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TOPIC:

THE WONDERFUL WORLD OF ANIMALS: THE ANCESTOR'S TALE AND DESCENDANT'S STORY

By

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An Inaugural Lecture Delivered at the University of Lagos J. F. Ade. Ajayi Auditorium on Wednesday 17th April 2019

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DEDICATION

This inaugural lecture is dedicated to the memories of my grandparents His Royal Majesty, Uku Akpolokpolo, Oba Akenzua II and Her Royal Highness, Oloi Obazuaye Akenzua.

PROTOCOL

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Deputy Vice-Chancellor (Academic & Research),
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Other Principal Officers of the University,
Your Lordships (Temporal and Spiritual),
Your Royal Majesties and Highnesses,
Distinguished Academic and Professional Colleagues,
Non-Academic Colleagues (Administrative and Technical),
Dear Students (Past and Present),
Members of the Press (Print and electronic Media),
Distinguished Ladies and Gentlemen.

1.0 PREAMBLE

I give glory, honour and adoration to the Almighty God who made today a reality in my life. It is neither by power nor by might but by the special grace of God that I am standing here before you this day, as a Professor of Zoology, in the prestigious University of Lagos, the University of first-choice and the Nation's pride to deliver the 340th Inaugural Lecture. A journey into the world of animals: a fulfilled life of teaching and research for over 3 decades in my alma mater.

When I embarked on my journey through Life, like most of us, it never crossed my mind that I will end up a lecturer, talk less of a professor. All my concern then and even now was reading

books and for this, I was nicknamed 'Bookworm' by family and friends and along the way, I also added 'Passing Exams extremely well' to one of my past times. How were my Grandparents, (who raised me) to know that the books I was reading as a young girl, which were cleverly shielded from them, were mere romance novels?

I came to Lagos for the first time in January 1972, at the age of 17 while awaiting my West African School Certificate result, to do the entrance examination for the Federal School of Science, Lagos. The idea to attend the Federal School of Science (FSS) for A/Level was sold to me by my late aunt, Princess Mrs. C.I. Tokunboh, one of those who nicknamed me a bookworm, and who was also aware of my bias for science subjects. I returned to Benin and few weeks later, I received my admission letter by post. I returned to Lagos in August 1972 to resume school and I was placed in the my chosen option - Botany, Chemistry, Zoology for the London General Certificate of Education Advanced level.

I applied to the University of Lagos to study Zoology in 1974 through direct Entry at the age of 19 years while awaiting my London GCE Advanced Level result. I was successful and was admitted to study Zoology at the University of Lagos at the same time that my A/L results were released by FSS. Fortunately, I passed with distinction in three A/L subjects, Botany, Chemistry and Zoology at one sitting. This cleared the way for me to accept the University of Lagos admission and at matriculation, I was 20 years old.

I was not one of medicine rejects, and my application to University of Lagos was to study Zoology and that was what I was admitted for. The decision to choose University of Lagos I believe was by Divine Providence. I recognised some of the lecturers who examined us at FSS as members of Staff of the

Department of Biological Sciences and Zoology Unit, and I was very happy that we were in good hands. The ever loving and ever knowing Almighty God used these wonderful men and women who introduced many of us to academics by their dedication to their careers as lecturers.

At the end of the first year, I was awarded a Federal Government Academic Scholarship as the best graduating student in BSc. Zoology (Year 1). This scholarship fully paid for my studies and my hostel accommodation at Moremi Hall.

As the best graduating student in my final year, I was encouraged to return for M.Sc.by my lecturers after my National Youth Service. This I did and I was offered admission, after which I was awarded a University of Lagos Academic Bursary which funded my Master of Science Degree by Dissertation in Zoology, to continue my fascinating adventure with animals under the able supervision of Professor V.L. Yoloye. Prof. Yoloye guarded me when I chose my area of research, to reflect the importance of the macrobenthic organisms in the Lagos Lagoon and the title of my M.Sc. Dissertation on the Ecology of *Tympanotonus fuscatus*, the periwinkle took shape. Due to the exit of Prof. Yoloye from the University of Lagos to the University of Ilorin, the Department appointed Prof. W.O. Odiete, a world renowned animal physiologist as my new supervisor.

Prof. Odiete introduced me to the world of physiology and directed my path to incorporate my love for ecology into physiology to carve out an area of research ECOPHYSIOLOGY which has been my area of fascination since then. I successfully completed my M.Sc. Zoology degree and I applied to the University of Lagos for employment as an Assistant Lecturer, and after the interview, I was employed as an Assistant Lecturer in the Department of Zoology, University

of Lagos in 1981 (but deferred to 1982), a position I held until I was admitted to the University of Oxford for D.Phil. (Zoology), on a Commonwealth Academic Scholarship in October 1984. Exactly three years after my matriculation in the University of Oxford, as a Post Graduate Student in the Department of Zoology, I successfully defended my thesis and was awarded a Doctor of Philosophy in Zoology (D.Phil. Oxford). I returned to Nigeria and resumed my teaching and research at the Department of Zoology, University of Lagos. The rest as it is commonly said is history.

2.0 STRUCTURE OF THE LECTURE

This inaugural lecture is divided into four major sections, all of which covers my, teaching and research activities for over 30 years, which have been summarised here. The first section will shed more light on the branch of science called Zoology, some of its sub disciplines, the origin of the wonderful group of organisms called animals. The second section will give further and deeper insight into, man's perceptions of animal evolution and extinction. Some of the amazing events that occurred in the animal world since the beginning of time about four billion years ago: some of which will appear as a 'tale by the moonlight' due to lack of documentary evidence and some will just be unbelievable. The third section will bring together, the ecosystem and physiological processes, the challenges encountered by key animal species in the natural habitat of mangrove swamps and rainforest, and most especially man's impact on the ecosystems. The fourth section will highlight my major areas of research – a detailed description and eco-physiological assessment of the mangrove swamps in Lagos and the tropical rainforest in Southern Nigeria and the key animal species that use the two ecosystems as habitats.

Mr. Vice-Chancellor, Sir, I used some terminologies and definitions which I now want to explain.

3.0 KEYWORDS

3.1 WHAT IS A 'TALE' AND WHAT IS A 'STORY'.

The English dictionary describes 'tale' as a fictitious or true narrative or story, especially one that is imaginatively recounted or simply a narration that is hard to believe while a story is a narrative, and in its broadest sense, anything told or recounted that has documented evidence that makes it easy to believe.

3.2 AN ANIMAL

Animals are eukaryotes (cell with a nucleus), and multicellular organisms (body is made up of numerous cells), placed in kingdom Animalia. Animals do not have cell walls like plants but have cell membranes.

3.3 BIOLOGICAL EVOLUTION

Biological evolution explains how living organisms have diversified into the incredible and spectacular types of animal and plant species we see today and in fossil records. Evolution is the reason organisms continue to adapt to changes that occur in their habitats. Evolutionary processes have revealed that animal populations change through time; therefore all organisms are somehow related through shared ancestry.

3.4 GEOLOGICAL TIME

Geological time is quite vast and runs into millions of years. For easy understanding, it has been divided into Eras, Periods and Epochs based on fossil evidence. Backward chronology will lead to the start of life forms while forward chronology will indicate the diversity of life forms as the ancestors of any set of species must meet at a particular geological moment (Dawkins, 2004), with the last common ancestor they share.

Table 1: GEOLOGICAL TIME SCALE

Era	Period	Epoch	Start/End
Archaean			4.56 - 2.5 billion years ago
Proterozoic			2.5 billion - 541 million years ago
Palaeozoic	Cambrian		541 - 485 million years ago
	Ordovician		485 - 444 million years ago
	Silurian		444 - 419 million years ago
	Devonian		419 - 359 million years ago
	Carboniferous		359 - 298 million years ago
	Permian		298 - 252 million years ago
Mesozoic	Triassic		252 - 201 million years ago
	Jurassic		201 - 145 million years ago
	Cretaceous		145 - 65 million years ago
Cenozoic		Palaeocene	66 - 56 million years ago
		Eocene	56 - 34 million years ago
		Oligocene	34 - 23 million years ago

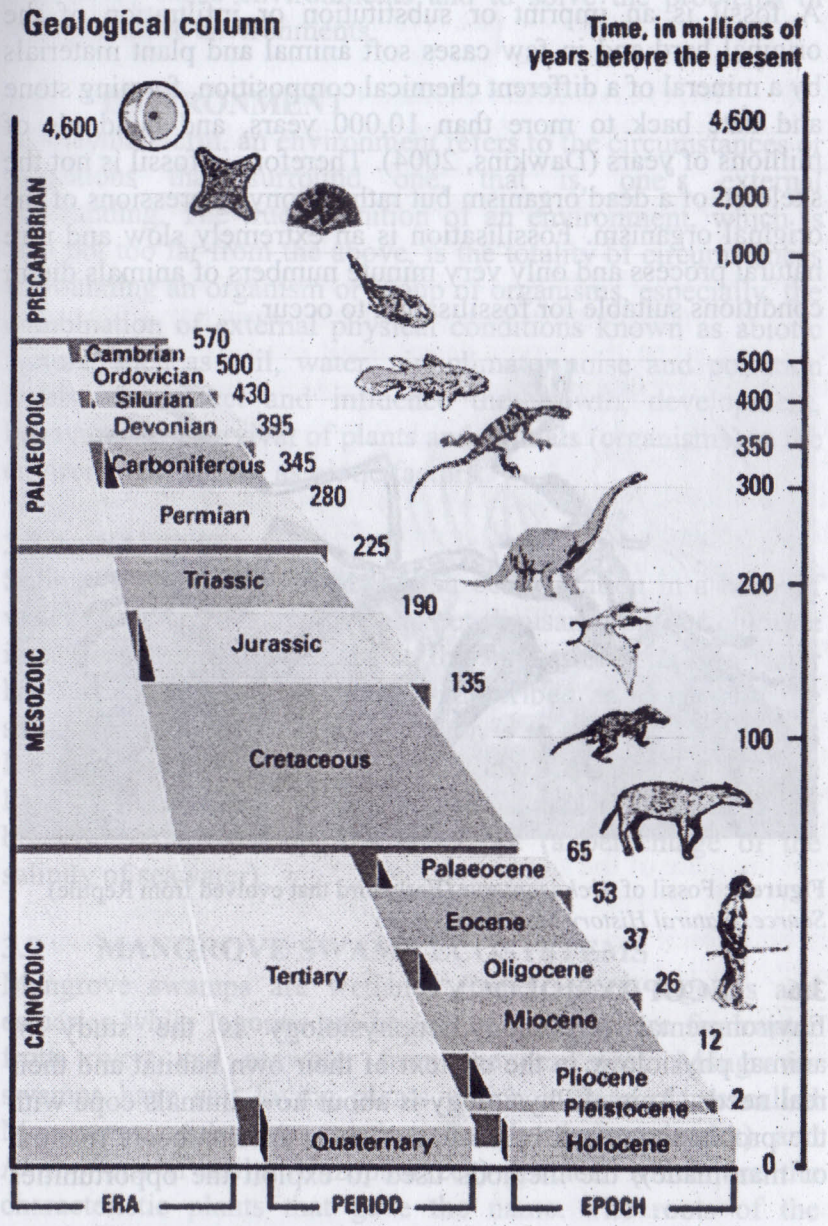


Figure 1: Geological Time Scale
Source:https://www.pinterest.com/pin/567383253031266525/

3.5 FOSSILS

A fossil is an imprint or substitution or infiltration of the original hard and in few cases soft animal and plant materials by a mineral of a different chemical composition, forming stone and date back to more than 10,000 years, and hundreds of millions of years (Dawkins, 2004). Therefore, a fossil is not the skeleton of a dead organism but rather stony impressions of the original organism. Fossilisation is an extremely slow and rare natural process and only very minute numbers of animals die in conditions suitable for fossilisation to occur.

