marrameli in the Zambezi Delta before uncontrolled hunting and civil war resulted in reduction of the buffalo population by almost 90% (Thornback, 1983).

There is a considerable demand in southern Africa for foot and mouth disease (FMD) virus free buffalo to stock game farms and ranches, usually for trophy hunting purposes. Woodford (1996) FMD virus free buffalo are produced by taking young calves away from their infected mothers and raising them in isolation under wild conditions. Calves first acquire infection with foot and mouth disease virus when they are few months of age when their cloistral immunity wanes.

2.7 Habitat Requirement

Knowledge of habitat requirements especially the specification of ideal habitat is the key to wildlife management. The habitat supplies food, space and cover needed by every species (Ayodele 1988). Heady and Heady (1982) reported that requirement for wild animals at the micro level were too many but at macro level the major one were adequate food, proper cover, adequate opportunities for reproduction, water supply, good soil and climatic conditions. They further stressed that because of the changing availability of these resources with season and changing physiological activities of animal emigration and seasonal periodic migration often occurs in the wild.

Ayodele (1988) identified the habitat requirement for wildlife as food both in quality and quantity water, right soil types, good topography adequate drainage pattern and cover. Beekman (1999) recognized four factors which are involved in the selection of habitat by buffalo, namely – the presence of acceptable forage, the cover available to predators, the proximity of water and the mobility of the herd. Prins (1993) identified the requirements for wild animals as good landscape and

terrain, feeding and drinking sites, good climate, chemical and physical factors (such as light, soil structure and nutrients, water chemistry, pH and salinity).

Adeyemo (1995) submitted that animal requirements vary greatly from one species to another, season, age and developed adaptive structures and physiological activity of the animal. The forest buffalo is found in the low land tropical rain forest zone and Okomu National Park is one of the preserved of this forest zone in Nigeria (Omorodion, 1991). Sinclair (1977) reported that buffalos are found in a variety of habitats including lowland tropical rain forest, grassland, tropical savanna woodland and semi desert. Wilson and Reeder (1993) reported that buffalos primary requirements are grasses, canopy cover and water.

2.8 Disease of Buffalo

Buffalo are highly susceptible to Rinderpest which is still endemic in parts of the Sudan and Ethiopia (Woodford. 1996). Bovine tuberculosis is a serious problem in the buffalo herd in Uganda, South Africa and Ivory Coast, it has not been reported in Nigeria (Smitters, 1995). Buffalo have long been consider4ed carriers of SAT strains of Foot and Mouth Disease (FMD) virus and as a result has been eliminated from large areas where disease free cattle are raised (Thornback, 1983). Wilson and Reeder (1993) reported that recent work in Zimbabwe seems to indica that cattle may be the carriers of foot and mouth disease (FMD) virus and that strains which infect and are carried by buffalo are less effective for cattle. According to Wild (1996) buffalos are carriers of the haemo-parasite (*Theibria lawrencei*) the causative agent of corridor disease, a serious disease of domestic cattle, which is transmitted by the thick (*Rhipicephaulis appendiculatus*).

2.9 Predators

This large powerful animal does not fear predators (Sinclair, 1977). Hyenas and Leopard kill stranded calves and lion and large crocodiles prey on isolated adults such as elderly males, calves, and the injured ones among them (Happold, 1987). The buffalo usually fight back and single lion often fail to capture them. Buffalos can attack the cats with their horns. In larger herds buffalo are almost immune to danger. They may initially run from predators but quickly turn and form a compact group with the adults moving towards the danger (Thomback, 1983). He further reported that the charging buffalo chases away the lion and they can always come to the aid of animals in distress.

According to Smitters (1995) buffalos are inquisitive, and will often approach vehicles to examine them. He also reported that if a herd is disturbed, individual buffalo would often stampede in an unexpected direction. Sinclair, (1977) reported that buffalo is considered to be the most dangerous of the African wildlife species to hunt and when wounded buffalo had been known to double cross and ambush the attackers. Illegal hunting and the continuous loss of suitable habitat are the most significant threats to this species (Hoffman 1985). Buffalo are also susceptible to drought, this has caused substantial decline in some population in 1990 in South Africa.

2.10 Strategies and Problem of Nature Conservation in Nigeria

There is need to conserve biodiversity because their loss is irreversible, there is no alternative to lost species and there is need for their conservation for the sake of the future generation who will also need them, this is a great task that must be achieved (Adebayo, 1995). He further reported that humanity depends on biodiversity for food, fuel, medicine, raw materials and that they are the basic determinants of the structure and function of all ecosystems and provides the foundation of which the future well being of the human society rests. Ayodele (1988) reported that biodiversity regulates the earth atmospheric climatic hydrological and biogeochemical cycles and that it protects watershed cycles, nutrients, combat erosion, enriches soil, regulate water flow, trap sediments, and mitigate pollution and controls pest population.

Ischei (1995) reported that the concepts of biodiversity and the sustainability of production and life support system carry with them the promise of tangible value and benefits to the community at large. The modern concept of conservation that is the wise utilization and maintenance of earth resource is the combination of two principles the need to plan resource on the basis of accurate inventory and the need to take preventive measures to ensure that resource do not become exhausted (Mackinon and Mackinon, 1986). Network of nature reserves are essential if we are to conserve the flora and fauna of Nigeria because they provide relatively secured basis for all our plants and animals, when opportunities for colonization arise many species of wildlife can spread out to the surrounding country side from the basis. Rare species usually depend on special condition which can only be maintained in protected sites and so their survival depends

increasingly on nature reserve (Moore, 1988). Various methods are currently being used to show the loss of biodiversity in Africa and each of these methods has its own merits and demerits. These could be in-situ and ex-situ. Conserving endangered species is an essential part of wildlife management and where species have been over exploited, intensive protection alone is only a temporary state. The long-term conservation of wildlife certainly is based upon the concept of sustainable yield and utilization (Asibey and Child, 1990).

Ayeni (189) reported that sustainable management of wildlife resource, apart from conventional protection of existing population, can be achieved in one or a combination of the following options; by means of game laws, restricting , harvest, re-introduction of species into selected suitable farming range, habitat improvement and through commercial farming or ranching of animals for meat and its by products. These options become relevant when one considers that most countries in West Africa now no longer have sufficient number of wild animals to meet their demand unlike in the East African countries.

The bane of nature conservation in Nigeria is human over population and over exploitation. Ayodele (1988) reported that one of the aims of developing countries like Nigeria should be meaningful natural resources conservation through of human population. This is to forestall excessive land use, abuses and over exploitation. Odun (1971) reported that mans ecology should be well understood because the shift from species conservation to total ecosystem conservation shows that man is part of a complex environment which must be studied, treated and modified as whole and not on the basis of isolated projects.

To achieve this there is the need to compare and adopt cultural practices that are well adaptable to the environmental and discard those that are not. This is because all ecological problems are man-made and require understanding, ecological principles to rectify them (Moore, 1988). As the fauna is delicate, dynamic equilibrium with environment forces, knowledge of the relationship of wildlife species to its environment and particularly to its habitat is basic to any successful programme of control or conservation.

An integrated plan for proper management of any animal species must be based on a sound knowledge of its ecology and behaviour (Ayodele et. al., 1999).

2.11 Impact of Farming on Wildlife Conservation

In West African sub-region over 70% of the labour force is employed in agriculture. This has a serious implication on biodiversity conservation, this is because most of the original high forest has been cleared and the soil tilled before crops are planted. These are practices that reduce biodiversity (Ischei, 1995). Okigbo (1995) reported that as the agricultural system evolves, the intensity of land use increases and the effects of such evolution on biodiversity vary. Harries (2000) reported that overgrazing; overploughing and deforestation are agents that encourage desert encroachment and that they expose the land surface to wind or soil erosion which encourages leaching and loss of fertility. Different farming methods such as shifting cultivation, monoculture activities like tillage, pesticides application all disturb the balance in the ecosystem (Adebayo, 1995).

The causes of deforestation have been classified into two categories, namely: direct and indirect causes. The direct causes of deforestation include

farming (Ajayi, 1986). Due to intensive competition for land use in the densely populated areas, farming activities have been reported on Game reserves, where over 86,000 hectares have been ceded to agriculture (Ayeni 1989). The use of pesticides and application of fertilizer in monoculture have the effect of changing the crumb structure of the soil, its water percolation and permeability, it make light soil to grow dry and powdering. Their application effect on biodiversity kills off beneficial non-target organisms (Adebayo, 1995). He further reported that the degradation of land resources has not only jeopardized food sufficiency by loosing fertility through misuse and neglect, has also led to loss of biodiversity with ecological and environmental consequences and many species of both plants and animals have gone into extinction because of habitat degradation.

Mechanical clearing is detrimental to soil fertility, structure and moisture retention because it leads to soil compaction, exposure of water infiltration, increase in run-off (erosion) fall in crop productivity, and vegetation removal also cause increase in harshness of the environment (Adeoye, 1992). Most of the farmers depend on the natural land fertility, fallow land, virgin forest or secondary forest removal. Land preparation for food is normally the cut and burn method and shifting cultivation system which depend on the use of cutlass, hoe or fire which enhances forest fragmentation and wildlife habitat loss and degradation (Osemeobo, 1988).

