SNAKES DIVERSITY AND DISTRIBUTION IN KAINJI LAKE NATIONAL PARK (KLNP), NIGERIA

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ABSTRACT

Snake is an important agent in ecosystem balance but people's fear makes it difficult to conserve. Thus, its diversity is declining rapidly due to anthropogenic factors. Information on snake species in Kainji Lake National Park (KLNP) is scarce despite their socio-economic value as source of antivenin, food, leather products and pets. Therefore, snake diversity and distribution in KLNP Nigeria were investigated.

Ten transect strips of 2 km each were laid in five ranges (Oli, Ibbi, Kuble, Doro and Kali) randomly selected from seven ranges in KLNP. Visual Encounter Survey was conducted along each transect to determine snake diversity and relative abundance during the day (09.00 - 12.00 h) and at night (19.00 - 21.00 h). Visit was replicated twice in each month both in dry (December – April) and wet (June - October) seasons in two consecutive years (2013 - 2014). Dead snakes were collected, preserved in 20% formalin solution and their morphometric parameters measured. Respondents (226) from 12 villages randomly selected from 21 villages at the buffer zones of KLNP were interviewed using structured questionnaire. Relative Abundance and diversity of snakes were measured using Simpson's (D) and Shannon-Weiner's (H) diversity indices. Data were analysed using descriptive statistics and ANOVA at $\alpha_{0.05.}$

Twenty-one species of snake belonging to 12 genera representing six families were identified. Eleven species (6 families) were observed at Oli, 14 species (6) at Ibbi, 13 species (4) at Kuble, 8 species (4) at Doro and 12 species (3 families) at Kali range. *Bitis arientans* (38.0%) had the highest abundance followed by *Boaedon lineatus* (15.5%), *Dendroapis jamesoni* (8.0%) and *Naja nigricolis* (7.0%) and the least encountered (1.0% each) were *Bitis gabonica*, *Causus Litchtensteini*, and *Mehelya Crossi*. Ibbi range had the highest diversity index (D =

0.781 and H’ = 1.667) and Kali range with the best evenness (0.957). Significant differences were observed in number of ventral scales (0.023), Inter-orbital length (0.025), snout- vent length (0.004) and head width (0.009) of different snake species. Pythonidae (8.5%, 48.5.0%),Viperidae (34.1%, 12.1%), columbridae (37.0%, 12.1%) and Elapidae (23.4%, 24.3%) were encountered during the day and night respectively. During wet season, 16.8%, 47.9%, 0.0%, 35.3% of Culubridae, Elapidae, Pythonidae, and Viperidae were encountered respectively while 28.5%, 15.3%, 35.6%, 20.6% of Culubridae, Elapidae, Pythonidae, and Viperidae were encountered during the dry season respectively. Snakes are utilised for preparation of traditional medicine (55.0%), decoration (20.0%), leather products (11.0%), Pets and entertainment (10.0%) and food (4.0%). Majority of respondents (56.0%) observed a decrease in snake population in the last deacade. Half of snake bites occurred on the farm with *Bitis arientans* (50.0%) and *Naja nigricolis* (38.0%) responsible for most bites. The leg was the major point of bites (70.0%) and mostly in male respondents (85.9%).

Twenty one species of snake were identified in Kainji Lake National Park. *Bitis arientans* and *Boaedon lineatus* were the dominant snake species. Ibbi range had the best snake species richness. *Bitis arientans* and *Naja nigricolis* were responsible for most bites in the study area.

Keywords: Snake diversity, Snake morphometric parameters, Snake distribution, Snake bite

Wordcsount: 494

DEDICATION

This project is dedicated to God of heaven and the earth that has created everything and pronounced them all to be beautiful. Unto Him be the glory.

To my ground father Pa Samuel Oyeleye (Late) who trained me up in the way of the Lord.

To my very dear mother, Mrs Mariani oyeleye (Late) who love education so much and bought me the first book that I knew and red (A B D).

CERTIFICATION

I certify that this project was carried out by Mr D.O Oyeleye in the Department of Wildlife and Ecotourism Management, University of Ibadan. The work has not been presented elsewhere for award of higher degree, Diploma or Certificate.

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Now unto the King eternal, immortal, invisible, the only wise God, be honour and glory forever and ever. Amen.

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ABBREVIATIONS

ASQ	:	Anti Snake Quleatox
BA	:	*Bitis arientans*
BL	:	*Boaedon lineatus*
CBD	:	Convention on Biological Diversity
CM	:	*Causus maculatus*
CITES	:	Convention on Trade in Endangered Species
DSJ	:	*Dendroaspis jamesoni*
FAO	:	Food and Agricultural Organization
FAO	:	UN Food and Agricultural Organization
HL	**:**	Head length
HW	:	Head width
IUCN	:	International Union for the Conservation of Nature
IO	:	Intra-orbital Length
KLNP	:	Kainji Lake National Park
NNC	:	*Naja nigricolis*
PAST	:	Paleontological Statistic software package for education and data analysis
PS	:	*Python sebae*
SL	:	Snout-vent length
No of Ve	:	Number of Ventral Scales
TL	:	Tail length
UI	:	University of Ibadan
VES	:	Visual Encounter Survey
WHO	:	World Health Organisation

CHAPTER ONE

1.1 INTRODUCTION

Biodiversity is the wealth of life forms found on earth; animals, plants, and microorganisms in their millions and their differences, the gene they contain and the intricate systems they form (Christ *et al.*, 2003). Biodiversity is a level of the nested composite of plants, animals and microbes and encompasses all levels of natural variation from the molecular and genetic levels to the species (Huston, 1994). It includes diversity within species, between species and ecosystems of all living organisms on Earth. Genetic diversity refers to the freq variety of genes or genomes within and between population of the same species, and the information contained within these genes provides the basis for evolution through adaptation. Species diversity on the other hand refers to the number and abundance of species in an area and extent to which species differ in their genetic make-up. It incorporates characteristics such as taxonomic uniqueness, size and structure, population dynamics, reproductive cycles and behaviour patterns.

Biodiversity is declining rapidly due to factors such as land use change, climate change, invasive species, overexploitation, and pollution. Such natural or human induced factors referred to as drivers tend to interact and amplify each other (Emmanuel, 2009). Species diversity is a very useful parameter for comparison of two communities. High species diversity is considered by most ecologists as a desirable state that knowledge of species diversity is particularly useful when one wishes to study the influence of biotic disturbances or to know the state of succession and stability in the environment (Kent and cocker, 1992). Generally, the idea of conserving wildlife resources is still growing in most West African countries. Moreover, most of the conservation efforts tend to focus on few species. Reptiles receive one of the least attention (Salami, 2006) and among the reptiles, snake require special skill and courage to handle.

Most scientists believe that life on Earth is now faced with most severe extinction episode (Eldredge, 2009). No one knows exactly how many species are being lost because no one knows exactly how many species exist on Earth. Estimate varies but the most widely accepted figure lies between 10 and 13 millions species, of these biologist estimate that as many as 27,000 species are becoming extinct every year. This translates into loss of 3 species every hour. (Eldredge, 2009). Species diversity of a community is a function not only of the rate of addition of species through evolution but also of the rate of loss of species through extinction or emigration (Charles, 1994). Compare with polar communities, the tropics could have a more rapid rate of evolution and a lower rate of extinction, and these two rates act together to determine species diversity. Knowledge of the history of diversity through geological time is based on analyses of the fossil records (Kim and Weaver, 1994). It is generally accepted that the fossil record can give a reasonable insight into past diversity in terms of taxonomic richness particularly at higher taxonomic levels. Since the living world is most widely considered in terms of species, biodiversity is very commonly used as a synonym of species diversity. The species level is generally regarded as the most natural one at which to consider whole organism diversity. Species are also the primary focus of evolutionary mechanisms and the origination and extinction of species are the principal agents in governing biological diversity in most senses. Every species occupies a specific niche with a specific set of habitat requirements and has a definite range of distribution. Each species has definite and specific roles to play in sustaining the dynamics of ecosystem processes as producers, consumers, decomposers, parasites and predators (Olembo, 1991). The ideal components of species diversity would be the groups of species within which consistent patterns appear and within which a given process will always produce the same pattern. Such group of species could be defined on the basis of properties of the areas in which they occur, which has been a common approach in ecology and biogeography (Huston, 1994).

Many sorts of reptile exist. Over 6,000 species are scattered through-out the world and about 3,000 of them are snakes that comprise of 12 families (George, 1976). Most snakes live in warm places, but there are some reptiles living in colder parts as well. Most snakes are carnivorous while few species feed on insect. Reptiles are frequently thought of as dangerous, but actually only a few species of snakes and lizards are venomous and only few them have a dangerous bite. Most reptiles are harmless and, indeed, are extremely beneficial to man because they feed on rodents and insect pests. Many are beautiful and all are interesting to behold. Acrochordid snakes (Xenopettidae and Acrochordidae) occur mainly in South Asia while the boas and pythons (Boidae) are distributed across South America, Africa and Asia. The Predominantly non-venomous columbrids (Columbridae) occur all over the world. The highly venomous cobras, kraits and their allies (Elapidae) are mainly distributed across Africa, Asia and Australia; Likewise highly venomous poisonous vipers (Viperidae) are restricted to Africa and some parts of Europe and the venomous vipers (Crotalidae) to America and Asia. Sea snakes (Hydrophidae) live in coastal waters of the Indian and Pacific Ocean (Charles, 1994).

Effective management of wildlife resources depend basically on awareness some basic ecological factors; population, distribution, migratory patterns and their ecological niches and other components (Ayeni, 2007). Population of organisms can become established in a region only if the range of condition under which the species or individual can thrive is consistent with some of the conditions prevailing in that environment (Marion, 2003). To establish and appraise management practices, wildlife managers must estimate the sizes of wildlife populations under their supervision. For game species, such inventories are ideally taken three times a year; during the breeding season, after young are born or hatched and before and after the hunting or trapping season (field, 2009).

Knowledge of snake diversity and distribution is important to monitor the population trends as they are widely utilized for their meat and skins and venom extraction for medical purposes is sourced from many species of Cobras, vipers and Pit vipers. In some regions, various other snakes, including venomous species are used for meat or traditional medicine whereas, the keeping of venomous snakes for commercial (anti-venom production) purpose are being practiced in different places (Charles, 1994).

1.2 STATEMENT OF PROBLEM

Most of the traded snake skins are still sourced through trapping and collecting of the animal in the wild, either by professional hunters or by villagers. According to the intended use they will either take them alive or kill them for skinning and food. In the remote areas of Nigeria and many other developing countries collecting snakes provides one of the few opportunities for earning cash. Apart from purposeful killing for different uses, snakes suffer kill at sight syndrome from people. Almost everywhere in Nigeria, snakes hardly escape when they are sighted. In fact everyone present (if not running away) will lend helping hands to kill any snake seen passing-by. Even though, sometimes after the killing, you may hear people discussing how beautiful the snake is, absolutely unconcerned if that is the only surviving male of the beautiful species just killed. This indiscriminate killing of snakes in combination with the continuous loss or change of habitat, has led to a drastic reduction of these reptiles in many parts of Nigeria and the World in general. Reptiles and amphibians populations are declining; some are endangered while some are already extinct (Kim and Weaver, 1994). The knowledge of diversity and distribution of snakes in Kainji Lake National Park is not yet fully documented. Lack of knowledge of available animal species and information of their population status will always limits their effective management.

1.3 JUSTIFICATION

Knowledge of ecology, distribution, abundance, reproduction, and management of reptiles is scanty in Kainji Lake National Park particularly when compared with volume of available information on mammals, birds and fishes (Salami, 2006). The knowledge of diversity, distribution and abundance of snake samples is urgently needed to provide a data base for their present population status; inter-specific and intra-specific variations; and, to provide needed indicators for necessary management strategies.

Researches on snake in Nigeria are still very few. Eniang (2004) and Akintunde (2006) have worked on snake biodiversity in other national parks in Nigeria. The relatively few numbers of researches on snakes may be due to the fear attached to the mention of snake even among wildlife professionals. There were various studies of different wildlife resources in Kainji Lake National Park (KLNP) (Meduna *et al.*, 2008, Salami, 2006 and , Hanks 1988), and a host of others but none of these scientists researched on snakes except for short survey carried out by Eniang (2007) who also recommended that detail research on herpetofauna resources should be carried out in the park (Ayeni, 2007) hence, the needs for this project becomes important.

This research work has therefore provided baseline information on snake species in Kainji Lake National Park. The result of this research will also serve as a point of reference for future scientist. The checklist and descriptions of snakes provided in this work was also aimed to serve as quick reference for the medical personnel in the study area when they are attending to snake bite victims. Importantly the data from this thesis will be an important document in the (snake) management plan of the park.

1.4 Scope of the Study

This study was carried out at the Kainji Lake National Park (Borgu and Sugurma Sectors). The research investigated and identified various species of snakes available within and around the KLNP. The distribution pattern and relative abundance of snakes in the park were investigated. It compared morph-metric parameters of different snake species. The study investigated behaviour, habitats, niches and food resources utilized by different snake species in KLNP. Actions and reactions of people living at the buffer zones were also assessed. The study spread over two years on the field (two raining seasons and two dry seasons).

1.5 RESEARCH OBJECTIVES

The broad objective of this study is to assess the species of snakes' presents in Kainji Lake National Park and its buffer zone.

Specific objectives

1. The study identified the snake diversity in KLNP and its buffer zone.
2. It compared morphmetric parameters of different snake species.
3. It determined the distribution and abundance of snake species in different rangesof the park.
4. Investigate behaviour, habitats/niches, mobility and feeding activities of snakes in the study area
5.

5. The study also assessed local community disposition and perception to snake conservation, utilization, and hazards.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Snake description, diversity and distribution

Serpentes (Snakes) are vertebrate animals that belong to order reptilia. Reptiles are a class of vertebrate animals that are composed of four living orders: the turtles or Chelonia; the tuataras or Rhyncocephalia; the Lizards and Snakes or Squamata; and, the Crocodilians or Crocodilia (McGraw-Hill, 1982). Snakes are thought to have evolved from lizards and share many characteristics with this group - particularly the so-called legless lizards, which have tiny, almost imperceptible legs but unlike most lizards, snakes have thin, forked tongues, and they lack external ears while most lizards have movable eyelids that periodically close to protect and lubricate the eyes, a snake's eyes are always open, protected by immobile, transparent scale, (Spawls and Branch, 1997, Eniang, 2010).

Snakes are mostly characterized by elongation and flexibility of the body and loss of limps. They have a more successful radiation than any of other group of vertebrates which have adopted similar body form: the snake like-lizards, for instance, the apodous amphibians or eels. Most of these animals live out their lives within rather narrow confines, beneath stones, underground or in mud; yet the snakes as a group have invaded both the trees and the water in addition to establishing themselves in a variety of terrestrial and subterranean habitats. Indeed even as individuals some types of snakes are so highly adaptable that they can range at will throughout most of the different types of environment available in the localities, grass and trees, rocks, sand, mud and water (Angus, 1975). Many sorts of reptile exist and over 6,000 species are known to be distributed throughout the world. Nonetheless, about 3,500 species are snakes inhabiting both land and sea (Sharma, 1999), of which about 375 are venomous. Most live in warm places, but there are some reptiles living in colder parts as well. Most snakes are carnivorous while few species feed on insect (Eniang *et al.*, 2011). Reptiles are frequently thought of as dangerous, but actually only a few species of snakes and lizards are poisonous and only the really large species have a dangerous bite. Most reptiles are harmless and, indeed, are extremely beneficial to man because they feed on rodents and insect pests. Many are beautiful and all are interesting to behold.

Snake Distribution knowledge is still very low especially in most part of Africa. Ayeni (2007) observed that there are very few wildlife population estimate studies in Nigeria Savanna. The main challenge is the shortage of technical expertise and lack of political interest from government. Distribution of snake in many parts of Nigeria is still at large. There limited information about snake at local level. In general, Acrochordid snakes (*Xenopettidae* and *Acrochordidae*) occur mainly in South Asia whereas the likewise non-venonous boas and pythons (Boidae) are distributed across South America, Africa and Asia. The Predominantly non-venomous columbrids (*Columbridae*) occur all over the world. The highly venomous cobras, kraits and their allies (*Elapidae*) are mainly distributed across Africa, Asia and Australia; Likewise highly venomous poisonous vipers (*Viperidae*) are restricted to the old world and the venomous vipers (*Crotalidae*) to America and Asia. Sea snakes (*Hydrophidae*) live in coastal waters of the Indian and Pacific Ocean (Charles, 1994).

2.2 BIOLOGY OF SNAKE

2.2.1 Snakes Sizes

The now extinct *Titanoboa cenejonensis* snakes were 12-15meters (39-49 feet) in length. By comparison, the largest extant snakes are the reticulated python, which measures about 9 meters (30ft) long and anaconda which measures about 7.5 meters (25ft) long and is considered the heaviest snake on earth today (Mertens,1961). Contrary in size, is the smallest extant snake *Leptotyphlops carlae* with a length of about 10 centimeters. Most snakes are fairly small animals approximately 1 (one) meter (3ft) in length (Mertens, 1961).

2.2.2 Methods of Perception in Snakes

2.2.2.1 Smell perception in Snakes

Snakes use smell to track their prey by using their forked tongues to collect air borne particles then passing them to the vemeronasal organ or Jacobairson organ in the mouth for examination (McDowell, 1972). The fork in the tongue gives snakes a sort of directional sense of smell and taste simultaneously. They keep their tongues constantly in motion, sampling particles from the air, ground and predators in the local environment. In water dwelling snakes, such as the Anaconda, the tongue function effectively under water.

2.2.2.2 Snakes Eyesight's

Murphy (1997) stated that snake vision varies greatly from only being able to distinguish light from dark to a keen eyesight, but the main trend is that vision is adequate although not sharp and allow them to track movement. Generally, vision is best in arboreal snakes. Some snakes such as the Asian vine snake (genus Ahaetulla), have binocular vision with both eyes capable of focusing on the same point. Most snakes focus by moving the lens back and front in relation to the retina, while in the amniotes groups the lens is stretched.

Pit vipers, pythons, and some boas have infrared-sensitive receptor in deep grooves on the snout, which allow them to detect the radiated heat of warm-blooded prey mammals. In pit vipers the grooves are located between the nostril and the eye, in a large "pit" on each side of the head. Other infrared-sensitive snakes have multiple, smaller labial pits lining the upper lip, just below the nostrils (Cogger 1991).

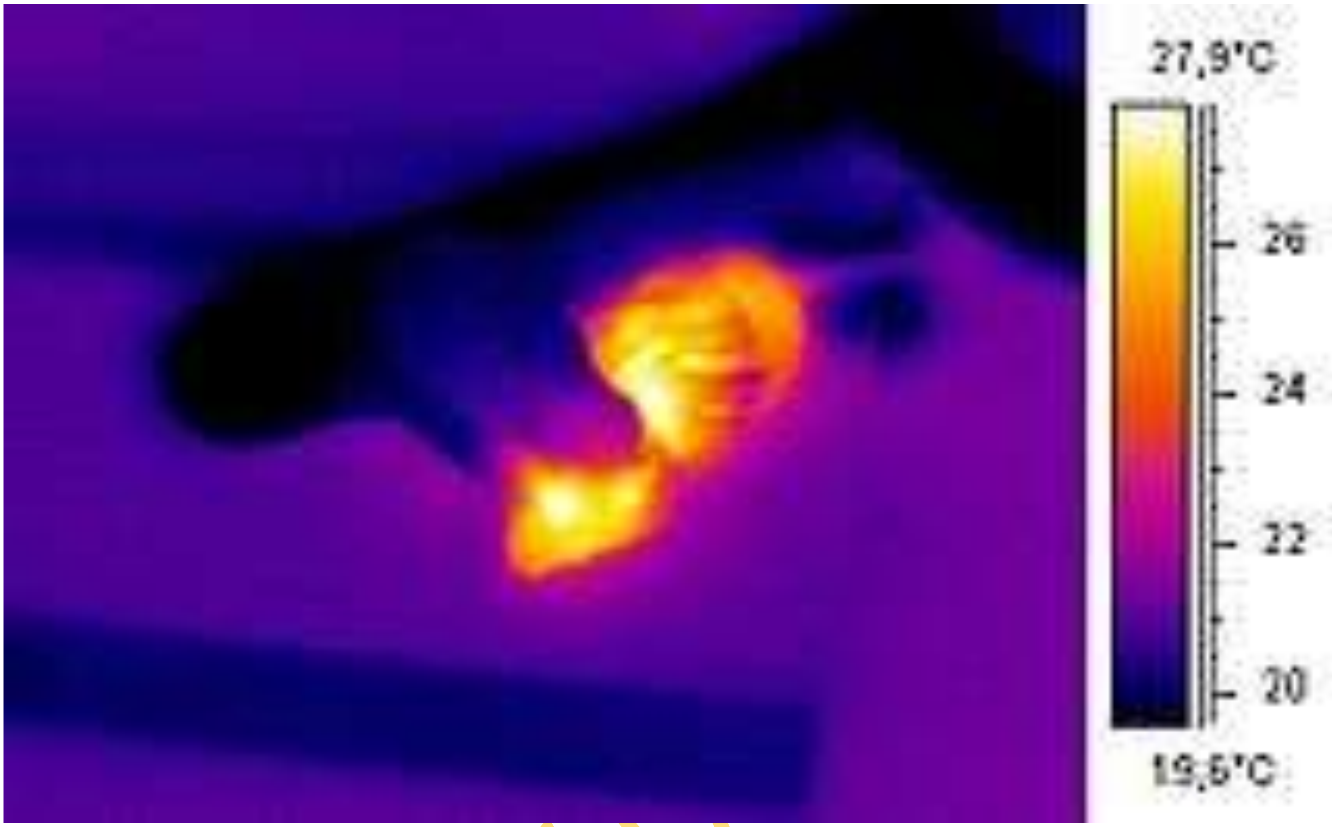


Fig 2.1 : Thermographic image of a snake eating a mouse

(Source : Cogger, 1991)

2.2.2.3 Snake Skin

The skin of a snake is covered with scales. Goodrich (2000) confirmed that contrary to the popular notion of snakes being slimy because of possible confusion with worm's snakes' skin has a smooth, dry texture. Most snakes use specialized belly scales to travel, gripping surface. The body scales may be smooth, keeled or granular. The eyelids of snakes are transparent "spectacle" scale which remain permanently closed and its also known as brille.

The shedding of scale is called ecolysis (or in a normal usage molting or sloughing). In the case of snakes, the complete outer layer of skin is shed in one layer. Snake skin are not discrete but extension of the epidermis, hence they are not shed separately but as a complete outer layer during each molt.

2.3 Snakes Locomotion

The lack of limbs does not impede the movement of snakes, (Durand, 2004). Snakes have developed several different modes of locomotion to deal with particular environments, unlike the gaits of limbed animals which form a continuum, each mode of snake locomotion is discrete and distinct from each other, transitions between mode are abrupt (Cogger, 1991).

2.3.1 Lateral undulation movements of snakes

Lateral undulation is the sole mode of aquatic locomotion, and the most common mode of terrestrial locomotion (Tattersall, *et al,* 2004). In this mode, the body of the snake alternately flexes to the left and right, resulting in a series of rearward-moving "waves". While this movement appears rapid, snakes have rarely been documented moving faster than two body-lengths per second, often much less. This mode of movement has the same net cost of transport (calories burned per meter moved) as running in lizards of the same mass (Tattersall, *et al*, 2004; Hekrotte, 1967).

2.3.2 Terrestrial Snakes Movements

Terrestrial lateral undulation is the most common mode of terrestrial locomotion for most snake species. In this mode, the posteriorly moving waves push against contact points in the environment, such as rocks, twigs, irregularities in the soil, etc. Each of these environmental objects, in turn, generates a reaction force directed forward and towards the midline of the snake, resulting in forward thrust while the lateral components cancel out. The speed of this movement depends upon the density of push-points in the environment. The wave speed is precisely the same as the snake speed, and as a result, every point on the snake's body follows the path of the point ahead of it, allowing snakes to move through very dense vegetation and small openings (Tattersall, *et al.*, 2004).

2.3.3 Snakes Movements in water

When swimming, the waves become larger as they move down the snake's body, and the wave travels backwards faster than the snake moves forwards (Socha, 2002). Thrust is generated by pushing their body against the water, resulting in the observed slip. In spite of overall similarities, studies show that the pattern of muscle activation is different in aquatic versus terrestrial lateral undulation, which justifies calling them separate modes (Jayne, 1988)). All snakes can laterally undulate forward (with backward-moving waves), but only sea snakes have been observed reversing the motion (moving backwards with forward-moving waves (Dunger, 1973).

2.3.4 Side winding Movement of Snakes

Most often employed by colubroid snakes (colubrids, elapids, and vipers) when the snake must move in an environment that lacks irregularities to push against (rendering lateral undulation impossible), such as a slick mud flat, or a sand dune. Sidewinding is a modified form of lateral undulation in which all of the body segments oriented in one direction remain in contact with the ground, while the other segments are lifted up, resulting in a peculiar "rolling" motion (Socha, 2002). This mode of locomotion overcomes the slippery nature of sand or mud by pushing off with only static portions on the body, thereby minimizing slipping. The static nature of the contact points can be shown from the tracks of a sidewinding snake, which show each belly scale imprint, without any smearing. This mode of locomotion has very low caloric cost, less than ⅓ of the cost for a lizard or snake to move the same distance. Contrary to popular belief, there is no evidence that sidewinding is associated with the sand being hot (Cogger, 1991).

2.3.5 Concertina Movement of Snakes

When push-points are absent, but there is not enough space to use sidewinding because of lateral constraints, such as in tunnels, snakes rely on concertina locomotion (Cogger, 1991). In this mode, the snake braces the posterior portion of its body against the tunnel wall while the front of the snake extends and straightens. The front portion then flexes and forms an anchor point, and the posterior is straightened and pulled forwards. This mode of locomotion is slow and very demanding, up to seven times the cost of laterally undulating over the same distance. This high cost is due to the repeated stops and starts of portions of the body as well as the necessity of using active muscular effort to brace against the tunnel walls (Cogger, 1991).

2.3.6 Rectilinear Movement of Snakes

The slowest mode of snake locomotion is rectilinear locomotion, which is also the only one where the snake does not need to bend its body laterally, though it may do so when turning. In this mode, the belly scales are lifted and pulled forward before being placed down and the body pulled over them. Waves of movement and stasis pass posteriorly, resulting in a series of ripples in the skin. The ribs of the snake do not move in this mode of locomotion and this method is most often used by large pythons, boas, and vipers when stalking prey across open ground as the snake's movements are subtle and harder to detect by their prey in this manner (Cogger, 1991).

2.3.7 Arborea Snakes

The movement of snakes in arboreal habitats has only recently been studied. *(*Astley and Jayne, 2007). While on tree branches, snakes use several modes of locomotion depending on species and bark texture. In general, snakes will use a modified form of concertina locomotion on smooth branches, but will laterally undulate if contact points are available. Snakes move faster on small branches and when contact points are present, in contrast to limbed animals, which do better on large branches with little cluster (Astley and Jayne, 2007)

2.4. Feeding in Snakes

Some snakes have a venomous bite, which they use to kill their prey before eating it. Other snakes kill their prey by constriction while some swallow their prey whole and alive (Hori, 2007). All snakes are strictly carnivorous, eating small animals including lizards, other snakes, small mammals, birds, eggs, fish, snails or insects (Hori, 2007). Because snakes cannot bite or tear their food to pieces, they must swallow prey whole. The body size of a snake has a major influence on its eating habits. Smaller snakes eat smaller prey. Juvenile pythons might start out feeding on lizards or mice and graduate to small deer or antelope as an adult, for example. The snake's jaw is a complex structure. Contrary to the popular belief that snakes can dislocate their jaws, snakes have a very flexible lower jaw, the two halves of which are not rigidly attached, and numerous other joints in their skull (see snake skull), allowing them to open their mouths wide enough to swallow their prey whole, even if it is larger in diameter than the snake itself (Hori, 2007). For example, the African egg-eating snake has flexible jaws adapted for eating eggs much larger than the diameter of its head. This snake has no teeth, but does have bony protrusions on the inside edge of its spine, which it uses to break shells when it eats eggs. While the majority of snakes eat a variety of prey animals, there is some specialization by some species. King cobras and the Australian bandy-bandy consume other snakes. Pareas iwesakii and other snail-eating colubrids of subfamily Pareatinae have more teeth on the right side of their mouths than on the left, as the shells of their prey usually spiral clockwise (Hori, 2007).

2.5 Snake reproduction

Only few species of reptile have their male and female staying together for a considerable length of time. In snakes mature male and female only come together during the breeding period (Maurice, 1980). Many snakes are oviparous (animals that lay eggs) while few species are viviparous (giving birth to their young ones alive). When a female snake is ready to breed, a special scent (hormones') is produced by her glands. The male picks up the scent using its

Jacobson organs, trail and follow the female. Once they are together, a ritual courtship follows. In many cases, the male will rub his chin along the back and sides of the female, constantly flicking Jacobson organ (Special touch receptors in the male's chin which establish whether the female is of the same species. If she is not, courtship is discontinued). If they are of the same species, the male will gradually work his way forward, nodding his head and rubbing his chin against her, until he reaches the nape of her neck. Then he throws a loop of the rear part of his body across her back and their tails intertwine. Most female remain passive during courtship, but in some species, both sexes engage in nuptial dance. When the courting ritual has been completed, the female snake opens her cloaca. The male inserts his penis and sperm is transferred into her body. The penis of a snake is a double structure. Mating may last from several minutes to several hours. Each female typically mates with several males during her reproductive season. Although some female mate with the same male more than once, (Spaws and Branch, 1997, Fry *et al.,* 2003). After mating, sperm is stored in the female's tube like oviduct. One to two months later, the female's ovary releases eggs, each with abundant yolks, which are fertilized by sperm waiting in her oviduct. The fertilized eggs are funneled to the cloaca, from where they are released and deposited in a shallow hole in the ground or an area under a rock or log. Among a few types of snakes, including the king cobra and diamond python, female constructs a nest for her eggs out of vegetation. In these and some other snake species, the female remain with the eggs and guards them against predators until they hatch. Female pythons warm their incubating eggs by twitching their muscles in a way that resembles human shivering, (Fry *et al.,* 2003 and Eniang, 2010).

Snakes typically begin mating in the spring in the temperate region while in the tropical regions they mate year round, (Reid, 2003 and Eniang, 2010). A male snake may track down a female only to discover that other male are already with it. Among most species, males ignore rivals and continue with their courtship efforts. In some species, however, competing males engage in ritual combat dances, in which they intertwine their bodies and try to force down one another's head, (Mathew and Gera, 2000).