Figure 2: Fossil of *Archaeopteryx* (Early bird that evolved from Reptile)
Source: Natural History Museum, London

3.6 ECOPHYSIOLOGY

Environmental physiology/Ecophysiology is the study of animal physiology in the context of their own habitat and their real needs. Animal Physiology is about how animals cope with the problems created by their particular environments (natural or man-made); the methods used to exploit the opportunities

offered by these environments and to solve the problems of living in those environments.

3.7 ENVIRONMENT

In a layman term, an environment refers to the circumstances or conditions that surround one, that is, one's external surrounding. The true definition of an environment, which is also not too far from the above, is the totality of circumstances surrounding an organism or group of organisms, especially, the combination of external physical conditions known as abiotic factors, such as soil, water, air, climate, noise and pollution levels, that affect and influence the growth, development, behaviour and survival of plants and animals (organisms) in the environment, known as biotic factors.

3.8 SALINITY

Salinity is the measurement of salt concentration in a body of water and it is measured in parts per thousand (ppt) of chloride ions. Freshwater has no salt, so the salinity is zero. Sea water has salt added to it and so it is described as saline and the salinity is about 35 ppt. Lagos lagoon is an estuary because it is located between Ogun River and the Atlantic Ocean. The lagoon water is described as brackish and salinity range of brackish water is about 0.1 – 25 ppt (a percentage of the salinity of seawater).

3.9 MANGROVE SWAMP ECOSYSTEMS

Mangrove swamps are wetlands found around lagoons and estuaries while lagoons are bodies of water where freshwater from rivers and seawater from the sea meet. Mangroves swamps have salt loving plants which include plants called Mangroves, *Avicennia* species (Family Avicenniaceae) and *Rhizophora* (Family Rhizophoracea) species, which are the characteristic plants that gave the name. The roots of the mangrove remain in water only during the flood of the rainy

period and are described as "breathing roots", because oxygen is taken in and carbon dioxide is released through the roots.

3.10 TROPICAL RAIN FOREST ECOSYSTEMS

Tropical rainforests in Africa are found near the Equator and are found in West Africa including Nigeria, as well as Central and East Africa. It is an area with a mean annual temperature of at least 25 °C, which experience monthly rainfall, with mean annual rainfall exceeding 250 cm and humidity is above 80%. Trees in tropical rainforests replace their leaves throughout the year, and when the leaves decay, they produce a continuous stream of detritus materials that provide food for ants and snails.

3.11 REPRODUCTION IN ANIMALS

Reproduction is the ability of living organism (plants and animals) to produce new individuals who resemble their parents in a number of characteristics. The two types of reproduction in animals and plants are sexual reproduction and asexual reproduction. In asexual reproduction, a single individual gives rise to gametes but there is no fusion of these gametes; which means no genetic input from another individual. In sexual reproduction, male and female parents produce offspring through the union of eggs from the female and spermatozoa from the male of the species. A hermaphrodite animal has both functional female and male reproductive organs so in reproduction it can produce both eggs and spermatozoa. During copulation in hermaphroditic species there is an exchange of spermatophores (bundles of spermatozoa) so that self-fertilization is avoided.

4.0 THE SUBJECT ZOOLOGY

4.1 SCIENCE OF ZOOLOGY AND A WONDERFUL GROUP CALLED ANIMALS

Zoology: is the scientific study of animals (from the Greek word *Zoon* = Animal + Logos = study of), the study of animals. It is a subdivision of Biology (from the Greek word *Bios* = life + *Logos* = study of), the study of all life. The Science of Zoology is exciting, fascinating and awe-inspiring (Hickman *et al.*, 2002). Zoology is so broad and diverse that no single individual can claim to know every aspect of it and a complete understanding of the subject is beyond the ability of a single person. Many of us came into zoology by choice but many of us were pushed to zoology. Zoology can be likened to a cake with many slices, therefore each person takes a little bit of it in slices - animal diversity (how animals function, live, reproduce and interact with their environment) and conservation are some of the key areas of Zoology. Each one of us in Zoology cuts a slice and masticates it thoroughly. The understanding of one sub discipline may require the knowledge of another subdiscipline, such as, a good understanding of the diversity of animal life, requires a good understanding of the long history of animal life, which is about 600 million years, in the subdiscipline known as Animal Evolution. There is interconnectivity among the various animal types and this relationship can be demonstrated as a genealogical tree called Phylogeny, where animals are positioned on the tree branches according to their evolution as ancestors or descendants.

5.0 MAN'S PERCEPTION OF ANIMAL EVOLUTION AND EXTINCTION

5.1 THE 'TALE' OF THE NATURAL WORLD

Astronomers calculated that the universe is fifteen billion years old; Geologists estimate that the Earth is about four billion years old and life has existed on Earth, these four billion years.

Life as we know it today originated from living matter millions of years ago, in conditions different from the present and since then living things; including us have to generate others like themselves by a process known as reproduction. Unlike single cell organisms such as bacteria without a nucleus, that have been in existence since the dawn of time, plants and animals have a recent evolutionary history, and the first eukaryote has been dated by DNA evidence to have evolved in the sea from prokaryotes between 2,500 and 1,000 million years ago.

Do these findings contradict the Bible story of creation? Life on planet Earth, has been constantly evolving to form the spectacular richness of our current living world (Pullin, 2002) but to some others, life on Earth has been attributed to series of coincidences, which were unknown or poorly understood. The interpretations of these coincidences depend on our religious and personal beliefs. Many of these coincidences were poorly understood until the 20th Century and to this moment can all of us answer logically this very important question: 'are Earth's features a product of blind chance or of purposeful design'?

The contradiction about the story of the creation is actually between the opinions of Christian Fundamentalists (Christians guided absolutely by the words of the Holy Bible and will force others to believe also) who wrongly believe that science disproves the Bible's account of creation, whereas a careful study of the Bible text does not show any conflict with established scientific facts. For the religious, the story of creation (Genesis 1:1) and that of the Great Flood (Genesis 7: 1 – 24) remind us that the Earth was a creation of God and that he filled the Earth with animals, male and female and gave them authority to procreate, multiply and fill the world. Even when he brought a flood, he ensured the survival of all the species by telling Noah to a take male and female of each kind into the ark, to ensure that all life will survive on earth after the flood

(Genesis: 1-3). Do scientific findings contradict the Bible story of creation?

However, in our world today, man, one of God's own creation is changing the environment in such a drastic manner that contravenes God's instruction of "Be fruitful and multiply". More and more species are threatened with extinction than ever before, in most cases due to reproductive toxicity from exposure of species to various man-made industrial and environmental chemicals and this is worrisome. The Astronomer Royal, Lord Martin Rees, in his book (2004) asked a very important question on the future prospect for humanity in the world as of today: 'is this our final century?' Because he believes that human civilization has only a 50:50 chance of surviving the 21st Century.

5.2 STORY OF CREATION

Myths and superstitions have surrounded the story of the origin of animal and plant species and if we support the story of creation, then does the progressive appearance of plants and animals imply that God used evolution to create the vast diversity of living things? No, as it is clearly stated in the Bible, that God created all the basic kinds of animals and plants (Genesis 1: 11, Genesis 2: 20 – 25). However, were these original kinds of plants and animals programmed by God with the ability to adapt to changing environmental conditions? The Bible story states that living creatures swarmed forth 'according to their kind' (Genesis 1: 21), and the Bible story clearly defined the boundary of each 'kind'. God blessed them and said, 'Be fruitful and increase in number and fill the water in the seas, and let the birds increase on the earth.' (Genesis 1: 22).

5.3 TALE OF ANIMAL DIVERSITY

Biodiversity or biological diversity describes the richness and diversity of life on Earth. Fossil records have revealed that there was a time when there was nothing on Earth, that is, it was void and without form and then the first life, and as a result of the constant evolution over geological time, life has steadily increased in diversity and complexity, to form the spectacular richness of life in our current living world (Pullin, 2000). The constant evolution of life on Earth has resulted in the formation of a spectacular richness of our current living world. Fossil records have revealed that on average, life has steadily increased in diversity and complexity over geological time to produce today's natural richness of living things of which humans, *Homo sapiens* are the product of and benefit from (Bruges, 2002). This increase in biodiversity cannot be described to have occurred at a steady rate, because it was punctuated by sharp drops when many taxa disappeared, a situation described as 'mega-extinction' events, followed by rapid recovery as many new taxa appear in their places. The mega extinction events are thought to have been caused by major climatic changes at these times and many species which were not able to cope with the rapid changes in their environments perished.

5.4 CHARLES DARWIN'S THEORY OF EVOLUTION

Charles Robert Darwin (1809 – 1882) during his trip round the world (December 1831 to October 1836) on the ship HMS *Beagle*, saw nature as it really was, and he was able to explain many happenings in the natural world of living things. The events Charles Darwin witnessed during the trip were so unbelievable even to himself, that he mockingly berated himself that he had devoted his life to 'fantasy' (taletelling or 'Ameboism'). This may be why it took Darwin twenty years after he returned from the trip round the world, to write his

famous journal '*On the Origin of Species by means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life*" (1859). Charles Darwin published his findings and views in the Journal of Linnean Society along with the theory of "evolutionary mechanism" published by Alfred Russel Wallace (1823-1913), who independently developed the same theory of Natural Selection like Charles Darwin.

Charles Darwin's book on the Theory of Evolution is over 150 years old, it explained that all species, whether plants or animals evolved and continue to evolve over vast periods of time by a principle named by him as 'Theory of Natural Selection', which is defined as the preservation of favourable variations and the rejection of injurious variations, by which stronger or 'fitter' organisms, equipped with useful variation, no matter how small, are likely able to survive and reproduce than their weaker counterparts.

5.5 THE TALE "CONQUEST OF THE LAND AND EVOLUTION OF FIRST TERRESTRIAL VERTEBRATES"

"Conquest of the land by first land vertebrates", is a pre - Darwinian tale which changed to a story as a result of evidence provided by fossil records. The early vertebrates with four limbs that evolved from fishlike ancestors and which had evolved characteristics such as modification of fins to limbs for life on land is the first Tetrapod (four legs). Fossil records revealed that evolution of Terrestrial Vertebrates took place in the Devonian period, of the Paleozoic era which began about 419.2 million years ago (mya) to 358.9 mya. The major ecological features of the period were mild temperatures and alternating flooding and drought and the instability of freshwater environment, when many pools and streams started to dry up (Hickman *et al.*, 2000). Obtaining oxygen from the polluted aquatic habitats became a problem and it was only the

fish that were able to use atmospheric oxygen for respiration that survived. The fishlike ancestors probably started by crawling from one pool to another and then spending more time on land. This may have been responsible for the evolution of lungs and limbs from pectoral and pelvic fins; two characteristics present in the late Devonian lobed finned lung fish, *Eusthenopteron foordi* (Superclass Osteichthyes, Class Sarcopterygii, Order Crossopterygii; Suborder Rhipidistia) the ancestor of the early tetrapod that gave rise to amphibians, the first group of terrestrial tetrapod. It involved the gradual transformation from the body plan of a fish to the body plan for life on land by the ancestors of early vertebrates. It involved the transformation of the fins of fish to forelegs and hind legs, gills transformed to lungs and eyelids developed. Amphibians (frogs, toads, salamanders etc.) are the first terrestrial vertebrate tetrapod and the only living vertebrates that display a transition from water to land in their ontogeny and phylogeny, while the major theme of the remaining vertebrate groups was an adaptation for life on land (Hickman *et al.*, 2000). Amphibians lay eggs in water, the eggs hatch into tadpoles, which are fish-like, limbless and breathe with gills. No amphibian has completely conquered the land, despite a time lag of 350 million years since the first land animals crawled out of the water to live on land.