Soil cultivation causes a great change in the ecological status, from a situation with the soil surface protected by vegetation to a situation with a bore soil exposed to climatic forces during some part of the year. Annual crop require

annual soil cultivation and the increased mineralisation with organic matter and the loss of soil productivity by erosion, leaching of nutrients and other degradation process remain a problem for suitainable crop production (Oyeniyi, 1995). Ajayi (1986) reported that appropriate clearing method should cause minimal disturbance of the natural ecological balance that exist betweens the soil, vegetation and climate. Complete clearing of the vegetation by any method accelerate solid degradation but mechanical clearing is more likely to increase sheet erosion and soil compaction. For small land areas and on communities where labourer is cheap. Manual clearing is preferred. Adverse effects of mechanical clearing are reduced by appropriate choice of attachment and use of skill operators. Also clearing should be done at the end of the rains or before the rain is heavy and soil moisture status become low. For soil conservation there should be selective removal of large tree in the woodland savanna.

Farmers should be encouraged to adopt cultivation practices such as mixed farming, early cropping, minimum tillage and the use of organic manure. Continues cropping will not only encourage land improvement practices, it will limit shifting cultivation and give farmers greater security system. Agricultural lands in the country should be surveyed and mapped out for different uses to prevent the current haphazard land utilization (Aderinola, 1995).

2.12 Impact of Hunting on Wildife Conservation

Legislation in wildlife in Nigeria dates back to 30th May 1916 when the wild animals' preservation law was enacted. The philosophy of wildlife law centered on hunting of game and preservation of rare species. The law did not

recognize wildlife as a source of protein nor did it consider the ecosystem as a unit of management, hence it provide for indiscriminate hunting of wildlife species (F.A.O., 1990). Anadu (1987) reported that the 1916 ordinance was patterned after the London Convention for protection of African fauna. The ordinance received wide criticism because it permitted the capture and killing of animal species for token fees. Also the ordinance wrongly put administration of wildlife under police, public administration and forestry. The forestry staff and administrative officers were mandated to issue hunting licenses, they were also empowered to confiscate animals' trophies and fire arms.

Ayeni (1989) reported that the colonial wildlife conservation ordinance was widely because it seems to have ignored the position of the traditional hunters in wildlife conservation, yet the ordinance persisted until Nigeria got her independence. The wildlife ordinance was replaced in 1963 with the wild animal law but despite the numerous amendments made to the ordinance in the various state of the federation, a lot of anomalies and inadequacies which are not commensurate with the procedure of protecting wild animals and their habitat still persist. The wild animal law of 1963 has a lot of clauses which are more injurious and harmful to wildlife conservation, for instance, the law provide for a fine of fifty naira (₦50.00) only for the killing of Elephant which could fetch a hunter as much as fifty thousand naira (₦50,000). also a hunting license for antelope would be obtained for twenty five (₦25.00) to the hunter to kill antelope and other numerous other small mammals and birds (Ayeni, 1989). Agbelusi (2000)

reported that Ondo State has no Game animal law of its own but still enforces the obsolete wildlife preservation law of western Nigeria, 1959.

The hunting pressure especially night poaching and the use of chemical poisoned arrows and snares often result in the decimation of wildlife population. The word poaching means illegal exploitation of wildlife species (Afolayan, 1987). Afolayan (1994) also reported that compacting the populations and biomass densities of wildlife in two areas in Nigeria with other areas in West and Central African countries, one find that Nigeria reserves have the lowest estimates. In the savanna zone, the Fulani herdsmen hunt carnivores and ungulates for meat or in protecting their cattle and indiscriminate burning of the vegetation to produce new seawards of grass or herbs for their cattle (Osemeobo, 1988).

Afolayan (1986) reported that the lack of effective and efficient enforcement of wildlife legislation and lack of management coordination among the state of the federation are some of the management problems militating against wildlife conservation in Nigeria. The game protection staffs are not in possession of anti-poaching equipment to combat hunters who often carry sophisticated fire arms.

2.13 Impact of Human Habitation on Wildlife Conservation

When one compares the past and the present population estimates and species composition of African wildlife, it is obvious that the modern man's rate of habitat destruction is the highest and if it is allowed to continue unchecked over

90% of our animal and plant resources would have disappeared before the next millennium (Afolayan, 1986). The report of the world commission on Environment and Development, underlines the connection between poverty and environmental degradation. It stresses that "poverty" itself pollute the environment and those who are poor and hungry will often destroy their immediate environment in order to survive. They will cut trees in the forest, overgraze land, over use marginal land and crowd into congested cities. This picture illustrates the ways in which economic ecology can interact destructively and into disaster.

Ayodele (1985) reported that human populations tend to grow very rapidly in tropics and so many forest have been cut down for farming, industrial and urbanization purposes which leads to destruction of birds nest, water catchment, areas and wild animals with no regard for size, sex and age. Wild animals are therefore continuously driven into shrinking forest areas. Oke and Fuwape (1995) reported that Ondo State is typically poor state with majority of habitants dependent on the forest land for their basic needs. It is most unfortunate today that the present day man would bribe his way through the chiefs and government and buy sacred bushes at exorbitant price bulldoze the area so badly that the water which was supporting the whole population in the area from time immemorial dries up within few days. Thus, the modern man does not care to sustain the natural resources around him in perpetuity for future generation (Afolayan, 1986).

Osotimehin (1995) reported that in Nigeria social and political systems have led to unequal access to resources, inadequate financial arrangement and terms of trade which forces people to over exploit their land for survival of developmental

conflict between export based cash crops and foreign exchange needs on one side and basic food security for the poor on the other. The causes of deforestation has been classified into two categories namely; direct and indirect causes. The direct causes of deforestation include conversion of forest reserves to human habitation with growth in population, the land area became inadequate for the needed agricultural production, hence the constant pressure on the exploitation of the forest reserves by the people whose traditional lands has been turned into forest reserves.

Forest to the people generally means source of food and shelter, clothing, the main requirement for sustaining life. Then, food crop production is combined with hunting as the main source of their livelihood. The food production processes involved short periods of continued cultivation on a given piece of land and is followed by relatively long fallow period but this have since changed because of the increase in population (Osemeobo, 1988). The increased in political pressure on forest reserves land and forestry official complicity in illegal forest reserves , cash crop production, timber exploitation, construction of dams and ponds animal grazing, bush burning, collection of fuel wood, milling of solid minerals such as Tin, mica etc. have made the rate of annual deforestation exceed the rate of regeneration (Ayeni, 1989).

The nomadic Fulanis with their herd of cattle are often present in the forest reserves in search of pasture and found maintaining permanent routes in the reserves and the concentration of cattle along these routes led to excessive trampling, overgrazing and erosion. The cattle sometimes forced the wildlife to

change movements to anywhere that activities are minimal even when such movements are unfavourable to these wild animals (Osemeobo, 1988). Both human population control and better resources management that include recycle are needed now. As the land becomes intensively farmed and urbanized, wildlife becomes largely a function of "edges" (Odun, 1971).

With the increase in human population, it becomes more important that adequate samples of all major natural communities be preserved undisturbed for study and tourism, since man establishes his civilization and his food chains by modifying natural ecosystems and not by creating completely new systems, it is important that we have samples of unmodified communities for study, only with such controls on the effects of man's modification be properly judged and unwise practice avoided (Odun, 1971).

Table 1: Distribution of Nigeria Forest According to Vegetational Zones

VEGETATION	TOTAL LAND AREA km^2	% OF TOTAL LAND AREA	(Km^2) OF FOREST RESERVE	RESERVE AS % OF TOTAL LAND AREA
SAHEL	31,463	3	2,571	0.3
SUDAN	342,168	35	31,271	3.2
GUINEA	400,168	40	38,247	3.9
DERIVED SAVANNAH	75,707	8	3,208	0.3
LOW TROPICAL RAIN FOREST	95,372	10	19,986	2.0
FRESH WATER SWAMP	25,563	3	250	-
MANGROOVE FOREST AND COASTAL VEGETATION	12,782	1	522	01

Source: Federal Department of Forestry, Lagos (1996).

2.14 Impact of Logging on Wildlife Conservation

One of the direct impacts of logging is deforestation. Deforestation is defined as any act leading to removal or destruction of the vegetation unaccompanied by deliberate effort at its replacement. The term therefore thus includes not only felling of trees but also removal of shrubs, lianas and other plants of the forest (Enabor, 1986). The forest has always been recognized as the habitat for wildlife as watershed protecting water supply a resort for recreational purpose and one of the most outstanding usefulness of the forest is the ability to protect the environment, soil and climate etc. and to this end forest and trees contribute to agricultural production (Adeola, 1986).

There are several agents of deforestation in Africa and Nigeria in particular. The main cause of deforestation are population growth, and the expansion of economic activities such as logging or timber extraction, farming, urbanization, bush burning, firewood collection, grazing and infrastructural development. Therefore deforestation must be seen as a means of providing for mans legitimate needs for wood and wood products and expanding agriculture (Oguntala, 1995). Enabor (1986) reported that deforestation is a symptom of widespread poverty or the exploitative utilization practices of foreign capitalist or both. Deforestation exposes the soil to much evapotranspiration and desiccation as the water table falls. The scourge of flood has occurred in areas where extensive removal of vegetation and the silting up of both natural and man-made water courses have reached the stage at which abnormal surface run-off are easily stimulated to flood proportions during occasional tropical storms (Ajayi, 1978). Logging also lead to

the destruction of the ecosystem of the wild animals, the nest and eggs of birds (Afolayan, 1992).