2.6 The Roles of snake in the environment

It has been observed that biodiversity is not just a collection of individual but an interaction system where the characteristics of individuals are no less important than their functions (Luck, 2007). Snakes play a significant role in ecosystem balancing in food chain or energy transfer as well as element of biological control of pest (Luck, 2007). Snakes to the nature are like acids to a chemist, a necessity (Acids are very dangerous chemicals but yet very useful. A chemist will not run away from acids but learn to handle them with utmost care). In the same vein, snakes control the population of destructive rodents and other pests in an environment. These rodents not only destroy crops and food stores but uncontrolled populations in disease-bearing pests may result in plagues and other health threats e. g the recent spread of laser fever in Nigeria led to pandemonium. Snakes control prey populations, including populations of other snakes. Being slow, snakes tend to eat whatever is in abundance. Uncontrolled prey population growth may adversely affect the habitat. By controlling prey populations, snakes also control the populations of predators which eat the same prey. Snakes are also an important food for many other creatures. Neglecting these groups of fauna resources will leave us in vogue of the full understanding of our natural ecosystem. Eniang and Luselli (2002) argued that while it is true that not every everyone finds snakes conservation fascinating or admirable, they can still respect them as important pieces in a balanced ecosystem and give them the little space, which they require.

2.7 Factors that are Affecting Snake Species Distribution and Density

One of the most interesting qualities of biodiversity is that it is not evenly distributed. Each species has its own unique range, determined by the interaction between existing ecological conditions and the species evolutionary history. The distribution of biodiversity is influenced by ecological factors such as temperature, moisture and soil, as well as seasonality and amount of variation in topography and prevailing climatic conditions (Stratterfied *et al*, 1998). Besides natural factors anthropogenic factors that alter natural habitats also influence the distribution pattern of biodiversity. Starting in the 1950's, western countries developed cities grow, suburbs encroached on agricultural land and high ways cut into forest. Agriculture was modernized with pesticides and by the draining of the marshes. A balance of nature made over millions of years was broken (Pough *et al.*, 2002). As we continue to destroy natural land, all animal population (including snake) will dwindle.

2.8 Threats to Conservation of snakes

Similar to what was reported by Shah, *et al.*, (2003) in Nepa, Snakes have great economic, ecological, religious and cultural, educational and inspirational values in Nigeria. However, the growth of human populations in more recent years has overshadowed the religious and cultural attachments; as a result survival of the species is directly or indirectly threatened. Many factors such as habitat loss and alteration, use of pesticides, wanton killing, accidental trappings, superstitions, illegal collection and trade and ignorance (lack of knowledge and conservation awareness) have contributed in the decline of snake's populations in Nigeria. Several authors have identified some of the factors affecting biodiversity conservation in Nigeria, including land clearing for agriculture and uncontrolled logging, gathering of firewood (Asibey and Child, 1990). Once Nigeria was extensively forested but over the period time some forests were cleared and converted to farmlands and settlements. Major developmental activities like construction of highways, dams and increased use of pesticides in agriculture has had serious impact on the snake population.

As compared to other wild animals snakes can be regarded as a highly vulnerable group in the country. Even these days all snakes are considered to be venomous and killed at sight. Such indiscriminate killings, mainly due to fear and superstitions, illegal collection by snake charmers are other serious threats. Aquatic species of snakes are sometimes trapped in the fish traps, and nets and during these accidental trappings they are instantly killed at the spots. Some species of snakes and their eggs are also collected for food and medicine purposes. Information gap (very limited information are available on the ecology, behavior and distribution of the species) and inadequate conservation awareness among the local people are equally responsible for their population decline.

2.9 Snake trade control and enforcement

Currently, wildlife killed (Bush meat) are being sold and bought freely by the road sides in many parts of Nigeria. It is not uncommon to see people advertising various species of wildlife for sale with little or no restriction to the sellers. Like many other laws in Nigeria, laws restricting the killing of wildlife species are rarely enforced except at the buffer zone of national parks where park staffs see this as one of their oversight function. Although many people are not pre disposed to consumption of snakes as bush meat there are villagers that specialized in killing snakes for meat, sale or medicinal purposes. After the complete ban of the snake-skin industry in India and protection of all snakes under the Indian Wildlife (Protection) Act 1972, they formed the Irula Snake Catcher's Cooperative and switched to catching snakes for removal of venom, releasing them in the wild after four extractions. The venom so collected is used for producing life-saving antivenom, biomedical research and for other medicinal products (Flynn, 2002).

2.10 SNAKES AND THEIR HABITATS

2.10.1 Burrowing Snakes

Only a few can truly dig out burrows, adaptations include: blunt noses protected by large tough scales or spade-shaped heads to dig with (Dunger, 1973); a powerful tail, spined or armoured to push against in tight spaces; heads not differentiated from the body and fused head and scales to minimize friction. They scoop soil out with loops of their body. True burrowing snakes are found where the ground is warm. Most snakes can dig through loose soil to make hiding holes or dig out prey. They do this by the concertina method to pile-drive into the soil. Snakes also happily use holes and burrows already dug out by other animals or even share them with a current tenant: Rock Python may share the burrow of an aardvark or porcupine.

2.10.2 Semi-aquatic and aquatic snakes:

These snakes are found where the water is warm. Most snakes can swim, moving by undulating, but fully aquatic snakes have additional adaptations: paddle-like tails, flattened bodies; sand-papery skin to grasp slippery fish (Dunger, 1971). All still breathe through lungs but can remain underwater for a long time. The lungs, which may extend the length of the body, help it to float. Marine snakes (right) excrete excess salt through a gland in their mouth. In the tropics where snake are more abundant, deforestation remain the greatest threat to snakes

2.10.3 Desert snakes:

Desert snakes conserve water well so they are ideal desert dwellers. In addition they able to hibernate during hot dry periods, living off stored fat; move by side- winding to keep off hot sand (Reid, 2003). The Horned Viper has horns above its eyes to protect it from the sun--serpent shades! Some can concave their bellies to create an air-space to breathe in underground. Some stick just their eyes and noses out of the sand in ambush and wiggle their tail to lure prey within strike range. They usually stay underground during the heat of the day and become active only at dusk or night.

2.10.4 Arboreal Snakes

Rectilinear locomotion ability of some snake make possible for them to adapt to tree climbing (Fry, 2003). Arboreal snakes are usually very long, thin and vine-like or shorter and stockier but with a prehensile tail. Vine-like snakes move quickly through the trees, and some can even glide (Wild, 1994). Those with prehensile tails move more slowly, using their tails to grip branches as they move across space or lunge out for prey.

Arboreal snakes also have anti-skidding side scales and broad belly scales to grip smooth branches (Eniang, 2011), and modifications in their heart and blood vessels so blood continues to flow even if they are vertical or their heart is lower than the rest of their body. Most are egg-laying as they need to keep their bodies light. Most tree-dwellers rest in a typical flat coil draped over a branch with the head in the centre of the coil (right). Arboreal snakes have different height preferences. In most forests, some snakes prefer the top canopy (Reid, 2003), others the middle layers (like Green Mambas), and yet others the lower branches and bushes (these are semi-arboreal).

2.11 Snake bite and identification

Snakes do not ordinarily prey on humans. Unless startled or injured, most snakes prefer to avoid contact and will not attack humans. With the exception of large constrictors, nonvenomous snakes are not a threat to humans. The bite of a nonvenomous snake is usually harmless; their teeth are not designed for tearing or inflicting a deep puncture wound, but rather grabbing and holding. Although the possibility of infection and tissue damage is present in the bite of a nonvenomous snake, venomous snakes present far greater hazard to humans (Sinha, 2006). Documented deaths resulting from non venomous snake bites are uncommon. Nonfatal bites from venomous snakes may result in the need for amputation of a limb or part thereof. Of the roughly 725 species of venomous snakes worldwide, only 250 are able to kill a human with one bite. In India, 250,000 snakebites are recorded in a single year, with as many as 50,000 recorded initial deaths (Bagla, 2002). The bites of black mamba and coastal taipan result in an untreated mortality rate of approximately 100%. Other species clinically known to cause high mortality rates include the common krait and king cobra, (Lee, 2007). Moreover, death time after envenomation can also reflect the danger of bites from a species to humans. Mambas, (Lee, 2007) the king cobra and the coastal taipan are examples of snakes whose bites may result in rapid fatality if untreated. On the contrary, the inland taipan has not caused any human death. However, it should be noted that the death rate or death time resulting from a bite may vary from person to person as the health state of the victim is also determining and thus snakebites from any kind of venomous snakes should be tackled seriously (Lee, 2007) and promptly .

The treatment for nakebite is as variable as the bite itself. The most common and effective method is through antivenom (or antivenin), a serum made from the venom of the snake. Some anti-venom is species specific (monovalent) while some is made for use with multiple species in mind (polyvalent). In the United States for example, all species of venomous snakes are pit vipers, with the exception of the coral snake. To produce antivenom, a mixture of the venoms of the different species of rattlesnakes, copperheads, and cottonmouths is injected into the body of a horse in ever-increasing dosages until the horse is immunized. Blood is then extracted from the immunized horse. The serum is separated and further purified and freeze-dried. It is reconstituted with sterile water and becomes antivenom. For this reason, people who are allergic to horses are more likely to suffer an allergic reaction to antivenom (Bagla, 2002). Antivenom for the more dangerous species (such as mambas, taipans, and cobras) is made in a similar manner in India, South Africa, and Australia, although these antivenoms are species-specific (Bagla, 2002).

Identification of venomous snake is advised to be left for the professionals or an individual who take interest to know each snake with its venomous status. People often asked for method of differentiating venomous snake from non venomous ones at a glance. It is a question that must be answer with a lot of caution as many of the propounded theories are always with exception. If somebody asked a laboratory scientist on how to differentiate water from acid, he may have to teach the person a bit of chemistry to ensure safety as water and acids look alike in bottles but while one may be used to quench a thirst the other one will destroy the throat. Weather a snake is venomous or not, all snake must be treated with caution and allow to go their way. However, some of the following observation has been suggested:

- Most venomous snakes usually have triangular shaped heads. (Exception, Cobra)
- Some venomous snakes such as the green member and coral snake have bright colors.
- Some venomous snakes have vertical eye slits, versus round pupils usually seen in non-venomous snakes. (Exception: Black Mamber and Cobra
- A venomous snake normally has a heat-sensitive pit there to locate warm-blooded prey. Non-venomous snakes lack such pits.
- A snake with a rattle on its tail must be a rattlesnake, which is venomous.

The use of the word "some" in most of these assumptions suggest clearly that most of the rules are not universal and are mostly with exception indicating that tendency to make mistake using these assumption is possible. A lot of caution is therefore advocated to avoid a costly mistake. In case of snake bite, general appearance; such as colour, size, length and dentition of snake if killed will enhance the identification of any snake by the medical herpetologist or medical personnel for administration of appropriate anti-venom if venomous snake is detected to be involved and basic wound treatment for non venomous bite.

2.12 First aid for snake bite victims

Snake bite is a common occurrence in the rural settlements most especially among forest workers. Most snakes bite, whether the snake involved is venomous snake or not, will have some type of local effect. There is minor pain and redness in over 90% of cases, although this varies depending on the site (Ismail *et al.*, 1993). People's approaches varied and sometimes, a wrong approach or first aid treatment applied may compound the suffering of the victim.

Potency or effect of snake bite varies by species involved and some other factors. The outcome of all snakebites depends on a multitude of factors: the size, physical condition, and temperature of the snake, the age and physical condition of the victim, the area and tissue bitten (e.g., foot, torso, vein or muscle), the amount of venom injected, the time it takes for the person to find treatment, and finally the quality of that treatment (Gold and Wingert (1994).

In recent years, first aid measures for snakebites have been radically revised to exclude methods that were found to worsen a patient's condition, such as tight (arterial) tourniquets, aggressive wound incisions, and ice. Initial treatment measures should include avoiding excessive activity, immobilizing the bitten extremity, and quickly transporting the victim to the nearest hospital.

A wide, flat constriction band may be applied proximal to the bite to block only superficial venous and lymphatic flow (typically, with about 20 mm Hg pressure) and should be left in place until antivenin therapy, if indicated, is begun. One or two fingers should easily slide beneath this band, since any impairment of arterial blood flow could increase tissue death. Upper extremities should be splinted as close to a gravity-neutral position as possible, preferably at heart level. The best and most important aid in case of snake bite is to quickly assist the victim to the nearest capable heath care centre for emergency attention.

2.13 SNAKE AS FOOD

Although many people tend to hate snake, a good number of Nigerian see snake as a delicacies. The writer of this work happens to be one of such person. I have personally tasted quiet a number of snake species with no regard to whether they are venomous or not. Snake happen to be a palatable meat, though many people dare not touch and could even be fainted at the imagination of putting snake in their mouth. Apart from their meat snake eggs are exceptionally delicious. Generally, reptile's yokes contain a far higher percentage of yoke than that of birds. Some snake species serve this purpose more adequately; Python and viper are more robust and consequently possess more meat than cobra and most elapids with long and slender body. While not commonly thought of as food in most cultures, in some cultures, the consumption of snakes is acceptable, or even considered a delicacy, prized for its alleged pharmaceutical effect of warming the heart. Snake soup of Cantonese cuisine is consumed by local people in autumn, to warm up their body. Western cultures document the consumption of snakes under extreme circumstances of hunger (Allen, 2001). Cooked rattlesnake meat is an exception, which is commonly consumed in parts of the Midwestern United States. In Asian countries such as China, Taiwan, Thailand, Indonesia, Vietnam and Cambodia, drinking the blood of snakes particularly the cobra is believed to increase sexual virility (Allen, 2001).

2.14 Snake as pet

In the Western world, some snakes (especially docile species such as the ball python and corn snake are kept as pets. To meet this demand a captive breeding industry has developed. Snakes bred in captivity tend to make better pets and are considered preferable to wild caught specimens (Ernest *et al.*, 1996). Snakes can be very low maintenance pets, especially compared to more traditional species. They require minimal space, as most common species do not exceed five feet in length. Pet snakes can be fed relatively infrequently, usually once every 5 to 14 days. Certain snakes have a lifespan of more than 40 years if given proper care (Ernest *et al.*, 1996).

2.15 Snake and people

Snake relationship with man is as old as history. In the Bible Satan deceived the first woman in the image of snake. Consequently, many people have associated snakes to evil, a sign of bad omen and each snake sighted is judged accordingly. Also during the popular exodus of Israelite to the Canaan Land, there was a time they experienced epidemic of snake bite. The instruction of God to Moses the leader is to prepare snake image made up of copper. As many that looked up to the image did not die. Although many people in modern times are frequently hostile towards snakes, there are some ancient culture that had great respect for them (George, 1976). . The unusual qualities of snake such as unblinking eyes, the legless movement, the ability to kill with a single bite- made some people regard snakes as gods. In Africa, Asia, North and South America and Europe snakes have been worshiped. In Egypt, the goddess Buto was frequently represented as a cobra (George, 1976). Indian has many legends built around the Najas, a magical race of snake gods. Some royal Indian families even claimed the Najas as ancestors. Statues of these snakes are still worship in the south of Indian. Snakes have also been the symbols of many peoples. The Aesculapian snake was used as the symbol of Greek god Aesculapius, who they believe was responsible for healing. This snake, twined around a staff, is used today as the emblem of the medical profession.

2.16 Some Common Myths, Names and Proverbs on snakes in Nigeria.

There are many folklores, myths, names and norms that express the feeling and understanding of indigenous people about snake ethology. Many of them could best be described as untested hypothesis (Observation with no logical conclusion). In some cases inconsistency in experiences force them to doubt some of their findings. In many cases observation become a mysteries with no adequate explanation and descriptions for certain behaviour of some snakes. But in all, there is a degree of truth based on common observations and hunters reports. Hunters and elderly individual from different tribes in Nigeria were engaged in personal interview to share their view on some of these assumptions. Personal experiences I had on the field also help to explain some of these myths or idioms.

2.16.1 Viper does not feed on guinea corn but on the guinea corn eaters. (Yoruba: *Oka ki je oka ohun ti o n je oka li oka n je*) : It is common to find viper snakes in harvested guinea corn sheaves bounded in bunches. In such occasion somebody with no knowledge of snakes favourite food may be thinking the snake has come around to eat guinea corn. Whereas, the truth of the matter is that the snake is laying ambush for mouse or birds that will come around to eat the grain and possibly become a prey for the snake.

2.16.2 We do not eat snake and also eat the prey inside it (Yoruba: *A kii je ejo ka tun je egun inu re*) : It is a taboo among people that eat snake in Nigeria to eat the snake and also eats the prey swallow by such snake. They have believed that you should let go of the prey. However sometimes, the meat obtainable from the prey might be far better and even bigger than the snake itself therefore there is always a temptation to want to eat the prey which is contrary to norms. The truth is that before a venomous snake swallows its prey, it would have injected high amount of venom to it via a series of bite. The deposited venom is primarily demobilized the prey and also help to aid the rate of decomposition / digestion of prey. Meanwhile, the same chemical is residents inside the prey and could be potentially dangerous for consumption to the third party who attempt to eat snake along with prey already poisoned with venom**.** Understanding that snake like python have no venom suggest that the prey inside of them should be free of poison provided it has not started decomposing. Either way, it might be the best to avoid consumption of prey found in any snake all together.

2.16. 3 Vipers babies cause the death of their mother. (Yoruba: *Omo inu oka lo n se iku pa oka*). In Yoruba language, there is general abelieve that when snake give birth to their youngs they die in the process. While this is true occasionally for certain species this philosophy does not hold for majority of snakes. Before commencement of this research, the researcher has personally encountered with a mother viper at the point of death hibernating in a hole. The snake was killed and dissected. There were 52 baby snakes inside the viper. This particular experience makes the researcher to take the idea of baby snake killing their mother serious. Previous studies (Angus d' B. *et al.*, 1975 and Maurice, 1980) observed that stories of adders and rattlesnakes swallowing their young to give them refuge are probably based on the appearance (emergence) of viable /living fetuses within the ruptured body of a parent which had been killed by a blow caused by developing fetus. It is therefore very clear that among ovoviviparous snake like viper with incubation taking place inside the animal some mothers are over blown by several fetuses growing inside of them. The life of the mother could be lost in the process and the young ones inside it forcing their way to outside world through different parts of their rotten mother. Sometimes the mother snake may survive the trauma and the rotten part will healed up.

2.16.4 Viper has the ability to swallow its teeth and therefore one should not carelessly fondle its intestine. There is an assumption that viper has ability to swallow its teeth and bring it forth when the need arises. This assumption is an illusion of the reality. The viper has fangs that can be erected by the rotation of the maxillae. The fangs lie along the roof of the mouth when not in use. Fangs are able to grow very long. With this understanding it becomes very clear that vipers do not actually swallow the teeth as assumed it only appear so when they retrieve their long retractable teeth. The fangs are long enough to hinder the snake from successfully injecting its prey if they are not in movable form.

2.16.5 Python does not bite during the day but at night. Python are more nocturnal than diurnal and for this reason they are more active and aggressive when hunting at night time. It should be noted that every snake has ability to bite even though some lack venom. For instance python can give a dry bite when cornered and this could occur during the day or at night time depending on level of disturbance.

2.16.6 Coinage (Yoruba: *Oka*). Oka simply means something that rolls up in Yoruba language. This name suggests the most usual position vipers were found while resting or waiting for its prey. They usually roll up their body with the tail carefully hide in the middle.

2.16.7 There is a general believe (Among Yorubas) that when you throw a roll up cloth to a viper they will be there to watch over it until the owner returns. It is so much so that villagers quickly look for clothing materials and roll it up and throw it to a viper lying on a spot. In such instance the people believe they will return to meet the snake on the same spot. And more often than not the dogma believes works! They will return to meet the snake on the same spot where it was left hours or perhaps days earlier as expected. However a close observation of viper behavior in University of Ibadan Zoological garden shows that snake like adder can lie on the same spot for days waiting for prey if not disturbed. This means that it is a natural behavior of such snake to lie quietly on the same spot for potential prey for considerable length of time. It does not matter whether you throw cloth to them or not it is their normal adaptive character**.**

2.16.8 It is where the Viper lies that the its prey will come to meet it. The explanation is also pointing to sedentary life style of some vipers that do wait patiently usually by the side of mammals track to catch the animal using the track.

2.16.9 Vipers can throw their fangs as arrows to their victims: This is another well rumored hypothesis. Although, vipers could be very slow while crawling away from threat and they seldom pursue their pray. This is however well compensated for by a very fast movement of their head when striking their victims. Its use to be so fast that the victims do not normally see the snake head movement but only realized the source of their pain as they sighted the deadly animal nearby. In most cases, fast movement of viper's head cause the fragile fangs to got broken and remain in the body of the victims. A careful examination of the injured area could lead to the removal of the broken pieces. Many traditional doctors have enjoyed cheap Popularity by claiming to have called out the teeth from victim's body. The truth is that the fangs are not thrown but got hooked in the flesh of the victims after the snake has stricken and removed its fast moving head. In most cases it hangs near the skin surface where it could be easily removed by a careful observer.

2.16.10 Tomorrow is too long (Hausa: *Gobedanisa*). This is the name given to viper in Hausa language, It is derived based on their observation that victims of this snake hardly survive 24 hours after bite. Most especially in rural areas where modern medicine is not readily available. Therefore, the name of the snake is suggesting to everybody, how dangerous it is when it bites and must be avoided like plaque.

2.16.11 Blend with leaf (Yoruba:*Abewere*): This is the name given to green mamber describing it green colour as it blends with green leaves of trees and grasses.

All these folklore and naming shows that indigenous people are very much aware of characters of snakes in their immediate environments, even if they do not have the luxury of time and resources to carry out their experiments to a logical conclusion.

2.16.11 Some snakes have two heads: It is a common believe in some tradition that some snakes have two or more heads. This is an exception rather than rule. There is no species of snake known to posse's multiple heads. However, there are reports of some individual snake with some genetic distortion that accidentally produced an animal of unusual structure e.g two heads. It should therefore be very clear that such snake will be very rear in nature but when it happened care must be taking as the two head will be potent enough to bite if the snake is a venomous species.

2.16.12 Darkness (Idu: *Igede* language): This is the name given to cobra in Igede Language depicting the general blackish colour of all cobras.

2.16.13 Green like grass (Idoma: Achimeme): This is green mamba's name in Idoma language explaning its greenish colourration.

2.16.14 Strength (Idoma: Edili): this describe the extra ordinary strength of python when it coiled around its prey.

2.17 The basic descriptions of common snakes in the study area.

2.17.1 Description of Vipers

Vipers are predominantly brown in colour with different pattern of black and creamy colour which usually creates a camouflage in their environment where they usually hide themselves in sub-soil. They are robust with triangular head which is very distinct from the rest of the body. They spend most of the day resting or hiding on the ground and are active both the day and night. The colour pattern is often varies based on the shade of colour of soil at a particular environment. The head has two well-marked dark bands: one on the crown and the other between the eyes. On the sides of the head, there are two oblique dark bands or bars that run from the eye to the supra-labials. Below, the head is yellowish white with scattered dark blotches. Iris colour ranges from gold to silver-gray. Dorsally, the ground-colour varies from straw yellow, to light brown, to orange or reddish brown. This is overlaid with a pattern of 18–

22 backwardly-directed, dark brown to black bands that extend down the back and tail. Usually these bands are roughly chevron-shaped, but may be more U-shaped in some areas. They also form 2–6 light and dark cross-bands on the tail. Some populations are heavily flecked with brown and black, often obscuring other coloration, giving the animal a dusty-brown or blackish appearance (Eniang and Ijeomah, 2011). The belly is yellow or white, with a few scattered dark spots (closer in the young ones). Newborn young have golden head markings with pinkish to reddish ventral plates toward the lateral edges. They are well distributed in the study area as they were found in large numbers in all the ranges under this study. The snake makes an hissing sound when threatened. It is the character of this snake to put it tail at bottom of it folded body. They are more common in the savannah than the rain forest region in Nigeria.

Plate 2.1: ***Bitis arientance restimg*** **(venomous snake)on a rocky surface**

(Source: Wikepedia, 2014)

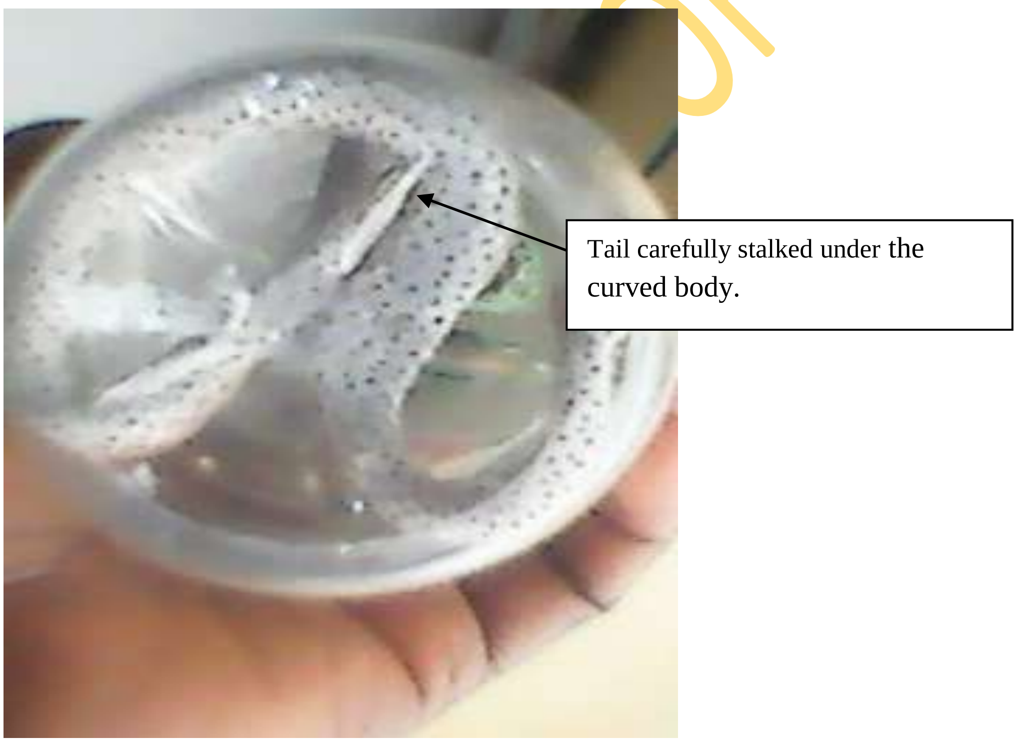


Plate 2.2: Underside view of *bitis arientans* showing the tail securely placed under the coiled body. Also note the black spots at ventral side of the snake.

(Source: Field Survey, 2014

2.17.2 Description of *Dendroaspis - viridis* (West Africa Green Mamba)

West African green member are commonly observed where thicket provides platform for it to bask and stay at alert for it prey which include insects, small birds or lizards. It is a long slender body snake with relatively long tail. The average length of an adult snake of this species was between 1.4 meters (4.6 ft) and 2.1 meters (6.9 ft). Some specimens of this species can grow to maximum lengths of 2.4 meters (7.9 ft) as reported by Spawls and, Branch (1995). The head is narrow and elongated and slightly distinct from the neck. On rare occasions the neck may be flattened when the snake is aroused, but there is no hood. Eyes are medium in size with round pupils and a yellow brown iris. Dorsal surface body colour is vivid yellowish green to green with anterior margins of the scales yellow. In many specimens the posterior body and tail are yellow. In some specimens, dorsal body scales are distinctly bordered with black forming chevron shaped markings. The black interstitial skin is clearly visible especially highlighting individual head scales and scales on the tail. Head dorsum is similar to dorsal surface anterior body colour or slightly darker green. Laterally, the head scales, particularly the labials, are distinctly black edged and colouration is usually paler than dorsum or slightly yellowish tinted. When viewed from above the black edging of scales and black interstitial skin result in a plaited appearance (Spawls and, Branch,1995).

2.17.3 Description of *Dendroaspis – Jamesoni*

There is a real challenge of differentiating this snake species from it close relative (West Africa green manba). They are both arborea in and always found in similar environment. However the dorsal scale of Jamesoni mamba is more coarse whereas the dorsal surface body scale of

Dendrospis viridis is smooth with vivid yellowish green to green with anterior margins of the scales yellow. Jamesonis snake rarely bite but when it does it is often fatal.

Plate 2.3: ***Dendroaspis viridis*** **(Venomous)**
(Source: Wikipedia, 2014)

Plate 2.4: Freshly Killed ***Dendroaspis jamesoni*** **(Venomous) in the study area (Note the blue hue on jamesoni's head).**

(Source: (oyeleye, 2016)

2.17.4 Dscription of Pythons

Pythons are large and muscular, and kill their prey by squeezing, or constricting, until the prey suffocates. Although most python feed on small mammals, some large species can kill and swallow small pigs or goats. Killing of humans by python is very rare and in an uncommon circumstances, such as events of attack of young individual with no body to rescue immediately. Rock python is a very massive snake compared to the sizes of other snake in the study area. They are usually longer than 2m in length and may grow up to 6m in the protected area. The body is solid and stout with very small smooth scales. Its head is triangular, with a large dark spearhead mark or crown. The body colouration is grayish green or grayish brown with dark brown bands that form isolated blotches on the flanks as was also described by Eniang and Ijeomah (2011).

Plate 2.5: *Python Sebae* (rock python) Crossing the road Near Kao Gate (Ibbi Range)

(Source: Field Survey, 2014)

2.17.5 Description of *Naja melanoleuca* (Egyptian Cobra)

Cobra is the common name for members of the family of venomous snakes, Elapidae, known for their intimidating looks and deadly bite. Cobras are recognized by the hoods that they flare when angry or disturbed; the hoods are created by the extension of the ribs behind the cobras' heads. Most cobras are found in Africa. Among them is the spitting, or black-necked cobra, found from southern Egypt to northern South Africa. This snake usually spray its venom from a distance of about 2.4 (about 8 ft) accurately to its target. Varieties of the spitting cobra exist and range in color from dull black to pinkish colour, the lighter-coloured ones marked by a black band around the neck. The ringhals, a different type of spitting cobra confined to southern Africa, is the smallest of the cobras, reaching only about 1.2 m (about 4 ft) in length (O'Shea, 2005). It is dark brown or black with ridged, or keeled, scales and light rings on the neck. The Asp, or Egyptian cobra is widely distributed throughout Africa, being the most common. Cobras will seldom attack unprovoked. When threatened, however, the Cobra will bite or spits its venom to defend itself.

Plate 2.6: Naja melanoleuca (venomous)

(Source: O'Shea, 2005).

2.17.6 Description of *Boaedon lineatus*

This species is highly variable in appearance, their colour varying from deep black through light reddish brown and often greenish. Their eyes are large and with vertically elliptical pupils. Stripes stretch from the mouth through the eye to the rear of the head where they typically terminate. The species gains its name due to the thick, bold white/cream stripes which stretch laterally along the length of the body, these occasionally terminate after around two thirds of the body & may be broken or very pale. Uncommonly these stripes may be totally absent. Striped house snakes are highly sexually dimorphic, females growing larger than males, reaching lengths of around 100 centimetres (39 in) males generally smaller rarely exceeding 60 centimetres (24 in). As with all members in the genus *Boaedon* these snakes are highly iridescent, having an oil-on-water sheen in certain lights (Kelly *et al.*,2010).