The movement of the lobbed fin fish ancestors of amphibians in Devonian Period, about 400 mya from the aquatic environment where it evolved, to land, may have been due to a survival strategy of the fish ancestor of amphibians. The fish may not have set out to evolve into land animals; so it may not have considered this momentous passage as anything extraordinary but a survival strategy. Evolutionary biologists regard that the momentous leap of lobbed fin fish from water to land at the end of Devonian period, about 400 mya, resulted in the jump from one vertebrate Class: Fish/Pisces to another vertebrate Class:

Amphibia (Dawkins, 2004). This major evolutionary event, which zoologists tag 'conquest of the land' was the beginning of the evolution of the Tetrapoda (four limbs), or animals with four appendages – amphibians, reptiles, birds and mammals. Two major adaptation characteristics of the ancestral fish were that they had lungs and bony limbed fins which were very helpful in the adaptation of a lobbed fin fishes that evolved and lived in aquatic or habitat containing water to live on dry land. The earliest amphibians, that evolved in the Devonian period from the lobbed fin fish diversified and became dominant during the Carboniferous and Permian periods, but were later displaced by reptiles and other vertebrates.

5.6 TALE OF MASS EXTINCTIONS

Mass extinction is the extermination of a large number of species within a relatively short period of geological time, probably due to factors such as a catastrophic global event or widespread environmental change that occurs too rapidly for most species to adapt. Five mass extinction events have occurred throughout earth's history (Figure 3).

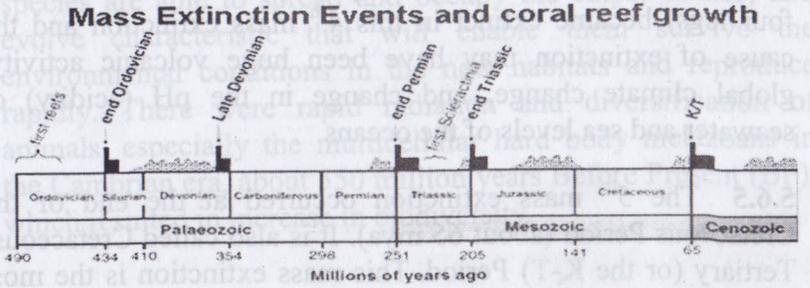


Figure 3: Timeline of mass extinction events. The five named vertical bars indicate mass extinction events (Veron, 2008).

5.6.1 The 1st mass extinction occurred at the end of the Ordovician Period (about 440 million years ago) when

according to the fossil record, 85% of the biodiversity of both terrestrial and marine life (animals) worldwide were exterminated. The cause of extinction was said to be due to Continental Drift and Climate Change.

5.6.2 The 2nd mass extinction occurred in the Late Devonian Period (about 375 mya). Nearly 80% of all living species existing at the time were completely wiped out. The causes were likely to be due to little or no oxygen in the oceans, quick cooling of air temperatures, possibly volcanic eruptions and/or meteor strikes.

5.6.3 The 3rd mass extinction took place at the end of the Permian Period (about 250 mya). An Estimated 80-96% of all species living on Earth at the time (marine species) were wiped out. The cause or causes of the mass extinction was unknown but scientists theorize that it might have been due to asteroid strikes, volcanic activity, climate change, and microorganisms.

5.6.4 The 4th mass extinction occurred at the end Triassic Period (about 200 mya). About half of all marine invertebrate and about 80% of all land quadrupeds (animals that walked on four legs) became extinct in this 4th mass extinction and the cause of extinction may have been huge volcanic activity, global climate change, and change in the pH (acidity) of seawater and sea levels of the oceans.

5.6.5 The 5th mass extinction occurred at the end of the Cretaceous Period (about 65 mya). It is also called Cretaceous-Tertiary (or the K-T) Period. This mass extinction is the most known because it is the mass extinction when the dinosaurs, the huge reptiles that walked on land (Figure 4) became extinct and up to 75% of all known living species also died. The cause of this mass extinction was a major asteroid impact.

5.6.6 The 6th Mass Extinction- is this happening now? Zoologists believe that it is possible we are in the midst of the 6th major mass extinction. This assumption is based on the high rates of species extinction due to anthropogenic (man-made) problems as a result of our lifestyle (Obot, 2009). The question is, will human survive or will we go the way of the reptiles called dinosaurs? Is it a "story" or "tale", that humanity has caused the rise in CO_2 levels by 7% - 10% in the last three decades, caused a phenomenon known the "greenhouse gas effect" which has led to a rise in temperature by 0.5 – 0.7 ^{0}C since 1900, causing global warming and climate change? We will not know if it is a tale or a story if the predicted 6th Mass extinction does take place, because no one will come back from heaven to say I told you so.

The good news is that after each catastrophic event, some of the extinct species were quickly replaced by new species that evolved but some species of animals became extinct and never to be seen alive. For example, birds are the sole survivor of a dinosaur line known as Theropod Dinosaurs. The mass extinction of species leaves habitats bare, so the surviving species are able to spread and occupy the empty niches, and evolve characteristic that will enable them survive the environmental conditions in the new habitats and reproduce rapidly. There were rapid radiation and diversification of animals, especially the multicellular hard body metazoans in the Cambrian era, about 550 million years Before Present (BP), which resulted in increase in biodiversity.

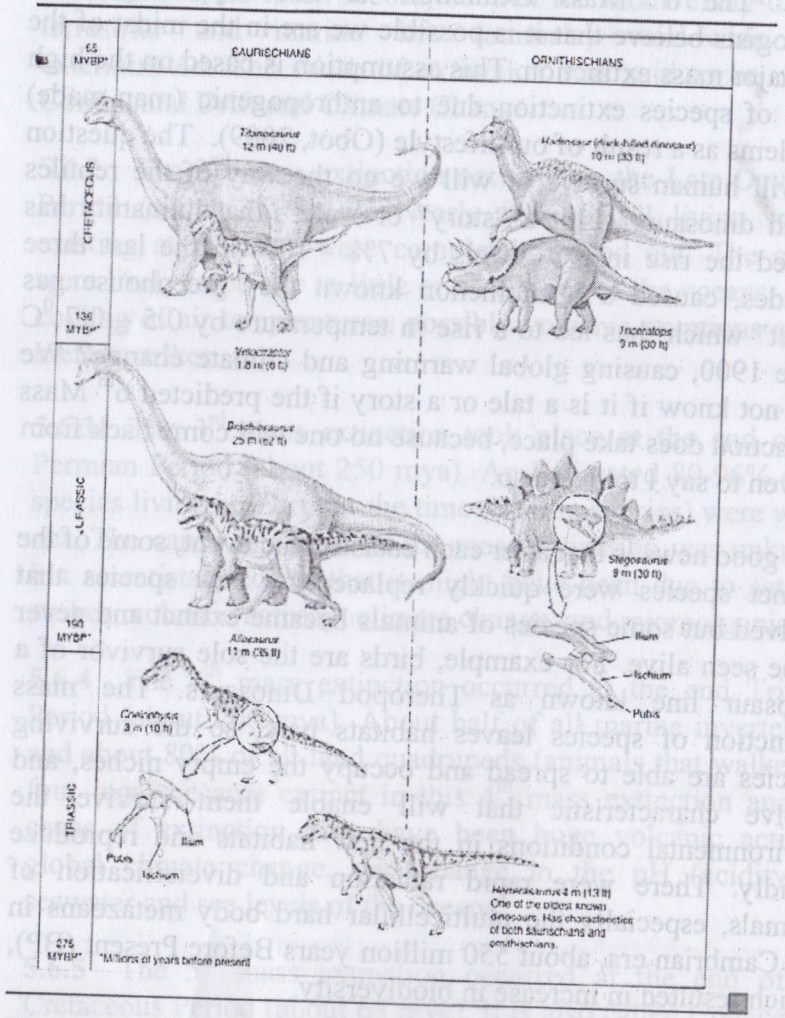


Figure 4: Mesozoic Park of Dinosaurs
Source: The Natural History Museum Book of Dinosaurs

5.7 TALE OF CONTINENTAL DRIFT

When the 'Theory of Continental Drift' was proposed by Alfred Wegener in 1910 to explain why the Earth's landmass is divided by oceans, mountain ranges and into different

continents. No one believed him and people considered it a tale, because according to Wegener, throughout most of the geological time, the world was made up of one single continent called Pangaea. This continent eventually separated and drifted apart, forming the 7 continents we have today. Some evidence that Alfred Wegener used to defend his theory included:

- Fossil records are similar between South America and Africa
- Similar rocks found in South America and Africa
- There is a ridge in the mid – Atlantic Ocean.

Despite the above reasons, Wegener could not provide convincing evidence for his theory, to explain what moved the continents, so he was not able to convince geophysicists and other scientists. Therefore, the discovery of phenomenon known as "seafloor spreading" by a Professor of Geology, Harry Hess generated a new theory called "Theory of Plate Tectonics", which was published in the History of Ocean Basins (1962). This new theory proposed thereafter was a more acceptable reason the continents are no longer all together as they used to be. Although, some questions are still being asked, this new theory was more accepted as the reason the continents are not together today. He published his theory in *History of Ocean Basins* (1962), and it came to be called "seafloor spreading."

5.8 The Story of the Duck-billed Platypus (*Ornithorhynchus anatinus*, Blumenbach)

The duck-billed platypus (Class Mammalia; Subclass Prototheria; Order Monotremata) is one of the few remaining egg-laying mammals, endemic to Australia and Tasmania. The duck billed platypus is a mammal because it has hair (Figure 5). In its natural habitat, the duck-billed platypus, is semi-aquatic and is covered with fur-like hairs, has no teeth; females have no placenta like mammals and lay eggs like reptiles and birds;

when the eggs hatch, the offspring lick up the milk produced by the mother off the fur of the mother's belly because the female duck-billed platypus have no mammary glands like placental mammals. Platypus has cloaca like reptiles and birds, instead of anus as in mammals. It lays eggs like reptiles and birds and the internal organs show that it shares many similarities with a reptile and the bill is like the beak of a duck, which is a bird (Figure 5).

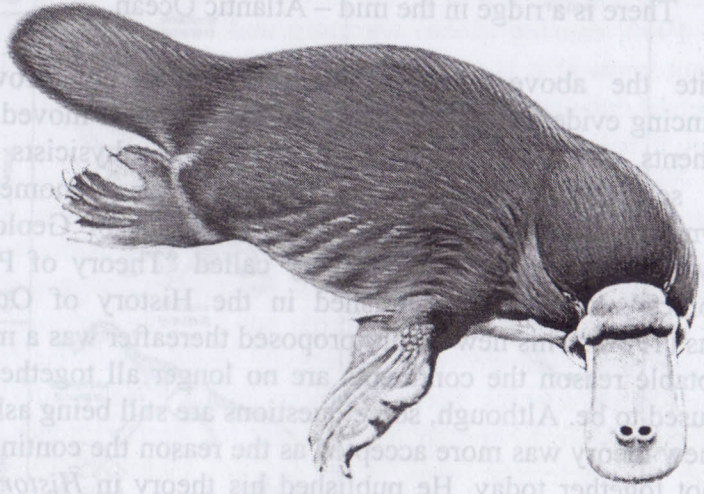


Figure 5: Duck-billed Platypus (*Ornithorhynchus anatinus*), a mammal
Source: Getty Images/Dorling Kindersle

When this creature was received in the British Museum in 1798 from Australia, the zoologists there concluded that someone had stitched together parts of different animals. The "creature" which was the size of a cat had webbed feet like a duck; it had a duck-like beak and flat paddle-like feet. The zoologists in the British Museum were so confused because they have never seen such a strange combination of the traits of mammals, birds and reptiles on a single creature and did not know what to make of them. When zoologists outside Australia and Tasmania were

able to see this strange mammal in its natural habitat, they all agreed that the strange combination of characteristics displayed by duck billed platypus could be used to explain the diversity of adaptations that evolved in vertebrate animals, to enable them, occupy nearly every habitat on planet Earth. Many of the characteristics are to correct the possible effects of the external changes found in other animal groups.