Oke and Fuwape (1995) identified the following as some of the major reasons for indiscriminate logging in Ondo State of Nigeria, poverty, political instability, unemployment and high market demand for timber products. Logging is one the major causes of forest destruction in Indonesia and many other developing countries like Nigeria. Although many countries insist on selective logging, this is rarely enforced and clear felling is still the other of the day (Okali, 1995). Even where selective logging is enforced it causes considerable damage. Cutting down just 10% of the trees in an area can destroy more than half the forest. Canopy (Afolayan 1994). Logging open up the virgin forest and make it accessible to the unrecognized incursion by the poor farmers, landless people and others under the combined pressure of degrading agricultural productions. Population increase and uncertain land tenure. The farmers on gaining access into the forest through the routes, extraction roads and rides created during logging operations further destroy the forest by killing young trees to make room for farming activities. Destruction of the forest automatically means loss of the protection, which the plant cover gives to the soil (Adebayo, 1995). Pearce (1987) reported that forest cover minimizes erosion in watersheds mainly because of reduce intensity and frequency of disturbance. A great variety of animal and plant species are associated with the primary forest. With increase logging and destruction of the primary forest, the variety of plant and animal species associated with it declines. The extinction represents an irreversible loss of unique resources, offer

resource of unusual value in the matter of their potential economic applications (Ayodele 1985).

2.15 Extinction of Wildlife Species

Species are recorded by the World Conservation Monitoring Centres as Extinct (Ex.) based on the criteria given in the International Union for the conservation of nature and natural resources (IUCN). Red data book categories of threat. These are wildlife species that are no longer known to exist in the wild after repeated search for their type proved futile. In the last 500 years, human activities have forced 816 species to extinction (or extinction in the wild). The increase in known bird extinction is partly due to improved documentation and new knowledge but 1032 extinction have occurred since 1800, indicating an extinction rate of 50 times greater than the natural rate. Many species are lost before they are discovered. 484 animals mostly invertebrate are recorded as having been extinct as published in the Red Data list of IUCN.

TABLE 2: Shows number of recorded extinct species.

Group	Number of Extinct Animals
MOLLUSK	191
BIRDS	103
MAMMALS	58
OTHERS	120
	484

Source: Red Data List of IUCN, 2000

The Red data list is a solid documentation of the global extinction crisis and it reveals just a tip of the iceberg (Russel, 2000). The most comprehensive source of information on extinction and threat of extinction are statistics on threatened published in the Red Data books on the categories of extinction by the IUCN. In classifying species, according to their extinction risk, the Red list provide information on species range, population trends, main habitat, major threat and conservation measures, both already in place and those needed. It allows a better insight than ever before into the processes driving extinction.

For the IUCN Red List system, scientific criteria are used to classify species into one of eight categories: Extinct, Extinct in the wild, critically Endangered, Endangered or vulnerable categories and a species thought to be risk of extinction in the foreseeable future because of random or deterministic factors affecting its population (Russel, 2000). The estimates of the minimum number in the globally threatened animals in 2000 Red list of the IUCN are 18,476 species and subspecies. Approximately, 25% of it are reptiles, 20% are amphibians, 30% are fishes (mainly freshwater), 11% birds 18% are mammals and 8% plant species. Since only a small proportion of these groups has been assessed, the percentage of threatened species could be much higher (Baboult and Sastradradja, 2000).

Table 3: Status and the Numerical Distribution of Plant and Animal Species in the Red data list of IUCN.

Species of Animals/plants	Endangered	Vulnerable	Rare	Indeterminate	Total
Mammals	277	399	189	68	833
Birds	188	241	257	170	862
Reptiles	47	88	79	43	257
Amphibians	32	32	55	14	133
Fishes	158	226	246	304	934
Invertebrates	582	702	422	941	264
Plants	3632	5387	11485	5302	26109

Source:IUCN 2000

The animal species listed as threatened (1,835) are classified as lower risk/near threatened a category that has no specific criteria and is used for species that has no specific qualifying as vulnerable. The majority of near threatened animal species are mammals (602 mainly bats and rodents) and birds (727). A total of 5,611 threatened plant species are listed but has only approximately 4% of the worlds described plants have been evaluated; the true percentage of threatened plant species is much higher. With 16% of conifers (the most comprehensively assessed plant group) known to be threatened the scale of threat for plants may be similar to that for some animals.

The overall percentage of threatened mammals and birds have not greatly changed in four years, the magnitude of risk, shown by movements to the higher risk categories has increased. The 2000 IUCN Red list of the threatened animals included 169 critically endangered and 315 endangered mammals, the 200 analysis now list 180 critically endangered and 340 endangered mammals. For birds there is an increase from 168 to 182 critically Endangered and 235 to 321 Endangered species. The fact that the number of critically endangered species have increased, even to those already familiar with increasing threat to biodiversity. This report should be taken seriously by the global community (Diamond, 2000).

Indonesia, India, Brazil, China and West Africa are among the countries with most threatened mammals and birds, while plant species are declining rapidly in south and Central America, Central and West Africa and South Asia.

2.16 Causes of Extinction

The factors that cause extinction of a particular species has been investigated by many researcher. Diamond (2000) showed that population size is a strong determinant of vulnerability. This is confirmed by the predictions of Leigh, (1981). According to Ricklef and Cox (1993),Terboigh (1974) and Baboult and Sastradradja (2000), the following factors expose animals to threat.

= loss of the animal natural habitat

= change in the habitat quality

= persecution or fragramentation and change in the biotic environment

Cox (1993) also gave the causes of threat on wild species to include: large body size and low reproductive potential of the species. Species with high economic value and exploitation for mea, tusk and skin. . Afolayan (1992), Ayodele et. al. (1999) and Adeola (1991) on their part, reported that the following factors are responsible for threat of wildlife species: Forest exploitation, shifting cultivation, pollution, misuse of fire, indiscriminate hunting of wild animals, use of agrochemicals such as fertilizer, herbicides and pesticides which have high potentials of changing the acidity of the soil.

Oguntala (1995) reported that logging, overgrazing and mining of minerals such as fossil fuels, solid minerals such as Iron ore and collection of fuel wood cause threat to wild animals.

2.17 The Need to Study the Diet of Ungulates

The management of wild herbivores largely involves the management of their food resources. Thus an understanding of diet selection is central to our

understanding these animals and their interaction with the environment. African herbivores are not ecologically isolated and overlap in diet and habitats do occur among species (Walker 2000 and Mentis 2003). Failure to consider spatial components when considering carrying capacities and assessment of ecosystems contribute to overgrazing, failed economic developments efforts and decline in wildlife population (Coughenour, 2002).

Diet selection and utilization at different feeding levels further complicate the ecological separation of wild ungulates (Leuthold, 2001). The feeding ecology of wild ungulates is therefore vital to the managements of National Parks. In ruminants, digestibility of food determines the rate of food utilization and is itself dependent on the nitrogen content of the food. Hence, in ruminants the quality of food intake is related to nitrogen concentration of the food (Crampton and Haries 1999).

Vansoest (1996) stated that grass eating ruminants digest their food more efficiently with increasing proportion of fibre in their diet than browse eating ruminants, but they are restricted to diets with crude protein concentration between 7 and 8%. Mentis (2003) reported that the faeces of herbivores reflect the nature and quality of the plant material available to them. He further stated that rich new growth is likely to be better digested than woody old growth and will produce softer faecal material but when they eat dry plant or coarse grasses, the droppings are firmer and more layered.

Stark (1999) described the faecal waste of the buffalo as unmistakably cow-like, often loose, dark in colour turning whitish brown with age. He further stated

that freshness is tested by breaking open the surface of the droppings. Cooper (2000) stated that mammals have no taste doctors for protein, thus must be positive association between protein levels and other metabolites and this must be a reason why animals select palatable species. Stobbs (1999) reported that the patterns in the availability and utilization of resources are important constraints on the social organization of mammals e.g. primates and antelopes. He further stated that the ability of the ungulates to meet their year round nutritional requirements depend on the utilization of available grass and browse plants at different times of the year.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Area

Okomu National Park was originally gazetted as wildlife sanctuary in 1986. It is located in Ovia Southwest Local Government area of Edo State. It became a full-fledged National Park in 1999 through the provision of Decree 46 of 1999. The Park lies 45 km West of Benin city and immediate south of Udo town. It drives its name from river Okomu which has its sources in the north east of the Okomu forest and flows southwest joining the Osse river. Okomu National Park covers a total area of 181 square kilometers, which is only 15% of the 1,200 square kilometers area covered by the Okomu forest reserves. It is situated between longitude 5° and 5.3' east and between latitudes 6° and 6.10" North (Omorodion, 1991).

The National Park contains the last remaining tropical rainforest ecosystem in the southwest of Nigeria and enriched with fauna and flora species. The park is divided into four smaller protection management units called beats. The park being a secondary forest, it was compartmentalized by early exploiters of the forest, primarily due to logging activities. The size of each compartment is usually one square mile. Today, various compartments in the park now serve as protection unit to different beat within the park.