Plate 2.6: Boaedon lineatus

(Source: Kelly et al., 2010)

CHAPTER THREE

3.0 MATERIALS AND METHODS

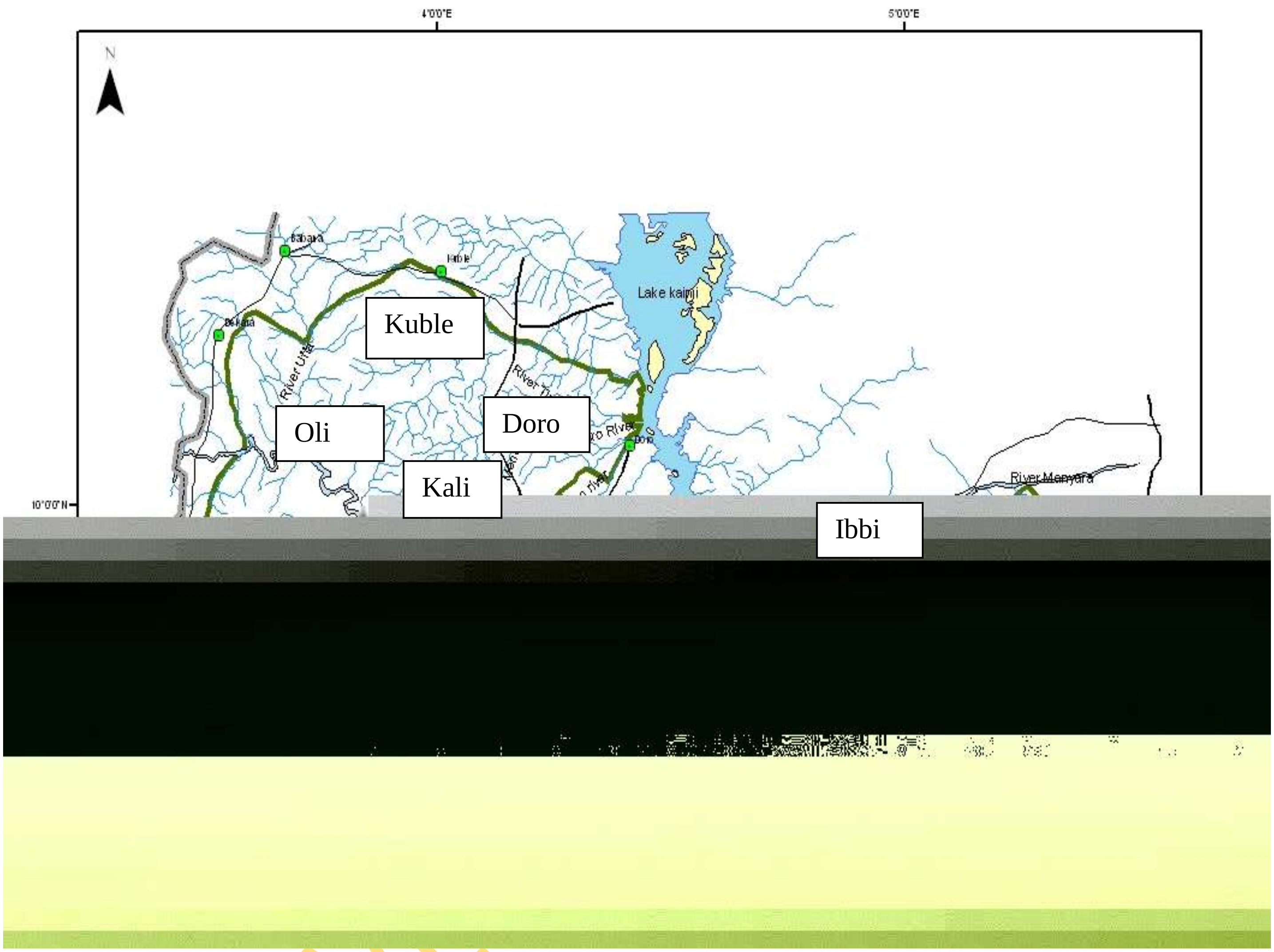
3.1 Study area

The research was carried out in Kainji Lake National Park (Borgu and Zugurma Sectors). The Park was established in 1979 by the merger of two former non-contiguous game reserves (Borgu and Zugurma) into one entity under Decree 46 of 29th July, 1979, later act 46 of 1999 and now CAP 65 LFN 2004. (Ayeni, 2007).

3.2 Location

Kainji Lake National Park is located in the north western part of Nigeria between Niger and Kwara state, close to the border with the republic of Benin (Ezealor, 2002). The park is about 560Km North of Lagos and 385Km West of Abuja, the Federal Capital (Ayeni, 2007). The two sectors (Borgu and Zugurma) of the park lie approximately between latitudes 9^{o}4''N and 10^{0}30''N and between longitude 30^{0}30'E and 50^{0}5'E respectively. The two sectors cover a total area of 5,340.82Km^{2} and are separated by the Kainji Lake, impounded on the river Niger for hydroelectric power generation (Aremu *et al.*, 2000).

Fig 3.1: Map of the study area



(Source, adapted from Ayeni, 2007)

3.3 Vegetation

Kainji Lake National Park is situated in the boundary between the North and South of Guinea Savanna. Riparian Forests also occur on the banks of larger water courses (*e.g* River Oli) (Ezealor, 2002). Generally the vegetation was described as been Northern Guinea Savanna types which are formations of mosaic of plant communities contrasting in structure and burkea/Deterium woodland, Afzelia/Anogiessus/Deterium woodland, Manyara complex (Ezealor,2002).

3.4 Topography and Drainage

The topography of the park is gently undulating with general decrease in elevation from West to East (Ezealor, 2002). Some areas are hilly with the highest elevation of about 300-350m above sea level near the west boundary. The topography of the Zugurma sector is to some extend related to the underlying geology of the area, the elevated or elevated plain with gradually sloping sides forming an East-West Watershed (Ayeni, 2007).Both sectors of the park are drowned by a network of rivers and streams, all of which empty into the rivers Oli, Timo and Doro while the drainage in Zugurma sector consists mainly of rivers Manyara and Ruwa Zorugi. Other streams include Yampere and Lausa which are seasonal (Ezealor, 2002).

3.5 Climate

The park has a yearly circle of dry and wet season based on Northern Savanna climate. The wet season begins from late April to October while the dry season is from November to early April with a short hamattan period between mid-December and February. The annual rainfall ranges from 975mm to 1220mm around Kainji Dam and Wawa respectively. (Ayeni, 2007).

Highest temperatures in the basin occurred in March and April just before the onset of rains Table 2.2 shows the mean maximum and minimum temperatures for three stations. The effect of the Lake Kainji on the microclimate modification of station in NIFFR compared to the two other stations can be clearly seen. In March for example, the hottest Month, mean maximum temperature for NIFFR was 36 ^{o}C, while it was 37^{o} C at Mokwa Yelwa respectively. However, because of land and sea breeze phenomenon NIFFR had the highest mean minimum temperature of 26.1^{o}C compared to 23.5^{o}C and 23.6^{o}C at Mokwa and Yelwa. Temperatures start rising from January (during which time, the cool Harmattan winds are receding) to a March/ April peak and then decline with the onset of the rains to an August minimum. It then goes up again after the rains. The hottest period of the day is around 3.00pm and the coolest is at 6.00am (Ayeni, 2007).

3.6 Floral and Fauna Resources

Kainji Lake National Park has about 59 plant families, consisting of 49 dicotyledonous and 10 monocotyledons: totaling over 252 plant species so far identified in the park (Ayeni, 2007). The dominant trees species around the park include; *Burkea africana*, *Deuterium microcarpum*, *Afzelia Africana*, *Isobalina tomentosa*, *Acacia spp.*etc. (Ezealor, 2002). There were over 66 species of large mammals represented by about 13 artiodactyls, 10 carnivores and 5 primate species. The area is also rich in bats, birds and insects (Ayeni, 2007). In addition there are also 62 species of fish belonging to 20 families and 28 species of reptiles and amphibians (Ezealor, 2002). Examples of the animal species in the park include: Buffalo (*Syncerus caffer*), Roan

Antelope (*Hippotragus equinues*), Senegal Kob (*Kobus kobus*), Hippopotamus (*Hippopotamus amphibuis*) *etc*. (Ayeni, 2007).

Snakes previously documented in the Park include the following:

Pythonidae
Python sebae
Python regius
Culubridea
Natriceteres olivaceus
Grayia smythii
Lamprophis sp
Mehelya crossi
Philothamnus heterodermrmus
Philothamnus irregularis
Boiga blandingii
Thrasops flavigularis
Rhamnophis aethiopissa
Dasypeltis fascia
Psammophis philipsii
Psammophis sibilans
Thelothornis sp
Dendroaspis jamesonii
Naja nigricolis
Naja meladenoleca
Viperidae
Bitis gaboonica
Bitis arientans
Causus maculates
Atheis squamiger
Echis ocellatus

(Source: Ayeni *et al*., 2007)

3.7 Materials

Materials used for this study include:

Field note and record sheets, Field guide book on reptile, Snake stick, Pen and pencil, Nikkon 60 photo camera and Map of the study area. Other instruments include; Electric head lamp, Bush beating stick, Measuring tape, Weighing balance, Cutlass, Boots, Formalin solution, Field bag and a Lap top computer.

3.8 Methods of Data Collection

3.8.1 Sampling Techniques

Borgu Sector of Kainji Lake National Park has six ranges; Doro, Kuble, Wurumokoto, Oli, Kali and Kemeji and four of them randomly selected for assessment (Doro, Kuble, Oli and Kali), while one range (Ibbi) was randomly selected from the two ranges (Ibbi and Kulho) of Zugurma Sector. Two transect strips of 2km (with 5m at both sides of the strips) were laid for snake searching in each range selected. Two settlements (except at Wurumokoto and Oli with only one settlement available for interview) adjacent to each range were randomly selected for interview with a well structured questionnaire. The respondents were selected randomly and proportionately to population of each village (10% of house holds of each village were sampled).

The direct survey was carried out using the Visual Encounter Survey (VES) method, Acoustic survey method, and opportunistic searches along the transect strips. Special attention was given to tree branches, old termites mould, fallen logs and holes along transect due to secretive nature of many snake species.

3.8.2 Visual Encounter Survey (VES) and Refuge Examination

Visual encounter survey was conducted in a regimented way with transect lines and time limits as used by Eniang *et al*., 2004. Visual walks along the transect lines were carried out to document snakes species present in the area. This method was carried out in conjunction with refuge examination at the same time. This is necessary due to secretive nature of many snakes. During visual searches and refuge examination, the different habitat types were carefully studied. The day time searches were carried out between 9.00hr to12.00hr, the time when most snakes come out to bask in the sun. The night searches were carried out at the dusk from 19.00hr to 22.00hr when the nocturnal snakes come out of their hidings to feed. In the dry season and in areas of limited habitat disturbance trails of snakes were easily observed especially on the sandy soil. It was equally easy in the raining season to recognize snake trail on the wet soil. Some trail led to active holes of some snake. Such holes or refuges were explored by excavating the hole or turning up the refuge. Upturned refuges were carefully restored to their formal position after the study. Global positioning system (GPS) was used to mark the snake locations when sighted (The longitudinal and latitudinal position of each snake encountered was recorded with the aid of GPS). The results of each walk were recorded in data sheets and field note. At each site, the habitat was approached quietly with a dimmed light in order to be able to spot snakes and possibly take their photographs. In this study, Dry season was defined to be from November to April while May to October was considered as raining season.Vegetation density and nature of relief of where the animals were found were observed and recorded.

3.8.3 Collection of Killed/dead Snakes

Apart from direct observation on the field, Dead snakes from the communities at the buffer zone of the park were collected with the help of representative from those villages and examined. Specimens available at the Federal College of Wildlife and Kainji Lake National Park Museums were also examined. For every killed specimen, information was obtained concerning the place it was first sighted before it was killed, time of death, cause of death, and activities prior to death. When not mutilated, the specimen was preserved in 20% formalin solution for proper preservation at the Federal College of Wildlife Management Biology

Laboratory. Data collected in the area throughout the survey were pooled together at the end of each month to monitor seasonal changes or trends of mortalityof each snake species.

8.3.4 Identification of snakes

Keys in Dunger (1973) and Eniang (2004) were used for snake identification in this study.

3.8.5 Examination and Measurement of Snake Morphometric parameters

Snakes were examined after they have been carefully confirmed dead. To confirm this, reptile thong was used to prod and turn the snake upside down. If the snake does not move, it will be picked firmly at the sexual aperture with the thong. This will most likely caused a feigning snake to react. The snake was now submerged in alcohol solution to confirm if it is not in comma. Once it is confirmed dead, measurements of most relevant morphological statistics of each snake were taken.

3.9 Measurements

3.9.1 Sex Probing

Snakes sex was determined by insertion of a small probe into the cloaca. The probe was gently inserted into the cloaca in the caudal direction. If the probe goes in and stops just posterior to the cloacal opening, it is a female but if the probe continues in for several centimeters (due to the presence of hemipenes), it is a male. (Another sex indication is that a male snake usually has a long gradually tapering tail whereby in majority of species there is no marked distinction of shape from the anal plate, while the female has an abruptly tapering tail from the point of the sexual aperture or anal plate (Doan, 2003)).

3.9.2 Snout – Vent Length (SVL)

The flexible tape was ran along the length of the snake's body. The measuring tape was used to measure the SVL of the snake length to the nearest millimeter. The measurement was made from the tip of snake snout down to its vent. The measurement was repeated 3 times to ensure accuracy.

3.9.3 Scale Counts

Scales on the snakes that were counted include: ventral, subcaudal, and dorsal rows. To count the ventral (beginning at the "neck" and extending to the vent), subcaudal (from the vent to tip of the tail), and dorsal scale rows (see illustration).

SCALE COUNTING

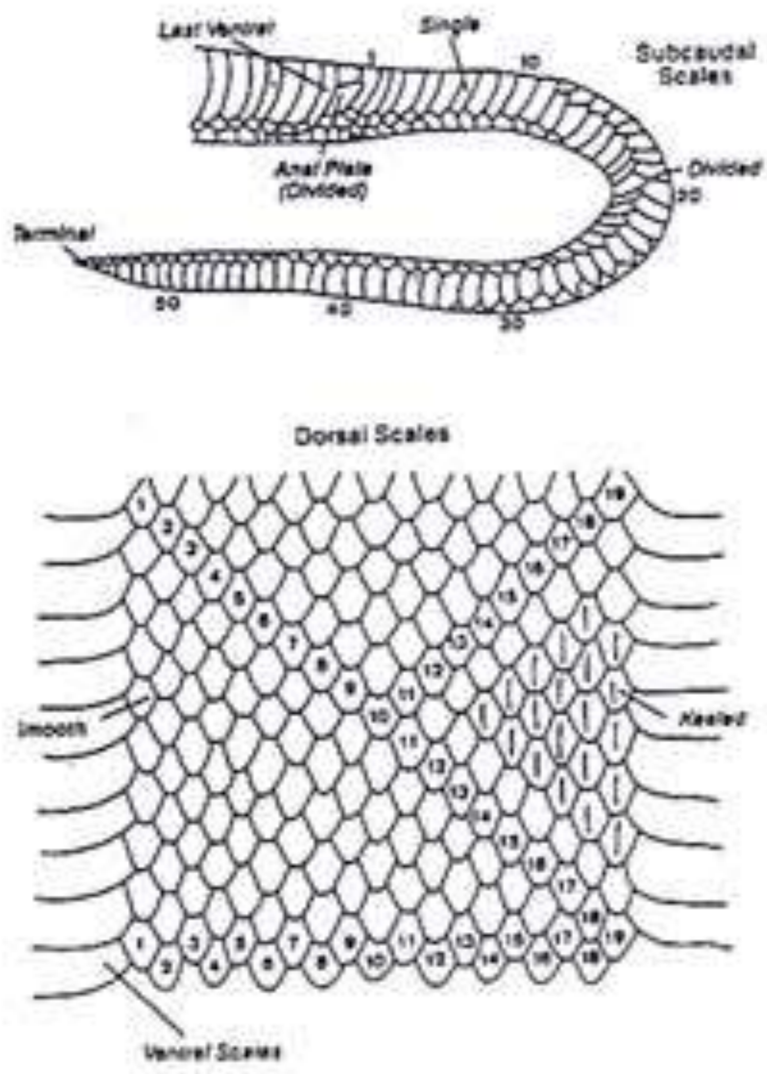


Figure2.1: Demostration of scale counting

Source: Dowling (1951)

3.9.4 Mass

Mass can be a useful indicator of health or reproductive status. Weighing balance was used to measure the weight of each snake to the nearest gram.

3.9.5 Head length (HL)

The snakes were turned upside down and the head length was measured on the ventral side using a measuring tape, from snout to the first ventral scale. The measurements were recorded in centimeter.

3.9.6 Head Width (HW)

The head width was measured in centimeter by placing the tape on the dorsal part of the head and starting from the end of the larger or posterior head plates (or scales) on one side of the head to the other end.

3.9.7 Inter Orbital Length (IOL)

Inter orbital length between the two eyes was taken to the nearest millimeters by placing the tape between the two eyes, irrespective of how they were placed on the head of the snake.

3.9.8 Tail length

This was measured from the last ventral scale to the tip of the tail and was recorded in centimeters.

3.9.9 Number of ventral Scale

All the ventral scales from the first complete scale on the neck to the anal plate were counted. The counting was repeated three times with all values recorded for confirmation and accuracy. The counting was done without blinking of eyes to avoid losing count. However, the counting was broken after 50 counts and the breakings were legibly marked with pencil on the ventral side of the snake. The counting was continued from the next scale after the pencil mark.

3.10 Appearance of the Pupil of the Snake Eyes

The pupils of each specimen were examine and recorded for a freshly killed snake in order to note the characteristics of the pupil of the snake eyes.

Research Methods Answer Sheet:

II. Measurement

Snake probed ______________________________________Sex_______________

Snake measured_____________________________________

Write down ALL SVL measurements taken (remember to get 3 within 1cm):

Snake used for scale counts______________________________________

Number ventral scales:

Number subcaudals:

Number dorsal scale rows:

3.11 Indirect Observations

In addition to life and dead snakes that were encountered, other indirect indicators or indices of snake, such as molted skins, snake tracks, snake droppings, active holes and snake escaping kills found along the transect were noted on the field.

3.12 Determination of indigenous names and values of snakes

The indigenous names and the uses of snakes in the study area were thoroughly investigated using contacts strategy. Knowledgeable men and women especially old person and hunters were visited in their homes or farmsteads to ask them predetermined open ended question and their responses were recorded in field note. Idiomatic expressions, proverbs, myths and names on snakes were carefully recorded.

3.13 Data Analysis

3.13.1 Diversity Indices of Snake Species

Snake diversity and richness were determined using Simpson diversity index according to Simpson, (1949). This showed the level of variation within each range and the entire study area (alpha diversity). Species diversity was calculated using the formula;

$$D = \sum ni\,(ni - 1)/N\,(N - 1)$$

Where D = Simpson diversity index

ni = number of individual in the ith species

N = Total number of individual animals collected.

The lower the Simpson diversity index (D) the higher the diversity.

3.13.2 Relative Abundance of Snake Species

Snake abundance was calculated on seasonal basis in the study area using the formula.

A = n/N x 100

Where A = Abundance expressed as a percentage of N

n = quantity/frequency of a particular species

N = Total quantity of species encountered

Descriptive statistics was used to analyze abundance mean value for the resources in the study area in relation to location and season. Analysis of variance was done to test for significant difference in snakes mophometric parameters measured.

3.14 Distribution of Snake Species

Variation in species distribution within different ecological sites were considered necessary in order to determine the species level of availability in relation to location and season in the study area.

3.15 Activities of Snake Species

Variation in species activities (Feeding, Mating, Basking, Incubating, resting, Crawling and swimming) was considered necessary in order to determine the species level of performance in relation to location and season in the study area.

3.16 Socio-ecological Data Assessment

The level of human awareness on the availability of snake species in the area was considered necessary in order to determine the knowledge or perception of the respondents on the snake resources in relation to availability, economy and conservation. Simple descriptive statistic was used to analyze frequency of the respondents in relation to abundance, availability, economic and conservation values. Eleven out of twenty three villages located closely (< 5KM) to the park were randomly selected for interview. Structured questionnaire were distributed proportionately based on population (10%) of each village (Wawa (44), Babanna, Malale (15), Luma(7), Kali(17) Kuble (9), Kemenji (17), Nasarawa (23), Sabo (40), Ibbi (30), Kere (7)) . A total of two hundred and sixty respondents were interviewed to obtain information on people experiences on snake and snake bite. The questions in the instrument used for this study bothered on respondent's snakebite experience(s) and methods of treatment engaged, their knowledge of snake conservation and population trends and how the people make use of snakes in their environment (Appendix III). Medical records on snake bites were also collated from hospitals in the study area to know the trend of snakebite incidences in the study area.

3.17 Statistical Analysis

Paleontological Statistic (PAST) software package for education and data analysis was used to analyse data on species diversity (Simpson's (D) and Shannon-Winners (H') diversity indices) and evenness of snake distribution in the study area. SPSS version 17 was used to carry out ANOVA and correlation analysis on snake morphological parameters (Morphometrics). Microsoft Excel 2010 was used to analyse decriptive statistics and data were presented in tables and figures.

CHAPTER FOUR

4.0 RESULTS

4.1 Snake Diversity in the Study Area

The species compositions of snakes in KLNP are presented In Table 1. Twenty-one species of snake belonging to 12 genera representing six families were identified. Eleven species (6 families) were observed at Oli, 14 species (6 families) at Ibbi, 13 species (4 families) at Kuble, 8 species (4 families) at Doro and 12 species (3 families) at Kali range. Snakes sampled comprise of six species of family viparidae, four species of elapidae, two species of pythonidae, one species of typhlopidae, one species of Atractaspidae and seven (+2) species of culubridae family (two member of culubrids are yet to be identified to species level).

Table 1: Snake diversity in Kainji Lake National Park

S/No	Family	Genus	Species	Common names English/Nupe/Yoruba Name	Number Examined	Conservation Status (CITES and IUCN Red List)
1	Viperidae	*Bitis*	*arientans*	Gbegi ninfoto/Oka Paramole	28	Not listed on IUCN and CITES red list
		Bitis	*narsiccornis*	Gbegi –tentigi/Oka	1	
		Bitis	*gabonica*	Gabon Viper /Oka olorupa	2	Not yet evaluated by IUCN and CITES
		Causus	*maculatus*	Spotted Night Adder	1	-
		Causus	*lichtensteini*	Forest Night Adder	1	-
		Echis	*ocellatus*	-	1	Least concern
2	Elapidae	*Dendroaspis*	*jamesonii*	Egofunfuru/ Abewere	6	-
		Dendroaspis	*viridis*	WestAfrica green Mamba/ Abere/Soro	1	-
		Naja	*nigricolis*	Spiting Cobra Ndazhiko/Sebe	4	-
		Naja	*melanoleuca*	Forest Cobra/ Sebe	2	-
3	Typhlopidae	*Typhlops*	spp	?/Gboraru	3	-
4	Pythonidae	*Python*	*sebae*	Ewanko/Ojola	3	Endangered (CITES) Appendix II)
		python	*regius*	Ewanko/Monamona	1	Least Concern (IUCN)
5	Culubridae	*Boaedon*	*lineatus*	Etsun/Isan	12	-
		Boaedon	*fuliginus*	Etsun/Abenukoko	3	-
		Boaedon	*virgatus*	Etsun/ Koomo	2	-
		Grayia	*Smithi*	Water snake/Olodo	2	-
		Mehelya	*Crossi*	-	2	-
		Mehelya	*poensis*	-	1	-
		Thrasops	*flavigularis*	-	1	-
6	Atractaspididae	*Atractaspis*	*irregularis*)	Burrowing asp	2	Least Concern (IUCN)

4.2 Average and Range of Morphometric Parameters of snakes in KLNP

The Morphometric parameter measured on each snake is presented in Table 2. Results revealed that Vipers were generally shorter (43.29 ± 3.05) in body length compared to the Columbrids (95.50 ± 8.77) and Elapids (81.25 ± 12.67). Analysis of Variance and Ranges of different parameters measured are recorded in table 3 while the result of analysis of variance on mean values of snake morphometric data is presented in table 4.

Table 2: Average Morphometric Parameters of studied Snakes in Kainji Lake National Park

Family	Species	Sex	Head length (cm)	Head Width (cm)	Intral orbital length(cm)	Snout vent Length (cm)	umber of ventral scale	Tail Length (cm)
Culubridae	*Boaedon lineatus*	F	3.05±0.32	0.90±0.29	0.83±0.09	84.88±4.81	195±16	27.05±5.16
		M	2.80±0.30	1.23±0.19	0.90±0.06	95.50±8.77	203±15	39.88±4.21
	Boaedon fuliginosus	M	2.80±0.50	1.75±0.25	0.95±0.05	71.30±0.30	242±33	11.50±1.00
Viparidae	*Bitis arientans*	F	2.16±0.09	0.69±0.13	0.54±0.05	43.29±3.05	158±04	5.76±0.4
		M	1.90±0.21	1.19±0.18	0.75±0.12	43.29±3.05	177±18	7.23±1.92
Elapidae	*Causus maculatus*	M	1.47±0.09	0.87±0.07	0.57±0.09	32.53±2.24	164±03	3.13±0.57
	Naja nigricolis	M	2.40±0.10	1.03±1.45	1.07±0.43	61.00±3.06	193±14	31.83±1.88
	Dendroaspis jamesoni	F	2.88±0.16	1.28±0.15	0.70±0.06	81.25±12.67	180±06	32.63±0.67

Table 3: Range of Parameters Measured in Each Species

Species	Number Measured (cm)	Head length (cm)	Head Width (cm)	Intra-Orbital Length (cm)	Snout- Vent Length (cm)	Number of ventral Scale (cm)	Tail Length (cm)
Boaedon lineatus	12	3.5-0.9	1.50-1.0	1.0-0.3	118.0-18.5	243-120	51.5-4.9
Boaedon fuliginosus	3	3.3-2.3	1.2-0.9	1.0-0.5	71.6-33.0	275-151*	12.5-2.6
Bitis arietans	28	2.5-0.9	1.8-0.2 *	1.2-0.4 *	57.0-18.0	289.0-101.0	9.0-1.1
Causus maculatus	4	1.6-1.2	1.0-0.7	0.7-0.4	37.0-19.0	171.0-130.0	3.8-0.8
Naja nigricolis	5	3.2-2.2	1.3-0.8	1.9-0.5	65.0-55.0	216.0-169.0	35.0-28.5
Dendroaspis Jamesoni	6	3.1-2.3	0.8-0.6	0.8-0.6	118-60.0	257.0-172.0	34.0-10.0
Python sebae	4	5.5-2.5 *	1.2-0.5	1.2-0.5	345.0-27.0 *	275.0-161.0	44.0-1.9
Thrasops flavigularis	3	1.0-0.6	0.4-0.6	0.3-0.3	*34.0-20.5*	*243.0-189.0*	*5.0-2.4*

Note ranges were only obtained from the species with more than one sample

and " *" signifies the species with longest parameters

4.3 Analysis of Variance and Correlation of different snake parameters

The study observed significant differences in all morphometrics parameters measured (Head length, Head width, Inter-orbita length, snout-vent length, Number of ventra scale and Tail length) among snake species. Result of correlation analysis in Table 5 revealed that there were significant correlation between different parameters measured except in relationship between Number of ventral scale and Head width.

Table 4: Analysis of Variance of snake morphometrics among snake species in KLNP

Treatment (Morphometric Parameters of snake species)	Degree of Freedom (df)	Means Square (MS)	F value	P value
Head length				
` Treatment (species)	6	3.386	8.261	.000*
Error	49	0.410		
Head Width				
Treatment (species)	6	0.487	3.235	0.009*
Error	49	0.151		
Inter-Orbita length				
Treatment (species)	6	0.182	2.685	0.025*
Error	48	0.068		
Snout-Vent length				
Treatment (species)	6	6307.181	3.777	0.004*
Error	50	1669.704		
Number of Ventral Scale				
Treatment (species)	6	3327.464	2.716	0.023*
Error	50	1225.142		
Tail length				
Treatment (species)	6	1228.926	14.049	0.000*
Error	47	87.472		

Note that "" signified that there is a significant difference in the mean of prarameters measured on different snake species.*

Table 5: Correlation Analysis of Morphometrics of all snake species

Variables	Head length (cm)	Head Width (cm)	Intral orbital length(cm)	Snout vent Length (cm)	Number of ventral scale (cm)	Tail Length (cm)
Head length (cm)	1					
Head Width (cm)	0.439**	1				
Intral orbital length(cm)	0.514**	0.702**	1			
Snout vent Length (cm)	0.645**	0.514**	0.557**	1		
Number of ventral scale (cm)	0.296*	0.16172	0.298*	0.530**	1	
Tail Length (cm)	0.466**	0.274*	.409**	0.725**	0.311*	1

Note" *" Indicates that Correlation is significant at the 0.05 level (2-tailed) for each species.

And "**" indicates that Correlation is significant at the 0.01 level (2-tailed).

4.4 Relative Abundance and Spatial Distribution of Snakes in the Study area

Abundance of snakes at family and species levels were illustrated in figures 1 and 2. Family viperidae had the highest percentage (49%) followed by the families *colubridae* (26%), *Elapidae* (16%), *pythonidae* (6%) and *Typhlopidae* (3%). In viper family, the dominant species was *Bitis arientans*. *Boaedon lineatus* dominated the culubrids family while *Dendroaspis Jamesoni* and *Naja nigricolis* were the dominant species in *Elapids*.

In Table 6, Ibbi range had the highest diversity index value as indicated by Simpson and Shanon diversity indices (Simpson's = 0.781 and Shannon's 1.667) while Kali range had the best evenness (0.957).

The geographical locations of snakes encountered on the field were documented in table 7, which marked out the species of snake encountered in different locations.

Python sebae was present in Oli, Kali and Ibbi Ranges whereas Bitis arientans, *Boaedon lineatus* and *Naja nigricolis* were encountered in all the studied ranges. *Grayia smithi,* a water snake was found only in Oli range (Table 7 & Fig 3).

Snake Indices found at different study sites were presented in Table 8, while Plate 1, 2, 3, 4 and 5 illustrated some of the snake indices observed in the study area during this study.