5.9 STORY AND TALE OF THE EVOLUTION OF *HOMO SAPIENS* (THE WISE ONE)

Zoologists, archaeologists and paleontologists, have documentary evidence to tell the story to make us believe that modern humans (*Homo sapiens*), the 'wise one' an upright-walking species that lives on the ground, very likely first evolved in Africa about 400,000 years ago, from a hominoid primate (Order Primates: Suborder Anthropoidea: Superfamily Hominoidea: Family Hominidae); The human-like primate which likely arose in Africa, 1 to 6 mya that is now extinct (Russell *et al.*, 2008).

The fossilised remains of a group of the extinct hominid fossils identified by scientists and assigned to the two genera *Australopithecus* (Family Hominidae: Genus *Australopithecus*) and *Paranthropus* (Family Hominidae: Genus *Paranthropus*) were discovered in East, Central and South Africa and dated 1.2 to 4.2 mya (Russell *et al.*, 2008). The most famous of them, *Australopithecus africanus* so far discovered only in South Africa was 'handsome' but ape-like in appearance and which scientists agree, is ancestral to humans (Genus *Homo*). The fossil of earliest human, dated 1.7 to 2.3 mya is the *Homo habilis* ('handyman') that manufactured and used stone tools was discovered in the woodlands and savannas of East and South Africa.

The fossil of *Homo erectus* ("upright man") was also discovered in East Africa and dated to be 1.8 mya. *Homo erectus* made sophisticated tools and believed to have dispersed, from Africa to other continents about 1.5 mya due to a growing population (Leakey, 1934, Leakey, 1937, Leakey, 1951, Russell *et al.*, 2008).

The descendant species of *Homo erectus*, regarded as early human first appeared about 400 mya; nearly all went extinct except modern humans, *Homo sapiens* who are the sole survivors, which evolved in Africa, 200,000 to 100,000 years ago. The fossil records revealed that these extinct early humans and surviving modern humans, *Homo sapiens*, had a rounder skull, larger brain and smaller molar teeth than their common ancestor, *Homo erectus* (Russell *et al.*, 2008).

Human evolution is hard to believe so it is considered a tale: according to Charles Darwin, man possibly evolved from animal ancestors rather than being created by divine intervention. There is a divergent view on human origin. The Christian story as in the bible which documented evidence that man was created by a beneficent God on the 6th day and gave him dominion over all the things He created and on the 7th day He rested. However, naturalists or scientists hold strongly to the tale that man emerged step by step from some animal ancestor. Charles Darwin, in his book '*Origin of Species by Natural Selection* in 1859, in discussing human origins, said "he was not prepared to speculate in print" (Wordsworth Edition, 2013). He traced man to Old World monkeys and that the species called man must have 'diverged from the original monkey ancestor stock very early before the tail-less man-like apes with long arms and highly developed brain did. That is, the ancestor of man and the ancestor of monkeys probably came from a common ape-like ancestor.

5.10 BISHOP OF OXFORD' S DENIAL OF STORY OF MAN'S EVOLUTION (1860)

The story is told that in 1860, after the publication of '*The origin of Species'* there was a confrontation between the Bishop of Oxford and one young student of Charles Darwin called Thomas Huxley. Thomas Huxley, whom Charles Darwin described as a youthful and quarrelsome scientist met the Anglican Bishop of Oxford in a function and there was a verbal exchange between them. The Bishop asked Huxley "whether it was through his grandfather or his grandmother that he claimed his descent from an ape". Huxley was said to have responded by saying "he would not be ashamed to have a monkey for his ancestor, but he would be ashamed to be connected with a man who used his great gifts to obscure the truth". No one accepted the theory that man descended from apes then and even today, the evolution of man from the great ape (Figure 6) is still a tale, and it is said also that the Bishop of Oxford suggested to Huxley to "dive into the African forests in search of his grandfather". Another zoologist, at the time of Charles Darwin, Alfred Wallace, who formulated the principles of "evolution by natural selection" and published scientific papers on the topic, where he argued that natural selection was the primary reason apes became human beings, however, quickly backed down in another article he published in 1869: while supporting Charles Darwin that natural selection may have been what pushed apes to seem like human being, but that in his opinion it was not sufficient to explain the origin of the extraordinary mental capacity of humans and that some 'spiritual powers' made man what he is.

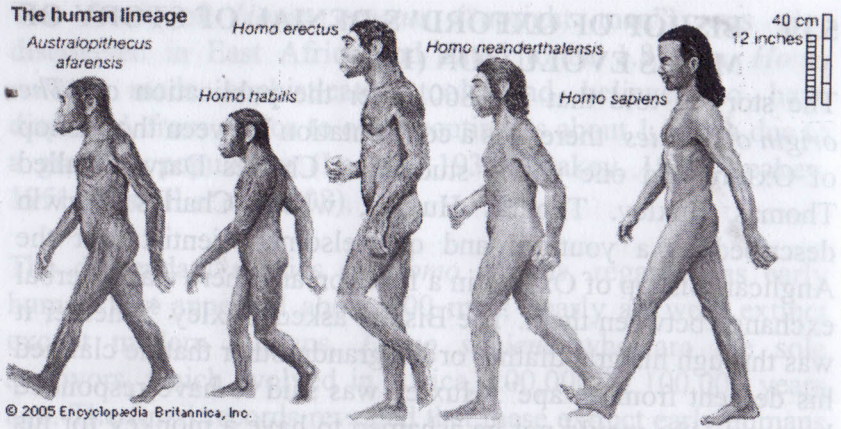


Figure 6: Evolution of *Homo sapiens*.
Source: Encyclopedia Britannica (2005)

5.11 UNBELIEVABLE

Despite the mountain loads of archeological and paleontological evidence on "Adam ancestors", by Dr. Louis Leakey (1903 – 1972), his family and other devoted scientists who worked tirelessly and demonstrated through their fossil discoveries the evolution of man was majorly and importantly an African event, instead of Asia as it was formerly thought. It is still distasteful to many people (including many of us in this auditorium) that man descended from some lower forms (some barbarians). Therefore, we will always contest our origin due to our more superior mental capacity, which is one of man's major evolutionary developments compared to "the other animals". It is also hard to believe that man has the same model with other mammals; our skeletal bones compare with those of monkeys, bats, and other mammals. It is also hard to believe that monkeys suffer from catarrh and stomach pain like us and lastly young monkeys also lose their milk teeth like human babies. Despite all of the above, the arrogance of man will not allow us to accept the simple truth.

6.0 THE STORY OF HUMAN RELATIONSHIP WITH THE ENVIRONMENT

Mr. Vice-Chancellor Sir, to best describe the monumental damage to the environment (air, water and land) two new words were added to the dictionary: "Anthropogenic" and "Anthropocene". The term "anthropogenic" is used to describe the effects of human on the environment (Tansley, 1935), and also refers broadly to all major human impact on the environment, resulting from human activity. The term anthropocene refers to the Geological period. "Anthropocene Epoch" was used by Steffen *et al.* (1970) to replace Holocene Epoch, as the name of this present time in Geological Time Scale, to describe a new period or era of event in history of the earth, dominated by man and characterised by environmental destructions through pollution emissions that are produced from human activity. It also applies broadly to all major human impacts on the environment. Anthropocene Epoch began in 1800 with the onset of industrialization which demanded the use of enormous expansion in the use of fossil fuels (Steffen *et al.*, 1970).

The period before 1800 was classified as pre-Anthropocene, which was the period before the advent of agriculture, 10000 to 12000 year BP. The first humans (*Homo sapiens*) were hunter-gatherers and used primitive tools to obtain their food, from their immediate environment. They were also opportunistic in their search for what to eat, gathering fruits and other food resources when available (Pullin, 2002). The first impact of humans on the environment was when humans discovered fire, which fossil records revealed started at the time of *Homo erectus* about 1,000,000 years BP. Although natural fires would have been a regular occurrence then, however, humans may have deliberately started fires on their own. Fires were used to drive out animals from their hiding places to make them easier to kill. Evidence for use of fires by early humans, *Homo*

sapiens in sites in East Africa dates from 60,000 years BP. Fires may also have been used to improve grassland to attract game animals. Fossil records showed that wherever these early humans migrated to, they were able to impact on the environment even with their primitive tools and fires. The fossil records also revealed that the sudden extinction of many large mammals, marsupials and birds such as the large flightless *Genyornis newtoni* in Australia and North America coincided with when hunter-gather humans reached these two continents about 50,000 and 12,000 years ago and took residence (Pullin, 2002). The loss of the large mammals and birds may have not been due to direct consumption by the early man in the habitat but through the use of fires may have done so much damage to the landscape that many species were not able to survive. In North America, the extinction of large mammals has been attributed to climate change and human colonisation.

There is evidence that Early Old World Agricultural practices which included the domestication of livestock such as goats, sheep and cattle occurred as early as 11, 000 BP in the Middle East (Pullin, 2002) and the grazing of the domesticated animals may have significantly impacted the local vegetation. There may have been an increase in the human population, which may have placed intense pressure on land use for agriculture. Domestication may have occurred side by side with the cutting down of trees for firewood, construction and tool making by the migrant Early Human. There may have been indiscriminate and intensive grazing, increasing use of fires, which may have prevented regeneration of the forest, and caused changes in the floral to the types more suitable for grazing.

Threats to the biodiversity of tropical rainforest have been identified as commercial logging and deforestation of the terrestrial tropical forests for subsistence farming a threat to biodiversity loss due to rapid population growth.

The most direct threat to biodiversity is the destruction of habitats and the unending clearing of tropical rainforest in the developing countries in the tropics, for mere subsistence agriculture due to rapid population growth. This has been described as the desperation of poor local population, which rather than leading to economic growth, is an indication of poverty and landlessness of the local population (Pullin, 2002). Peasant farmers in the tropics have always practiced their subsistence farming, however the population was low then, but now with the growing population, subsistence farming is now affecting the landscape more than ever before and causing environmental degradation and monumental loss of animal and plant species. Large trees and timbers are cut down and sold in many instances by the government of countries in tropical rainforest, to pay debts or to raise funds to run the government. Deforestation affects soil fertility and this has pushed farmers deeper into the rainforest, with the resultant degradation of new areas.

As for human, what is ingrained into many human societies is view that nature and its resources are there for humans to control and exploit, a mindset described as 'frontier ethics' (Pullin, 2002), whose principles are; there is always more and it is for us; humans are higher than nature, so will not obey the laws of nature and thirdly humans must dominate and control nature at all cost.