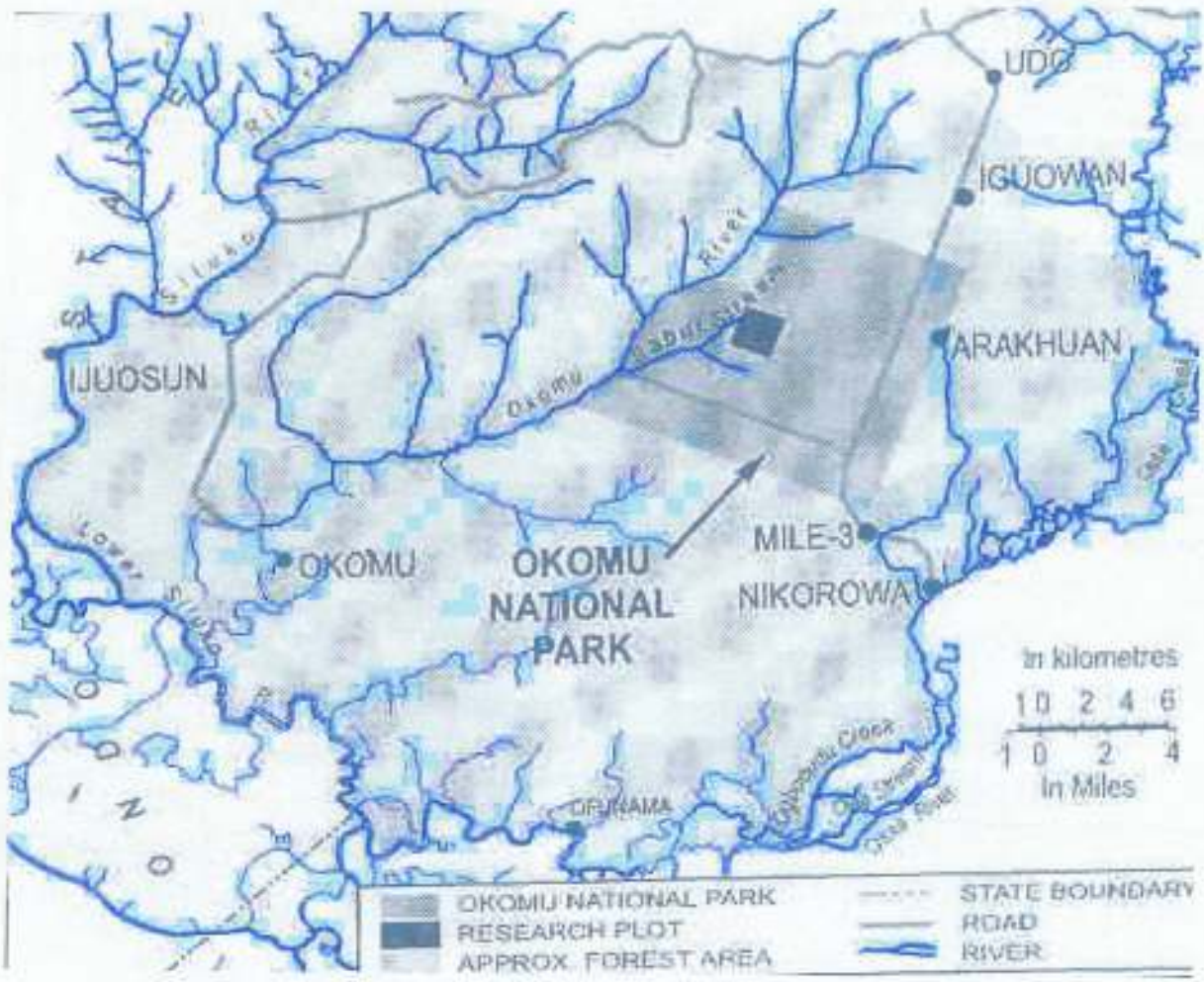


Fig. 1: Map of Okomu Forest Reserve Showing Okomu National Park.

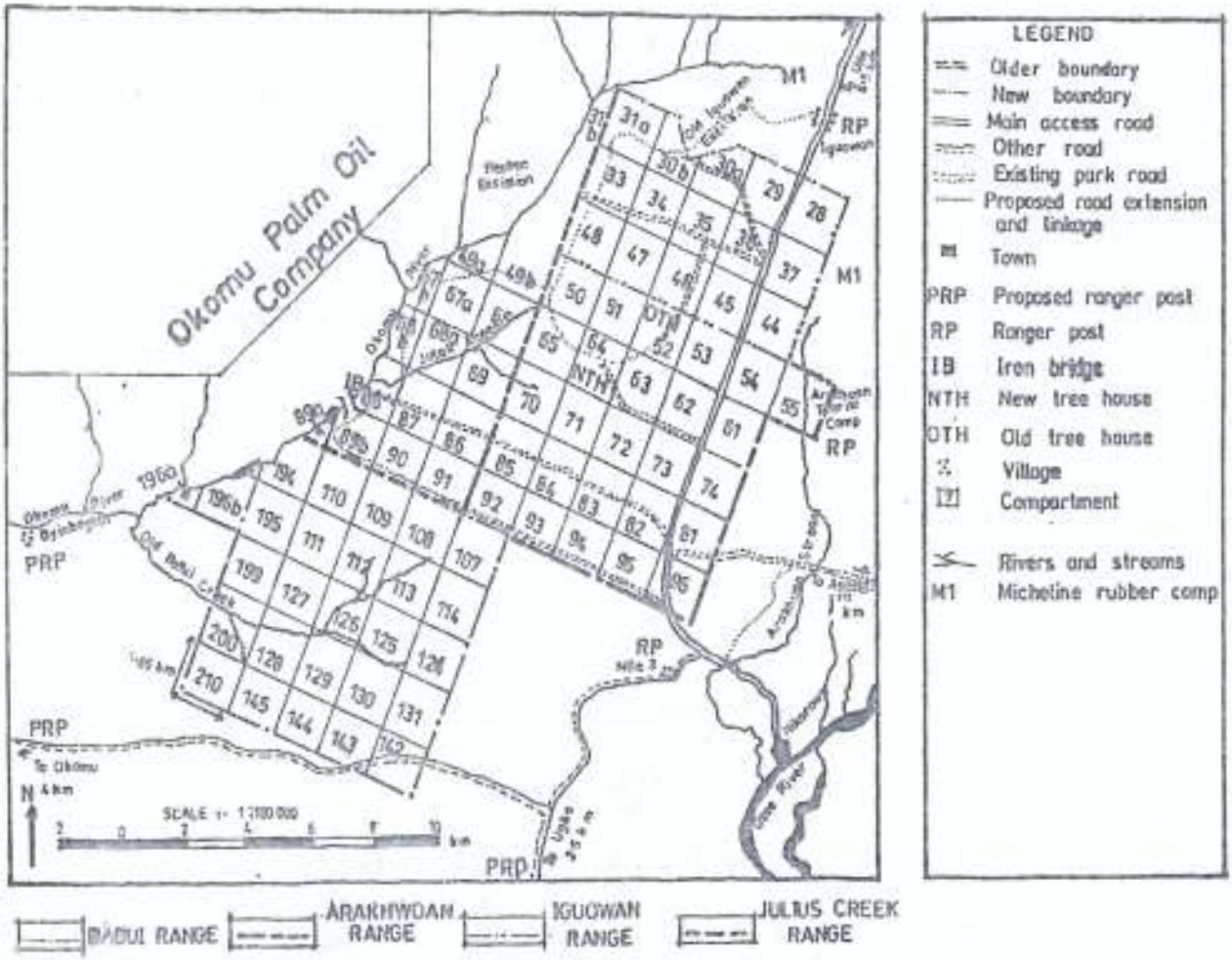


Fig. 2: Layout (compartmentalized) Map of Okomu National Park

3.2 Climatic and Soil Conditions

The National Park is about 75 km above the sea level. The soil is sandy-loam derived from the deep loose deposit, apparently of Exene age and it is sometimes called Bini sand.

As a result of having substantial fraction of coarse sand, generally about 70% of the soil pH is 5.0. The rainfall in the area is between 1542 mm and 2540 mm per annum. December and January are the driest months and the wettest months are July and September. The mean annual temperature is 30°C. The relative humidity is not below 65% in the driest months and 100% during the wet seasons.

3.3 Vegetation

The vegetation of this area is described by Orhiere and Ohenhen, (1991) as moist semi deciduous forest. The vegetation has close stand of three layers of trees consisting of lower and middle stories and discontinuous layers of tall emergent trees. Grasses are common, but are found along the tracks within the National Park. Other creeping grasses like the *Cylondon dactylon* are found around the lake areas. There are few endemic tree species. The notable ones are the *Entandrophragma angolensis, E. mile, Kaya ivorensis, Aurea cedrata* and *G. thompsonii*, while the only Nigeria specimen of *Stombosia postulate* (*Olacaceae*) a large forest tree is found in Okomu National Park.

Orhiere and Ohenhen (1991) stated that Okomu National Park has 150 tree species of these 45% are known to be medicinal plants, while 35% are fruit trees

3.4.2 Direct method

This method involves direct observations of the animal on the field. Three visits (3x) were made per week for six months for both wet and dry seasons. This visit was made between 0600 h to 1600h in the evening.

The plant species and parts of plant eaten by this animal in the park were identified after the group had finished feeding and moved out of the site. Data were taken of the plants species and parts eaten and it was categorized as follows, leaves, shoots, fruits, flowers and pods. Then the species fed upon were combined as five food types' sedges, grass, tree, shrub and herb. Samples of plants that could not be identified on the field were collected and preserved in 10% formalin in specimen bottles for identification at the department of forestry, Federal University of Technology, Akure.

3.4.3 Statistical Analysis

All data collected were analysed using percentage distribution range; standard deviation was used to compare the plants species utilized by the Forest Buffalo. Bar and Pie charts were also used where appropriate for further explanation and analysis of the result.

CHAPTER FOUR

4.1 Results

Table 4.1show the plant species consumed by the forest buffalo during the wet season. The list is made up of grass and browse species. *Panicum maximum* constitute the major diet of this animal, while *Sporobolous pyramidalis* is the least consumed. The table also reveals that *Myrianthus arboreus* is most consumed browse species while *Cappanies thonningii* is the least consumed. The tables also show that the succulent shoot, leaves are the parts eaten. However, the leaves are the major parts preferred by this animal. The percentage utilization of the grass is 84% while that of the browse species is 16%. This shows that the major diet is grass species during the wet season.

Table 4.1: plant species consumed by the Forest Buffalo in Okomu National Park in wet season.