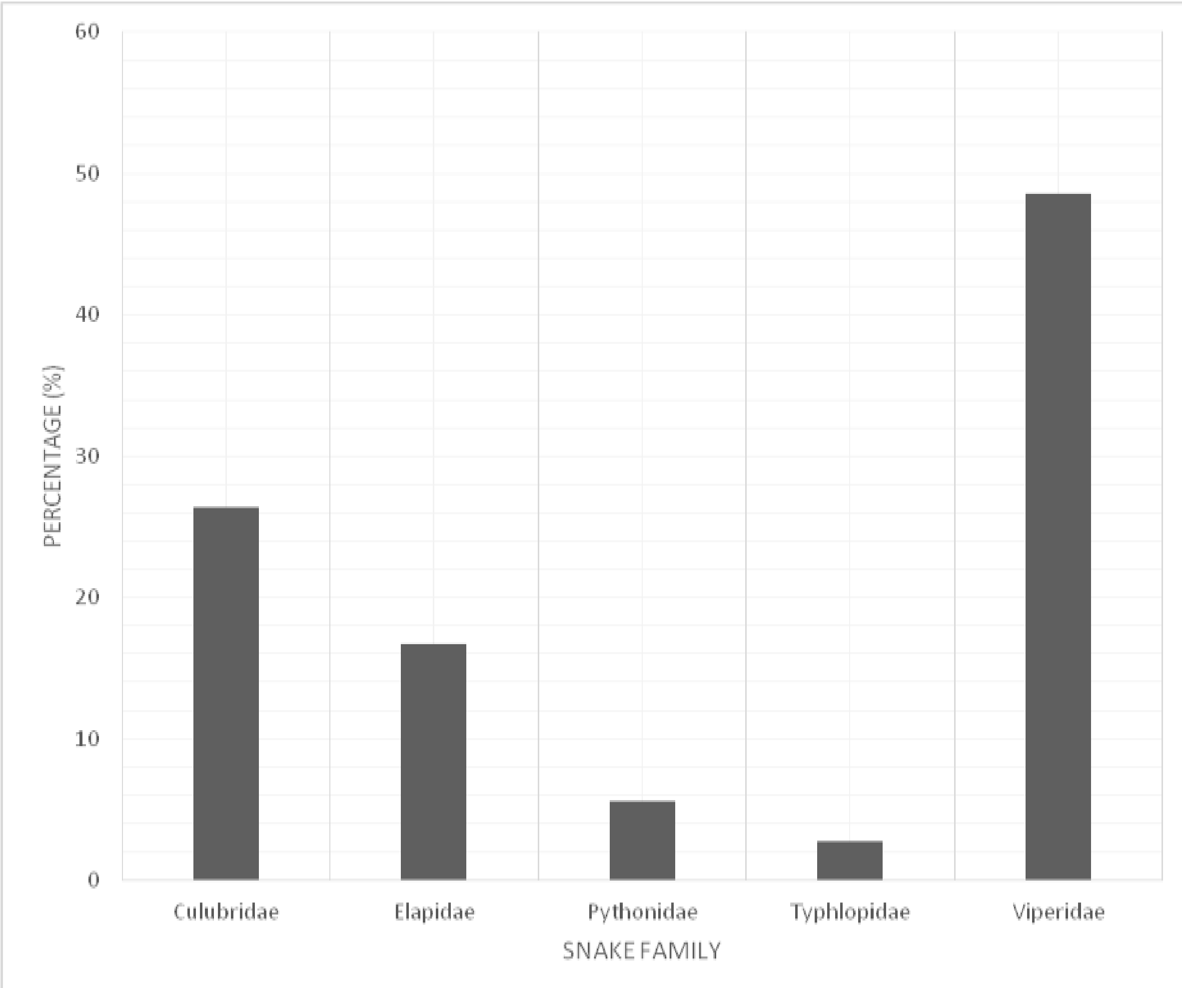


Figure 1: Relative Abundance of Snakes Families in KLNP

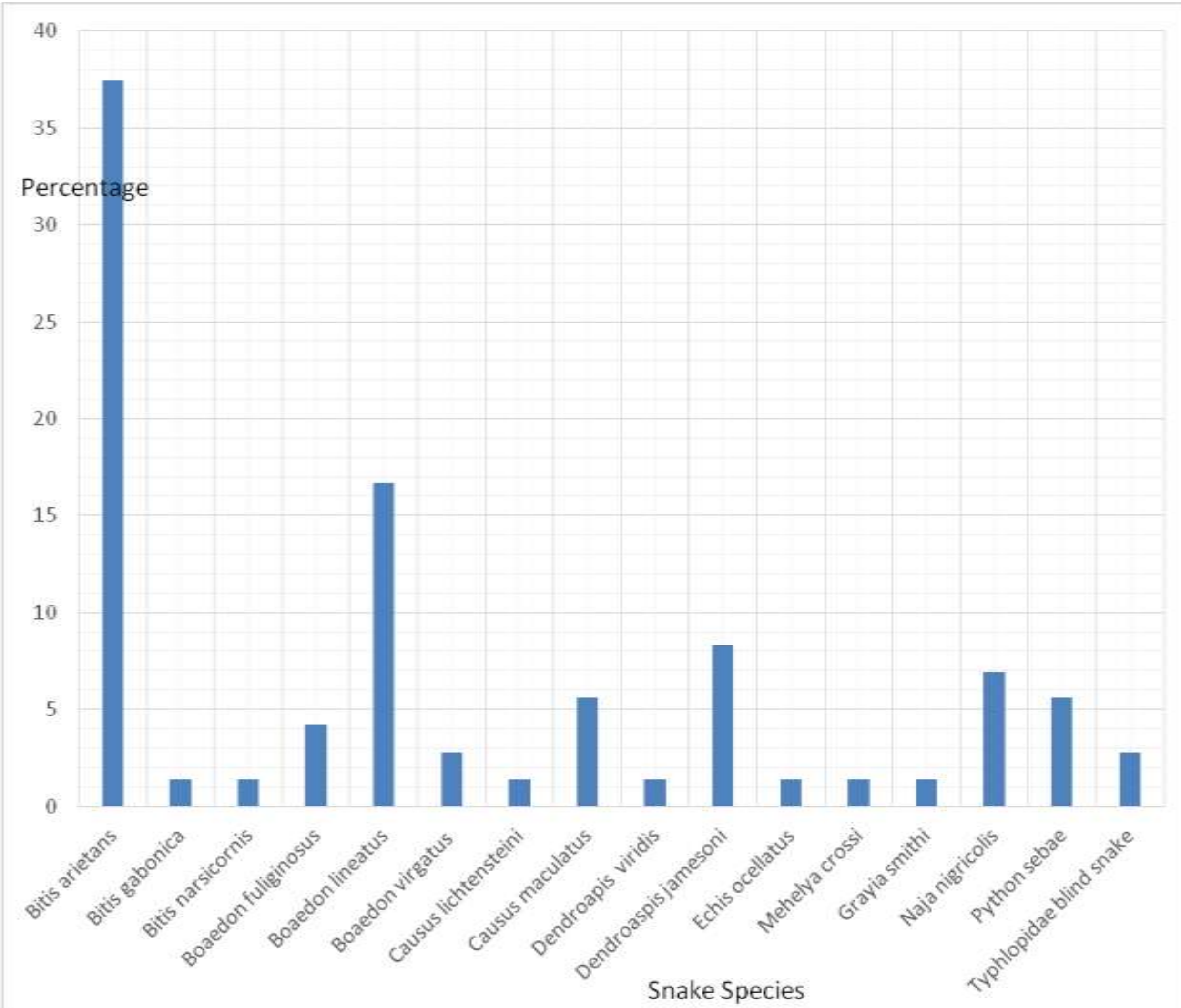


Figure 2: Relative Abundance of Snake Species in KLNP

Table 6: Snakes diversity, abundance, and evenness Index across the ranges

	OLI RANGE	KALI RANGE	KUBLE RANGE	DORO RANGE	IBBI RANGE
Taxa_S	6	3	4	4	6
N	29	15	24	15	24
Dominance_D	0.243	0.360*	0.281	0.280	0.219
Diversity (Simpson' s)	0.757	0.640	0.719	0.720	0.781*
Diversity (Shannon's)	1.586	1.055	1.321	1.332	1.667*
Evenness_e^H/S	0.814	0.957*	0.937	0.947	0.883
Brillouin	1.175	0.680	0.928	0.819	1.102
Menhinick	1.664	1.342	1.414	1.789	2.121
Margalef	1.949	1.243	1.443	1.864	2.404
Equitability_J	0.885	0.960	0.953	0.961*	0.931
Fisher_alpha	4.322	3.167	3.184	9.284	10.910
Berger-Parker	0.385	0.400	0.375	0.400	0.375

Note (*) indicates the range with the highest value of diversity, evenness or Dominance

Table 7a: Locations and coordinates of snakes encountered in the study area

Number	Range	Snake Species	Coordinates
1.	Oli	*Naja nigricolis*	N 09^{0}54.4, E003^{0}56.8
		Python sebae	N 09^{0}54.8, E003^{0}56.4
		Python sebae	N 09^{0}54.4, E003^{0}56.8
		Grayia smithi	N 09^{0}54.239, E003^{0} 58.521'
		Boaedon Lineatus	N09^{0}54.4, E003^{0}56.8
2.	Kali	*Naja nigricolis*	N09^{0}52.7', E004^{0}10.5'
		Python sebae	N09^{0}52.7', E004^{0}10.6'
		Thrasops irregularis	N09^{0}52.9', E004^{0}10.5'
3.	Kubli	*Bitis arientans*	N10^{0}22.6',E004^{0}07.6'
		Bitis arientans	N10^{0}22.6',E004^{0}07.6'
		Naja nigricolis	N10^{0}22.6',E004^{0}07.6'
4.	Doro	*Naja nigricolis*	N09^{0}40.1', E004^{0}54.3'-
5.	Sugurma	*Naja nigricolis*	N09^{0}39.9', E004^{0}54.3'
		Python sebae	N09^{0}39.9', E004^{0}54.3'
		Boaedon lineatus	N09^{0}40.1', E004^{0}54.3'
		Bitis arientans	N09^{0}39.9', E004^{0}54.3'

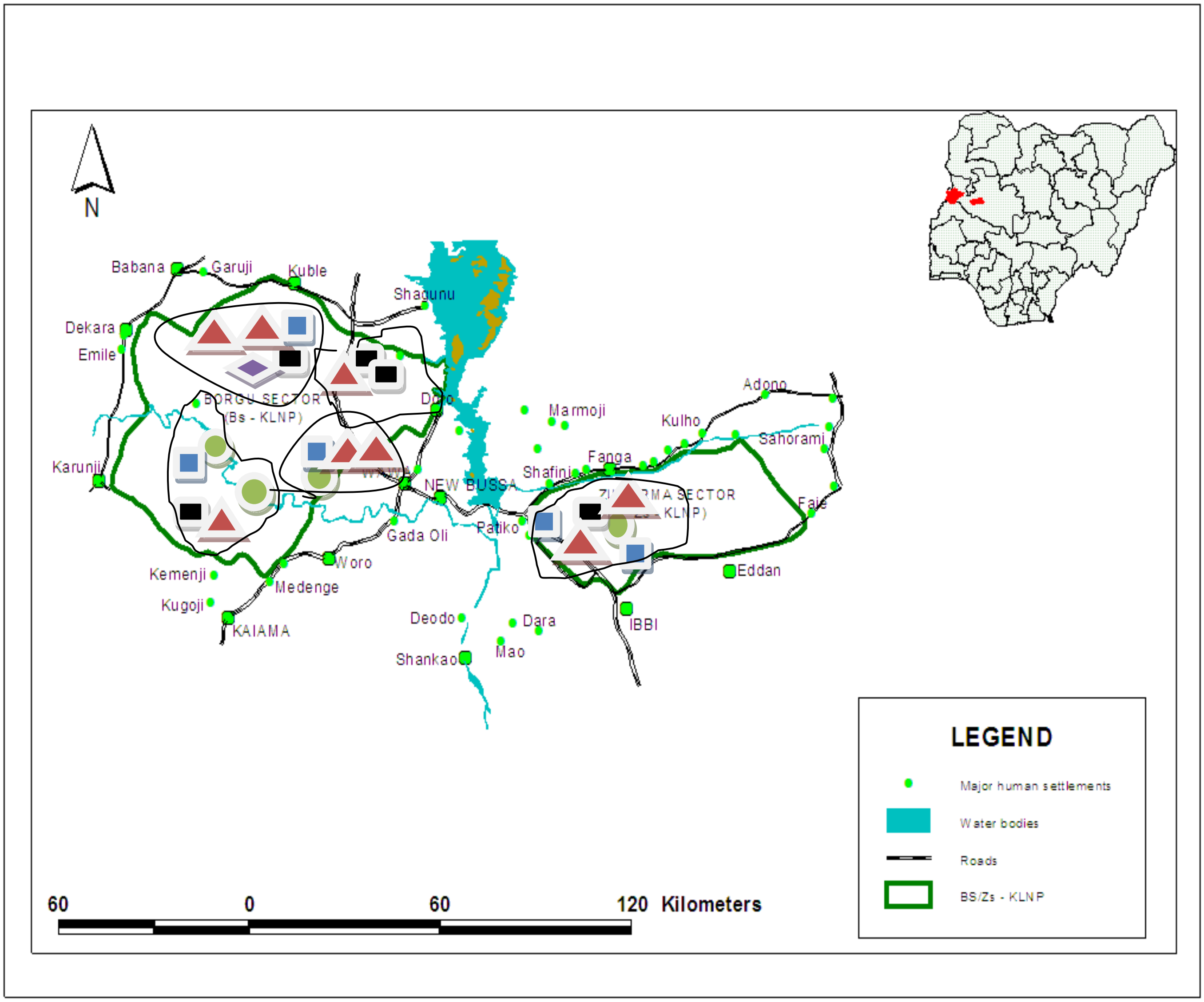


Fig. 3. Spatial distribution of snake families (clusters) in the study area

KEYS

Pythonidae	
Elapidae	
Culubridae	
Viparidae	
Typhlopidae	

Table 8. Snake Indices in the Study Area

Range	`Indices			
	Snake Slough	Snake Hole in Use	Snake Trail	Snake Faeces
Oli	†††††	••••• ••••• •••••	--------	**
Doro	Nil	Nil	-----	Nil
Kuble	Nil	•••	--------	
Kali	††	••••• •••••	----	Nil
Ibbi	Nil	•••••	Nil	Nil

Note : † stands for number of snakes slough, • number of active hole, -- number of snake trail, and * for number of snake faeces found at different study sites.

(Source: Field Survey, 2013/2014)

Plate 1. Rock Python active hole on Kali Hill (Kali Range) KLNP

(Source : Field Survey ,2013)

Plate 2: A typical tree (*ficus dicranostyla*) burtress that creates natural niche for Vipers in KLNP.

Source: Field Survey, 2014

Plate 3. Viper trail in the study area (Oli Range)

(Source: Field Survey, 2014)

Plate 4. Python Slough at Hole Entrance in Oli Range, KLNP

(Source: Field Survey, 2013)

Plate 5. Cobra slough in Gilbert Child Track (KLNP)

Source: Field Survey, 2013

4.4 Behaviour, Niches, and Activities of snakes in the Study Area

In Table 9, many (57.1%) of the snake encountered were solitary. These results showed that most snakes were solitary except in breeding season when male and female were seen temporarily staying together or their young ones newly hatched from a clutch. Snakes activities (Fig.4) observed under this study revealed that vipers were mostly found resting (60%) on the ground and only small percent (14%) were met crawling. Pythons were also found mostly resting (40%) or feeding (25%). In contrast to sedentary behavior vipers and pythons were the more mobile Culubrids found mostly on motion (44%) and in rear occasion were found basking (14%), feeding (14%), resting (13%) and swimming (15%). Elapids were also very mobile found to be either swimming (45%) or crawling (14%). Small percentages of Elapids were also found resting (15%) or feeding (10%). Vipers were the only group found mating, given more credits to their high level of survival in the study area.

Figure 5 indicates the immediate environment (Niche) in which snakes were found. Vipers were usually found on the ground (90%) resting or waiting for their prey. Only a small percentage of them were found hidden in the hole. Pythons utilize the holes (50%) and were equally common on the land (50%). The Culubrids, among which are water snakes were uniquely found in water (56%) while some were found on the ground (38%). The Elapids were found on the ground (48%), on the trees (27%) and in the hole (25.0%). The snake found on the tree was West Africa green mambers which usually waits on tree branches to catch its prey.

The age group in figure 6 revealed that adults (42.9%) and juvenile (42.9%) were more commonly encountered, while snakelets (14.2%) were the least encountered age group. The habitats where the snakes were encountered were illustrated in figure 7. Pythons were found mostly in the riparian forest (50%) and woodland vegetation (50%) of the study area. In contrast, culubrids were mostly found in the grassland (70%) and smaller percentage were found in the woodland (30%), Elapids were found in both the grassland (50%) and the woodland (50%) while all vipers (100%) were found in grassland of the study area.

Table 9: Solitary behaviour of snakes in the study area

NUMBER(S) OF SNAKE SIGHTED TOGETHER	FREQUENCY	PERCENTAGE
1 snake	40	57.1
2 snakes	24	34.3
3 snakes	5	7.1
4 snakes	1	1.4
Total	70	100.0

(Source: Field Survey, 2014)

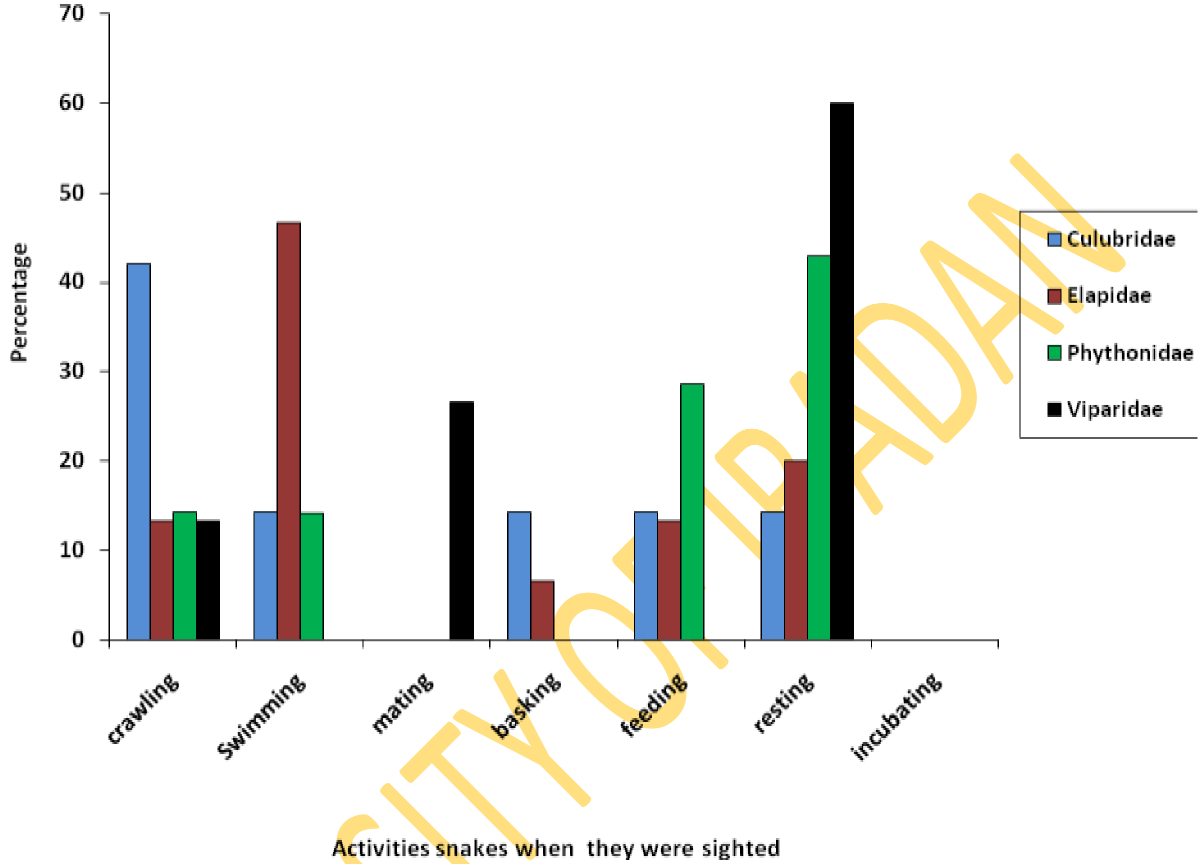


Figure 4: Activities of snakes when they were sighted in KLNP

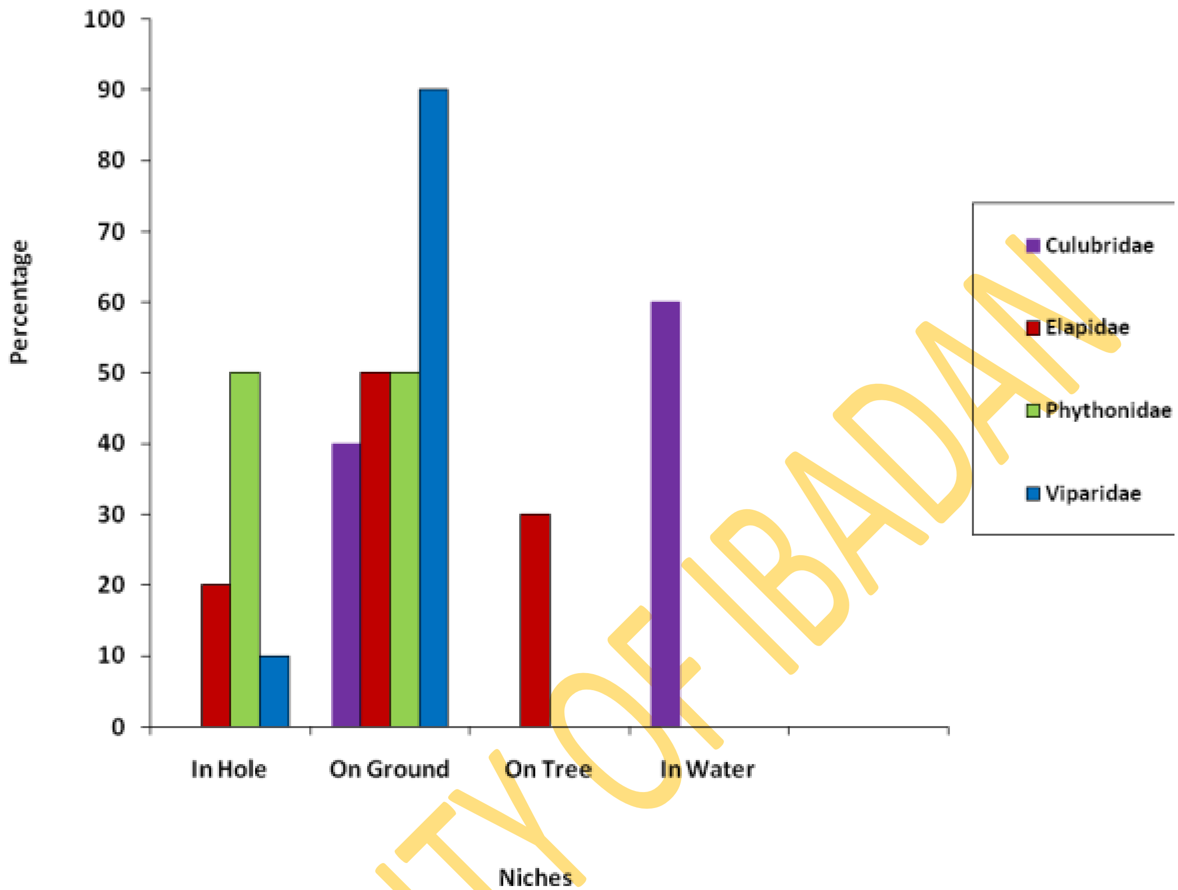


Fig. 5. Niches of Snakes Encountered in the Study Area

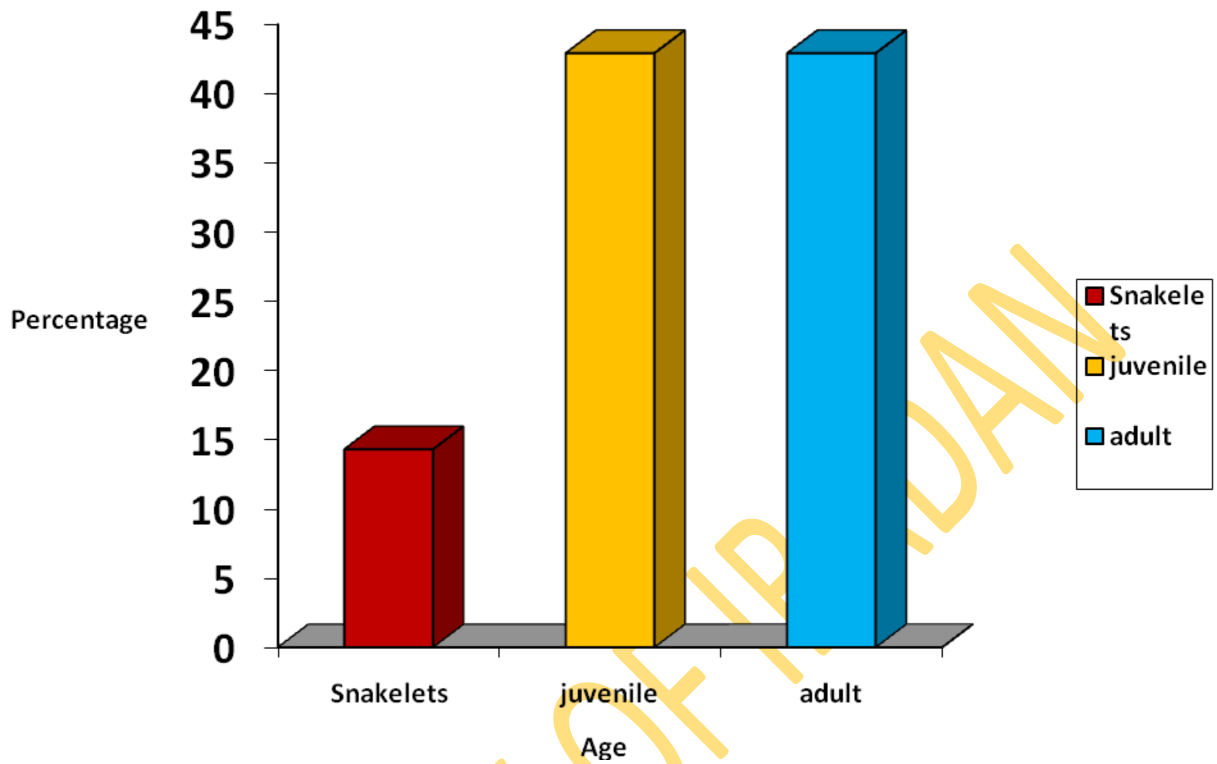


Fig. 6. Age Group of Snakes encountered in KLNP

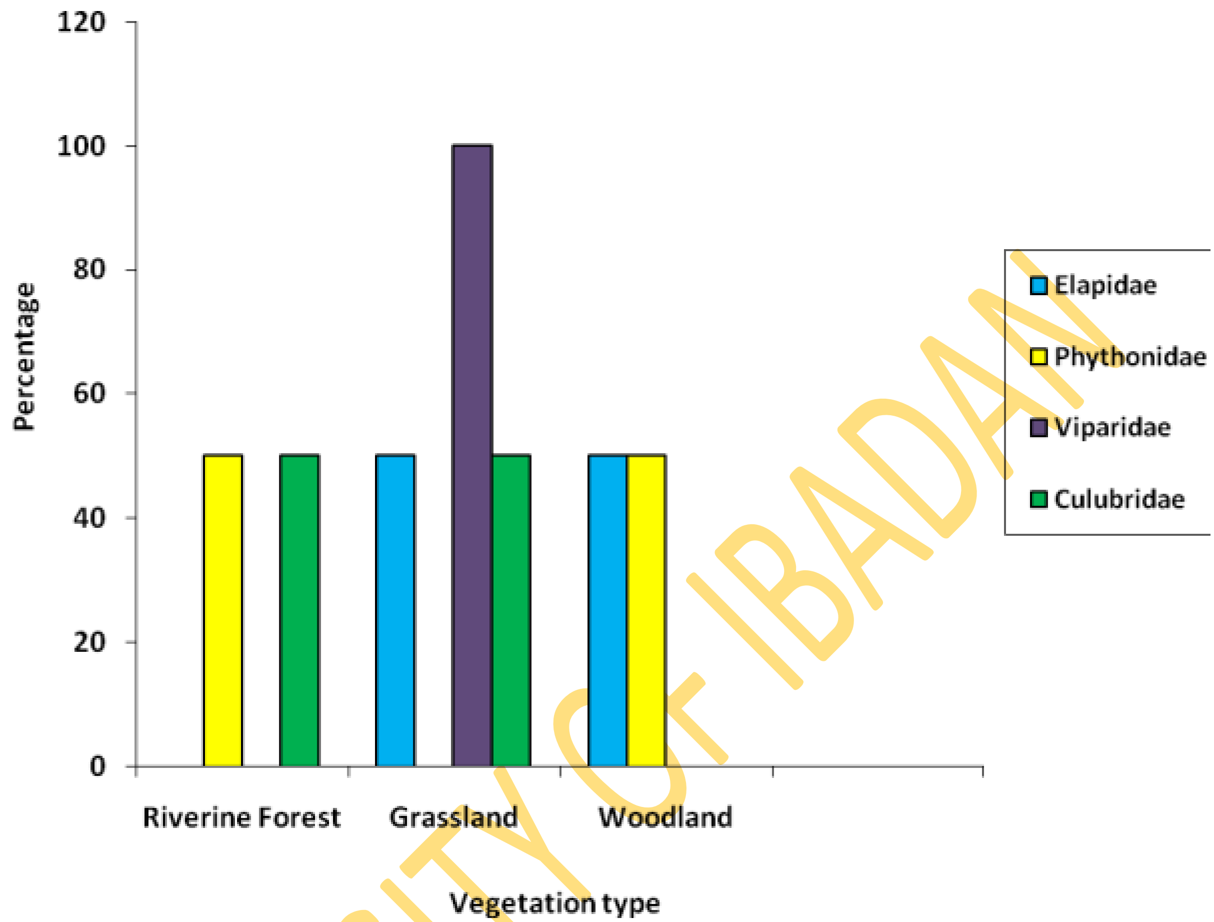


Figure 7: Vegetation/habitat where snakes were encountered in KLNP

4.5 Season and time of the day Snakes were encountered in the study area.

Snake breeds and move about more freely in the raining season while most of them hid in holes in the drier months of the year. During wet season, 16.8%, 47.9%, 0.0%, 35.3% of Culubridae, Elapidae, Pythonidae, and Viperidae were encountered respectively while 28.5%, 15.3%, 35.6%, 20.6% of Culubridae, Elapidae, Pythonidae, and Viperidae were encountered during the dry season respectively. However, animal visibility was higher in the dry season. Pythons were encountered more in the late raining season (Sep.-Nov.) and early dry season (Dec.-Feb.) of the year. Elapids (70.0%) were encountered majorly in the raining season. Vipers were encountered more in the late raining season and late dry season. Culubrids (76.0%) were encountered more in the late raining season and early dry season of the year (Fig.8a & b).