7.0 MY RESEARCH CONTRIBUTIONS TO KNOWLEDGE: DESCENDANT'S STORY

In discussing my humble contribution to knowledge, Mr. Vice-Chancellor Sir, I will be looking at how the relationship of humans with the environment has affected significantly the physiological processes in animals and their eco-physiological adaptations, if any. Unstable habits stretch the physiological tolerance of animals to the greatest limit and the animals there

can either adapt or perish, at least locally. The adaptations by animals to be able to stay alive, whether as single species or community of animals, in extremes of climates or changed climates due to environmental degradations are so extraordinary, so that if they fail, it is not because they did not try. You will be amazed by the ingenuity of animals in physiologically unstable habits due to anthropogenic disturbance, in their bid to stay alive.

My research interests span the following areas:

- Ecology of Mangrove Swamp, the Lagoon and Rainforest Ecosystems
- Comparative animal physiology within an environmental context
- Behavioural responses of animals to changes in their Habitats - How animals sense, react to and cope with environment changes
- Biodiversity Assessment of animals and Conservation
- Biotic Analysis of Pollutants, Environmental Assessment and Impact Analysis
- National Reserves and Forest Parks in Nigeria

Many of our research findings and discoveries are published in top International Biological Journals; the Journals of Animal Ecology and Physiology; Animal Conservation Journals; Journals of Environmental Protection and Monitoring. Many of our findings have contributed significantly to the baseline data for teaching and researches in ecology, physiology, toxicology, pollution and conservation. Some of my significant results and discoveries are hereunder highlighted.

7. 1 OSMOREGULATION AND SALINITY TOLERANCE OF PERIWINKLES (PHYLUM MOLLUSCA: CLASS GASTROPODA) IN THE LAGOS LAGOON AND MANGROVE SWAMP

7.1.1. SALINITY TOLERANCE OF *TYMPANOTONUS FUSCATUS VAR RADULA*

An investigation of the ecology of the Lagos lagoon (Figure 7) and the mangrove swamps was carried out (Egonmwan, 2008). Also, the salinity tolerance of the indigenous edible snails (Mollusca; Gastropoda; Prosobranchia; Superfamily Cerithiacea) that inhabit the lagoon and mangrove was carried out. These edible snails are the most common member of macrofauna community of brackish waters of West Africa (Nickles, 1950), they are very conspicuous in the University of Lagos Lagoon (Egonmwan, 1980) and are dominant members of the macrobenthos of the Lagos Lagoon (Egonmwan, 1980). Two families, Potamididae and Melaniidae, are endemic to West Africa and are represented by two genera *Tympanotonus* and *Pachymelania* (Buchanan, 1954), which are commonly known as "periwinkles" in Nigeria, although they are not true periwinkles. One species of the Nigerian "periwinkles" inhabit the main Lagoon (*Pachymelania aurita*) and two species (*Tympanotonus fuscatus var radula* (Linnaeus, 1758) (Family: Potamididae) (Plate 1) and *Pachymelania fusca* (Gmelin) *var quadriseriata* (Gray) (Family: Melaniidae) which is much smaller and inhabit only the mangrove swamp and mud flats and are absent from the main Lagoon (Oyenekan, 1975; Egonmwan, 1980). In this habitat *T. fuscatus var radula and P. fusca* are submerged at high tide and exposed at low tide. Although *T. fuscatus* is euryhaline, it can osmoregulate in salinities of 0 – 17 ppt and in more concentrated media with salinity above 17 ppt. Like other brackish water molluscs (Prosser, 1973), it is isosmotic with its external media. Salinity tolerance experiments carried out (Egonmwan, 1983) showed

that periwinkles will die if the habitat becomes flooded with seawater, which will raise the salinity of the habitat above 27.5 ppt. The water in the mangrove swamp is not freshwater: the lowest salinity recorded was 0.1 ppt in October and the highest was 25 ppt in March. The temperature of the mangrove swamp varies between 27.5 $^{\circ}$ C and 30 $^{\circ}$ C (in March) (Figure 8). Hydrogen ion concentration (pH) of the water varies between 6.73 and 8.3; in some months, pH was below 7 (acidic) while in others it was above 7 (alkaline) (Figure 9).

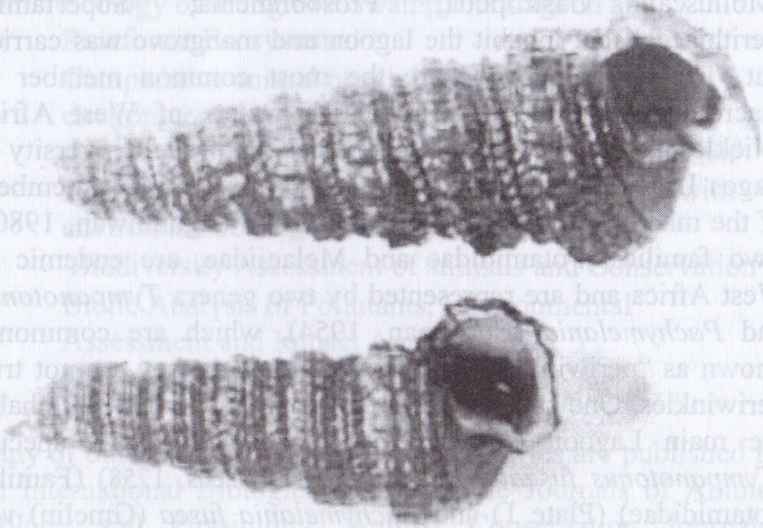


Plate 1: *Tympanoyonus fuscatus var radula* collected from University of Lagos Mangrove Swamp, Scale bar = 10 mm (Egonmwan, 1983)

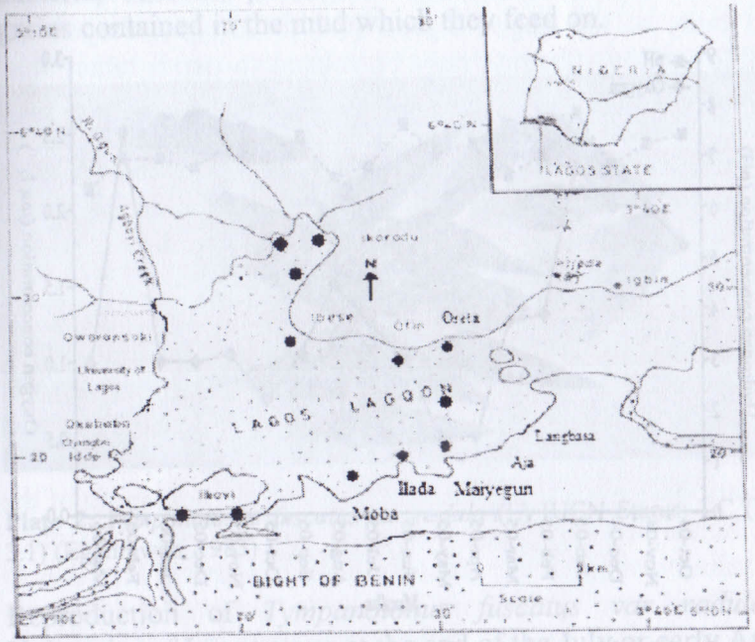


Figure 7: Map of Lagos Lagoon showing Sampled areas (Egonmwan, 2008)

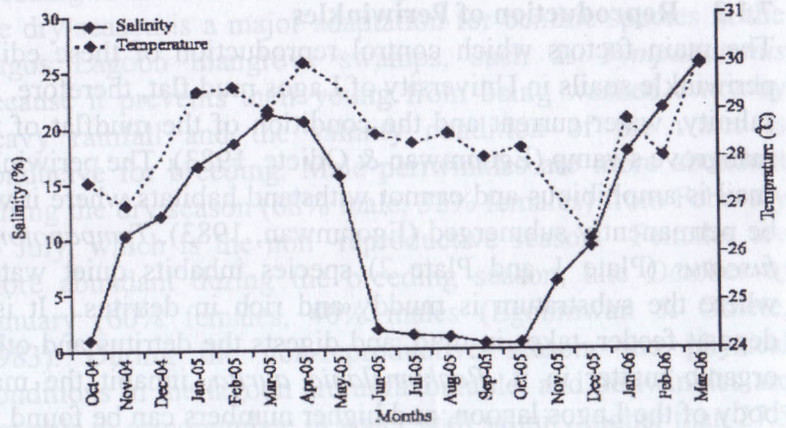


Figure 8: Monthly variation in Salinity (S) and Temperature (T) in the Lagos lagoon mangrove swamp: (Egonmwan, 2008)

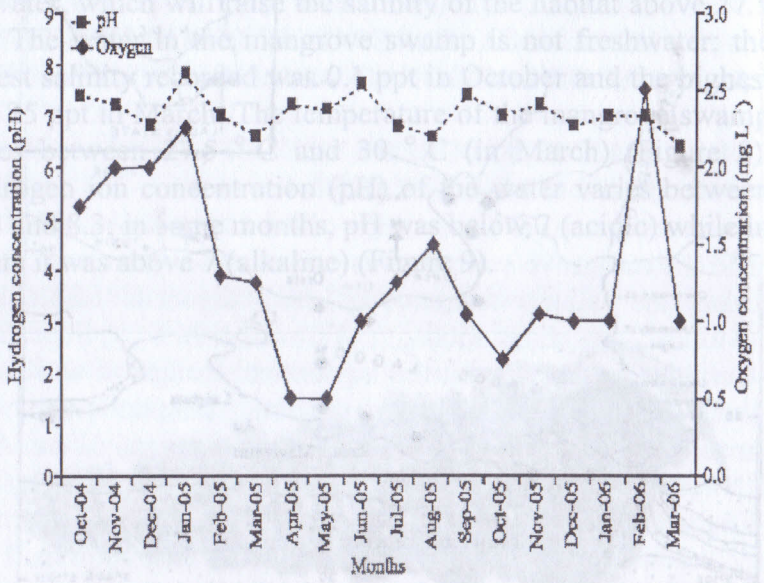


Figure 9: Monthly variation in hydrogen ion concentration(pH) and Dissolved Oxygen (DO) in University of Lagos mangrove swamp (Egonmwan, 2008)

7.1.2 Reproduction of Periwinkles

The main factors which control reproduction of these edible periwinkle snails in University of Lagos mud flat, therefore, are salinity, water current and the condition of the mudflat of the mangrove swamp (Egonmwan & Odiete, 1983). The periwinkle snail is amphibious and cannot withstand habitats where it will be permanently submerged (Egonmwan, 1983). *Tympanotonus fuscatus* (Plate 1 and Plate 2) species inhabits quiet waters where the substratum is muddy and rich in detritus. It is a deposit feeder, takes in mud, and digests the detritus and other organic matter in it. *Pachymelania aurita*, inhabit the main body of the Lagos lagoon, and higher numbers can be found far from where freshwater from Ogun River enters the lagoon (Uwadiae *et al.*, 2009). Their diet included phytoplankton,

bacteria, vascular plant materials, organic debris and sand grains contained in the mud which they feed on.

Plate 2: *Tympanotonus fuscatus var radula* (L) IUCN Status: LC (IUCN 3.1) (Egonmwan, 1983)

Reproduction of *Tympanotonus fuscatus var radula* in University of Lagos starts at the end of the July or early August (salinity 0.3 ppt) and ends in February of the following year (salinity, 20 ppt) (Egonmwan & Odiete, 1983). Restriction of breeding to the end of the raining season and the beginning of the dry season is a major adaptation for benthic species in the Lagos Lagoon mangrove swamps, such as *Tympanotonus* because it prevents their young from being washed away by heavy rainfall and the salinity condition of the water is conducive for breeding. Male periwinkles are more abundant during the dry season (68% male, 32% females) from February to July, which is the non -reproductive season. Females are more abundant during the breeding season, late October to January (60% females, 40% males (Egonmwan & Odiete, 1983). During the non-reproductive season, the physical conditions in the lagoon are unfavourable, and periwinkles are not able to osmoregulate in water with salinity higher than 27.5 ppt (Egonmwan, 1985) as the species shows a remarkable

degree of euryhalinity and the absence of the snail from the main body of the Lagos lagoon (0.1 to 25 ppt), despite the suitable muddy substrate may be related to depth rather than salinity.