Grass species	Frequency	Percentage	Part Eaten
Panicum maximum	102	39	Shoot and leaves
Pennisetum purpureum	66	25	Leaves
Cylondon nlemfuensis	18	7	Shoot and leaves
Cylondon dactylon	18	7.	Shoot and leaves
Sporobolous pyramidalis	16	6	Shoot and leaves
Browse Species			
Myrianthus arboreus	16	6	Leaves
Gouania longipetala	10	4	Leaves
Crudia klainei	8	3	Shoot and leaves
Erythrophleun suaveolens	5	2	Leaves
Capparis thonningii	3	1	Leaves
	262	100	

Table 4.2 shows that *Panicum maximum* remains the major grass species preferred by forest buffalo while *Axonopus ccompressus* is the least consumed. The table also reveals that *Cylondon nlemfuensis* is also highly consumed around the lakes within the Park.

The table also shows that *Ocorrnocalamus spp.* is the highest consumed browse species, while *Eleusine indica* is the least consumed. *Cyperus spp* was also highly consumed during this period of the year. The percentage utilization as revealed by the table shows that the there is a change in diet from grass to browse species during the dry season. The percentage utilization of grass species is 32% while that of browse species is 68%. From the table, it could be observed that sedges constitute the highest preferred species during the dry season. The table also shows that the flowers and pods of *Baphnia pubescens* were eaten by this animal during this period. The table also revealed that *Capparis thonningii* is the only browse species eaten in both seasons.

Table 4.2: **Plant Species Consumed by the forest buffalo in the dry season in Okomu National Park.**

Grass species	Frequency	Percentage diet	Part eaten
Panicum maximum	30	13	Leaves
Cylondon nlemfuensis	23	10	Shoot and leaves
Cylondon dactylon	9	4	Shoot and leaves
Pennisetum purrium	7	3	Leaves
Axonopus compressus	6	2	Shoot and leaves
Browse Species			
Oncocalamus spp	30	13	Leaves
Cyperus exculentus	28	12	Shoot and leaves
Cyperus rotundalus	26	11	Shoot and leaves
Baphia pubescens	21	9	Shoot, leaves, flowers/fruits
Bosqueia angolensis	18	8	Leaves
Capparis thonningii	14	6	Leaves
Eragrostis superba	12	5	Leaves
Chloris pilosa	2	1	Shoot and leaves
Eragrostis ciliaris	6	2	Shoot and leaves
Eleusine indica	2	1	Leaves
	234	100	

Figure 4.1 show the percentage utilization of plant species consumed by the forest Buffalo in both seasons in Okomu National Park. The Figure reveals that the percentage utilization of grass species was 84% in the wet season and browse species was 16%. While in the dry season the percentage utilization of grass species was 32% and that of browse species was 68%.

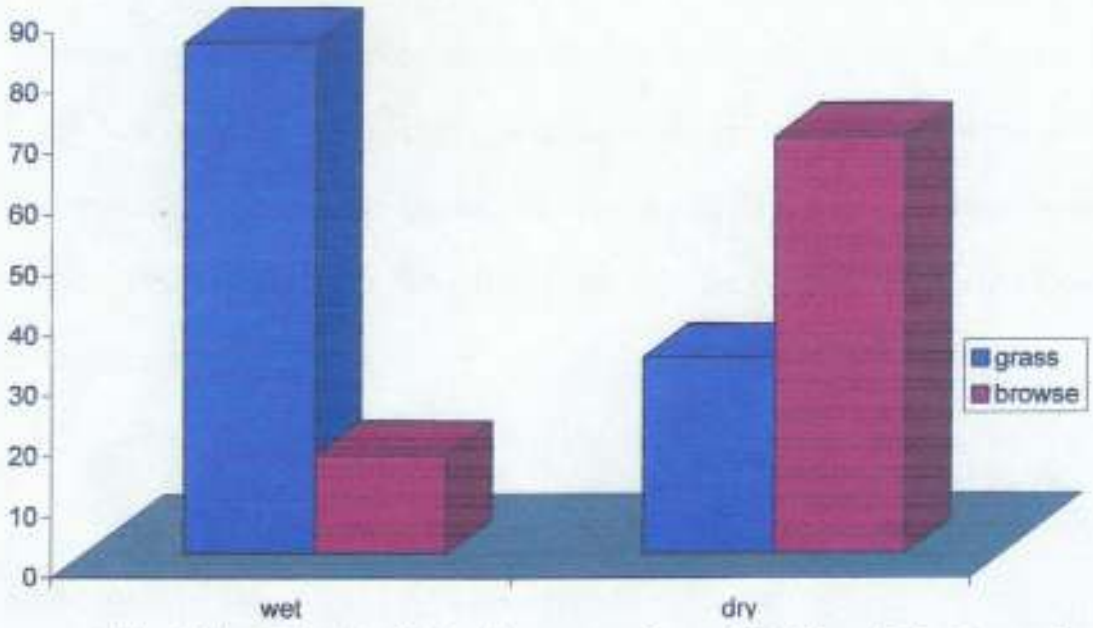


Fig. 4.1: A Bar chart showing percentage utilization of plant species consumed by the Forest Buffalo in Okomu National Park

Table 4.3 shows the proximate composition of the plant species eaten by the forest buffalo in the wet season. The table shows that the plants were highly nutritious. *Panicum maximum* which was the highest consumed grass species, have the highest crude protein concentration (CP) while *Sporobolous pyramidalis* which is the least consumed grass species have the lowest protein content. The table also shows that the few browse species consumed during the season have higher protein content than grass species. The table also reveals that the grass species and browse species are highly fibrous.

Table 4.3: The proximate composition of plant species eaten by the forest Buffalo in the wet season

	%DM	%CF	%CP	%EE	%ASH	%NFE
Mynathus aboreus	63.10	19.50	19.50	2.20	4.20	48.40
Gouania Longipetala	60.50	15.40	21.10	2.00	3.60	51.10
Crudia klainei	61.40	16.00	18.60	1.80	5.40	49.20
Erythophleum saviolensis	60.20	14.21	19.70	2.10	4.80	59.40
Capparis thonningii	59.40	15.40	13.80	4.10	3.20	60.50
Grass species						
Panicum maximum	59.60	11.88	20.84	1.46	5.70	62.04
Panisetum purpurium	61.20	9.61	18.23	2.36	4.20	44.54
Cylondon nlemfuensis	60.40	6.76	16.40	3.42	6.41	56.84
Cylondon dactylon	60.70	8.21	13.40	2.35	5.80	64.48
Sporobolous pyramidalis	63.60	4.91	9.53	2.96	3.60	63.37

Table 4.4 shows the proximate composition of plant species eaten during the dry season. The table shows that the browse species have more crude protein content than the grass species. The table also shows that *Ocoreocalamus spp.* which is the major plant consumed by this animal during dry season have the highest crude protein content. The sedges, *Cyperus spp.* despite having low crude protein content is highly consumed by these animals. The table reveals that the *Eleusine indica* which is least consumed has the least crude protein content.

Table 4.4: The proximate composition of grass species eaten by the forest buffalo in the dry season.

	% DM	% CF	% CP	%EE	%ASH	%NFE
Panicum maximum	61.4	12.42	21.72	5.51	2.51	59.55
Cylondon nlemfuensis	59.2	6.34	20.90	4.41	3.0	58.42
Cylondon dactylon	63.6	10.56	15.46	3.88	1.76	68.25
Pennisetum purpurium	60.1	11.15	23.31	4.52	2.42	63.11
Axonopus ccompressus	62.4	5.46	19.41	2.56	1.65	62.61
Browse species						
Ocoreocalamus spp	66.1	18.6	23.6	3.4	1.61	55
Cyperus exculentus	62.4	12.1	20.2	3.1	7.4	61
Cyperus rotundalus	61.0	21.4	19.6	2.5	4.8	57
Baphinia pubescens	62.4	21.6	23.4	3.1	5.4	59
Bosquenia angolensis	61.5	16.5	21.3	2.4	5.5	62
Capparis thonningii	63.7	17.4	21.1	2.8	4.6	61
Eragrostic superba	58.9	9.6	16.4	2.5	3.1	60
Chloris pilosa	60.5	11.4	19.5	2.7	4.2	58
Eragrostis ciliaris	59.0	10.6	20.4	3.3	5.1	63
Eleusine indica	56.9	9.7	18.9	2.6	3.8	62

Fig. 4.2 and 4.3 show the proximate composition of the faecal output of the forest buffalo in both wet and dry seasons. The figures show that the crude protein is higher in the dry season than wet season. It also shows that the crude fibre was higher in the dry season than the wet season. The moisture content was lower in the dry season than in the wet season. However, the food consumed by the forest buffalo as revealed by the proximate composition of the faecal output shows that the food is very nutritious in both seasons.