Pythonidae (8.5%, 48.5.0%), Viperidae (34.1%, 12.1%), columbridae (37.0%, 12.1%) and Elapidae (23.4%, 24.3%) were encountered during the day and night respectively (Fig. 9a & b). Eighty percent (80.0%) of Pythons encountered happens at night time. Pythons were encountered more at night than the day time while the culubrids tend to be more diurnal and were encountered less at night time. Elapids were found almost equally both in the day and night time. Vipers were encountered more in the day than the night time.

Food resources utilized by different families of snake were documented in Table 10, while plate 6 shows the picture of a rock python (*Python sebae*) that had just swallow a young Kob.

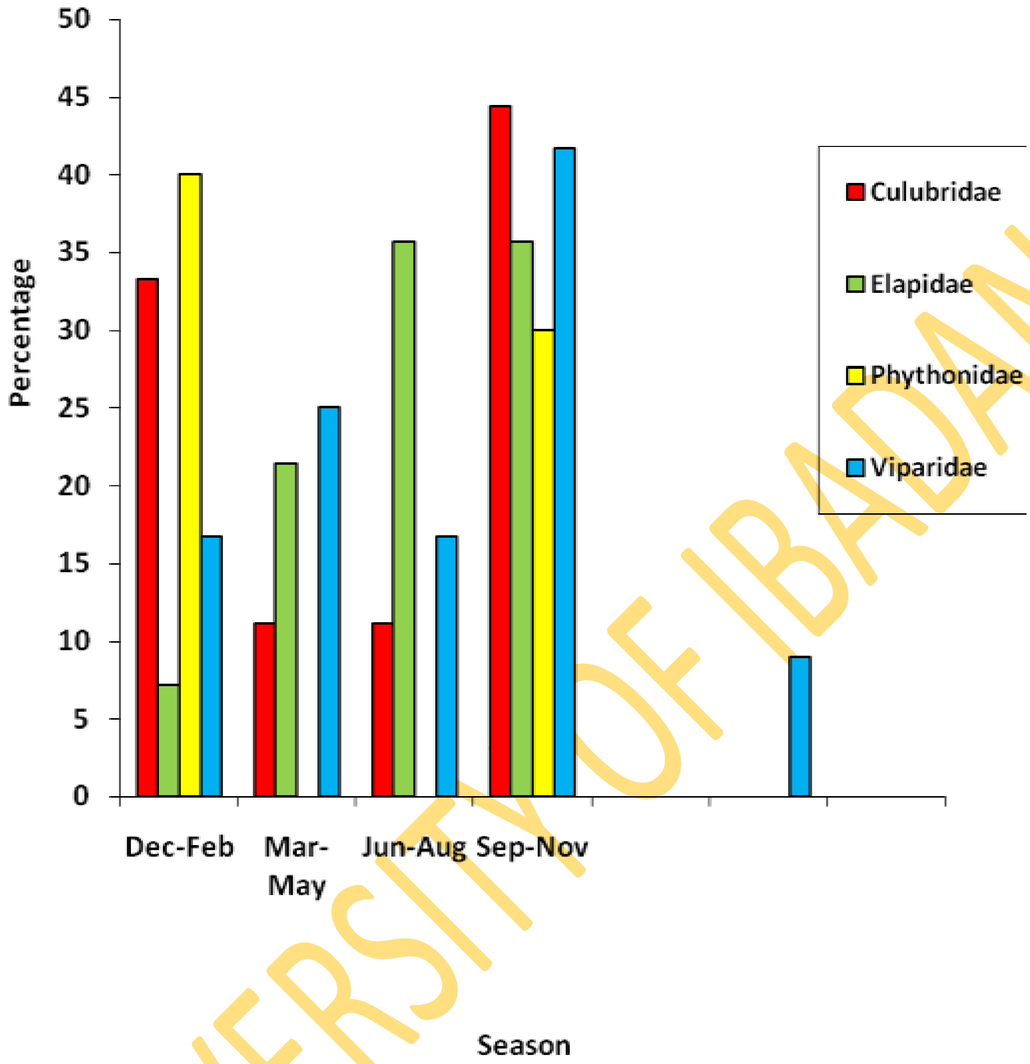


Figure 8a. Time of the year when snakes were encountered in the Study Area

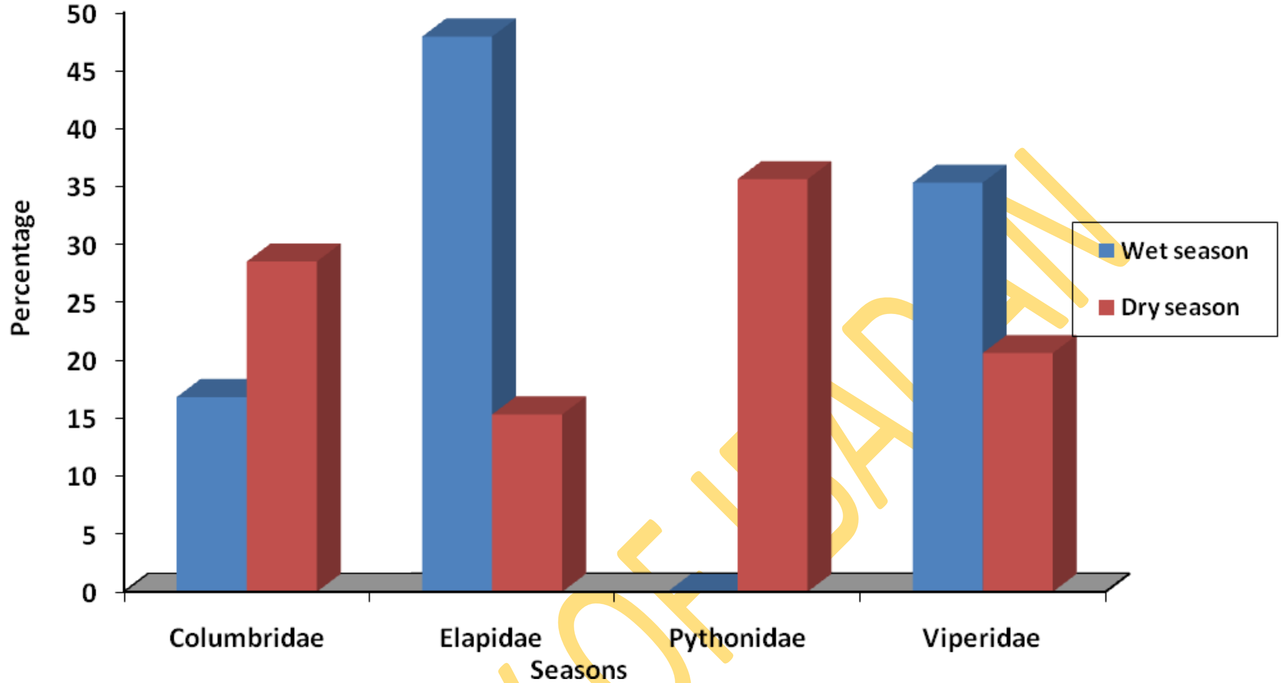


Figure 8b: Season of the year when snakes were encountered in the Study Area

Figure 9a: Day and night encounter of snakes in the study area

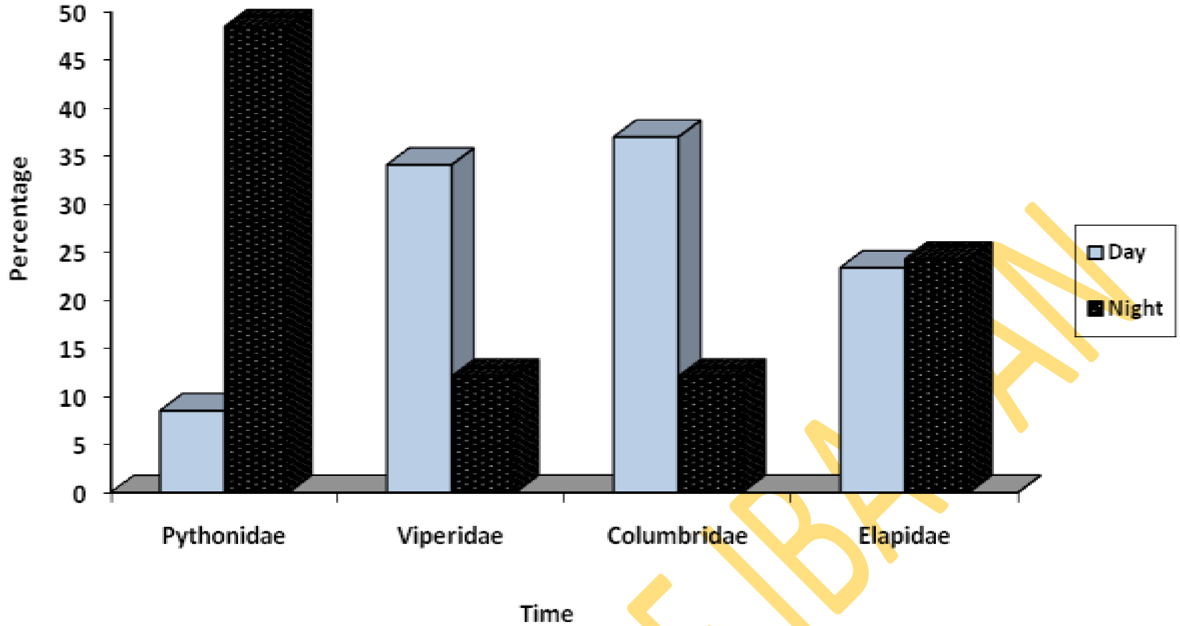


Figure 9b: Day and night encounter of snakes in the study area.

Table 10: Food resources utilized by snakes in Kainji Lake National Park

Snake Family	Common Food Items
Viperidae	Rats Rabbit Toad Giant Rats
Pythonidae	Young and Medium Size Antelopes; Kob, Duiker Rock Hyrax Giant and small rats
Culubrids	Rats Toad Fish Frog Lizards Insects
Elapidae	Birds Rats eggs Frogs Lizards
Typhlopidae	Insects

(Source: Field Survey 2013)

Plate 6. A Rock Python that just swallowed Kobus kob in KLNP (Oli Range)

Source: (Field survey, 2014)

4.6 Snake Mortality and Conservation in the Study Area

The major occupation in the study area was farming (Table 11a&b). Most of the respondents (70%) were in their active years (21-40). In Figure 10, the highest percentage (45%) of respondents kill snake for self defense (Plate 7) while some (28%) kill snake for medicinal purposes. Other reasons why people kill snakes were for meat and sale. Figure 11 presented methods of utilization of snakes in the study area. Preparation of medicine has the highest percentage (55%), while very low percentage (4%) of respondents gave priority to eating of snake. In Plate 8, Other uses of snake in the study area include decoration (20.0%), leather products (11.0%), Pets and entertainment (10.0%). Majority of respondents (56%) observed that the population of snake is decreasing in the study area.

Table 11a: Socioeconomic Characteristics of Respondents in the Study Area

VARIABLES	FREQUENCY	PERCENTAGE (%)	MODE/ MEAN
SEX			
Male	174	77.0	Male
Female	52	23.0	
Total	226	100	
MAJOR OCCUPATION			
Farmer	120	53.1	Farmer
Craftsman /Business	23	10.2	
Hunter	16	7.1	
Civil Servant	23	10.2	
Student	27	11.9	
Others	17	7.5	
Total	226	100	
AGE			
≤ 30	77	34.1	
30-50	111	49.1	31-50years
51-70	28	12.4	
Above 70	10	4.4	
Total	226	100	

Table 11b. Socio-Economic Characteristics of Respondents in the Study Area

VARIABLES	FREQUENCY	PERCENTAGE (%)	MODE/ MEAN
LEVEL OF EDUCATION			
No formal education	47	20.8	
Primary	39	17.3	
Quran studies	12	5.3	
Secondary education	69	30.5	Secondary education
Tertiary education	59	26.1	
Total	226	100.0	
Total	126	100	
Islam	134	59.3	Islam
Christianity	66	29.2	
Traditional	26	11.5	
Total	226	100	

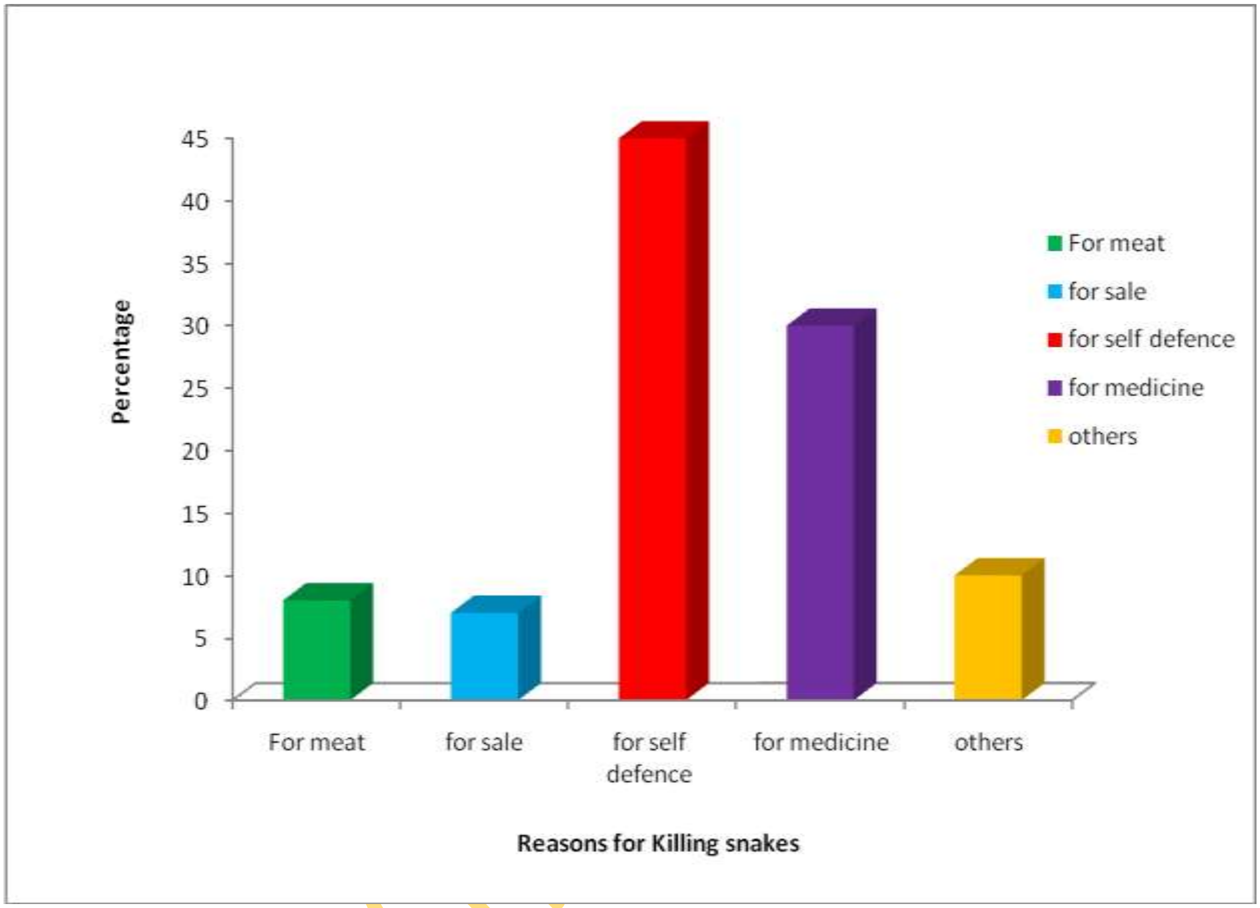


Figure 10: Reasons why people Kill Snakes in the Study Area

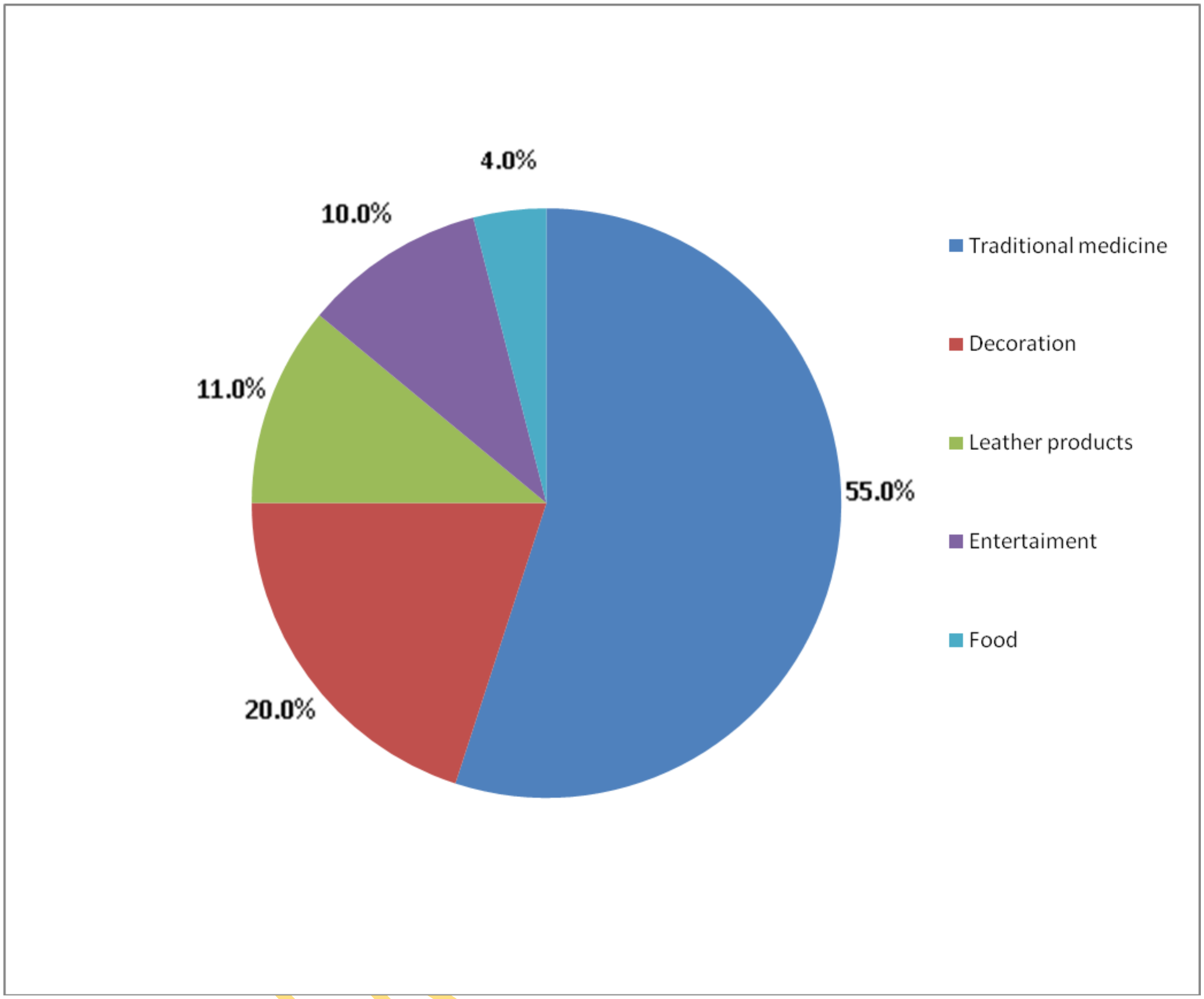


Fig. 11. Common uses of snakes around KLNP

Plate 7. Freshly Killed *Boaedon Lineatus* (Non poisonous Snake) hanged on a stump by the road side at the buffer zone of the Park

(Source Field survey, 2013)

Plate 8: A Juvenile Rock Python Kept as pet by a villager in the Study Area
Source: (Field survey, 2014)

4.6 Prevalence of Snake Bites in the Study area

Results in Table 12 shows that a large number of respondents (40%) had experienced snake bite at least once in their life time. Fifty percent (50%) of snake bite accidents happened on the farm/field where snake were hiding themselves or searching for prey (fig. 12). Others were affected when walking through narrow paths commonly used in the rural areas. Snake bite rarely occurred in the residential area where environment is open and clean without a hiding place for snakes and their prey. Results in figure 13 showed that viper (50%) and (cobra 38%) were the main culprits of most snake bite in the study area. Legs (70%) were the major point of bite (Plate 9), but few people reported eyes attack which could be uniquely associated with spitting cobra (fig.14,). Tissue destruction (38%) and nervous disturbance (30%) were the most commonly reported pains experienced by victims (Fig.15).

Data in Table 13 shows records of snake bite patients obtained from hospitals in the study area. Eighty percent (80%) of victims recorded were males, only 11.4% were female. A clean environment was the commonest method used to avoid snake encounter by the people in the study area.

Table 12. Respondents Snake Bite Experience(s) in the Study Area

Response	Frequency	Percentage (%)
Yes	91	40.3
No	135	59.7
Total	226	100

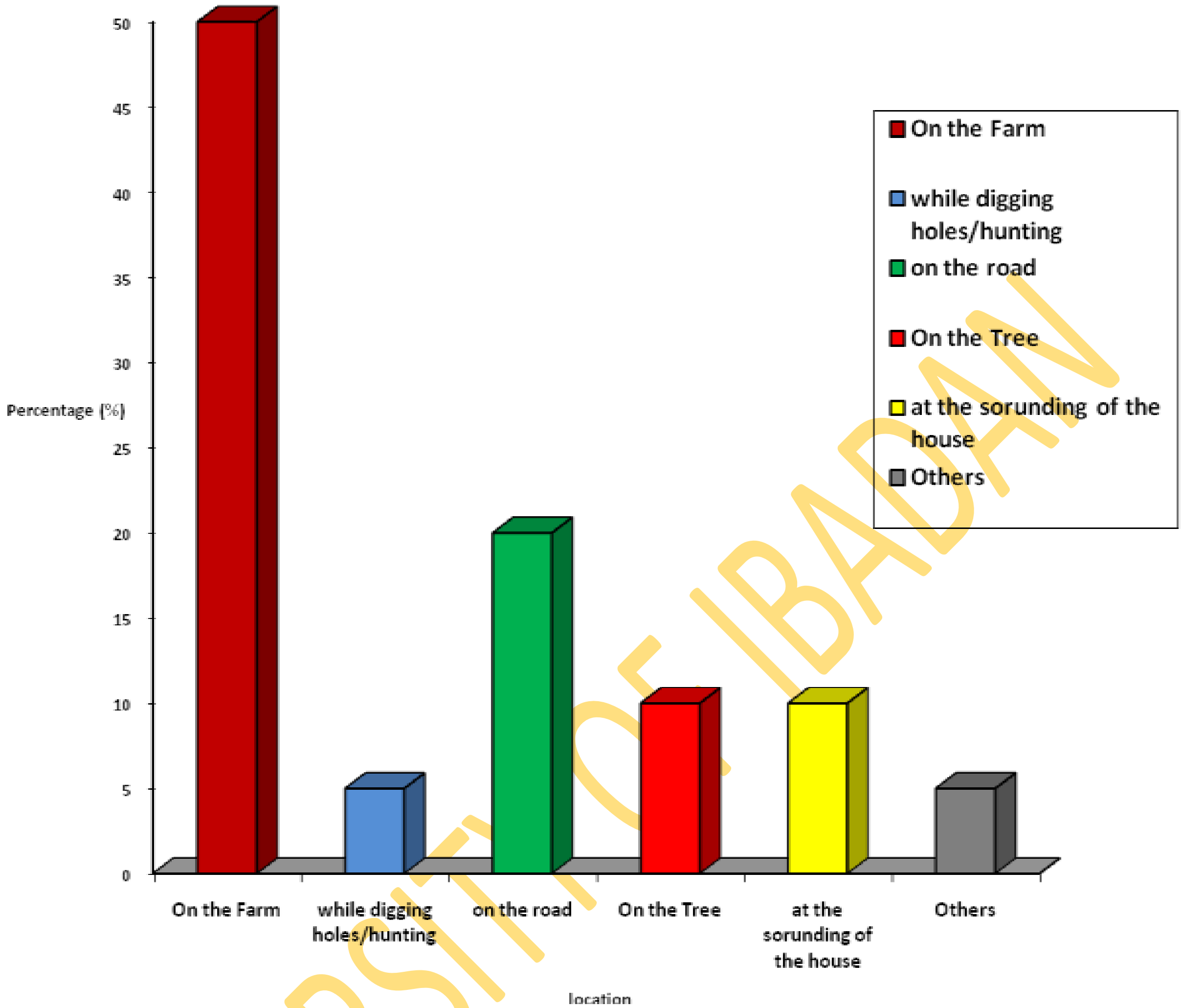


Figure 12. Location of snake bite incidence in KLNP

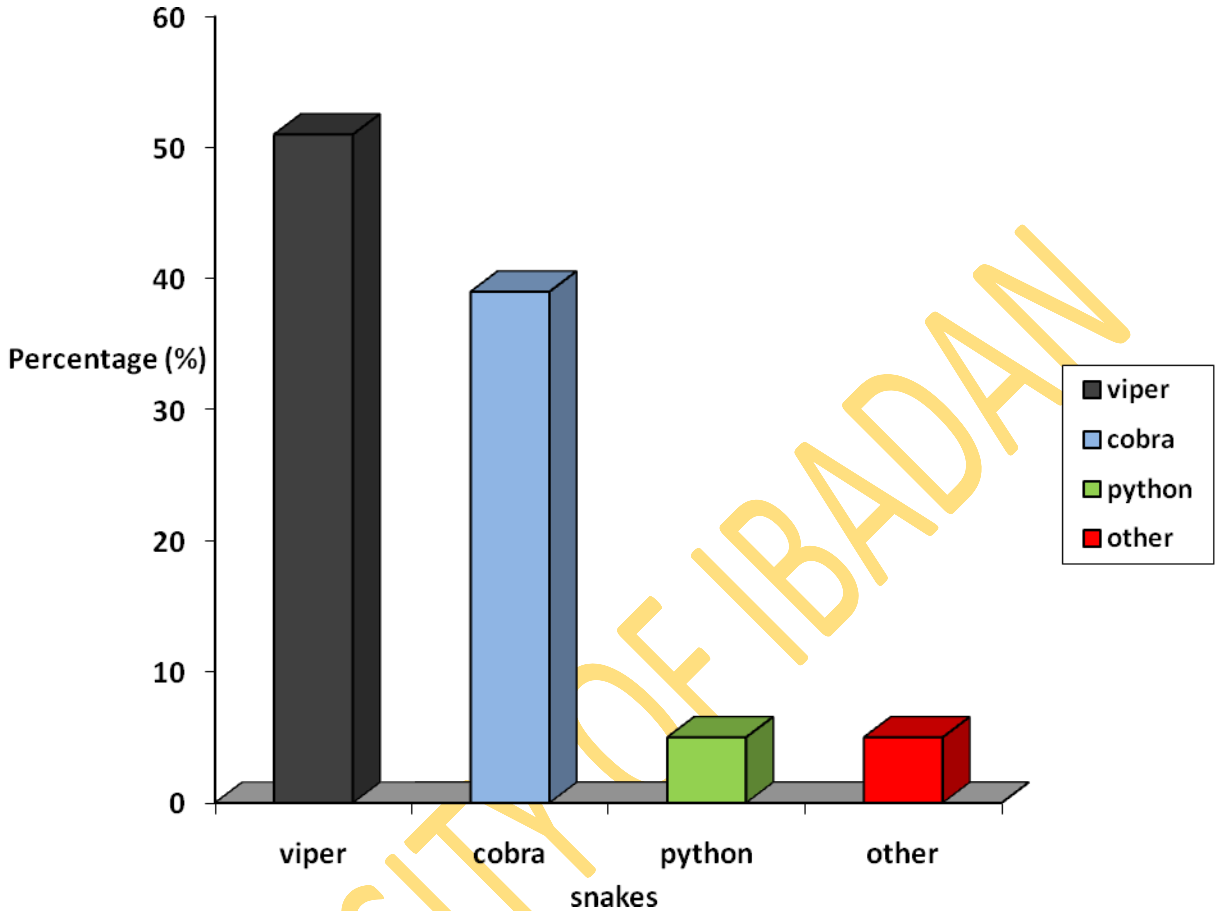


Fig 13: Snake species involved in biting in the study area

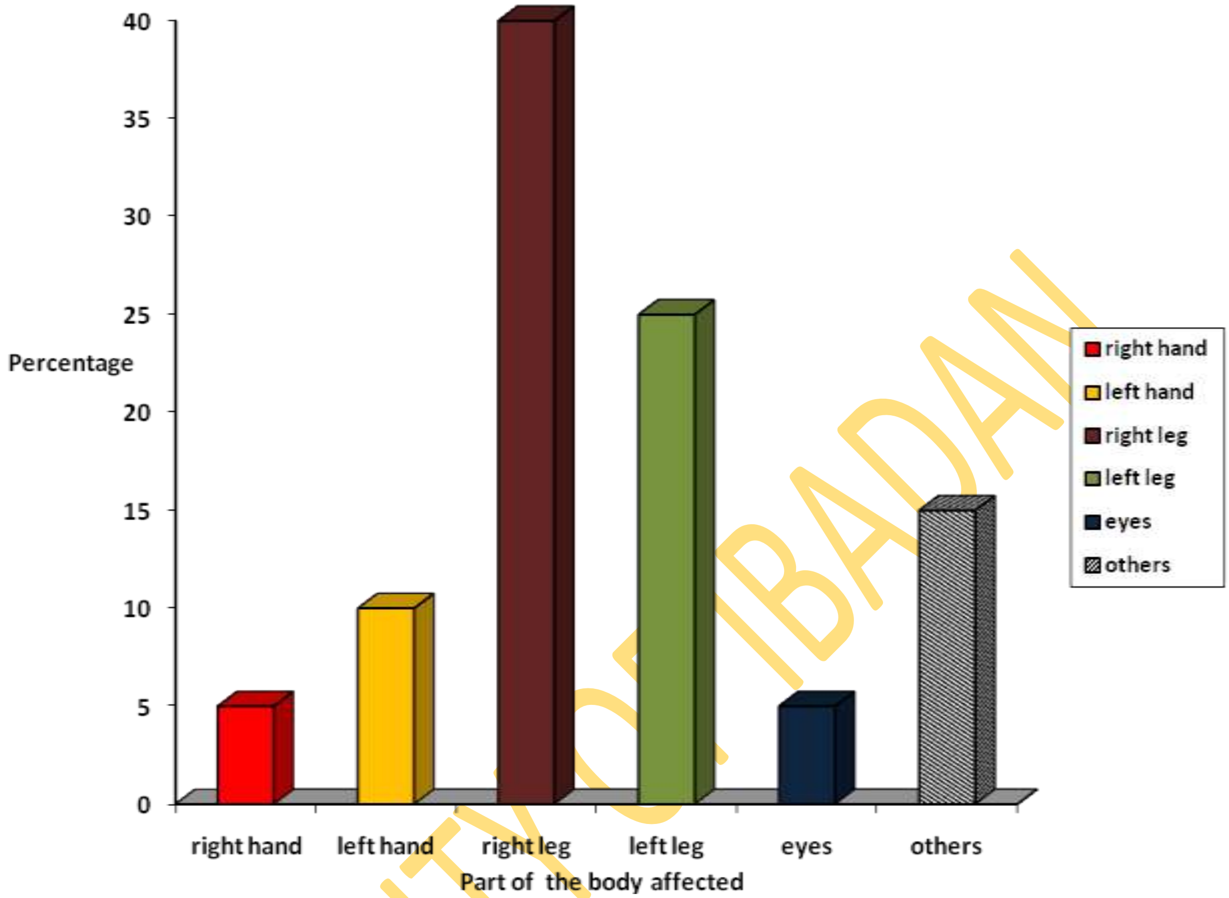


Fig 14. Part of the body of the victims affected by Snake attack in the Study area