The salinity of the Lagos Lagoon and mudflat at the edges of the lagoon is 0.1 – 29 ppt and the waters of the creeks in the mangrove swamps (except those without an opening to the sea) undergo a diurnal fluctuation in salinity due to an influx of water from the sea at high tide, which makes the area to be classified as a brackish water ecosystem, with the salinity of the water ranging from 0.1 ppt in October to 25 ppt in March. Olaniyan (1957), as well as Hill and Webb (1958) also reported that the salinity of the Lagos lagoon is brackish with seasonal fluctuations due to rainfall. Accordingly, at the beginning of the year, January to May, Lagos lagoon water was high in salinity. The salinity of the water decreased from June to July due to rainfall and rose again from August to September (formerly known as August break). Salinity fell again from October to November due to rainfall (short rainy season). Periwinkles withstand exposure when the habitat dries up at low tide especially during the dry season months, by withdrawing completely into the shell, without food, and remain inactive for up to 4 weeks. This is an adaptation to reduce water loss by evaporation.

7.1.3 *Pachymelania fusca, (var quadriseriata)* (Gastropoda: Melaniidae)

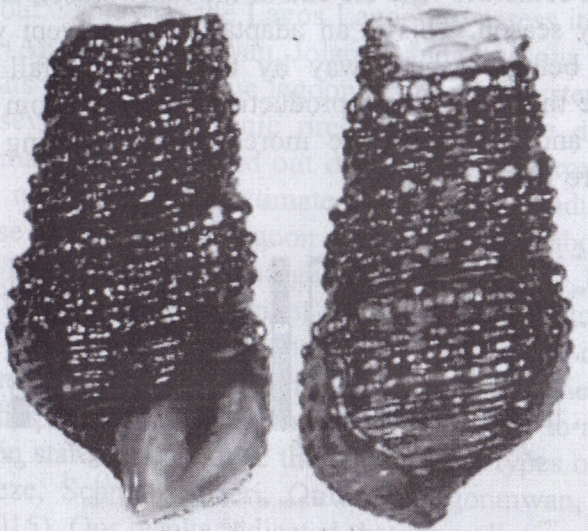


Plate 3: ***Pachymelania fusca*** **(Gmelin)** ***var quadriseriata*** (Gray): IUCN Status: LC (IUCN3.1) (Egonmwan, 2007)

Pachymelania fusca (Plate 3) occurs abundantly in the swampy areas and environ towards the Vice-Chancellor's lodge (Egonmwan, 2007). , Faculty of Science and High rise areas of the University of Lagos Lagoon Front. It was observed that the annual cycle of reproduction of this snail coincided with the end of the rainy season and the beginning of the dry season in the (Egonmwan, 2007). The maturation of the gonad and spawning of this snail is associated with increasing salinity. Therefore any environmental conditions to the contrary to what this snail is adapted to spells doom for it. Therefore, the recent changes going on along and on the lagoon and mangrove swamps, for example, the Bariga area of the Lagos lagoon which though may be beneficial for humans may be disadvantageous to the original inhabitants of University of

Lagos site, the '*Omoniles*' so to say. Breeding in this snail occurs between late October to January of the following year, which coincides with the end of the rainy season and beginning of dry season. This is an adaptation to prevent young snails from being washed away by torrential rainfall that occurs before then. The non-reproductive season is from February to July, and the males are more abundant during this period (Figure 10a-c).

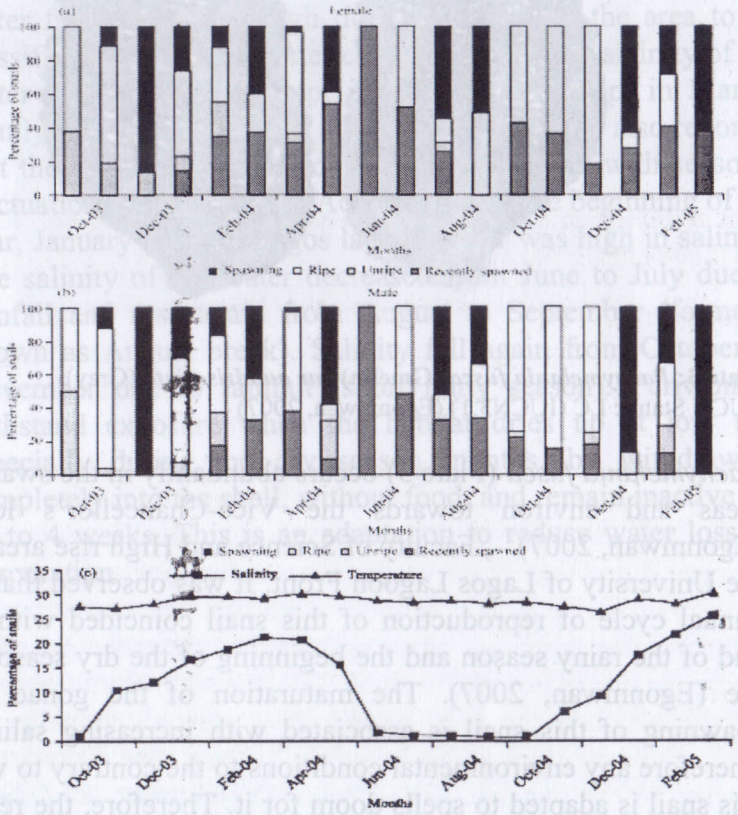


Figure 10 a-c: Percenage of gametogenic stages in *Pachymelania fusca*, a (female) b (male) c (Hydrographic data of surface water of the mangrove swamp, University of Lagos, Nigeria) (Egonmwan, 2007).

BIOTIC INDICATORS OF LAGOS LAGOON POLLUTION

We carried out a study on the Lagos Lagoon to assess its state of pollution (Amaeze,Egonmwan, Jolaoso, and Otitoloju, 2012) and the results revealed that the lagoon is under consistent and sometimes severe anthropogenic pressures from the diverse forms of human activity carried out due to its close proximity to the city of Lagos. We estimated over 2,000 industries situated close to the Lagos lagoon and in the neighbouring Ogun State, Nigeria, that discharge effluents into the Lagos lagoon and in fact, the location of many of these industries close to the lagoon was for the unhindered discharge of the waste known as effluent from their factories. We carried out detailed studies of different sites in the Lagos lagoon to assess their pollution status and analyse the number and types of fish catch (Amaeze, Schnell, Sozeri, Otitoloju, Egonmwan, Arit, and Bury (2015). Our results indicated that the pollution of the brackish water Lagos lagoon continues unabated and has caused a steady deterioration of the lagoon health by the changes made to its physicochemical properties, macrobenthic fauna composition, fish species (Table 2) and plankton diversity. There has been a drastic reduction in the species richness and biodiversity and dismantling of the five macrobenthic communities described by Oyenekan, (1985) and fish catch (Amaeze *et al*., 2012) of the Lagos Lagoon due to the discharge of untreated waste, such as sewage, sawdust and wood waste, refined oil, industrial and municipal waste into the Lagos Lagoon by known Companies (Akpata *et al*, 1993; Nwaokoro & Odiete, 1997; Chukwu & Nwankwo, 2004; Brown & Ajao, 2004; Onyema, 2007; Nwoji, 2010) (Plate 4, Table 3).

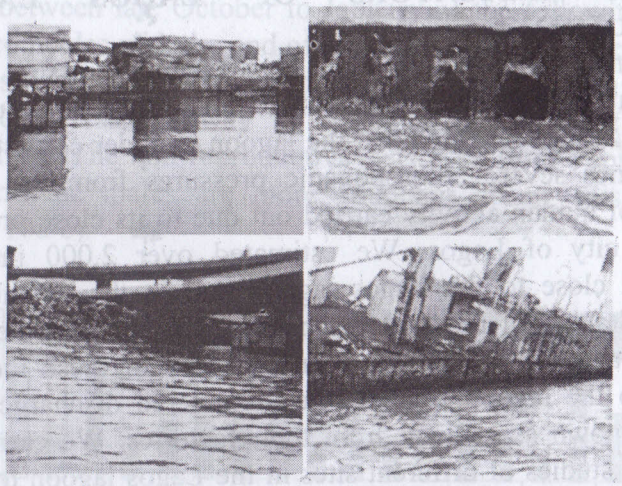


Plate 4: Sections of the Lagos lagoon showing some of the sources of pollution
(Amaeze, Egonmwan, Jolaoso, and Otitoloju. 2012)

Table 2: Overall fish diversity in the Lagos lagoon (Dec. 2010 – Nov. 2011)
(Amaeze, Egonmwan, Jolaoso, and Otitoloju. 2012)

Family	Species	I	II	III	IV	Total
Mugilidae	Liza falciptnnis	15	25	40	20	100
Cichlidae	sarotherodon melanotheron	126	117	18		263
	Sarotherodon galilae		5			5
	Hemichromis fasciatus	18	10			28
	Tilapia guinensis		43	20		63
	Tilapia zilli		1			1
Lutjanidae	Lutjanus agennes	5	7			12
	Lutjanus goreensis				3	3
Monodactylidae	Psettias sebae	29				29
Clupidae	Ethmalosa fimbriata	24	2			26
Carangidae	Caranx hippos	12	3			15
Cynoglossidae	Cynoglossus senegalensis	10		56		66
Osteodolossidae	Heterotis niloticus	1				1
Bagridae	Chrysichthys nigrodigitatus	53	58	33	5	149
Clariidae	Clarias gariepinus	21	10			31
Mochokidae	Synodontis nigeriata	12	3			15
Electridae	Batanga lebritonis	15				15
Schilbeidae	Schilbe mystus	21				21
Sciaenidae	Pseudotolithus typus			3	27	30
Pomadasydae	Pomadasys jubelini			9		9

Table 3: Description of sampling sites in the Lagos Lagoon for ecological and toxicological Studies
(Amaeze, Egonmwan, Jolaoso, and Otitoloju. 2012)

Sampling sites	Location within Lagos lagoon	Sources of pollution/characteristics
1	Victoria Island	Solid waste dump, boat transportation. Relatively undisturbed.
2	Apapa port	Shipping activities, loading and offloading of cargo, cement and sugar plants, canals discharging municipal sewage.
3	Apapa tank farm	Petroleum products jetty, shore-side automobile repair workshops or garages, ship welding centres, solid waste dumps.
4	Iddo	Major centre for the discharge of septic tank wastes, solid waste dump, subsistence recycling of jute bags and chemical cans by hand washing.
5	Makoko	Solid waste dumps, canals discharging municipal sewage, domestic sewage.
6	Off Unilag High Rise	Relatively undisturbed shallow coastline, receives wastes from other parts of the lagoon mainly by tidal action.
7	Off third mainland bridge (Unilag section)	Deep lagoon area receiving wastes from different parts of the lagoon at high tide. Off-road wastes from the third mainland bridge.
8	Off Unilag power station	Solid waste dumps, canals discharging municipal sewage, university campus sewage treatment plant effluents, electricity power station effluents.
9	Ilaje	Solid waste dumps, canals discharging municipal sewage, domestic sewage.
10	Oworonshoki	Solid waste dumps, domestic sewage, sand mining, boat construction and water transportation
11	Odo-Iya Alaro	Industrial effluents from Ikeja/Ogba Industrial Estate.