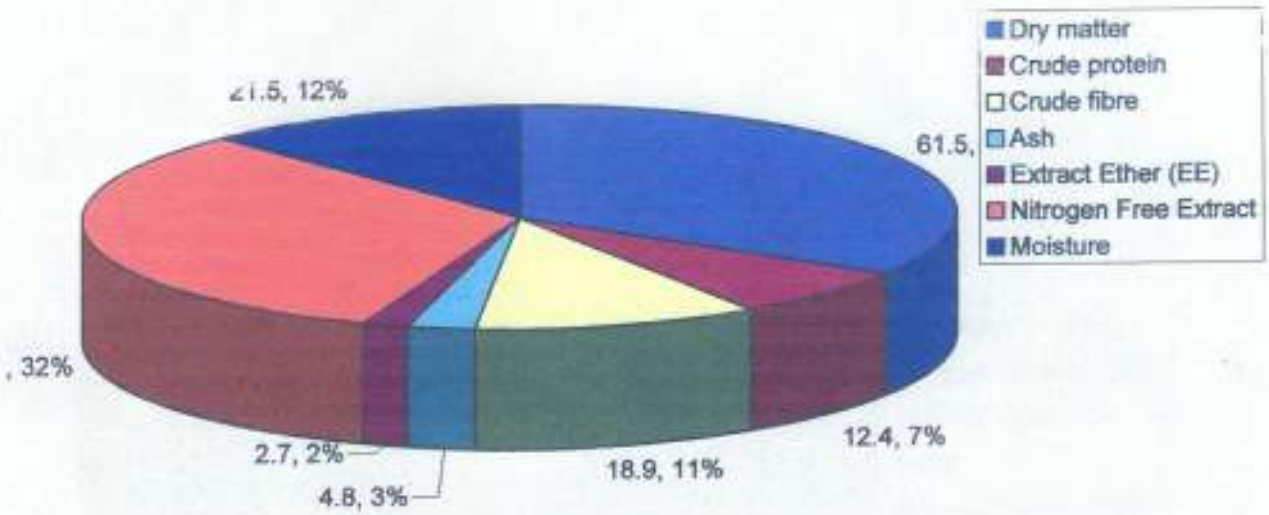
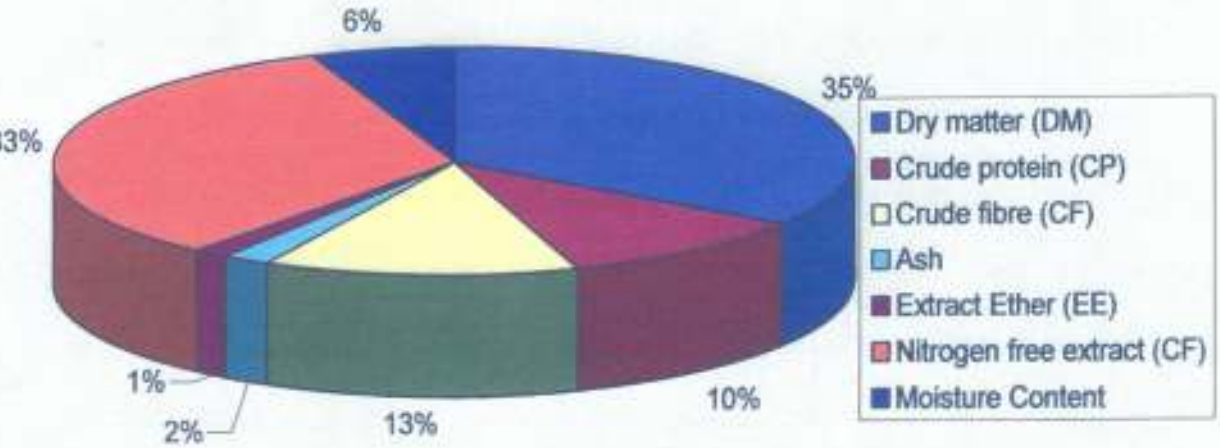


Fig. 4.2: The proximate composition of the buffalo faeces during the wet season in Okomu National Park



g. 4.3: The proximate composition of buffalo faeces during the dry season in Okomu National Park

CHAPTER FIVE

5.1 Discussion

The results show that the forest buffalo feed on wide varieties of plant species which include, browse and grass species. The major browse species are *Ocorcolalamus spp. Cyperus rotundalus, Cyperus exculentus, Baphinia pubescens, Bosquenia angolensis, Capparis thonningii, Eragostic citaries, Eragostic superba, Chloris piloa, Gouania longipetala, and Eleusine indica.* The grass species preferred by this animal are *Panicum maximum, Pennisetum purpurium, Cylondon dactylon, Cylodun nlemfuesis,* and *Axonopus compores.* The *Panicum maximum* is the most preferred grass species while *Ocorcolalamus spp.* is the most preferred browse species.

The consumption of browse and grass species confirmed the work of several researchers in different parts of Africa who worked on the feeding habit of the buffalo. Mboszekwi (1983) reported that at the Tamrayire in dry area in Tanzania 680mm rainfall, that 94% observation of the food eaten by the forest buffalo were grass, 5% were shrubs and 1% of herbs. Jarman (1981) in the Zambezi valley observed that shrubs and trees increased in diet inn the wet season but grasses was predominantly eaten during the dry season.

Vessey-Fitzgerald (1984) observed that swamp loving sedges *Cypsus laevigatus* together with grass *Sporobolous picaties* along the edge of the alkaline lakeManyara in the rift valley were the most important species in the dry season. In Queen Elizabeth Park Uganda, Field (1991) observed that grass was also the

predominant component of the diet but that the prickly shrubs *capparis tomentosa* was eaten by adults.

Stark (1999) reported that buffalo eat grass during the wet season but increases the intake of browse species during the dry season. These observations show that buffalo are grazers but they are capable of changing their diet to wide range of browse plants.

The result also shows that the parts eaten in the different plant species were succulent shoots and leaves, except the flowers and pods of *Baphinia pubsences*. This is in line with Prins (1993) who reported that the leaves of plant are richer in protein content than the stem and the dead parts.

It was observed during the period of this study that a change in season plays a vital role in the diet of these animals. It was observed that perennial grasses form the mainstay of the diet during the wet season but the percentage utilization of grass drop to 32% in the dry season while the browse species increased to 68%.

It was observed during the period of this study that the forest buffalo is selective in their diet due to change of season. Toward the end of the wet season, this animal become selective, this may be due to low quality of plant species. At this period, the grasses become highly lignified, thus the quality become very low, during the dry season, they become highly selective in its diet. Buffalo not only change their diet but feed on sedges and herbs to meet their body requirements and the food rejected during the wet season were utilized during the dry season. These observations are in line with the work of Greenway (1992) and Prins (2000) which stated that buffalo are selective in its diet due to changes in season.

The change of food due to change of season was not a total change in that some grass species were utilized during the dry season while during the wet season, few browse species were also utilized. The percentage utilization of the grass species was 32% during the dry season while the percentage utilization of the browse species was 16% during the wet season. This observation is in line with Darkson (1999) who stated that quick shift from poor food to highly quality food can cause death in ruminant as this result to reduction in body immunity.

During the wet season, it appeared that the forest buffalo will widely distributed in three ranges which it utilizes for the selection of the preferred food within the park due to the availability of food in this ranges but during the dry season, the activities was restricted around permanent water point (lakes 90, 64 and 52) within the park. This is consistent with Skinner (1994) who reported that a forest buffalo shows a seasonal movement, in the wet season, they use large areas, but in the dry season they concentrate in a permanently water area. This observation is also in agreement with Milligan et al (1986) who reported that the utilization of forage by large mammals in Kanji lake National park reduced with increased distance from water points particularly streams and rivers during the dry seasons. This is also in line with the work of Afolayan (1986) who reported that the distribution and movement of wild animals are usually affected by the availability of water, food and bush cover.

In the wet season, the forest buffalo is observed to drink water from the nearest water point scattered within the park but with the unset of the dry season and the subsequent drying up of the numerous water points of the forest floor, the

animals appeared to be more restricted to areas with perennial water bodies within the park. This confirmed with the work of Sinclair (1977) who reported that forest buffalo drink water twice a day and they even wade into water up to their bellies when drinking. He further stated that during the heat of the day, this animal moved into the shade but sometimes bulls wallow in the mud.

The plant species utilized by the forest buffalo consumed are fibrous, which is very high in cellulose. Their ability to consume and utilise fibrous materials suggest they have effective digestive system. This is in agreement Field (1991) who reported that the forest buffalo have the most efficient digestive system for digesting fibrous material than any other ruminants while the feed on fresh grass such as occurred in freshly burnt area, the readily eat old grasses an effectively digesting it.

It would appears that nutrients in some ways was used to determined the choice of plant species consumed by this animal but this did not mean that they were using this nutrient as proximate selection of their food. During the dry season, sedges with low crude protein (CP) were highly consumed that those browse species with higher crude protein. A number of parameters influence the nutrition of the herbivores, namely, vegetation height (Whitter, 1995), the ratio between the green leaves and green stem (Stobbs, 1999), and the bulk density. The nutrients in some way determined the choice of plant species consumed.

There were some activities which suggest that forest buffalo graze at night during the period of this study, there were complaints by farmers around mile 3 enclave that this animal destroyed their crops at night. They reported that crops

like pepper and cassava were completely eaten up. This is consistent with the work of Haris (1995) who reported that the forest buffalo are active at dawn, dusk and during the night.

CHAPTER SIX

6.1 Conclusion

The food and feeding habits of the forest buffalo was studied extensively for the period of six months. The food and feeding habits include the plant species consumed by these animals, effects of season on the consumption of their preferred species and grazing habits of these animals.

From the result it was revealed that the forest buffalo are mainly grazers during the wet season but changes their diet to browse species, with a lesser amount of grass species been consumed. *Panicum maximum* was highly favoured grass species, while *Oncocalamus spp.* was the highly consumed browse species.

It was observed that plant species rejected during the wet season at a period of abundance of food resources were consumed during the dry season when there was scarcity of food. For instance, *Oncocalamus spp.* which was not preferred during the wet season was highly consumed during the dry season.

Grazing activities peak once during the wet season after which grazing continues but light till dusk, but during the dry season grazing activities peak twice daily. There was a high percentage utilization of browse species of high crude protein content during the dry season, though there were exceptional cases when sedges which were low of crude protein content were highly consumed during this period. It was observed that the forest buffalo spends more time grazing during the dry season than wet season as the grasses were few and scattered. They therefore spend more time to searching for pastures.