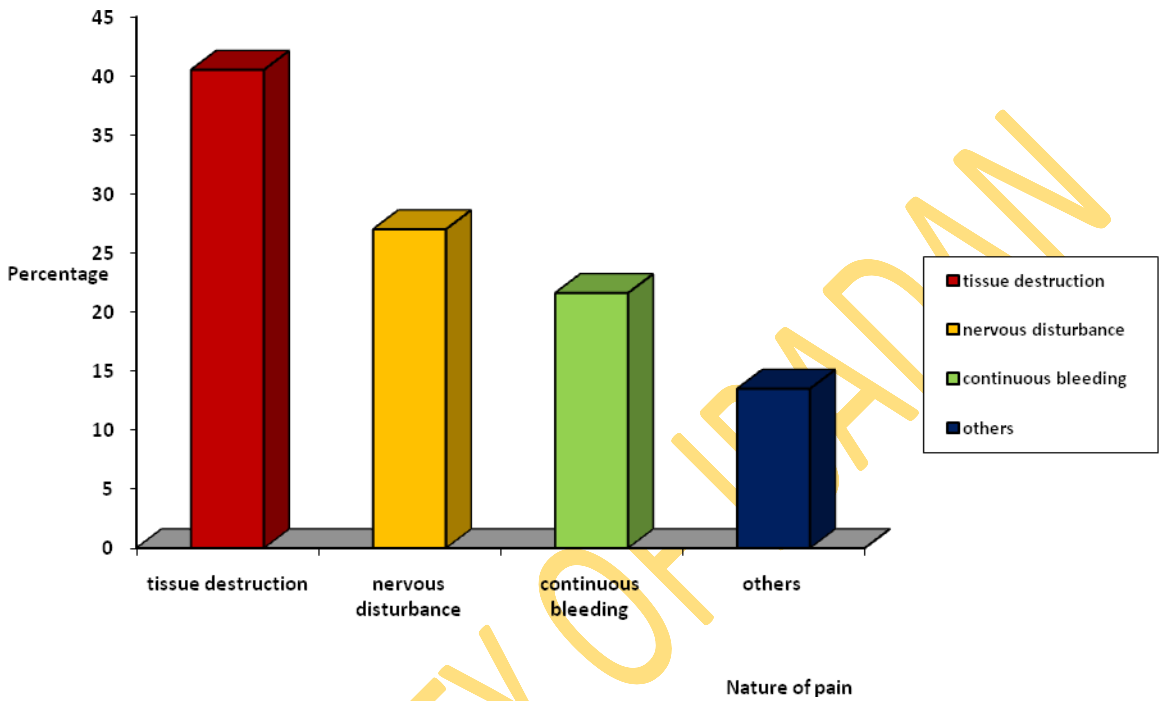


Fig 15: Description of pain experienced by victims of snakebite at the buffer Zone of KLNP

Plate 9 : Destruction of leg tissue of a70 years old man bitten by a cobra under the treatment of a traditional snake healer in the study area (A village near Kuble Ranger,s quarters)

(Source: Field Survey 2014)

Table 13: Records of Snake Bite Reported in Hospitals in the Study Area over a period of two years (2012 -2013)

Month	Total no of Patients	No of Male	No of Female	Number Successfully Treated	Number of Death
January	8	6	2	7	1
February	7	5	2	7	0
March	21	17	4	18	3
April	8	7	1	6	2
May	20	19	1	18	2
June	25	22	3	22	3
July	26	23	3	25	1
August	18	15	3	16	2
September	10	8	2	10	0
October	11	10	1	10	1
November	4	3	1	3	1
December	12	11	1	11	1
Ground Total	170 (100%)	146 (85.9%)	24 (14.1%)	153 (90.0%)	17 (10.0%)

(Source: Records collated from hospitals files in the study area, 2013)

5.7 Association between personal factors of respondents and snakebite experience in the study area

In Table 14, there was no significant association between snake bite experience and sex (X^2 = 1.184, P > 0.05) of the respondents. However, there were significant associations between snakebite experience and Major Occupation (X^2 = 39.878, P > 0.05), Marital Status (X^2 = 19.294, P > 0.05), Age (X^2 = 6.551, P > 0.05), Level of education (X^2 = 25.142, P > 0.05) and Religion (X^2 = 4.081, P > 0.05).

5.8 Asociation between personal factors of respondents and support for snake conservation in the study area

In Table 15, Chi-square analysis revealed that association exist between respondents willingness to support snake conservation and sex (X^2 = 1.18, P > 0.05), Major Occupation (X^2 = 39.878, P > 0.05), Marital Status (X^2 = 4.081, P > 0.05) and Religion (X^2 = 4.081, P > 0.05). Level of educationa and age of respondents had no significant association with their Suppor for snake conservation in the study area.

Table 14: Chi-square asociation between personal factors of respondents and snakebite experience in the study (N = 226)

Variable	X^2	df	P value	Decision
Sex	1.184	1	0.276	Not Significant
Major Occupation	39.878	4	0.000	Significant
Marital Status	19.294	2	0.000	,,
Age	6.551	3	0.010	,,
Education	25.142	4	0.000	,,
Religion	4.081	2	0.043	,,

Source: Field Survey 2013

Table 15: Chi-square asociation between personal factors of respondents and support for snake conservation in the study area (N = 226)

Variable	X^2	df	P value	Decision
Sex	1.184	1	0.000	Significant
Major Occupation	39.878	4	0.000	,,
Marital Status	19.294	2	0.002	,,
Age	6.551	3	0.931	Not Significant
Education	25.142	4	0.072	,,
Religion	4.081	2	0.039	Significant

(Source: Field Survey 2014)

CHAPTER FIVE

DISSCUSION

5.1 Snake Diversity in the Study Area

Based on the results of this study twenty one species of snakes belonging to six different families were identified. The result indicated a lower level of snake diversity when compared to results of similar study carried out by Eniangs (2004) in the southern part of the country (Cross River National Park) who reported 56 species in six families. This could be explained based on Ita (1994) observation who noted that herpetofauna resources are known to have close association with water. He argued that as one moves towards the coast species diversity of reptiles and amphibian they prey on increase. Therefore, the southern part of Nigeria with more river courses is expected to parade higher number of reptiles and amphibian compared to a drier Northern part of the country where the present study was undertaken.

5.2 Family – viperidae (Adders)

5.2.1 Bitis arietansin in KLNP

This was the most commonly encountered snake species in the study area. It is economically important as it was responsible for majority of snakebite incidents in the study area. The high population of this species could be associated with it large liter size (40 -60 young per clutch) and ovoviviparity nature which guaranty a better safety for the numerous eggs inside the mother snake. In addition to this, the ability of *Bitis arientans* to feed on toad excludes it from serious competition for food. Mallow, *et al.*, (2003) and Spawls *et al*., (2004) reported that this species was responsible for more snakebite fatalities than any other African snake. This they claimed, is probably due to a combination of factors, including its wide distribution, common occurrence, large size, potent venom that is produced in large amounts, long fangs, their habit of basking by footpaths and sitting quietly when approached.

It is brown in colour and make it difficult to be noticed when it is hiding in the sand. It is found commonly in open grass land and around human settlement since it depends largely on rodents that tend to multiply themselves around the farms for its prey. One specimen was collected from the room of a ranger (Mr Galadima) at Kuble range.

5.2.2 *Bitis nasicornis* in KLNP

This snake species has become very rear in the study area. The only two encountered were met mating.

Look very much like West African Gaboon Viper but usually smaller in size and also has paired horns on snout. The head is narrower with dark arrow shape on crown; body with geometric pattern, but bolder and bluer. They are more common in the forest, preferring humid to wet areas, often along rivers. This is most northern specimen observed in Nigeria in recent time. Typical of viper family, it relies on camouflage and does not move immediately. It is generally a very calm snake which rarely bites but could be as well very dangerous if it does. They feed on toads, frogs, lizards, small rodents and young rabbit.

5.2.3 *Causus lichtensteini* (Forest Night Adder) in KLNP

Only one sample of this snake species was encountered under this study. It was found in front of the camp at night. It typical long body length makes it unusual among vipers known generally for short body length. It is a small (30-55cm long) ground living viper with greenish body colour and slightly triangular head covered on top with large scales. It looks superficially like a greenish colubrid snake. Occurs more frequently in the forested areas thus it is rarely encountered in the study area. This is the first record of this snake species in the study area.

5.3 Family- Pythonidae

5.3.1 *Python Sebae* (Rock Python) in KLNP

This is an endangered snake species that is now largely restricted to the reserve area. The characteristic long and robust body frame make them to be one of the biggest snakes presently existing on the planet earth. There were several encounter of this snake under this study as the the park is now one the few places where this rear snake could be found in the guinea savanna. It is a very large snake with triangular head and heavy body with small scales. It was found mostly near the major rivers in the study area similar to Chippaux (2006) observation, who reported that Python sebae though found mostly in the savanna ecosystem are usually found close to water source and forest area. Python sebae is non-venomous, but may be dangerous to humans because of its size. It can also bite (with no venom) if it is threatened. Many people in the community do not eat this snake by their tradition which might have actually contributed to survival of this unique reptile in the study area. However many people use them as component part of some local medicines as was also observed by Eniang and Ijeomah (2011). It was commonly encountered under this study in the riparian forest, aardvark holes and rock crevices (on Kali hill). The longest measured under this study was 3.95m long.

5.3.2 *Python regius* in KLNP

This snake species are exceptionaly rear in the study site. In fact only one sample of this snake was encountered under this study. Other individuals were from oral report from the farmers and hunters from the study area. This species is far smaller than the rock python but are esentially similar in colouration and non aggressive disposition. They also depend on their muscular body structure to twist around and suffocate their prey. Known generally to be carried around by snake charmer as pet, it is very shy and easy to handle due to it small size and non venomous nature. They are more common in the southern part of Nigeria.

5.4 Family- Elapidae

5.4.1 *Naja nigricolis* (Black Spitting Cobra) in KLNP

Many people are familiar with Cobra due to it characteristics nature of spreading its head in readiness to fight by spiting or by biting its enemies. Cobra is the common name for members of the family of venomous snakes, Elapidae, known for their intimidating looks and deadly bite. Cobras are recognized by the hoods that they flare when angry or disturbed; the hoods are created by the extension of the ribs behind the cobras' heads. It is a very aggressive snake and is usually black or pale grey in colour. It also exhibits a series of pinkish or reddish bands interspersed with black bars on the ventral side of the neck region. The black spiting Cobra can easily be distinguished from the black forest cobra for being black on the ventral side. They were commonly found dead on a tarred road as victims under the vehicles tire when they are seeking for prey e.g Frog, toad or skinks. They were also common around residential areas where they usually make use of soak -away as their holes. The strong hold (big holes) of cobra is virtually in all the rangers quarters visited during this study. They feed on toads, frogs, lizards, small rodents and could also become a threat to local poultry keepers by incessant consumption of the poultry eggs.

5.4.2 *Naja melaloleuca* (Black Forest Cobra) in KLNP

This is predominantly forest cobra species with limited population in the savanna ecosystem. Only few samples of this species were encountered under this study. While black forest cobra is also black in colour, it could be differentiated from spiting cobra with it lighter ventral side which could either be white or cream in colour. The sides of the head have clearly black and white markings, giving the appearance of vertical black and white bars on the lips. Dunger (1973), Eniang and Egwali (2010) observed that this species, which is previously, a forest dweller has adapted extensively to deforestation as it can be found readily in suburbs, plantations and farmlands. Though it is extremely venomous, it primarily nocturnal behaviour and arboreal disposition keeps it out of conflict with humans. Despite the possession of a front fang, it does not spit venom like the spiting cobra. It feeds on toads, frogs, rodents, birds and some smaller snakes.

5.5 Family-Culubridae

5.5.1 *Grayia smithi* in KLNP

This rather robust snake lives mostly in or around the water both in the savanna and forest areas where they are found in Nigeria. Many people will find it difficult to differentiate this snake from black cobra (*Naja Malanoleuca*) due to their black colouration and considerable long length. The two snakes also use water as their niches. The major distinction is that Grayia smithi lack the redish colouration at the neck of cobra and does not sread the hood or spit like the black cobra. Grayia smithi is usually bigger in size than cobra. Also the snake has yellowish colouration in between its shining black colour which is usually more conspicuous in the young ones. The eyes are relatively small and the pupils are circular. Smooth dorsal body scales with vertebra row unenlarged. The tail is relatively long, subcaudals paired. The snake is stout for its length when matured. The colour is dark olive brown with yellow chin and light yellow belly. Anteriorly the ventrals show bilateral dark symmetrical spots, patches or aggregations of speckling giving an overall appearance of bilateral longitudinal lines, either single or double. Two specimens of this snake were found in KLNP. One was found in water of river Oli by Lydia A. a research Student from A.P Leventis Ornithology Research Institute, Jos. The other one was encountered at Kubli Range by Mr Galadima (A park ranger) in the river bed near Kubli rangers quarter. Skin of the dead *Grayia Smithi* was also acquired from traditional medicine sellers in Monday Market (New Bussa).

5.5.2 *Mehelya egbensis* in KLNP

Mehelya egbensis (Decribed by Boulenger, 1920; Dunger, 1971 and listed by Eniang, 2007). The specimen examined in this study was collected from Kali Range. It has nearly smooth dorsal scales (unusual of Mehelya with mostly keels scale) with only a faint of keels and in this make it resembles *Melhelya stenophthalmus*. However, the vertebral and dental features are those of Mehelya family. They are non- venomous and totally harmless to man.

5.5.3 *Boaedon fuliginosus* (Black house snakes) in KLNP

The house snakes are harmless non-venomous, nocturnal, terrestrial snakes. They are the innocent snakes often killed but harmless. Despite the fact that these set of snake are not venomous, they suffer kill at sight syndrome from people like any other venomous snakes. Dorsal Scales are smooth and in longitudinal rows with the dorsal row unenlarged.

5.5.4 *Boaedon- lineatus* (Lined house Snake) in KLNP

The lined house snake is widely distributed in the study area. They were usually found around the residential areas where they can get access to their preferred preys e.g rodents and lizards. They are known generally with characteristic stripes of marks on their head through the entire body length. They are not venomous and will quickly run away from any perceived threat. Some lined house snake could be exceptionally beautiful due to multiple striking lines. It could be olive-green or olive brown and sometimes a rich chesnut-brown. The belly is off white grey or silver- grey sometimes with pink or yellow hue. The chin is white, with and usually with a pink. There is a pair of yellow or greenish yellow lines on each side of the head. This snake was also recorded by Dunger (1976) who commented on the wide distribution of the snake in the study area.

5.6 Analysis of Variance, Ranges and Correlation of different snake parameters

The study observed significant differences in all morphometrics parameters measured (Head length, Head width, Inter-orbita length, snout-vent length, Number of ventra scale and Tail length) among snake species. This revealed that Morphometrics parameters are reliable criterial to distinguish snake species. Dunger (1973) documented morphometric parameters of snakes collected from various parts of Nigeria and this has been a good point of reference for any scientist studying snakes in Nigeria field. Results of correlation analysis of paired morphometric parameters of snake in this study revealed that there were correlation between different parameters measured on each species except in relationship between Number of ventral scale and Head width. In general vipers are shorter in body length compared to elapids and culubrids. The longer snakes as expected also possess londer tail.

5.7 Relative Abundance and Spatial Distribution of Snakes in KLNP

The family viperidae had the highest percentage of the total collection followed by family *colubridae*, *Elapidae*, *pythonidae* and *Typhlopida*e which occurred the least. In viper family, the dominant species was *Bitis arientans*, *Boaedon lineatus* dominated the culubrids family while Dendroaspis jamesoni and *Naja nigricolis* were the dominant species in Elapids.

Python sebae was present in Oli, Kali and Ibbi Range whereas the only species of Typhlops encountered was found in Kuble range. *Boaedon lineatus* was also present in Ibbi range while *Naja nigricolis* were found in all the ranges of the study area. *Grayia smithi* a water snake is found only in Oli range.

Diversity indices showed that Ibbi Range paraded the higest level of snake diversity among all the studied sites. This can be associated with low level of disturbance from poachers and tourist that has made the place conducive for both the specialist and generalists among the snake species. In contrast, the least level of snake diversity was observed at Doro Range.This could be artributed to high level of enchroachement due to proximity to a relatively large community (Wawa) and the major road along this study site. Doro Range is also far from perennial water source making the place almost unhabitable for snake like python. However, the location favours relatively high population of elapids which are generalist and known to adapt to an altered landscape. Results further revealed that snake were more evenly distributed at Kali Range. The even distribution of snakes at the site may be due to availability of diverse habitats; Grassland, Rivering Forest and Woodland that allows the even spread of snakes population in the range.

5.8 Behaviour, Niches and Activities of snakes in the Study Area

Most snakes were met solitary except in breeding season when male and female were seen temporarily staying together or their young ones newly hatched. Most snakes are very mobile and usually find their way of escape whenever they are threatened. Other major activities of snakes observed were feeding and resting (commonly among the vipers).

Vipers were usually found on the ground and are most unlikely to be found in the water. Few snakes found on the tree were green mambers which are primarily arborea in nature are usually waiting on tree branches to catch their preys. Only few snakes were found in the water. Most snakes were encountered in the raining season (March-August). Snake breeds and move about more freely in the raining season while most of them were hiding in holes in the drier months of the year. Generally speaking availability of holes as micro habitat serve as great attraction for many snakes and may even retained them as long as those holes are available and maintained by natural (e.g; rock crevices) or some biological agents (e.g tree holes or aardvark holes). This explains why rock pythons were common at Kali where big rock crevices serve as formidable accommodations for the giant snake. Also aardvark holes scattered along Oli river bank serves the same purpose. Snakes enjoy holes for many reasons. First, it serves as shelter and helps snakes in changing environment to regulate their body temperature. A comfortable hole also as serves as breeding spot for some snakes. Apart from housing and hibernation holes help snake to cheaply prey on other animals that may want to use or share the holes with them.

Holes in rocks, big tree buttress and those dug by mammals, especially aardvark are serious centre of attraction for snakes. Although some species e.g *Dendroapis jamesoni* and *Dendroapis viridis* spend most of their time on tree branches or shrubs a greater percentage of snakes are land dwellers and prefer hiding places. Snakes seek these holes to take cover, hibernate, broods and regulate their body temperature by moving to appropriate position along the hole, close to the entrance when the temperature is very high and craw inward when it drops.

5.9 Feeding habits and biological role of snakes in KLNP

Among Other ecological roles of snakes, their feeding habits play a leading role on how they impact on their environment. Snakes played key role in the food chain as they prey on certain animal species that are termed inedible to man and even rejected by some other animals in the wild. For instance vipers prey on toad along with their poisonous glands. A good number of vipers dissected under this study were found to have swallowed toad, an animal many other carnivorous animals will not consider for prey. Viper is a muscular snake and serves as meat for man’s consumption in many part of Nigeria. Snakes occurred in various sizes and this make them to fall to different categories on the food chain. They could be found at lowest and the highest level of animal food chain as secondary or tertiary consumer level. Eniang *et al.*, (2011) reported that snakes are all carnivores and have perfected methods of eating their food. Some snakes have specialized diets, such as only bird's eggs or only fish eggs. Species that feeds on eggs always constitutes a threat to poutry farm especially free ranging birds with no effective housing that can hinder snake infiltration.

Rock python is capable of killing big games including some big cats. The rock python observed in this research was found swallowing a young *Kobus kob*, a medium size antelope. Apart from their roles as sources of protein, some snake feeds on bird and insect pest. Application of chemicals to destroy pest on the farms usually left us with some unfavourable side effects such as environmental (soil and water) pollution and destruction of harmless organisms. Farmers In a bid to safeguard their farms from pest invasion have done more harm than the intended good through application of various chemicals. Biological control of pests although appears to be slow in effect is usually without side effects. A single green mamber introduced to a tree hosting a weaver birds will chased the bird away and this will mean a lot to a rice farmer in that environment. When the snake start to pick up the eggs and the young birds up, they will quickly deserts the three and leave that environment. An environment without snake allows some pest to breeds uncontrollably and results into ecosystem imbalance.

5.10 Snake predators in the study area

Apart from man as the major threat, wild animals preying on snakes in the study area include baboon, Mongoose and captor birds; various species of eagles and owls. There were several reports of baboon seen feeding on snakes especially during the dry season. This was also observed in the course of this study when a baboon was met with the snake slough kept on top of the tree. Mongooses are Small carnivorous mammal with short legs noted for their ability to kill venomous snakes. The animals move in group and leverage on this behaviour to quickly overpower snake they came across as a team work. Several groups of these animals were encountered in the course of this study. Birds feed mostly on newly hatched and the juvenile snakes.

5.11 Snake Mortality and Utilization in Study Area

The major occupation in the study area was farming. Most of the respondents were in their active years. Most respondents killed snake for self defense while some killed it to prepare medicine. Other reasons why people kill snake are for meats and money. Many people killed snake not because they want to eat or sell but just to get rid of those snakes. Among the consumptive use of snakes, preparation of medicine was the commonest method of usage reported under this study, only few respondents give priority to eating. Fat was the most commonly used part of snake for medicinal purpose in the study area. Majority of respondents observed that the population of snake is decreasing in the study area.

5.12 Prevalence of Snake Bites in the Study Area

Fourty percent of respondents sampled under this study had experienced snake bite at least once in their life time. People living in urban settlements hadly experience snake bite but snake bite is a frequent experience as villagers worked on farm or involved in other activities in the bush as was observed by Lalloo (1995) who posited that snake bite is largely rural area problems. However, ocationally people in urban settlement may also be victims of snakebite in some perculiar situations. The recent outcry from plateau state as reported by Premium Times News Paper on the fifth of December, 2015 attested to level of snake bite in North central part of Nigeria. The paper stated stated as follow:

“The massive flooding in Plateau had washed snakes from far distances into farms and residences in Pankshin/Kanke/Kannam Federal Constituency, according to Timothy Golu, who represents the area in the House of Representatives, told the News Agency of Nigeria, in Jos on Sunday that “all manner of snakes” had taken over his constituency. “The floods have pushed snakes into my constituency. They move around openly and snake bites have become very common there”. “As the waters pushed them, some snakes climbed trees; others entered holes while some just held unto any straw. All of them later descended into residences and farms where they have been wreaking havoc,” he said. He said that the commonest species were black mamba and carpet viper” The paper reported (Anon, 2015).

Although the people assumed that rain drove the snake from the upstream to that environment the most likely situation is that the excess water only succeeded in flushing the snakes in that very environment out of their holes. They are their unknown ‘neighbours’ in the holes.Half of snake bite accidents in the study area happened on the farm/field where snake were hiding themselves or searching for prey. Others were affected when walking through narrow paths commonly used in the rural areas. Snake bite rarely occur in the residential area where environment is open and clean with no provision for hiding place for snakes and their prey (Oyeleye *et al*., 2013), except in some special conditions as reported from Jos.

Results of this study revealed that *Bitis arientans* and *Naja nigricolis* were the most reported snake species involed in biting in the study area. Legs were the major points of bite on the body of victims, when they are walking barefooted or with slippers. Few people also reported eyes attack when snake spits venom on the victim's eyes. This could be uniquely associated with spitting cobra which is the only snake with the ability to spits it venom to its victim from a considerable distance. This result is contrary to Eniang (2004) report who observed that the major point of bite was hand. It is however similar to observation of oyaberu (1984) who also noted the leg as the most common point of bite. Tissue destruction and nervous disturbance were the commonly reported pain experienced by victims. The respondents descriptions of pain experienced were similar to Lallo (1995) reports, who stated that Snake venoms, are complex mixtures of enzymatic proteins and different toxins. In terms of their effects, however, they may be broadly categorized as hemotoxic (damaging blood vessels and causing hemorrhage), or neurotoxic (paralyzing nerve centers that control respiration and heart action); they may also contain agents that promote or prevent blood clotting. Among snakes, cobras and coral snakes may be singled out as having particularly neurotoxic venom.

Data in table 13 shows records of snake bite patients obtained from hospitals in the study area. Majority of the victims recorded were males with only few female genders. This could be associated with the fact that male genders were more involved in outdoor activities which consequently make them to be more exposed to snakebite. This result agrees with observation made in earlier studies (Tun-pe et al., 2002) that majority of snake bite victims were young males, bitten on lower limbs while working on the field. Sadly enough, 10.0% of the snakebite victims recorded in hospital in the study area did not survive the incidence.

The mortality rates falls on upper value of the range of 2-10% reported by Eniang (2011) and Hughes (1983). The direct consequence of death due to snakebite is depletion of workforce on the farm since majority of victims were young males with a lot of strength. A clean environment was the commonest method employed by respondents to avoid snake encounter and bites. Only few and very rich individual use chemical (Anti Snake Quleatox) to drive away the snake as majority could not afford the price of the the chemical (70,000 Naira per litre).

The study further indicated that occupation, marital status, age, level of education and religion of respondents had significant relationship with experience of snakebite, but there was no significant relationship between snakebite and sex. Eniang (2002) also noted an association between occupation and snakebite experience but reported contrary to the result of this study that level of education has no relationship with snakebite experience.

Results further indicated respondent sex, occupation, marital status and religion orientation had significant relationship with their willingness to support snake conservation, while level of education and age had no significant relationship.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

Twenty one species of snake were identified in Kainji Lake National Park. *Bitis arientans* and *Boaedon lineatus* were the dominant snake species. Ibbi range had the best snake species richness. *Bitis arientans* and *Naja nigricolis* were the most reported snake species responsible for bites. The endangered Python Sebae had a restricted (to riverine area) distribution across the ranges of the park. Till date there is no specialized programme that caters for snake conservation in the study area apart from general ecosystem preservation and ecotourism potential of snake has not yet been explored.

Snake bite accidents happened often on the farm/field where snake are hiding themselves or searching for prey. Others were affected when walking through narrow paths commonly used in the rural areas. Legs were the major point of bite. Male genders were generally more exposed to snake bite than females and they had the highest number of victims. Hospitals records show regular reports of snake bites which were more common in the raining season.

The study successfully highlighted the checklist of snake species in Kainji Lake National Park. Abundance and distribution of snake species in KLNP were established.Morphometric parameters measured on snakes species identified provide additional information on snake identification indices in the study area. Prevalence and management of snakebites in the study area were elucidated and ecotourism management plan for snake View in KLNP was designed and recommended in this study.

Having been informed by some revelation from this research work the following recommendations are therefore suggested for successful conservation of snakes and safety of people in the study area.

6.2 RECOMMENDATIONS

1. Continuous monitoring of presence or absence of snake species in the study area is still very crucial to build on the results of these findings.

2. Effective management based on regular inventory of wildlife resources and maintenance of natural ecosystem will enhance the survival of various species in their preferred habitat.

3. Ecotourism Management plan for Snake watching was designed and recommended in this study. It is hope that the park management will look into the plan and deliberate on it feasibility.

4. Snake viewing centres are recomended at Kali, Oli and Kuble Ranges of KLNP.

5. Prevention is far better than treatments of snake bite. Therefore, farmers are encouraged to always make use of protective shoes while working on the farm. However, many of them complained of inconveniency associated with the use of common boots. To address this problem the researcher fashioned a comfortable and

unique biteproof boot for the farmers by making some improvement on existing common boots available in the market.

6. In addition to the use of boots the use of gloves will be required when gathering products from the forest floor and during the harvest and some special agricultural work.

7. A clean environment in residential area is also highly recommended. Avoid gathering of woods that may host rodents near your accommodation or poutry far m.

8. There should be regular reorientation for villagers to quickly help any victims of snakebite to the nearest hospital. They should be encouraged to use the modern hospital to save them from pain and untimely deaths that may results from negligence and delay.

9. State and Local Government in the study area should find a way of subsidizing medical bills for snake bite victims. Federal Ministry of Health is currently treating tuberculosis patients free of charge; the same method could be employed in the study area to make modern medicine appealing and affordable to the people to save guard the human resources in the study area from further depletion.

6.3 ECOTOURISM MANAGEMENT PLAN FOR SNAKE VIEWING IN KAINJI LAKE NATIONAL PARK

At a time like this in Nigeria, when everybody seems to realise the need to diversify the economy from mono product to other sources of income generation to the government, improving our tourism industry will be an appropriate venture. Many of Nigeria tourism sites are still underutilized. Apart from high level of insecurity in some parts of the country, many of our natural area are not yet at their best due mainly to paucity of funds, deficient data on ecological information and low level of interest from the policy makers.

Each National Park in Nigeria has its perculiar characteristics and endowment that is difficult to replicate perfectly in other park. This now points to the fact that the manager of each National Park must look inward creatively to assess the area of advantage perculiar to their specific natural arear and resources available and tailoured their ecotourism towards that direction.

Among other spectacular wildlife resources; Roan Antelope, Hippopotamus, Lion, Kobs and crocodile in KainjiLake National Park Rock Python has been a negnected wonder on the range of the park. As the second largest snake on the planet Earth today, Python deserve a place of pride to be advertised to World to come and watch. Anaconda of South Americal has been made so popular by its host and only few people know little thing about the Africa Rock Python a contemporary of Anaconda.

This study revealed that snakes primary needs were their unique micro habitats, that is, holes and crevices. This fact makes snakes viewing in the natural environment a multiple adventures. Snake viewing will be associated with some natural features such as rocky area as we have it in Kali range or aardvark holes, a common phenomenon along Oli river bank. The visitors mind must be prepared to see those unique snakes' accommodations as a very pertinent part of their adventure. Snakes are secretive animals and will always do their utmost to hide away from any impending danger. The visitors should be prepared not to be perturbed in case they are not able to sight snake at their first visit but surely, some other indirect evidences such as exceptional smooth holes, snake slough e.t.c will convince them of snake presence in those sites.

Special dressing for snake viewing exercise should be incorporated as part of fun and means to educate the visitors on snake bite prevention. There will be no need to go to those sites with snake kits so as to avoid unnecessary agitation and anxiety. Tour guide should be knowledgeable on basic snake habitat preferences and must not make attempt to handle any snake, whether venomous or not. After all, visitors are not ordinarily allowed to be handling game in the park. The visitors should be reassured of their safety and pleasures in visiting such area.

Proposed Snake Viewing Centres

Kali hill near the ranger's quarters will be one of the appropriate place to mark out for this purpose. The unique vintage from the hill top and many big holes occupied by python (Non-venomous) will be unique features to parade for the visitors.