Our studies on sediment samples from 11 sites of the Lagos Lagoon revealed that the bottom sediments from three sites were cytotoxic to the fish gill cell lines (Amaeze *et al*, 2015) (Figure 11).

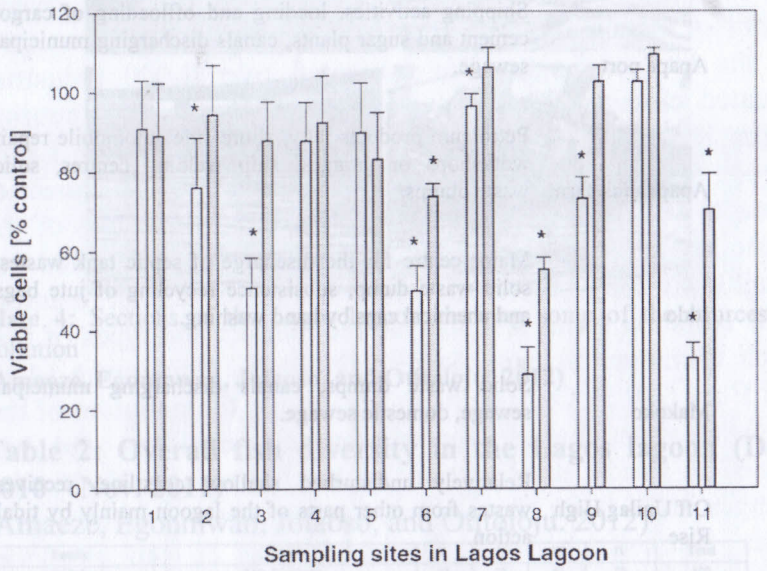


Figure 11: Viability of RTgill cell lines exposed to Lagos Lagoon sediment extracts
(Amaeze, Schnell, Sozeri, Otitoloju, Egonmwan, Arit, and Bury (2015)

Sediments collected from all the sites caused significant DNA damage, however the extent of damage was site-specific. Toxicity to yeast cells was observed in sediment extracts from six sites and of the remaining sites, only two exhibited oestrogenic activity. There was no strong correlation between sediment PAH concentrations and toxicity of the fish gill cells, which may be due to the dynamic nature of the Lagos lagoon due to tides and freshwater input from nearby rivers (Table 4).

Table 4: Ranking of sites for total sediment PAH concentrations as well as cell viability, Induced DNA damage and yeast toxicity
(Amaeze, Schnell, Sozeri, Otitoloju, Egonmwan, Arit, and Bury (2015)

Sites in Lagos lagoon	PAH	Cell viability	Comet assay (unmodified)	FPG-modified Comet assay	Yeast toxicity	Total toxic unit
1	4	4	4	3	4	15 (11)
2	2	3	3	4	2	12 (7)
3	2	2	2	1	1	6 (2)
4	2	4	2	3	2	11 (5)
5	4	4	4	3	4	15 (10)
6	3	2	4	1	4	11 (5)
7	3	4	1	1	2	8 (3)
8	1	1	1	2	1	5 (1)
9	1	3	3	3	3	12 (7)
10	3	4	1	4	4	13 (8)
11	1	1	2	3	4	10 (4)

The sources of the pollution of the Lagos Lagoon was widely varied, **(Amaeze, Egonmwan, Jolaoso, and Otitoloju. 2012)**

ranging from chemical inputs and sewage to solid waste which have caused far-reaching effects ranging from foul odour, loss of aesthetics (Plate 4), deterioration of the water quality, to reduced fish catch. Overall fish catch was higher in zone 1 (Ilaje, Oworonsoki, Agboyi and Ogun River) and zone 2 (University of Lagos Lagoon front, community Road, Pako and adjoining the Third Mainland Bridge), areas close to where the Ogun River inputs into the Lagos lagoon, where the pollution input was mainly sewage and diluted effluents. The unregulated deposition and burning of sawdust at Okobaba, combined with oil pollution at Apapa and Tincan Island Ports may have been responsible for the depletion of fish catch in Zone 3 (Makoko, Okobaba sawmills area, Iddo Railway terminal) and Zone 4 (Ikoyi, Victoria Island, harbour and Apapa Port jetties).

Mr. Vice-Chancellor Sir, one of the implications of environmental pollution in the Lagos Lagoon from our findings (Amaeze, Schnell, Sozeri, Otitoloju, Egonmwan, Arit, and Bury (2015) pollution is the cause of the potential for damage to reproductive structures of fishes inhabiting the Lagos lagoon (Amaeze, 2014). The fish inhabiting the lagoon were found to show a range of abnormalities in the gonads (Figure 12, Plate 5 & 6).

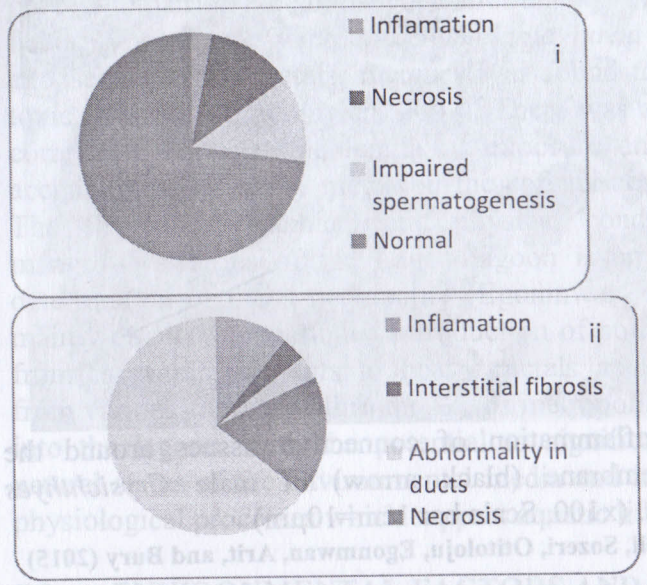


Figure 12: Gonadal abnormalities in (i) male and (ii) female *Sarotherodon. melanotheron*
(Amaeze, Schnell, Sozeri, Otitoloju, Egonmwan, Arit, and Bury (2015)

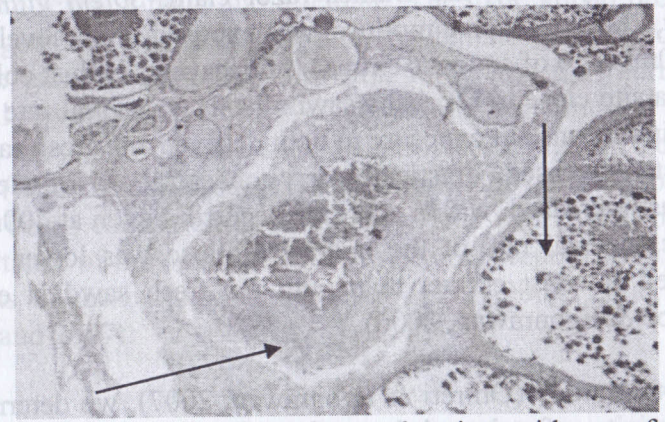


Plate 5: Ovary of *S. melanotheron* showing evidence of necrotic follicles (black arrows) (x400, Scale bar 1cm=10μm)
(Amaeze, Schnell, Sozeri, Otitoloju, Egonmwan, Arit, and Bury (2015)

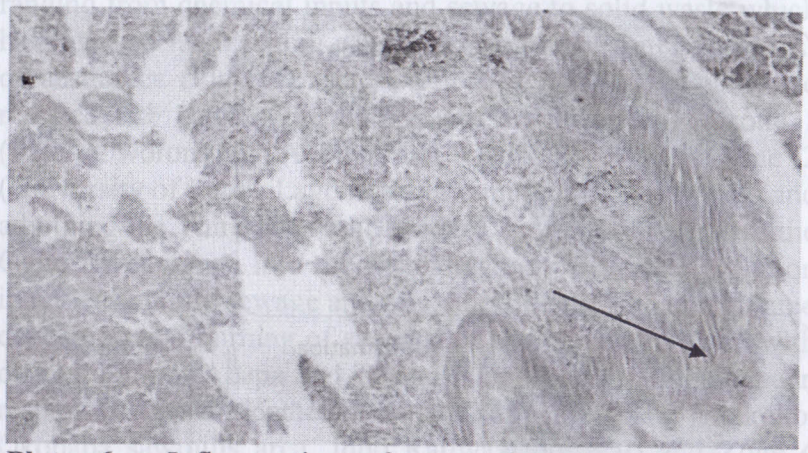


Plate 6: Inflammation of connective tissues around the basement membrane (black arrow) of male *Crysichthyes nigrodigitatus*. (x100, Scale bar 1cm=10μm)
(Amaeze, Schnell, Sozeri, Otitoloju, Egonmwan, Arit, and Bury (2015)

Mr. Vice-Chancellor Sir, in one of our previous studies aimed at assessing the impacts of anthropogenic activities on microbenthic fauna of the Lagos Lagoon (Ajagbe and Egonmwan, 2006), the Guinea razor clam, *Solem guineensis* (Gray, 1842) a bivalve mollusc, was exposed to six levels (400 to 600mL L^{-1}) of aqueous extracts of decayed sawdust collected from a site close to Okobaba sawmills. The survival rate of the clam in response to exposure to both decayed and fresh sawdust extract decreased drastically as concentration of decayed sawdust increased, with a decrease occurring even at 400mL L^{-1}. The survival rate of the bivalve mollusc was lower in the decayed sawdust extract than with the fresh sawdust extract (Ajagbe & Egonmwan, 2006).

In another study (Onireti & Egonmwan, 2007), we determined the toxicity of selected heavy metals (lead, cadmium and mercury) to edible periwinkles snails inhabiting our lagoon. Metals have the ability to alter biochemical and physiological

process impairing metabolism and life function of microbenthic fauna. When the periwinkle *Pachymelania aurita* (Muller) were exposed to heavy metals, mercury was found to be the most toxic (Onireti & Egonmwan, 2007). There was also a positive correlation between the length of exposure and the rate of accumulation of heavy metals in the soft tissues of this snail. The fluctuating chemical and physical conditions of the mangrove swamps of the Lagos lagoon is an indication of deterioration of the water quality (Egonmwan, 2008). This is mainly due to the continued introduction of pollutants ranging from inorganic nutrients to heavy metals and hydrocarbons from various sources within the Lagos metropolis and environs into the lagoon; with the potential to significantly alter the natural status of the environmental media and impair the eco-physiological processes which support aquatic life.

7.0 ENVIRONMENTAL FACTORS AND REPRODUCTION IN EDIBLE LAND SNAILS

Mr. Vice-Chancellor Sir, most animals are described as unisexual (i.e. dioecious), which means the species consists of separate sexes, a male and a female. The male gonad produces male gametes (spermatozoa) and the female gonad produces female gametes (eggs). In my first foray into the journey of animal reproduction, I observed something very unusual in one of our very familiar land snail which is called Igbin (Yoruba), Egile (Bini) Dodon Kodi (Hausa), Ejuna (Ibo) or Congo meat, when being consumed as a delicacy. Due to the gastronomic importance of the snail, many of my studies report on different aspects of the biology of the snail (1997, 2004, 2006, 2007, 2007 and 2007).