6.2 Recommendations

In order to reduce the risk of these animals being killed outside the park:

- The management of Okomu National Park should open an area within the Park where all grass species consumed by this animal be planted as this will restrict their movement to the park.
- The facilities in the camping site should be improved upon as this will enable the rangers to closely monitor the movement of this animal.
- The park management should build more infrastructures for the villages within and immediate surrounding of the park so as to divert the attention of people away from the resources of the park.
- The park management should train the rangers and armed them with modern weapon to confront the poachers who are well organized.
- Okomu national park is the smallest out of the eight National Parks in the country, there is need to increase the land area of the park, so as to avoid over population of this animal which could cause diseases out break in the park.
- Game viewing centres should be constructed around Lake 90 and 64 which is similar to tree house in Lake 52 to enable the researchers and eco-tourists to sight this animal.

REFERENCES

Adebayo C.O. (1995): Impact of land uses on Biodiversity proceedings of the Regional Training Workshop held at FUTA. Nigeria on 23rd – 26th July, 1995, pp. 153-155.

Adeola, A.O. (1991): Deforestation - optional in Rural Communities. In: The challenge of deforestation in Nigeria. Forestry Association of Nigeria Annual Conference (ed.) A.E. Oguntala, Pp. 147-156.

Aderinola E.A. (1995): Implications of land tenure systems. Land use patterns and increasing agricultural population for sustainable food production in Nigeria. Proceedings of the Regional Training Workshop held at FUTA, Nigeria on 23rd – 26th July, 1995. pp. 334-340.

Adeyemo A.I. (1992): Some aspects of Ecology of Baboons at Old Oyo National Park. Ph.D thesis University of Ibadan.

Adeyemo, A.I. (1995): Nature conservation, a tool for the development of Nigeria Tourist Industries. Proceedings of the Regional Training held at FUTA Nigeria on 23rd – 26th July, 1995.

Adeoye, K.B. (1992): Land preparation methods for sustainable agriculture. Invited paper presented at the 20th Annual Conference of the Soil Science Society of Nigeria, University of Ilorin.

Afolayan, T.A. (1980): The influence of seasonality on the Distribution of large mammals in Yankari Game Reserve, Nigeria. Invited paper 3rd Wildlife Symposium for Eastern African Moreya, Uganda.

Afolayan, T.A. (1982): Trends in the utilization of wildlife resources in Nigeria. An invited paper presented at Annual Conference and General meeting of the Forestry Association of Nigeria, Akure, 22nd – 28th December, 1981.

Afolayan, T.A. (1986): Savanna structure and productivity in relation to burning and grazing regimes in Kainji Lake National Park. Unpublished Ph.D thesis University of Ibadan.

Afolayan, T.A. (1992): Man's inhumanity to nature. The over exploitation of Wildlife Resources, inaugural lecture series FUTA.

Afolayan, T.A. (1994): UNESCO publication of factors affecting livestock and wildlife production in the Guinea Savanna.

Agbelusi E.A. (2000): Conservation of Biodiversity. A paper presented at 2000 World Environmental Day held at Ondo State Library Complex Akure.

Allden, W.G. and Whitter, I.A. (1995): The determination of herbage intake by grazing sheep. The interrelationship of factors influencing herbage intake and availability. Austr. J. Agric. Res. 21: 755-766.

Akegbejo-Samson, Y. (1996): Definitions and concepts of wildlife management pp. 3-10. Introduction to wildlife management in Nigeria.

A.O.A.C. (1990): Official Method of Analysis. Association of Official Agricultural Chemistry Washington D.C.

Anadu, P.A. (1987): Small terrestrial vertebrate of the Nigerian savanna. In: Nigeria-savanna selected from the state of knowledge workshop. W.W. Strandford, H.M., Yesufu and J.S.O. Ayeni (ed.) Nigerian MAB National Committee/UNESCO, New Bussa.

Asibey, E.A. and Child, G.S. (1990): Wildlife Management of Old Oyo National Park, Ph.D thesis University of Ibadan.

Ajayi, S.S. (1986): Wildlife in crisis conservation – Antidote University of Ibadan inaugural lecture series 1986.

Ajayi, S.S. (1979): Utilization of Forest Wildlife in West Africa. F.A.O. Rome 1979.

Ajayi, S.S. (1978): "Wildlife and Tourism in Tanzania possibilities in Nigeria". The Nigerian Journal of Forestry vol. 2, no. 1, published by the Forestry Association of Nigeria.

Ajayi, S.S. (1974): Wildlife as a source of protein in Nigeria. Some priorities for development Nigerian Field, vol. 36, (3), 115-127.

Ayeni, J.S.O. (1989): A general review of wildlife and wildlife policy in Nigeria. Nigerian MAB Regional Committee/UNESCO New Bussa.

Ayodele, I.A. (1988): Ecological basis for the Management of Old Oyo National Park. Ph.D thesis University of Ibadan.

Ayodele, I.A. Ebin, C.O. and Alarape, A.A. (1999): Essentials of wildlife management,published by Jacchin publisher Ibadan pp.19-77.

Ayodele I.A. (1985): "Cattle population and utilization of range in Kainji Lake Basin" M.Sc.dissertation submitted to the Department of Wildlife and fisheries Management University of Ibadan .

Baboult, R. and Sastradradja, S.P. (2000): Generation, maintenance and loss of Biodiversity in Heywood Y.H. and Waston R.T. (ed.).

Baker, J.K. (2001): Animal health, a Layman's Guide to Disease Control. Danville, Illinois. The InterState Printers and Publishers, Inc.

Beekman, T.H. (1993): A balanced diet as a goal of grazing for the food of Manyara Buffalo. In: The Buffalo of Manyara, the individuals in the context of Herd life in a seasonal environment of East Africa (ed.) Prins H.H.T. Ph.D thesis University of Gromign.

Bell, R.H.V. (1991): A grazing ecosystems in the Senegel. Sci. Am. 241: 86-95.

Bligh, F. and Harthoom P.C. (1985): Nutritional balance between grassland productivity and large Herburone demand in the Etosha National Park Modoqua. 11: 141-150.

Brincihman, L.L. and Pradua, J.H. (1979): The use of epidermal characteristics for the identification of grass in the leafy stage. *J. Br. Grassland Soc.* 14: 7-16.

Chacon E. and Stobbs, T.H. (1999): Influence of progressive defoliation of a grass sward on the eating behaviour of cattle. *Aust. J. Agric Res*: 27: 707-727.

Charter, J.R. (1970): The economic value of wildlife in Nigeria. Research paper No. 19, *Federal Department of Forestry research, Ibadan Nigeria.*

Cooper, W. (2000): Tannin – Does its structure Determine Function? An cological Perspective. American Nutritionist 121: 335-365.

Coughenour, M.B. (2002): Spatial components of plants Herbivore interactions in pastoral ranching and native ungulate ecosystems *Journal of Range Management* 44: 550-532.

Cox, R. (1993): A Technical Evaluation of the Philippine Tarnaraw Report presented to the Department of Environment and Natural resources, Republic of the Philippines.

Crampton. E.W. and Harris, L.E. (1999): Applied Animal Nutrition – The Use of Feedstuff in the Formulation of Livestock Ration. 2nd edition; Freeman San Francisco.

Diamond, J.M. (2000): Normal Extinction in isolated populations, pp. 191-245 In: M.H. Niteeki (ed.) Extinctions University of Chicago.

Darkson, G. (1999): Acidiosis. In: Physiology of Digestion and metabolism in Ruminants (ed.) A.T. Philison Orci Press New Castle Upon Tyne.

Dott, J.P. (1989): Embryo transfer in exotic bovids International Zoo Year book 25- 35: 138-142.

Estes, R.D. (1991): The large herbivores population of Ngorogone crater. African Journal of Ecology 19: 175-185.

Enabor, E. (1986): Socio-Economic factors of deforestation in Nigeria. In: The Challenge of deforestation in Nigeria. Forestry Association of Nigeria Annual Conference (ed.) A.E. Oguntala, pp. 111-125.

Falade, G.O. (1996): Socio-economic Evaluation of Wildlife Based Tourism Development. In: Selected conservation areas in Nigeria. Ph.D thesis University of Ibadan.

F.A.O. (1986): National Parks Planning. A manual with amotted example. FAO conservation Guide No. 17, FAO, Rome, pp. 105.

FAO (1990): Food composition table used in Africa. Research project sponsored

jointly by U.S. Department of Health Education and welfare and Food consumption and Fishing Division FAO, Rome.

Field, C.P. (1991): Elephant ecology in the queen Elizabeth National Park, Uganda, East Africa Wildlife Journal (9): 99-124.

Foggin, C.M. (1999): Management and utilization of the African Buffalo as a Game Ranch Animal (ed.) B.H. Penzhoor South African Veterinary Association Wildlife Group Odersterpoort, pp. 144-162.

Gbile, Z.O. (1985): Ethnobotany, Taxonomy and Conservation of Medicinal plants. The state of medicinal research in Nigeria.

Greenway, P.J. (1992): Annotted Checklist of plants occurring in Lake Manyara Park. *J. Ecol. Nat. Hist.* 28: 1-29.

Grimsdell, J.J.R. (1993): The Ecology of the Buffalo (*Syncerus caffer*) in Western Uganda. Ph.D thesis Cambridge University.

Groves, C.P. (1991): Specialisation, Mecaca. The view from sulcewes. In the Macaques: Studies of Ecology, Behaviour and Evolutioned. D.G. Lindburg, New York, Norstrand Reinhold.

Grubb, P.C. (1986): National Audubon Society, Guide to African wildlife New York, Charterseen Press.

Happold, D. C. D. (1987): The mammals of Nigeria Oxford University Press, Western Street Oxford. OX 26 DP, pp. 1-405

Harries, S. (2000): Home range analysis using – Radio tracking Data – a review of problems and technique particularly as applied to the study of mammals.