Another perculiar area where snake viewing centre could be set up is located at about a kilometer away from Oli tourist camp along Gilbert Child track. There were concentration of aardvark holes between the track and the Oli riverbank. Big holes dug out by aardvark is quiet an interesting sight on it own. Hips of soil from just two holes dug could fill up a tipper lorry without exaggeration. Python is still the major target species due to their big size that make them to be more conspicuous and their non venomous nature. However care must be taken and routine caution followed to safe guard against other species of snakes that may be encountered at the viewing sites.

Visitors must also be aware that other animal species apart from snakes, such as porcupine, hyaena, and even Lion could be hidden in the aardvark holes. People that may not be interested in sighting snakes will also find these special accommodations very interesting to behold. Creating a tourist site at Kali and possibly Kuble will ultimately decongest the concentration of tourist at Oli camp. Various tourist sites at the suggested areas will distribute visitors to various ranges in the park. Using these ranges as tourist site will also enhance the level of security/conservation of natural resources in those ranges as low level of utilization in the past has expose those environment to encroachment by poachers and cattle keepers.

I believe that using this plan will improve visitor's patronage of the park and improve the management of snakes as the focal animal of the proposed sites.

Table 14. Research Summary Table

Research Objective	Methodology	Results	Recommendations
Identify the snake species present in the park	- Encounter Survey (VES) along the Transect. $D = \sum ni (ni - 1)/N (N - 1)$ -Collection and identification of snake specimens from adjoining communities. - Indices.	21 species of snakes in 6 different families were identified in the study area.	Continuous monitoring of presence or absence of snake species in the study area is still crucial to build on the result of this findings.

Investigage Behaviour,niches, and other activities of snakes in the study area	-Mean value for location, season, species and ecological sites in the study area.	Bitis arientans has the highest abundance and wildly distributed followed by Elapids and Culubrids. The endangered Python Sebae had a restricted distribution across the ranges of the park.	Effective management based on regular inventory of wildlife resources and maintenance of natural ecosystem will enhance the survival of various species in their preferred habitat.
Determine the local distribution and relative Abundance of snakes within the study area.	-The following formula was used to estimate relative abundance; A = n/N x 100		
Current management strategy of KLNMP to conserve the snake and	-Interview of Park Staff in the relevant Departments, -Assessment of current management plan relating to snake	Till date there is no specialized programme that cater for snake conservation in the study apart from general ecosystem preservation and ecotourism potential of snake has not yet been explored.	Ecotourism Management plan for Snake watching was designed and recommended in this study.

	conservation.		
Examine local community disposition to snake conservation, utilization, and hazards	-Use of structural questionnaires to obtain information from some selected members of Communities at the buffer zone.	Snake bite accidents happened often on the farm/field where snake are hiding themselves or searching for prey. Others were affected when walking through narrow paths commonly used in the rural areas. Snake bite rarely occur in the residential area where environment is open and clean with no provision for hiding place for snakes and their prey. Vipers (50%) and cobra (38%) are the main culprits of most snake bite in the study area. Legs are the major (70%) point of bite.	Wearing of boot was recommended but many of them complained of inconvenience associated with the use of common boot

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APPENDIX I

IDENTIFICATION KEYS FOR COMMON SNAKES IN KAINJI LAKE NATIONAL PARK

Vipers

***Bitis arientance* (venomous)**

Vipers are predominantly brown in colour with different pattern of black and creamy colour which usually creates a camouflage in their environment where they usually hide themselves in sub-soil. Dorsally, the ground-colour varies from straw yellow, to light brown, to orange or reddish brown. This is overlaid with a pattern of 18–22 backwardly-directed, dark brown to black bands that extend down the back and tail. Usually these bands are roughly chevron-shaped, but may be more U-shaped in some areas. They also form 2–6 light and dark cross-bands on the tail. Some populations are heavily flecked with brown and black, often obscuring other coloration, giving the animal a dusty-brown or blackish appearance. The belly is yellow or white, with a few scattered dark spots (closer in the young ones). They are more common in the savannah than the rain forest region in Nigeria. It has average Head Length: 1.2 – 1.6cm, Head width 0.7 - 1.0 cm, Intra-Orbital Length 0.4 – 0.7cm, Snouth-Vent Length 19.0 -37.0, Number of ventral Scale 130 - 171, Tail Length 0.8 – 3.8.

***Casus maculates* (Night adder,Venomous)**

Usually with a characteistc V-shape mark, solidaly black-brown in adults. There are patches of black spots all over is back. It could be grayish or greenish in colour. It is relatively rare in the in KLNP. It has average Head Length: 0.9 – 2.5cm, Head width 2.0 -1.2cm, Intra-Orbital Length 0.4 – 1.2cm, Snouth-Vent Length 33.0 -57.0, Number of ventral Scale 101-289, Tail Length 1.1 – 9.0.

Bitis Narsicornis: known uniquely for hornlike structures on the upper lips of the snake, just as it appeared in Rhinoceros from where the snake derived its name (Rhinoceros Viper). The mature one cannot be mistaken for another viper due to this distinct feature. There were not enough samples in the study area to establish an unbiased morphometric keys apart from the hornlike feature.

***Dendroaspis - viridis* (West Africa Green Mamba)** It has average Head Length: 0.9 – 2.5cm, Head width 2.0 -1.2cm, Intra-Orbital Length 0.4 – 1.2cm, Snouth-Vent Length 33.0 -57.0, Number of ventral Scale 101- 289, Tail Length 1.1 – 9.0.

West African green member are commonly observed where thicket provides platform for it to bask and stay at alert for it prey which include insects, small birds or lizards. It is a long slender body snake with relatively long tail. The average length of an adult snake of this species was between 1.4 meters and 2.1 meters. Some specimens of this species can grow to maximum lengths of 2.4 meters as reported by *Spawls and, Branch (1995). T*he head is narrow and elongated and slightly distinct from the neck.

Dendroaspis – Jamesoni

There is a real challenge of differentiating this snake species from it close relative (West Africa green manba). They are both arborea in and always found in similar environment.

However the dorsal scale of Jamesoni mamba is more coarse whereas the dorsal surface body scale of Dendrospis viridis is smooth with vivid yellowish green to green with anterior margins of the scales yellow. Jamesonis snake rarely bite but when it does it is often fatal. It has average Head Length: 2.3 – 3.1cm, Head width 0.6 - 0.8cm, Intra-Orbital Length 0.4 – 1.2cm, Snouth-Vent Length 60.0 – 118.0, Number of ventral Scale 172- 257, Tail Length 10.0 – 34.0.

Python sebae

Pythons are large and muscular, and kill their prey by squeezing, or constricting, until the prey suffocates. Although most python feed on small mammals, some large species can kill and swallow young kob. The body colouration is grayish green or grayish brown with dark brown bands that form isolated blotches on the flanks. It has average Head Length: 2.5 – 5.5cm, Head width 0.6 – 1.2cm, Intra-Orbital Length 0.5 – 1.2cm, Snouth-Vent Length 27 – 345.0, Number of ventral Scale 161- 275, Tail Length 1.9 – 44.0.

Python regius

This snake species are exceptional rear in the study site. In fact the only one sample of this snake was encountered under this study. Other individuals were from oral report from the farmers and hunters from the study area. This species is far smaller than the rock python but are esentially similar in colouration and non aggressive disposition. It also depends on its muscular body structure to twist around and suffocate its prey. Known generally to be carried around by snake charmer as pet, it is very shy and easy to handle due to it small size and non venomous nature. They are more common in the southern part of Nigeria. There were no enough numbers to establish Body Morphometic key.

Naja nigricolis

Most cobras are found in Africa. Among them is the spitting, or black-necked cobra, found from southern Egypt to northern South Africa. This snake usually spray its venom from a distance of about 2.4 (about 8 ft) accurately to its target. Varieties of the spitting cobra exist and range in color from dull black to pinkish colour, the lighter-coloured ones marked by a black band around the neck. The Asp, or Egyptian cobra is widely distributed throughout Africa, being the most common. Cobras will seldom attack unprovoked. When threatened, however, the Cobra will bite or spits its venom to defend itself. It has average Head Length: 2.2 – 3.2cm, Head width 0.8 – 1.3cm, Intra-Orbital Length 0.5 – 1.9cm, Snouth-Vent Length 55.0 – 65.0, Number of ventral Scale 169 - 116 , Tail Length 28.5 – .35.0.

***Boaedon- lineatus* (Lined house Snake)**

The lined house snake is widely distributed in the study area. They are usually found around the residential areas where they can get access to their preferred preys e.g rodents and lizards. They are known generally with characteristic stripes of marks on their head through the entire body length. They are not poisonous and will quickly find a way of escape at the sight man. Some lined house snake could be exceptionally beautiful due to multiple striking lines. It could be olive-green or olive brown and sometimes a rich chesnut-brown. It has average Head Length: 0.9 – 3.5cm, Head width 1.0 – 1.5cm, Intra-Orbital Length 0.3 – 1.0cm, Snouth-Vent Length 18.5 – 118.0, Number of ventral Scale 120 - 243 , Tail Length 4.9 – 51.5. The wide range in measurement of this species indicates changes in features with age.

***Boaedon fuliginosus* (Black house snakes)**

The black house snakes are harmless non-venomous, nocturnal, terrestrial snakes. It resembles cobra in first appearance but closer looked and gentle disposition of this innocent and smaller smooth scales will help to identify the snake. Despite the fact that these set of snake are not venomous, they suffer kill at sight syndrome from people like any other venomous snakes. Dorsal Scales Smooth and in longitudinal rows with the dorsal row un enlarged It has average Head Length: 2.3 – 3.3cm, Head width 0.9 – 1.2cm, Intra-Orbital Length 0.5 – 1.0cm, Snouth-Vent Length 33.0 – 71.6, Number of ventral Scale 151 - 275, Tail Length 2.6 – 12.5.

APPENDIX II

Table 14.Checklist of other Reptiles and Amphibians encountered in Kainji Lake National Park during the study.

Common Name	Scientific Name	Frequency
Crocodile	*Crocodilus niloticus*	9
Monitor Lizard	*Varanus niloticus niloticus*	5
Bosc's monitor lizard	*Varanus exanthematicus*	2
Skinks	*Mochlus guineensis*	7
	Scincus scincus	3
	Panaspis kitsoni	1
Chameleon	*Chamaeleo jacksoni*	2
Wall Ghecko		6
Tortoise	*Kinixys belliana*	6
Turtle	*Pelusios castaneus*	15
Agama Lizards	*Agama agama*	12
Amphibians		
Frog	*Rana galamensis*	5
	Rana occipitalis	2
	Conraua sp	5
	Ptycadaena mascareniensis	1
	Astylostermus sp	5
Toad	*Bufo latifrons*	3
	Bufo bufo	5
	Bufo maculatus	1
	Bufo gracilipes	2

APPENDIX III

Plate 11: Research Student and rangers on Kali Hill, KLNP

(A place where rock pythons were commonly encountered)

APPENDIX IV

Plate 12: Unique scenery from the top of Kali Hill (KLNP)

APPENDIX V

Plate 12: Research assistants at work measuring snake morphometric parameters in the Laboratory

APPENDIX VI

Some Suggested Tips to Identify Venomous Snakes

- Look at the snake length. Most short snakes are venomous
- Be careful when you see a snake that is sluggish or refuse to move from the same spot.
- The snke that is able to raise it body off the ground is definetly set to bite; which could be deadly in most cases
- A snake that spits is definetly dangerous. It can attack without a direct contact spiting venom to victim's eyes.
- Long and robust snake may not necessary give a venomous bite but is can strangulate its victim to death.
- Look into their eyes. Some venomous snakes have vertical eye slits, versus round pupils usually seen in non-venomous snakes. (Exception: Black Mamber and Cobra)
- Look at the head. Most venomous snakes usually have triangular shaped heads. (Exception, Cobra)
- Look for a pit between the snake's eyes and nostrils. A venomous snake normally has a heat-sensitive pit there to locate warm-blooded prey. Non-venomous snakes lack such pits. S
- See if there is a rattle. A snake with a rattle on its tail must be a rattlesnake, which is venomous.

Administration of anti-venom (**Under Medical Supervision**)

Polyvalent anti-snake venom contains antibodies against cobra, common krait and viper.

5 vials are given if signs are mild -primarily local manifestations.

10 vials if signs are moderate -bleeding from gums, ptosis.

15 vials if signs are severe -vascular collapse, progressive paralysis.

1/3 of the dose should be given subcutaneously (near bite but not in fingers or toes).

1/3 intramuscularly.

1/3 intravenously.

The intravenous dose can be repeated every 6 hours till the symptoms disappear.

More on Anti-Snake Venom and Its Administration

Manage toxic signs/symptoms

Anti-venom acts only against circulating toxin, not toxin fixed to tissue. Therefore, specific measures have to be taken.

In case of neuro toxic signs and symptoms, atropine (0.6 mg) subcutaneously should be followed by 5 injections of neostigmine (0.5 mg) intravenously (repeated 2 hourly depending on response) to reverse muscle paralysis.

In case of vasculotoxic signs and symptoms, fibrinogen along with heparin may be given, but with extreme caution and constant monitoring, as heparin can intensify bleeding.

Take supportive measures

These include blood or plasma transfusion to combat shock, mechanical respiration to combat respiratory distress, antibiotics to prevent secondary infection. Neuromuscular paralysis is the most dreadful. Complication of snake bite may occur within 15 minutes but may be delayed for several hours.

To tackle hypersensitivity reactions to antivenom, steroids, adrenaline and antihistamines may be given.

Snake venoms, are complex mixtures of enzymatic proteins and different toxins. In terms of their effects, however, they may be broadly categorized as hemotoxic (damaging blood vessels and causing hemorrhage), or neurotoxic (paralyzing nerve centers that control respiration and heart action); they may also contain agents that promote or prevent blood clotting. Among snakes, cobras and coral snakes may be singled out as having particularly neurotoxic venom.

Serums against various venoms can be produced by injecting animals such as horses with sub lethal doses and extracting the immune serum, or antivenin, that the animal body produces. Venoms themselves have occasional medicinal uses; for example, some are used as painkillers in cases of arthritis or cancer, and some serve as coagulants for people with hemophilia.

(American Red Cross Snakebite Procedure)

APPENDIXES

APPENDIX VII

Snake catch record sheet

Surveyor	**Field sheet ref**	**Date**

Location

Survey site Altitude Range

Latitude Longitude

Vegetation Human disturbance

Soil Type Leaf-litter/ground cover

Season Weather Lunar phase Temperature

Other:

Transect Number	Microhabitat	Water association	Topography	Species and specimen sheet ref	Other

APPENDIX VIII

Department of Wildlife and Ecotourism Management, Faculty of Agriculture and Forestry, University of Ibadan.

QUESTION GUIDE FOR SNAKE SAMPLES ENCOUNTERED WITHIN AND AROUND KAINJI LAKE NATIONAL PARK.

Instructions: Please kindly fill in a questionnaire for any snake you come across in the process of patrolling, research or other legal activities you engaged in within and around Kainji Lake National Park. The information you supply will be for research purpose only.

1.The name of the range/ village where the snake is found

____

2.The number of snakes sighted at once

____

3.The name of the ranger/ officer/Individual that found the snake________________________________

4.Co ordinates of the spot at which the snake is found (if you are with GPS)__________________________

5.Name of the snake (Common name and vernacular if known)

____

6.The colour of the snake; Brown ( ) Black ( ) Green ( )

Rainbow ( ) Others ______________________________________

7.The activities of the snake when it was sighted ; Crawling ( ) mating ( ) Basking ( ) ( ) eating ( ) Resting ( ) Incubating ( ) Others ____________________

8.Description of the surrounding in which the snake was sighted; In a hole ( ) On the ground ( )

On the tree ( ) In the water ( )

9.Snake body description Long and slender ( ) Long and robust ( )

Short and slender ( ) Short and robust ( )

10. Size with no 159xaggeration Small ( ) Big ( ) Very Big ( )

11. Age assessment Baby ( ) Juvenile ( ) Adult ( )

12. Vegetation Type where the snake was found; Forest ( ) Grassland ( ) Rocky area ( )

Woodland ( )

13. Date of sighting ____

APPENDIXES IX

Department of Wildlife and Ecotourism Management, Faculty of Agriculture and Forestry Resources, University of Ibadan.

QUESTION GUIDE FOR PERSONAL INTERVIEW ON THE ASSESSMENT OF LOCAL COMMUNITIES DISPOSITION TO SNAKE CONSERVATION AND UTILIZATION AROUND KAINJI LAKE NATIONAL PARK.

SECTION A

1. Gender: male ( ) female ( )

2. Occupation: Farmer ( ) Craftsman/Business ( ) Hunter ( )

   Civil Servant ( ) Student ( )

3. Age: __________________

4. Level of Education: No formal Education ( ) Primary ( ) Secondary ( )

   Tertiary ( )

5. Religion: Christianity ( ) Islam ( ) Traditional ( )

SECTION B

6. Do you support the idea of conservation? Yes ( ) No ( )

7. Do you believe in conservation of snakes? Yes ( ) No ( )

8. If No why?

(i) ……………………………………………………….

(ii) ……………………………………………………….

9. Have you ever seen snake in captivity? Yes ( ) No ( )

10. If yes, does it impress you? Yes ( ) No ( )

11. Why do you kill snakes? For meat ( ) for sale ( ) for safety ( )

For Medicine ( ) All of the above ( )

12. Does snake serves any importance to you? Yes ( ) No ( )

13. If yes in what way? Consumption ( ) Treatment of Diseases ( ) Control of Pests ( ) All of the above ( )

14. Do you know any other uses of snakes? Please state them:

(i) ……………………………………………………….

(ii) ……………………………………………………….

(iii) ……………………………………………………….

(iv) ……………………………………………………….

176 What can you say about the population of snakes in your environment?

Increasing ( ) Decreasing ( ) the Same ( )

16. Are all snakes poisonous? Yes ( ) No ( )

17. Will you like to participate in snake farming or breeding? Yes ( ) No ( )

SECTION C

18. Have you ever been bitten by snake before? Yes ( ) No ( )

19. How Many times Ones ( ) Twice ( ) 3 times ( ) Above 3 times ( )

20. If your answer is yes when (year) 19_ _ 20_ _

21. Season Dec.- Feb. ( ) Mar.-May ( )

Jun.-Aug. ( ) Sept.-Nov.

22. Where? On the field while working ( ) While digging holes or hunting ( ) on the road ( ) While climbing tree ( )

At the surrounding of the house ( ) Others Specify

…………..

23. If at work which activities? Doing weeding ( ) Cutting grass ( )

Night hunting/ watchman ( )

24. Which snake was involved Vipers ( ) Cobra ( )

Python ( ) Others ……………………………

25. Which part of your body was affected? Right hand ( ) Left hand ( ) Right leg ( ) Left leg ( ) Eyes ( )

26. How did you treat yourself? Visit modern hospital ( ) Apply local treatment ( ) Prayers ( ) others ( )

27. Was the treatment effective? Yes ( ) No ( )

28. Was the snake eventually killed? Yes ( ) No ( )

29. Briefly describe the experience of your pain? Tissue destruction ( )

Nervous disturbance ( ) Uncontrolled Bleeding ( ) Stooling ( )

Others ……………………………………………………………………………..

30. What have you been doing to save yourself from snake bite?

Put on a cover shoes ( ) Keep the environment clean ( )

Use charm ( ) others ……………………………………………..

31. Are you aware of any traditional belief (s) associated with snake? ……………

…………………………………………………………………………………….

……………………………………………………………………………………..

……………………………………………………………………………………..

31. How do you utilize snake that you kill or collected?

Preparation of Traditional Medicine (   ) Decoration (   ) Leather products (   ) Pets and Entertainment (   ) Food (   ).

32. Please kindly list names of all the snakes you know in your area (Vernacular Language used should be stated please).

(i) …………………………… (ii) ……………………………..

(iii) ………………………….. (iv)……………………………

(v) …………………………….. (vi)…………………………..

(vii) ………………………… (viii) …………………………

(ix)………………………….. (x) ……………………………

APPENDIX X

Table 15a. Morphometric Parameters of individual Snake sampled in Kainji Lake National Park

Species	Nominal no.	Head length	Head Width	Intral orbital length	Snout vent Length	Number of ventral scale	Tail Length
Dendroaspis jamesoni	1	3.0cm	1.2cm	0.8cm	75cm	172 Scales	34.0cm
Dendroaspis jamesoni	7	3.0cm	1.0cm	0.6cm	72cm	173 Scales	33.5cm
Dendroaspis jamesoni	1	3.1cm	1.3cm	0.6cm	64.0cm	176 Scales	-
Dendroaspis viridis						184 scales	
Boaedon lineatus (House snake)	2	3.0cm	0.1cm	0.9cm	84cm	236 Scales	11.5cm
File Snake	3	1.8cm	0.1cm	0.5cm	35cm	154 Scales	5.4cm
Psammophis sibilans	4	3.2cm	1.0cm	0.6cm	97cm	196 Scales	27.0cm
Boaedon lineatus	10	3.5cm	1.5cm	1.0cm	100.5cm	243 Scales	36.0cm
Boaedon linatus	12	3.0cm	0.7cm	0.8cm	86.0cm	200 Scales	51.5cm
Boaedon lineatus	14	0.9cm	0.5cm	0.3cm	18.5cm	120 Scales	8.0cm
Boaedon lineatus	21	2.5cm	1.5cm	1.0cm	78.0cm	170 Scales	40cm
Boadon lineatus	23	3.3cm	1.5cm	1.0cm	85.0cm	193 Scales	37.7cm
Boadon Lineatus	27	1.3cm	0.5cm	0.3cm	24.4cm	167 Scales	40.4cm
Boaedon lineatus	1	2.7cm	1.0cm	0.80cm	73.50cm	156 Scales	32cm
Bitis arietans	5	2.2cm	0.2cm	0.5cm	40cm	150 Scale	5.9cm

Table 15b. **Morphometric Parameters of individual Snake sampled in Kainji Lake National Park**

Species	Nominal no.	Head length	Head Width	Intral orbital length	Snout vent Length	Number of ventral scale	Tail Length
Bitis arietans	6	1.7cm	0.5cm0	0.4cm	35.5cm	179 Scales	4.7cm
Bitis arietans	8	2.4cm	0.8cm	0.5cm	52.0cm	152 Scales	5.0cm
Bitis arietans	11	3.0cm	2.0cm	1.3cm	77.0cm	210 Scales	18.5cm
Bitis arietans	13	1.5cm	1.2cm	0.5cm	27.5cm	163 Scales	1.6cm
Bitis arietans	15	2.2cm	0.5cm	0.6cm	49.5cm	151 Scales	7.7cm
Bitis arietans	17	2cm	1.0cm	0.4cm	49cm	177 Scales	9cm
Bitis arietans	18	2.2cm	7.0cm	0.5cm	32.0cm	172 Scales	6.5cm
Bitis arietans	19	2.5cm	0.7cm	0.5cm	42cm	149 Scales	3cm
Bitis arietans	26	1.9cm	1.0cm	0.8cm	41.4cm	175 Scales	-
Causus maculatus	30	1.6cm	1.0cm	0.7cm	37.0cm	162 Scales	3.8cm
Causus maculatus	31	1.5cm	0.8cm	0.6cm	20.6cm	130 Scales	3.6cm
Causus maculatus	34	1.3cm	0.8cm	0.4cm	30.0cm	171 Scales	2.0cm
Causus maculatus	33	1.2cm	0.7cm	0.5cm	19.0cm	148 Scales	0.8cm
Bitis arietans	1	1.50cm	0.5cm	0.5cm	57cm	289 Scales	8.6cm
Bitis arietans	2	1.50cm	0.6cm	0.5cm	25cm	192 Scales	1.1cm

Table 15c. **Morphometric Parameters of individual Snake sampled in Kainji Lake National Park**

Species	Nominal no.	Head length	Head Width	Intral orbital length	Snout vent Length	Number of ventral scale	Tail Length
Bitis arietans	3	2.0cm	1.3cm	0.8cm	42cm	153 Scales	5.5cm
Bitis arietans	4	2.1cm	1.4cm	1.2cm	37cm	160 Scales	8.9cm
Bitis arietans	5	2.5cm	0.7cm	0.5cm	25.5cm	145 Scales	3.6cm
Bitis arietans	1	1.7cm	1.4cm	0.8cm	43.0cm	128 Scales	4.4cm
Bitis arietans	5	2.2cm	0.2cm	0.5cm	40cm	150 Scales	5.9cm
Bitis arietans	6	1.7cm	0.5cm0	0.4cm	35.5cm	179 Scales	4.7cm
Bitis arietans	8	2.4cm	0.8cm	0.5cm	52.0cm	152 Scales	5.0cm
Bitis arietans	11	3.0cm	2.0cm	1.3cm	77.0cm	210 Scales	18.5cm
Typhlopidae	9	0.6cm	0.4cm	0.3cm	20.5cm	243 Scales	2.4cm
Python sebae	16	5.5cm	0.7cm	0.5cm	27cm	171 Scales	1.9cm
Python sebae	35	3.3cm	2.3cm	1.2cm	64.0cm	201 Scales	4.0cm
Naja nigricolis	1	2.5cm	1.3cm	1.9cm	65cm	193 Scales	35cm
Naja nigricolis	2	2.2cm	1.0cm	0.8cm	55cm	216 Scales	28.5cm
Naja nigricolis	2	3.2cm	1.1cm	0.7cm	57.0cm	175 Scales	-

Table 15b. Morphometric Parameters of individual Snake sampled in Kainji Lake National Park

Species	Nominal no	Head length	Head Width	Intral orbital length	Snout vent Length	Number of ventral scale	Tail Length
Naja nigricolis	22	2.5cm	0.8cm	0.5cm	63.0cm	169 Scales	32cm
Boaedon fulliginous	1	2.3cm	1.5cm	0.9cm	71.0cm	275 Scales	10.5cm
Boaedon fulliginous	2	1.3cm	0.9cm	0.5cm	33cm	151 Scales	2.6cm
Boadon fulliginosus	24	3.3cm	2.0cm	1.0cm	71.6cm	209 Scales	12.5cm
Grayia smith	25	2.6cm	1.5cm	1.0cm	70.0cm	215 Scales	19.0cm
Specimen B Brown Snake	29	2.7cm	1.2cm	1cm	56.0cm	137 Scales	5.5cm
Boadon fuliginosus (Black house snake)	32	1.2cm	0.4cm	0.3cm	34.3cm	194 Scales	2.7cm
Dendroaspis viridis	1	3.0cm	1.8cm	0.8cm	84cm	175 Scales	30cm
	1	3.1cm	1.0cm	0.6cm	49.2cm	184 scales	29cm
Dendroapis jamesoni							
Specimen A Black snake with tiny eyes	28	2.1cm	1.0cm	0.8cm	56.8cm	170 Scales	3.7cm
Specimen B Brown Snake	29	2.7cm	1.2cm	1cm	56.0cm	137 Scales	5.5cm
Boaedon fuliginosus (Black house snake)	32	1.2cm	0.4cm	0.3cm	34.3cm	194 Scales	2.7cm

APPENDIX XI

DATASET ACTIVATE DataSet1. CORRELATIONS /VARIABLES=Hl_bl Hw_bl io_bl sl_bl No_of_ve_bl HL_ba hw_ba io_ba sl_ba No_of_ve_ba tl_ba Hl_cm hw_cm io_cm sl_cm No_of_ve_cm tl_cm Hl_dsj hw_dsj io_dsj sl_dsj No_of_ve_dsj tl_dsj Hi_ps hw_ps io_ps sl_ps No_of_ve_ps tl_ps Hl_nnc hw_nnc io_nnc sl_nnc No_of_ve_nnc tl_nnc Hl_tp hw_tp io_tp sl_tp No_of_ve_tp tl_tp tl_bl /PRINT=TWOTAIL NOSIG /MISSING=PAIRWISE.

Correlations

[DataSet1] C:\Users\mathias257yahoo.com\Desktop\SNAKE DATA.sa

Correlations

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
Hl_bl	Pearson Correlation	1	.427	.822**	.816**	.728**	.059	.020	-.305	.326	-.217	.183	-.923	-.954	-.564	-1.000**	-.691	-.974	-.485	-.958*

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
	Sig. (2-tailed)		.166	.001	.001	.007	.872	.957	.391	.358	.548	.638	.252	.194	.619	.008	.514	.146	.407	.010
	N	12	12	12	12	12	10	10	10	10	10	9	3	3	3	3	3	3	5	5
Hw_bl	Pearson Correlation	.427	1	.565	.494	.150	.449	.131	.258	.255	-.311	-.084	-.993	-1.000*	-.769	-.958	-.466	-.999*	-.483	-.232
	Sig. (2-tailed)	.166		.056	.103	.643	.193	.719	.471	.477	.382	.830	.075	.017	.442	.185	.691	.031	.409	.707
	N	12	12	12	12	12	10	10	10	10	10	9	3	3	3	3	3	3	5	5
io_bl	Pearson Correlation	.822**	.565	1	.820**	.643*	.463	-.052	-.177	.268	-.486	.072	.038	-.052	.577	-.362	-.919	-.127	-.632	-.923*
	Sig. (2-tailed)	.001	.056		.001	.024	.177	.887	.624	.454	.154	.853	.976	.967	.609	.764	.258	.919	.253	.026
	N	12	12	12	12	12	10	10	10	10	10	9	3	3	3	3	3	3	5	5

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
sl_bl	Pearson Correlation	.816**	.494	.820**	1	.697*	.185	.382	.046	.205	-.448	.060	-.998*	-.988	-.872	-.890	-.298	-.973	-.449	-.941*
	Sig. (2-tailed)	.001	.103	.001		.012	.608	.277	.899	.570	.195	.878	.042	.099	.325	.302	.808	.147	.448	.017
	N	12	12	12	12	12	10	10	10	10	10	9	3	3	3	3	3	3	5	5
No_of_ve_bl	Pearson Correlation	.728**	.150	.643*	.697*	1	-.094	-.068	-.075	.191	-.266	.071	.142	.052	.658	-.263	-.873	-.024	-.456	-.939*
	Sig. (2-tailed)	.007	.643	.024	.012		.796	.851	.836	.598	.457	.856	.909	.967	.543	.831	.325	.985	.441	.018
	N	12	12	12	12	12	10	10	10	10	10	9	3	3	3	3	3	3	5	5
HL_ba	Pearson Correlation	.059	.449	.463	.185	-.094	1	.098	.209	.583**	.148	.475*	-.043	-.473	.246	-.821	-.974*	-.017	-.241	-.075
	Sig. (2-tailed)	.872	.193	.177	.608	.796		.641	.326	.002	.480	.019	.957	.527	.754	.179	.026	.983	.646	.887

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
	N	10	10	10	10	10	25	25	24	25	25	24	4	4	4	4	4	4	6	6
hw_ba	Pearson Correlation	.020	.131	-.052	.382	-.068	.098	1	.693**	.082	-.216	-.010	-.220	-.200	-.701	.063	.335	-.050	.101	-.010
	Sig. (2-tailed)	.957	.719	.887	.277	.851	.641		.000	.695	.299	.964	.780	.800	.299	.937	.665	.950	.848	.985
	N	10	10	10	10	10	25	25	24	25	25	24	4	4	4	4	4	4	6	6
io_ba	Pearson Correlation	-.305	.258	-.177	.046	-.075	.209	.693**	1	.174	-.046	.315	-.894	-.973*	-.632	-.871	-.320	-.864	-.061	.076
	Sig. (2-tailed)	.391	.471	.624	.899	.836	.326	.000		.415	.830	.143	.106	.027	.368	.129	.680	.136	.909	.887
	N	10	10	10	10	10	24	24	24	24	24	23	4	4	4	4	4	4	6	6
sl_ba	Pearson Correlation	.326	.255	.268	.205	.191	.583**	.082	.174	1	.502*	.737**	-.055	-.447	.294	-.794	-.943	-.056	-.680	-.653

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
	Sig. (2-tailed)	.358	.477	.454	.570	.598	.002	.695	.415		.011	.000	.945	.553	.706	.206	.057	.944	.137	.159
	N	10	10	10	10	10	25	25	24	25	25	24	4	4	4	4	4	4	6	6
No_of_ve_ba	Pearson Correlation	-.217	-.311	-.486	-.448	-.266	.148	-.216	-.046	.502*	1	.525**	.631	.931	.486	.983*	.652	.532	.055	.392
	Sig. (2-tailed)	.548	.382	.154	.195	.457	.480	.299	.830	.011		.008	.369	.069	.514	.017	.348	.468	.918	.442
	N	10	10	10	10	10	25	25	24	25	25	24	4	4	4	4	4	4	6	6
tl_ba	Pearson Correlation	.183	-.084	.072	.060	.071	.475*	-.010	.315	.737**	.525**	1	-.190	-.324	.341	-.556	-.580	-.304	-.796	.036
	Sig. (2-tailed)	.638	.830	.853	.878	.856	.019	.964	.143	.000	.008		.810	.676	.659	.444	.420	.696	.058	.946
	N	9	9	9	9	9	24	24	23	24	24	24	4	4	4	4	4	4	6	6

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
Hl_cm	Pearson Correlation	-.923	-.993	.038	-.998*	.142	-.043	-.220	-.894	-.055	.631	-.190	1	.871	.849	.576	-.133	.979*	.627	-.435
	Sig. (2-tailed)	.252	.075	.976	.042	.909	.957	.780	.106	.945	.369	.810		.129	.151	.424	.867	.021	.373	.565
	N	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
hw_cm	Pearson Correlation	-.954	-1.000*	-.052	-.988	.052	-.473	-.200	-.973*	-.447	.931	-.324	.871	1	.718	.890	.345	.794	.600	.053
	Sig. (2-tailed)	.194	.017	.967	.099	.967	.527	.800	.027	.553	.069	.676	.129		.282	.110	.655	.206	.400	.947
	N	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
io_cm	Pearson Correlation	-.564	-.769	.577	-.872	.658	.246	-.701	-.632	.294	.486	.341	.849	.718	1	.346	-.325	.747	.121	-.513
	Sig. (2-tailed)	.619	.442	.609	.325	.543	.754	.299	.368	.706	.514	.659	.151	.282		.654	.675	.253	.879	.487

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
	N	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
sl_cm	Pearson Correlation	-1.000**	-.958	-.362	-.890	-.263	-.821	.063	-.871	-.794	.983*	-.556	.576	.890	.346	1	.731	.505	.608	.485
	Sig. (2-tailed)	.008	.185	.764	.302	.831	.179	.937	.129	.206	.017	.444	.424	.110	.654		.269	.495	.392	.515
	N	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
No_of_ve_cm	Pearson Correlation	-.691	-.466	-.919	-.298	-.873	-.974*	.335	-.320	-.943	.652	-.580	-.133	.345	-.325	.731	1	-.185	.272	.945
	Sig. (2-tailed)	.514	.691	.258	.808	.325	.026	.665	.680	.057	.348	.420	.867	.655	.675	.269		.815	.728	.055
	N	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
tl_cm	Pearson Correlation	-.974	-.999*	-.127	-.973	-.024	-.017	-.050	-.864	-.056	.532	-.304	.979*	.794	.747	.505	-.185	1	.731	-.495

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
	Sig. (2-tailed)	.146	.031	.919	.147	.985	.983	.950	.136	.944	.468	.696	.021	.206	.253	.495	.815		.269	.505
	N	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Hl_dsj	Pearson Correlation	-.485	-.483	-.632	-.449	-.456	-.241	.101	-.061	-.680	.055	-.796	.627	.600	.121	.608	.272	.731	1	.312
	Sig. (2-tailed)	.407	.409	.253	.448	.441	.646	.848	.909	.137	.918	.058	.373	.400	.879	.392	.728	.269		.547
	N	5	5	5	5	5	6	6	6	6	6	6	4	4	4	4	4	4	6	6
hw_dsj	Pearson Correlation	-.958*	-.232	-.923*	-.941*	-.939*	-.075	-.010	.076	-.653	.392	.036	-.435	.053	-.513	.485	.945	-.495	.312	1
	Sig. (2-tailed)	.010	.707	.026	.017	.018	.887	.985	.887	.159	.442	.946	.565	.947	.487	.515	.055	.505	.547	
	N	5	5	5	5	5	6	6	6	6	6	6	4	4	4	4	4	4	6	6

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
io_dsj	Pearson Correlation	.589	.017	.888*	.528	.766	-.107	-.459	-.243	.391	.297	.583	.000	.229	.447	.185	.145	-.204	-.749	-.312
	Sig. (2-tailed)	.296	.978	.044	.361	.131	.840	.360	.643	.443	.567	.225	1.000	.771	.553	.815	.855	.796	.087	.547
	N	5	5	5	5	5	6	6	6	6	6	6	4	4	4	4	4	4	6	6
sl_dsj	Pearson Correlation	-.995**	-.504	-.820	-.998**	-.885*	.278	-.158	-.129	-.384	.411	.151	.999**	.849	.836	.546	-.164	.987*	.426	.828*
	Sig. (2-tailed)	.000	.386	.089	.000	.046	.594	.765	.808	.452	.418	.775	.001	.151	.164	.454	.836	.013	.399	.042
	N	5	5	5	5	5	6	6	6	6	6	6	4	4	4	4	4	4	6	6
No_of_ve_dsj	Pearson Correlation	-.108	-.093	-.070	-.108	-.242	.078	.359	-.481	.267	.503	.667	-.997**	-.835	-.868	-.513	.208	-.978*	-.621	.121
	Sig. (2-tailed)	.863	.882	.910	.863	.695	.883	.484	.334	.609	.309	.148	.003	.165	.132	.487	.792	.022	.189	.819

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
	N	5	5	5	5	5	6	6	6	6	6	6	4	4	4	4	4	4	6	6
tl_dsj	Pearson Correlation	-.228	-.101	-.100	-.252	.012	.162	-.769	.443	-.344	-.392	-.819	.996	.849	.933	.689	.084	.995	.735	.082
	Sig. (2-tailed)	.772	.899	.900	.748	.988	.794	.128	.455	.571	.514	.090	.055	.355	.234	.516	.946	.061	.157	.896
	N	4	4	4	4	4	5	5	5	5	5	5	3	3	3	3	3	3	5	5
Hi_ps	Pearson Correlation	-1.000**	-1.000**	1.000**	-1.000**	1.000**	-.050	-.941	-.966	.063	.779	.647	.899	.966	.899	.646	.053	.774	-.706	-.070
	Sig. (2-tailed)	.	.	.	.	.	.968	.220	.166	.960	.431	.552	.289	.166	.289	.553	.966	.436	.501	.955
	N	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
hw_ps	Pearson Correlation	1.000**	1.000**	-1.000**	1.000**	-1.000**	.413	.751	.993	.308	-.955	-.323	-.676	-.993	-.676	-.881	-.415	-.488	.397	-.300

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
	Sig. (2-tailed)	.	.	.	.	.	.729	.459	.073	.801	.192	.791	.528	.073	.528	.314	.727	.675	.740	.806
	N	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
io_ps	Pearson Correlation	1.000**	1.000**	-1.000**	1.000**	-1.000**	.429	.740	.991	.324	-.960	-.306	-.663	-.991	-.663	-.889	-.431	-.473	.381	-.317
	Sig. (2-tailed)	.	.	.	.	.	.718	.470	.084	.790	.181	.802	.539	.084	.539	.303	.716	.686	.751	.795
	N	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
sl_ps	Pearson Correlation	.953	.833	.618	.718	.532	.431	-.420	.877	.501	-.612	.755	-.782	-.744	-.337	-.678	-.216	-.853	-.975*	.105
	Sig. (2-tailed)	.196	.373	.576	.490	.643	.569	.580	.123	.499	.388	.245	.218	.256	.663	.322	.784	.147	.025	.895
	N	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
No_of_ve_ps	Pearson Correlation	.883	.720	.748	.582	.675	.677	-.565	.824	.742	-.676	.896	-.595	-.694	-.110	-.775	-.492	-.661	-.967*	-.200
	Sig. (2-tailed)	.311	.488	.462	.604	.528	.323	.435	.176	.258	.324	.104	.405	.306	.890	.225	.508	.339	.033	.800
	N	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
tl_ps	Pearson Correlation	.944	.817	.639	.699	.556	.391	-.443	.852	.467	-.564	.754	-.773	-.709	-.321	-.633	-.172	-.854	-.979*	.146
	Sig. (2-tailed)	.214	.391	.559	.507	.625	.609	.557	.148	.533	.436	.246	.227	.291	.679	.367	.828	.146	.021	.854
	N	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Hl_nnc	Pearson Correlation	-.115	.163	-.971	.339	-.990	-.841	.711	.000	-.865	.241	-.718	-.430	-.062	-.730	.387	.861	-.388	.294	.874
	Sig. (2-tailed)	.927	.896	.154	.780	.088	.159	.289	1.000	.135	.759	.282	.570	.938	.270	.613	.139	.612	.706	.126

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
	N	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
hw_nnc	Pearson Correlation	-1.000**	-.961	-.350	-.895	-.251	-.648	.097	-.981*	-.651	.928	-.590	.789	.954*	.496	.943	.497	.757	.775	.191
	Sig. (2-tailed)	.000	.177	.772	.294	.839	.352	.903	.019	.349	.072	.410	.211	.046	.504	.057	.503	.243	.225	.809
	N	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
io_nnc	Pearson Correlation	-.875	-.974	.148	-.999*	.250	-.384	-.391	-.908	-.334	.912	-.133	.842	.979*	.800	.838	.290	.731	.426	.032
	Sig. (2-tailed)	.322	.145	.905	.029	.839	.616	.609	.092	.666	.088	.867	.158	.021	.200	.162	.710	.269	.574	.968
	N	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
sl_nnc	Pearson Correlation	-.127	-.395	.885	-.555	.928	-.233	-.760	-.171	-.099	.532	.471	.077	.389	.434	.407	.356	-.128	-.459	.389

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
	Sig. (2-tailed)	.919	.742	.309	.625	.243	.767	.240	.829	.901	.468	.529	.923	.611	.566	.593	.644	.872	.541	.611
	N	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
No_of_ve_nnc	Pearson Correlation	-.923	-.993	.038	-.998*	.142	.467	-.045	-.464	.399	.002	-.053	.769	.361	.617	-.030	-.651	.846	.504	-.862
	Sig. (2-tailed)	.252	.075	.976	.042	.909	.533	.955	.536	.601	.998	.947	.231	.639	.383	.970	.349	.154	.496	.138
	N	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
tl_nnc	Pearson Correlation	-1.000**	-1.000**	-1.000**	-1.000**	-1.000**	-.959	-.887	-.461	-.910	.826	-.047	.197	.620	.461	.797	1.000*	.015	-.044	.887
	Sig. (2-tailed)	.	.	.	.	.	.183	.305	.695	.272	.382	.970	.874	.574	.695	.413	.018	.990	.972	.305
	N	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
Hl_tp	Pearson Correlation	.[a]	.[a]	.[a]	.[a]	.[a]	-1.000**	-1.000**	-1.000**	-1.000**	1.000**	-1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	.[a]	1.000**
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2
hw_tp	Pearson Correlation	.[a]	.[a]	.[a]	.[a]	.[a]	-1.000**	-1.000**	-1.000**	-1.000**	1.000**	-1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	.[a]	1.000**
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2
io_tp	Pearson Correlation	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
	N	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2
sl_tp	Pearson Correlation	.[a]	.[a]	.[a]	.[a]	.[a]	-1.000**	-1.000**	-1.000**	-1.000**	1.000**	-1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	.[a]	1.000**
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2
No_of_ve_tp	Pearson Correlation	.[a]	.[a]	.[a]	.[a]	.[a]	1.000**	1.000**	1.000**	1.000**	-1.000**	1.000**	-1.000**	-1.000**	-1.000**	-1.000**	-1.000**	-1.000**	.[a]	-1.000**
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2
tl_tp	Pearson Correlation	.[a]	.[a]	.[a]	.[a]	.[a]	-1.000**	-1.000**	-1.000**	-1.000**	1.000**	-1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	.[a]	1.000**

		Hl_bl	Hw_bl	io_bl	sl_bl	No_of_ve_bl	HL_ba	hw_ba	io_ba	sl_ba	No_of_ve_ba	tl_ba	Hl_cm	hw_cm	io_cm	sl_cm	No_of_ve_cm	tl_cm	Hl_dsj	hw_dsj
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2
tl_bl	Pearson Correlation	.498	.475	.480	.481	.238	.462	.452	.271	.555	-.314	.376	-.992	-.999*	-.762	-.961	-.476	-.999*	-.869	-.604
	Sig. (2-tailed)	.100	.119	.114	.114	.457	.179	.190	.449	.096	.376	.318	.082	.024	.449	.178	.684	.024	.056	.281
	N	12	12	12	12	12	10	10	10	10	10	9	3	3	3	3	3	3	5	5

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Cannot be computed because at least one of the variables is constant.

Correlations

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
Hl_bl	Pearson Correlation	.589	-.995**	-.108	-.228	-1.000**	1.000**	1.000**	.953	.883	.944	-.115	-1.000**	-.875	-.127	-.923	-1.000**	.[a]	.[a]	.[a]
	Sig. (2-tailed)	.296	.000	.863	.772	.	.	.	.196	.311	.214	.927	.000	.322	.919	.252	.	.	.	.
	N	5	5	5	4	2	2	2	3	3	3	3	3	3	3	3	2	1	1	1
Hw_bl	Pearson Correlation	.017	-.504	-.093	-.101	-1.000**	1.000**	1.000**	.833	.720	.817	.163	-.961	-.974	-.395	-.993	-1.000**	.[a]	.[a]	.[a]
	Sig. (2-tailed)	.978	.386	.882	.899	.	.	.	.373	.488	.391	.896	.177	.145	.742	.075	.	.	.	.
	N	5	5	5	4	2	2	2	3	3	3	3	3	3	3	3	2	1	1	1

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
io_bl	Pearson Correlation	.888*	-.820	-.070	-.100	1.000**	-1.000**	-1.000**	.618	.748	.639	-.971	-.350	.148	.885	.038	-1.000**	.a	.a	.a
	Sig. (2-tailed)	.044	.089	.910	.900	.	.	.	.576	.462	.559	.154	.772	.905	.309	.976	.	.	.	.
	N	5	5	5	4	2	2	2	3	3	3	3	3	3	3	3	2	1	1	1
sl_bl	Pearson Correlation	.528	-.998**	-.108	-.252	-1.000**	1.000**	1.000**	.718	.582	.699	.339	-.895	-.999*	-.555	-.998*	-1.000**	.a	.a	.a
	Sig. (2-tailed)	.361	.000	.863	.748	.	.	.	.490	.604	.507	.780	.294	.029	.625	.042	.	.	.	.
	N	5	5	5	4	2	2	2	3	3	3	3	3	3	3	3	2	1	1	1

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
No_of_ve_bl	Pearson Correlation	.766	-.885*	-.242	.012	1.000**	-1.000**	-1.000**	.532	.675	.556	-.990	-.251	.250	.928	.142	-1.000**	.[a]	.[a]	.[a]
	Sig. (2-tailed)	.131	.046	.695	.988	.	.	.	.643	.528	.625	.088	.839	.839	.243	.909	.	.	.	.
	N	5	5	5	4	2	2	2	3	3	3	3	3	3	3	3	2	1	1	1
HL_ba	Pearson Correlation	-.107	.278	.078	.162	-.050	.413	.429	.431	.677	.391	-.841	-.648	-.384	-.233	.467	-.959	-1.000**	-1.000**	.[a]
	Sig. (2-tailed)	.840	.594	.883	.794	.968	.729	.718	.569	.323	.609	.159	.352	.616	.767	.533	.183	.	.	.
	N	6	6	6	5	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
hw_ba	Pearson Correlation	-.459	-.158	.359	-.769	-.941	.751	.740	-.420	-.565	-.443	.711	.097	-.391	-.760	-.045	-.887	-1.000**	-1.000**	.[a]
	Sig. (2-tailed)	.360	.765	.484	.128	.220	.459	.470	.580	.435	.557	.289	.903	.609	.240	.955	.305	.	.	.
	N	6	6	6	5	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2
io_ba	Pearson Correlation	-.243	-.129	-.481	.443	-.966	.993	.991	.877	.824	.852	.000	-.981*	-.908	-.171	-.464	-.461	-1.000**	-1.000**	.[a]
	Sig. (2-tailed)	.643	.808	.334	.455	.166	.073	.084	.123	.176	.148	1.000	.019	.092	.829	.536	.695	.	.	.
	N	6	6	6	5	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
sl_ba	Pearson Correlation	.391	-.384	.267	-.344	.063	.308	.324	.501	.742	.467	-.865	-.651	-.334	-.099	.399	-.910	-1.000**	-1.000**	.[a]
	Sig. (2-tailed)	.443	.452	.609	.571	.960	.801	.790	.499	.258	.533	.135	.349	.666	.901	.601	.272	.	.	.
	N	6	6	6	5	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2
No_of_ve_ba	Pearson Correlation	.297	.411	.503	-.392	.779	-.955	-.960	-.612	-.676	-.564	.241	.928	.912	.532	.002	.826	1.000**	1.000**	.[a]
	Sig. (2-tailed)	.567	.418	.309	.514	.431	.192	.181	.388	.324	.436	.759	.072	.088	.468	.998	.382	.	.	.
	N	6	6	6	5	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
tl_ba	Pearson Correlation	.583	.151	.667	-.819	.647	-.323	-.306	.755	.896	.754	-.718	-.590	-.133	.471	-.053	-.047	-1.000[**]	-1.000[**]	.[a]
	Sig. (2-tailed)	.225	.775	.148	.090	.552	.791	.802	.245	.104	.246	.282	.410	.867	.529	.947	.970	.	.	.
	N	6	6	6	5	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2
Hl_cm	Pearson Correlation	.000	.999[**]	-.997[**]	.996	.899	-.676	-.663	-.782	-.595	-.773	-.430	.789	.842	.077	.769	.197	1.000[**]	1.000[**]	.[a]
	Sig. (2-tailed)	1.000	.001	.003	.055	.289	.528	.539	.218	.405	.227	.570	.211	.158	.923	.231	.874	.	.	.
	N	4	4	4	3	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
hw_cm	Pearson Correlation	.229	.849	-.835	.849	.966	-.993	-.991	-.744	-.694	-.709	-.062	.954*	.979*	.389	.361	.620	1.000**	1.000**	.[a]
	Sig. (2-tailed)	.771	.151	.165	.355	.166	.073	.084	.256	.306	.291	.938	.046	.021	.611	.639	.574	.	.	.
	N	4	4	4	3	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2
io_cm	Pearson Correlation	.447	.836	-.868	.933	.899	-.676	-.663	-.337	-.110	-.321	-.730	.496	.800	.434	.617	.461	1.000**	1.000**	.[a]
	Sig. (2-tailed)	.553	.164	.132	.234	.289	.528	.539	.663	.890	.679	.270	.504	.200	.566	.383	.695	.	.	.
	N	4	4	4	3	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
sl_cm	Pearson Correlation	.185	.546	-.513	.689	.646	-.881	-.889	-.678	-.775	-.633	.387	.943	.838	.407	-.030	.797	1.000**	1.000**	.[a]
	Sig. (2-tailed)	.815	.454	.487	.516	.553	.314	.303	.322	.225	.367	.613	.057	.162	.593	.970	.413	.	.	.
	N	4	4	4	3	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2
No_of_ve_cm	Pearson Correlation	.145	-.164	.208	.084	.053	-.415	-.431	-.216	-.492	-.172	.861	.497	.290	.356	-.651	1.000*	1.000**	1.000**	.[a]
	Sig. (2-tailed)	.855	.836	.792	.946	.966	.727	.716	.784	.508	.828	.139	.503	.710	.644	.349	.018	.	.	.
	N	4	4	4	3	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
tl_cm	Pearson Correlation	-.204	.987*	-.978*	.995	.774	-.488	-.473	-.853	-.661	-.854	-.388	.757	.731	-.128	.846	.015	1.000**	1.000**	.[a]
	Sig. (2-tailed)	.796	.013	.022	.061	.436	.675	.686	.147	.339	.146	.612	.243	.269	.872	.154	.990	.	.	.
	N	4	4	4	3	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2
Hl_dsj	Pearson Correlation	-.749	.426	-.621	.735	-.706	.397	.381	-.975*	-.967*	-.979*	.294	.775	.426	-.459	.504	-.044	.[a]	.[a]	.[a]
	Sig. (2-tailed)	.087	.399	.189	.157	.501	.740	.751	.025	.033	.021	.706	.225	.574	.541	.496	.972	.	.	.
	N	6	6	6	5	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
hw_dsj	Pearson Correlation	-.312	.828*	.121	.082	-.070	-.300	-.317	.105	-.200	.146	.874	.191	.032	.389	-.862	.887	1.000**	1.000**	.[a]
	Sig. (2-tailed)	.547	.042	.819	.896	.955	.806	.795	.895	.800	.854	.126	.809	.968	.611	.138	.305	.	.	.
	N	6	6	6	5	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2
io_dsj	Pearson Correlation	1	-.410	.331	-.417	.966	-.993	-.991	.480	.470	.524	-.272	.000	.413	.970*	-.396	.887	1.000**	1.000**	.[a]
	Sig. (2-tailed)		.420	.522	.485	.166	.073	.084	.520	.530	.476	.728	1.000	.587	.030	.604	.305	.	.	.
	N	6	6	6	5	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
sl_dsj	Pearson Correlation	-.410	1	.138	.178	.868	-.625	-.612	-.791	-.597	-.785	-.441	.772	.814	.030	.798	.145	1.000**	1.000**	.[a]
	Sig. (2-tailed)	.420		.795	.774	.331	.570	.581	.209	.403	.215	.559	.228	.186	.970	.202	.907	.	.	.
	N	6	6	6	5	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2
No_of_ve_dsj	Pearson Correlation	.331	.138	1	-.969**	-.856	.606	.592	.749	.543	.744	.495	-.740	-.812	-.059	-.805	-.145	-1.000**	-1.000**	.[a]
	Sig. (2-tailed)	.522	.795		.007	.346	.585	.597	.251	.457	.256	.505	.260	.188	.941	.195	.907	.	.	.
	N	6	6	6	5	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
tl_dsj	Pearson Correlation	-.417	.178	-.969**	1	1.000**	-1.000**	-1.000**	-.999**	-.992	-.994	-.359	.886	.774	-.176	.785	.112	1.000**	1.000**	.[a]
	Sig. (2-tailed)	.485	.774	.007		.	.	.	.032	.081	.071	.766	.307	.437	.887	.425	.929	.	.	.
	N	5	5	5	5	2	2	2	3	3	3	3	3	3	3	3	3	2	2	2
Hi_ps	Pearson Correlation	.966	.868	-.856	1.000**	1	-.930	-.924	-.953	-.021	-.992	-.468	.829	.983	.900	.189	1.000**	1.000**	1.000**	.[a]
	Sig. (2-tailed)	.166	.331	.346	.		.239	.250	.196	.987	.082	.690	.378	.118	.287	.879	.	.	.	.
	N	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
hw_ps	Pearson Correlation	-.993	-.625	.606	-1.000**	-.930	1	1.000*	.998*	.386	.876	.112	-.976	-.982	-.997*	.184	-1.000**	-1.000**	-1.000**	.[a]
	Sig. (2-tailed)	.073	.570	.585	.	.239		.011	.043	.748	.321	.929	.139	.121	.048	.882	.	.	.	.
	N	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2
io_ps	Pearson Correlation	-.991	-.612	.592	-1.000**	-.924	1.000*	1	.996	.402	.867	.094	-.980	-.979	-.998*	.201	-1.000**	-1.000**	-1.000**	.[a]
	Sig. (2-tailed)	.084	.581	.597	.	.250	.011		.054	.737	.332	.940	.128	.132	.037	.871	.	.	.	.
	N	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
sl_ps	Pearson Correlation	.480	-.791	.749	-.999*	-.953	.998*	.996	1	.950*	.998**	-.136	-.861	-.598	.314	-.593	-.062	-1.000**	-1.000**	.[a]
	Sig. (2-tailed)	.520	.209	.251	.032	.196	.043	.054		.050	.002	.864	.139	.402	.686	.407	.960	.	.	.
	N	4	4	4	3	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2
No_of_ve_ps	Pearson Correlation	.470	-.597	.543	-.992	-.021	.386	.402	.950*	1	.939	-.433	-.870	-.533	.261	-.317	-.237	-1.000**	-1.000**	.[a]
	Sig. (2-tailed)	.530	.403	.457	.081	.987	.748	.737	.050		.061	.567	.130	.467	.739	.683	.847	.	.	.
	N	4	4	4	3	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
tl_ps	Pearson Correlation	.524	-.785	.744	-.994	-.992	.876	.867	.998**	.939	1	-.117	-.830	-.559	.366	-.623	.000	-1.000**	-1.000**	.[a]
	Sig. (2-tailed)	.476	.215	.256	.071	.082	.321	.332	.002	.061		.883	.170	.441	.634	.377	1.000	.	.	.
	N	4	4	4	3	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2
Hl_nnc	Pearson Correlation	-.272	-.441	.495	-.359	-.468	.112	.094	-.136	-.433	-.117	1	.189	-.175	-.099	-.655	.887	1.000**	1.000**	.[a]
	Sig. (2-tailed)	.728	.559	.505	.766	.690	.929	.940	.864	.567	.883		.811	.825	.901	.345	.305	.	.	.
	N	4	4	4	3	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
hw_nnc	Pearson Correlation	.000	.772	-.740	.886	.829	-.976	-.980	-.861	-.870	-.830	.189	1	.878	.202	.299	.560	1.000**	1.000**	.[a]
	Sig. (2-tailed)	1.000	.228	.260	.307	.378	.139	.128	.139	.130	.170	.811		.122	.798	.701	.622	.	.	.
	N	4	4	4	3	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2
io_nnc	Pearson Correlation	.413	.814	-.812	.774	.983	-.982	-.979	-.598	-.533	-.559	-.175	.878	1	.545	.309	.716	1.000**	1.000**	.[a]
	Sig. (2-tailed)	.587	.186	.188	.437	.118	.121	.132	.402	.467	.441	.825	.122		.455	.691	.492	.	.	.
	N	4	4	4	3	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
sl_nnc	Pearson Correlation	.970*	.030	-.059	-.176	.900	-.997*	-.998*	.314	.261	.366	-.099	.202	.545	1	-.441	.959	1.000**	1.000**	.[a]
	Sig. (2-tailed)	.030	.970	.941	.887	.287	.048	.037	.686	.739	.634	.901	.798	.455		.559	.184	.	.	.
	N	4	4	4	3	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2
No_of_ve_nnc	Pearson Correlation	-.396	.798	-.805	.785	.189	.184	.201	-.593	-.317	-.623	-.655	.299	.309	-.441	1	-.528	-1.000**	-1.000**	.[a]
	Sig. (2-tailed)	.604	.202	.195	.425	.879	.882	.871	.407	.683	.377	.345	.701	.691	.559		.646	.	.	.
	N	4	4	4	3	3	3	3	4	4	4	4	4	4	4	4	3	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
tl_nnc	Pearson Correlation	.887	.145	-.145	.112	1.000**	-1.000**	-1.000**	-.062	-.237	.000	.887	.560	.716	.959	-.528	1	1.000**	1.000**	.[a]
	Sig. (2-tailed)	.305	.907	.907	.929	.	.	.	.960	.847	1.000	.305	.622	.492	.184	.646		.	.	.
	N	3	3	3	3	2	2	2	3	3	3	3	3	3	3	3	3	2	2	2
Hl_tp	Pearson Correlation	1.000**	1.000**	-1.000**	1.000**	1.000**	-1.000**	-1.000**	-1.000**	-1.000**	-1.000**	1.000**	1.000**	1.000**	1.000**	-1.000**	1.000**	1	1.000**	.[a]
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.
	N	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
hw_tp	Pearson Correlation	1.000**	1.000**	-1.000**	1.000**	1.000**	-1.000**	-1.000**	-1.000**	-1.000**	-1.000**	1.000**	1.000**	1.000**	1.000**	-1.000**	1.000**	1.000**	1	.[a]
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.
	N	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
io_tp	Pearson Correlation	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
	N	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
sl_tp	Pearson Correlation	1.000**	1.000**	-1.000**	1.000**	1.000**	-1.000**	-1.000**	-1.000**	-1.000**	-1.000**	1.000**	1.000**	1.000**	1.000**	-1.000**	1.000**	1.000**	1.000**	.[a]
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
No_of_ve_tp	Pearson Correlation	-1.000**	-1.000**	1.000**	-1.000**	-1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	-1.000**	-1.000**	-1.000**	-1.000**	1.000**	-1.000**	-1.000**	-1.000**	.[a]
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

		io_dsj	sl_dsj	No_of_ve_dsj	tl_dsj	Hi_ps	hw_ps	io_ps	sl_ps	No_of_ve_ps	tl_ps	Hl_nnc	hw_nnc	io_nnc	sl_nnc	No_of_ve_nnc	tl_nnc	Hl_tp	hw_tp	io_tp
tl_tp	Pearson Correlation	1.000**	1.000**	-1.000**	1.000**	1.000**	-1.000**	-1.000**	-1.000**	-1.000**	-1.000**	1.000**	1.000**	1.000**	1.000**	-1.000**	1.000**	1.000**	1.000**	.[a]
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
tl_bl	Pearson Correlation	.474	-.614	.658	-.838	-1.000**	1.000**	1.000**	.839	.728	.824	.151	-.965	-.972	-.384	-.992	-1.000**	.[a]	.[a]	.[a]
	Sig. (2-tailed)	.420	.271	.227	.162	.	.	.	.366	.481	.384	.903	.170	.152	.749	.082	.	.	.	.

N	5	5	5	4	2	2	2	3	3	3	3	3	3	3	3	2	1	1	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Cannot be computed because at least one of the variables is constant.