Harris, L.D. (1995): The Fragmented Forest. Island Biogeography theory and

preservation of Biotic Diversity. Chicago University, Chicago Press.

Hardin, T. (1965): Meat production in Africa. The case for new domestic species. University of Bristol, Bristol.

Heady, H.F. and Heady, E.B. (1982): Range and wildlife management in the tropics I.T.A.S. Longman London and New York.

Hoffman, R.R. (1985): Digestive physiology of their morphophysic specialization and adaptation, In Biology of Deer production (ed.) K.R. Fenessy and K.R. Drew, pp. 393-407. Bulletin no. 22, The Royal Society of New Zealand Wellington.

Isichei, A.O. (1995): Impact of Land use on Biodiversity in the savanna zone of West Africa. Proceedings of the Regional Training Workshop held in FUTA, Nigeria on the 23rd – 26th July, 1995.

IUCN, (2000): Conserving the World Biological Diversity Forest Resources Assessment. Journal No 37,pp 34

IUCN/SSC (1998): Antelope conservation news-letter and journal of the IUCN/SSC. Antelope specialist group No. 7, 1998, pp. 123.

Jarman,P.J. (1981): Diets of large mammal in the woodlands around Lake Kanba Rhodesia.

Kearney S.R. and Gilbert, T.T. (1984): Habitat use by white tailed deer and mouse on sympatic ranges. Journal of Wildlife Management 40.

Kingdom, J. (1977): East African mammals. An Atlas of Evolution in Africa vol. 1 Academic Press, pp. 446.

Kio, P.R.O., Gbile, Z.O., Soladoye, M.O. and Nozie, V.C. (1986): Some medicinal

plants of Africa and Latin America, FAO Forestry paper.

Lasson H.M. (1999): Mammals of Thailand Association for the Conservation of Wildlife Bangkok.

Leigh, E.G. (1981): The average life time of population in varying environments. J. Theor. Bioscience 90: 213-239.

Leuthold, B.M. (2001): Food habits of Giraffe in Tsovo National Park, Kenyan Oceecologia 35: 221-251.

Loft. E.R., Menke, J.W. and Kie, J.G. (1986): Interaction of Cattle and Deer on mountain Rangeland California Agriculture vol. 40 no. 1, February (1986) University of California, Division of Agriculture and Natural Resources Report in Research.

Mackinon, F. and Mackinon, F. (1986): Mountain Anoa and Lowland Anoa IUCN/SSC Wild Cattle Group Species. Information Sheet. IUCN Gland Switzerland.

Mentis, M.T. (2003): Stocking rates and carrying capacities for ungulates on African rangelands South African Journal of Wildlife Research 7: 129-141.

Milligan K.N., Ayayi, S.S. and Afolayan, T.A. (1986): Habitat utilization by wildlife herbivore communities in Kainji Lake National Park. Some proposals for Range Mgt. MAB Nigeria Savanna Workshop papers (ed.) Standford W.W., Yesufu, H.M. and Ayeni J.S.O.

Mboszekwi, M.J. (1983): The behaviour and ecology of the African Buffalo Cambridge University Press, Cambridge.

Moore, R. 91988): The root are the problem. Uses. 127: 34-36.

Mossman, F. (1987): Sustainable management of the Saiga Antelope. Oryx. 28: 257-262.

Odsun, P.M. (1971): Fundamental of Ecology 3rd Edition Published by W.B. Sanders Company USA, pp. 371-431.

Oguntala, A.B. (1995): Rome of Fire in the Management of Savanna Ecosystems. Proceedings of the Regional Training Workshop held at FUTA Nigeria on the 23rd – 26th July, 1995.

Okali, D.U. (1995): Planning strategy for conservation of Natural Resources in Nigeria. Proceedings of seminars on Nation Conservation for Nigeria held in Kano, pp. 12-30.

Oke, D.O. and Fuwape, J.A. 91995): Environmental impact of indiscriminate logging in Ondo State. Proceedings of the Regional Training Workshop held at FUTA Nigeria, July 1995.

Okigbo, B.N. (1995): Land uses and productive potentials of African savanna. In: Ecology and Management of the World's Savanna J.C. Torhill and J. Mott (eds.) Ausdtralia Academy of Sciences Cambera, pp. 95-106.

Omorodion, F.I. (1991): Socio-economic survey of Okomu Forest Reserve. An M.Sc project University of Benin.1991

Orherre, S.S. and Ohenhen, A. (1991): Botanic Gardens, Conservation News Magazines of the Botanic Garden Conservation Secretariat, vol. 8, pp. 48-51.

Osemeobo, G.J. (1988): Poaching in wildlife conservation, the experience in Nigeria. The Nigeria Journal of Forestry 20: 35-40.

Osotimehin, K.O. (1995): Environmental Resource Management in Sub-saharan African. A co-management approach. Proceedings of the Regional Training Workshop held at FUTA, Nigeria, July 1995.

Owen-Smith, N. (1999): Assessing the foraging efficiency of large herbivore, the Kudu. South Africa Wildlife, pp. 102-110.

Oyeniyi, S.O. (1995): That Our Soil May Not Die. An Inaugural lecture delivered at FUTA, Nigeria.

Pearce, P.L. (1987): The social physiology of tourist behaviour.

Pelink, M. (1994): Draft Report on the Elephant of KLNP Technical Report. Kainji Lake Research Institute, New Bussa, Niger State, Nigeria.

Pennings, O.D. (1986): Some effects of sward condition on grazing behavior and intake by sheep. In: Grazing Research at Northern Latitudes.

Phole, T.C. (2002): Feeding ecology in the Queen Elizabeth National Park Ph.D thesis University of Nairobi.

Poak, C.R. (1995): Revenue Derivable from Wildlife Resources. Fauna and Flora presentation oryx 19: 45-56.

Ponnycuick, L. (1990): Grazer or Browser, A classification based on the stomach structure and feeding habits of East African ruminants mammalian, 36, 226-240.

Prins, H.H.T. (2000): The herbivore as prisoners of its food supply. In: Disturbances in grassland species and population response (ed.) J. Van Andel, J.P. Bakker and R.W. Snaydon, D.R. Junk Publishing Company Dordrecht.

Prins, H.H.T. (1993): Plant phelogy pattern in Lake Manyara National Park, Tanzania. Journal of Biogeography 15: 465-480.

Ricklef, W.F. and Cox, W. (1995): The Indian decline of the wild water Buffalo in North East India oryx 22: 70-73.

Russel, T.A. (2000): Extinct and vanishing of mammals of the Old World Space Amer. Comm. Wildl. Prot. 12: pp. 819.

Scarce, A.R.E. (1986): The selection of plant species by Buffalo in Lake Manyara National Park By Analysis of faecal out. M.Sc thesis University of Gwanigen, Utreach.

Sinclair, A.R.E. (1977): Studies of the Ecology of the East African Buffalo. Ph.D thesis Oxford University, London.

Sinclair, A.R.E. (1974): The Natural Regulation of Buffalo Population in East Africa. Africa journal of ecology vol.37 pp. 50

Smitters, R.H.N. (1995): The mammals of the South African Region University of Pretoria, Pretoria. Journal of Biography vol,15 pp 465-480

Skinner, F.G. (1994): The North American Buffalo. David and Charles Newton Abolt. WWF annual report mimeograph pp19 -30 WWF Washington

Stark, M.A. (1999): Movement grazing activity and diet of savanna Buffalo in Benowe National Park Cameron. African Journal of Ecology 24: 255-262.

Stewart, D.R.M. and Stewart, J. (1995): The Distribution of large mammals in SKenyan. Journal Ecol. Afri. Nat. Hist 24.

Stobbs, T.H. (1999): The effects of plant structure on the intake of tropical pastures. In: Variation on the bite size of grazing cattle. Aust. J. Agric. Rees. 24: 809-819.

Surring, F.G. and Voh, W.P. (1993): Herbivore overlap and competition in Kenyan Rangeland. African Journal of Ecology 28: 259-268.

Terbough, J. (1974): Preservation of Natural diversity. The problem of extinction of animals species. Bioscience 24: 715-722.

Thornback, J. (1983): Wild cattle Bison and Buffaloes, their status and potential value. IUCN Conservation Monitoring Centre, Cambridge, UK.

Tyler, S.J. (1992): The Behavior and social organization of the New Forest Pondes. Aim. Behav. Monogr. 5: 85-96.

Vansoest, P.J. (1996): Nutritional Ecology of the Ruminants. O. and So Books Corvallis.

Vessey-Fitzgerald, D.F. (1984): Utilization of the habitat in the Lake Manyara National Park. Ecology of African Wildlife 7: 131-145.

Walker, B.H. (2000): An assessment of the ecological basis of game ranching in southern African savanna. Proceedings of the Grassland Society of South Africa 11: 1606-1615.

Whitter, T.R. (1995): An Ecological study of the Koupra Novibas Sauvell. Institute of Science and Technology, Manila, 5: 1-10.

Welch, J.G. and Smith, A.M. (1999): Forage quality and rumination time in cattle. J. Dairy Science 53: 797-803.

Wild, T.C. (1996): Population ecology of the wild and Feral Equis. University of

Wyoming Laramie Sept. (1999).

Wilson, T. and Reeder, G. (1993): Impact of season of serminal characteristic and endoclime status of adult free ranging African buffalo (*Syncerus caffer*). Journal of Reproduction fertility 92: 47-67.

Woodford, M.H. (1996): Rinderpest and Wildlife. FAO African Working party on Wildlife Management and National Parks. Arushia Tanzania, Sept. 1973.