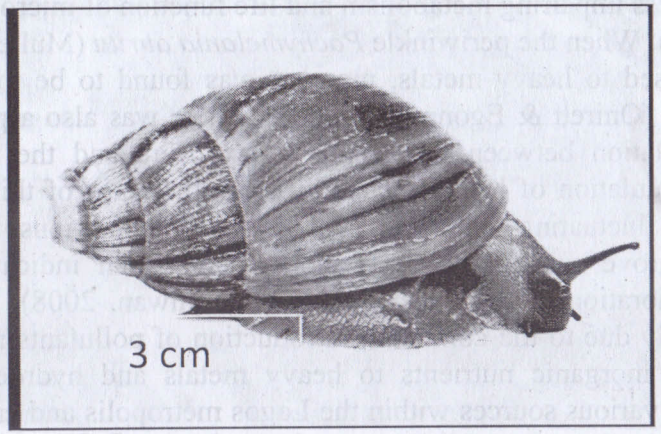


Plate 7: Giant African Land Snail, *Archachatina marginata ovum* (Scale bar: 2cm = 3cm)

Scientifically, it is called the giant African land snails, family Achatinidae. One species in this family, known as *Archachatina marginata, ovum* (Plate 7) is endemic to Nigeria. The fact that this edible delicacy is a hermaphrodite was what spurred my interest. The gonad or ovotestis of each animal is capable of producing both male and female gametes (Egonmwan, 1988), a situation I jokingly refer to as 'boy-girl'. Due to the presence of both gametes in one gonad, self-fertilization has been reported in rare instances in some members of the family. However, our giant snail, *Archachatina marginata* prevents self -fertilization by producing the gametes at different times of the year, so that while some groups are in the male phase, others are in female phase (Egonmwan 1988; Egonmwan & Odiete, 1988; Egonmwan, 1990) and at another time, there is a reversal or sex change. We also observed that the male system develops before the female system, and this adaptation is probably what prevents self-fertilization (Egonmwan, 2004). Another unusual happening that was observed in these snails, is their ability to store mature and

viable spermatozoa received at copulation for up to 4 months, a sizeable portion of its lifespan. The ability to store viable spermatozoa enhances the breeding rate of land snails especially when they come out of aestivation (hibernation) due to adverse environmental conditions. The breeding season of the giant African land snail is between March and October, which is the rainy season in Southern Nigeria where they are found in abundance.

Limicolaria Flammea (The Garden Snail)

The garden snail (ihon, Bini; ipere, Yoruba; eju, Igbo; kodi, Hausa) (Plate 8), scientifically known as *Limicolaria flammea* is another member of the family Achatinidae; it is found in the same geographical zone as the giant land snail, but much smaller and it breeds throughout the year. While the reproductive investment of the garden snail is nearly 200% of the parents' body weight, that of the giant snail is about 97% (Egonmwan, 1990).

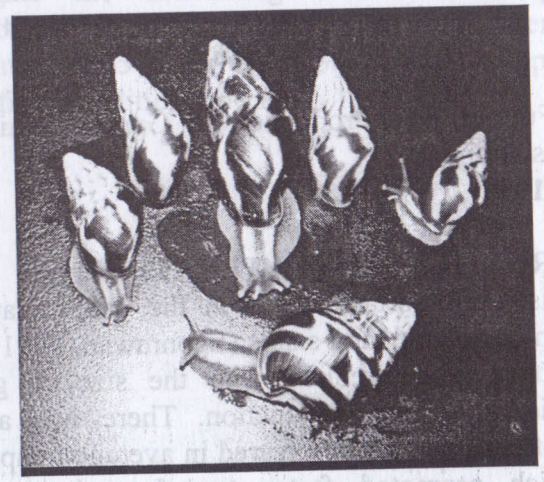


Plate 8: *Limicolaria flammea* (Garden snail) (Scale bar; 2cm = 2.5 cm)

When garden snails were taken from the wild and kept singly and isolated for a period of 15 days and 111 days, each snail continued to lay eggs and the eggs were viable (Egonmwan, 1990). The snails are able to store viable allosperm received at copulation for a long period of time and the snail use the stored sperm to fertilize the eggs. This adaptation is what enables land snails to quickly colonise a new habitat, if they are driven away by harsh environmental conditions such as no food, dried up habitat, pesticides and other natural or man-made problems.

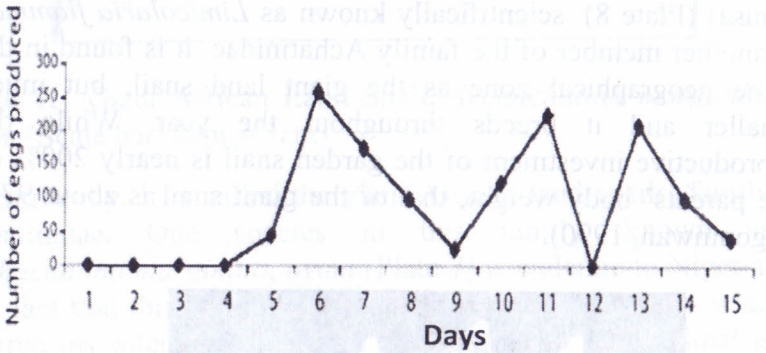


Figure 13: Further Egg Production in Garden Snails kept singly and in isolation
(Egonmwan, 1990)

8.0 ENVIRONMENTAL TEMPERATURE

Temperature is an important factor in the determination of reproduction in our edible land snails (Egonmwan, 1991). Very high temperatures cause reduction in the size of gonads, therefore reduction in egg production. There was arrested growth in giant land snails when reared in average temperature (30 °C), which promoted faster growth and more egg production (Egonmwan, 1991).The growth of the albumen gland follows the maturation of the gonad in *L. flammea*, but in *A. marginata ovum* the growth is cyclical and seasonal. The

first oviposition occurs at approximately 19 months of age in *A. marginata ovum* and 5 months in *L. flammea* bred in the laboratory. *L. flammea* breeds almost throughout the year, whereas this process is restricted to March-October in *A. marginata ovum*. In *L. flammea*, the reproductive investment is nearly 200% of parental body weight and the species is estimated to produce 375 young with full size biomass of 1,725 g, while the 140 young produced by *A. marginata ovum* represent 97% of parental body weight in 3 years and have at full size a biomass of 54,740 g (Table 5).

9.0 PHOTOPERIOD AND REPRODUCTION IN SNAILS

I investigated the effect of photoperiod on gonad maturation in the edible snail (Egonmwan, 1991). Photoperiod is the ratio of daylight (L) and darkness (D) that occur at night and in most cases it is circadian (24 hour cycle). The common garden snail *Limicolaria flammea* (Muller) was used as a model to investigate the interacting effects of temperature and photoperiod (Egonmwan, 1991). The snails were exposed to temperature of 15 ^{0}C 25 ^{0}C and 30 ^{0}C, and photoperiod of LD = 12:12 (field condition) and LD = 16:8 (Table 5).

Table 5: Summary of the Effects of Temperature and Photoperiod on Gametogenesis in the Garden Snail *Limicolaria Flammea*
(Egonmwan, 1991)

Temperature (°C) Photoperiod Summary of Gametogenesis L : D	State of Gonad A	B	C	D	E
25 12: 12 Spermatogonia-Spermatocyte	10	1	0	0	0
25 16: 8 Spermatocyte –Spermatids +Oocytes	5	6	1	0	2
30 12: 12 Spermatotogia - Spermatocyte	10	1	0	0	0
30 16 8 Spermatocyte – Spermatid + Oocytes	3	4	5	1	1

A = Spermatogonia – Spermatocyte Stage
B = Spermatocyte – Spermatid Stage
C = Spermatid Stage
D = Spermatid – Spermatozoa Stage
E = Spermatozoa – Oocyte Stage

The results showed that when the snails were exposed to variable temperature and constant photoperiod of LD = 12:12 (periodicity of the field condition), the snails reared at 15 ^{0}C were not active, had a short lifespan and failed to grow at this temperature despite the constant photoperiod. In the two groups reared at 25^{0}C and 30^{0}C, there was good growth but the 5^{0}C difference in temperature between the two groups was probably responsible for the significantly higher rate of growth experienced by those reared at 30^{0}C. When the animals were exposed to variable temperature and variable photoperiods, the results showed that the effect of increasing the photoperiod by just 4 hours from LD = 12:12 to 16:8 was responsible for better growth than increasing the temperature by 5^{0}C from 25^{0}C to

30°C. There was little effect of high temperature once the photophase reached 16 hours in contrast to increasing the temperature by 5^{0}C at 12 hours photophase..

Also, while there was no significant effect (P>0.05) of temperature as a main effect, however, there was a significant of photophase as the growth was better in the animals reared under LD =16:8 than 12:12, whether the temperature was 25^{0}C or.30°C. The most important result in this study was that there was a significant interaction between temperature regime and length of daylight time – longer day stimulate faster growth.

A low density of natural snail population of land snails occurs at the end of dry season. This may reduce the contact between individual snails and enhance the storage of allosperm which are used for the reproduction that occurs immediately the snails break off aestivation at the onset of the first few rainfalls (Hodasi, 1979).

10.1 FOOD AVAILABILITY AND LAND SNAILS IN NIGERIA

In the land snails reared in the laboratory (Egonmwan, 1990, 1992 and 2004, 2007) the first egg laying occurred at approximately 19 months in the giant African land snail and 5 months in the garden snail. While garden snail breeds throughout the year, the process is reduced to March – October in giant land snails. The reproductive investment is nearly 200% of the parent body weight in reared garden snail with production of 375 offspring after 16 months and 97% in the giant snail, with production of 140 offspring after 4.5 years. If not disturbed, the giant snail can live for 11 years, with 9 years being the reproductive years (Egonmwan, 2004). The estimated viable offspring each snail will produce is 436 in its lifetime. Although there is no parental care in terrestrial snails, the eggs are laid on moist soil and covered with dead leaves before the

snail crawls away. Juvenile snails showed greater selectivity of food, depending on whether the food was needed for body growth or for reproduction (2004). When snails are not allowed to choose food and calcium (needed for the good shell development) during artificial rearing or in the tropical rainforest habitat, due to destruction of the vegetation or the forest by man, the snails are likely to search for the food everywhere that will enhance their growth and reproduction and if they cannot find such, they are likely to become stunted and not attain the maximum body weight and reproductive potential, to lay eggs. This is the reason there is depletion where snails used to be abundant and why there is collector's pressure in the present search for snails and the high cost of edible snails in the markets.

Generally, shell length and therefore growth of the snails is proportional to time (Figure 13 and 14). Thus allowing for sufficient recovery before episodes of harvesting is essential for sustainable supply of wild snails in the face of growing demand due to human population increase.

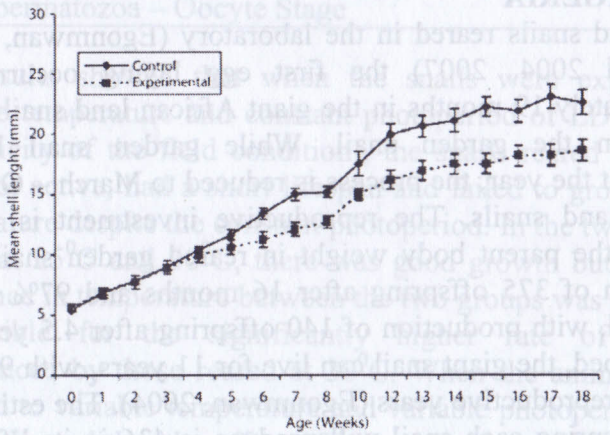


Figure 14: The mean increase in shell length of garden snail, reared singly with calcium supplement (Control) and without calcium supplement (Experimental) **(Egonmwan, 1991)**

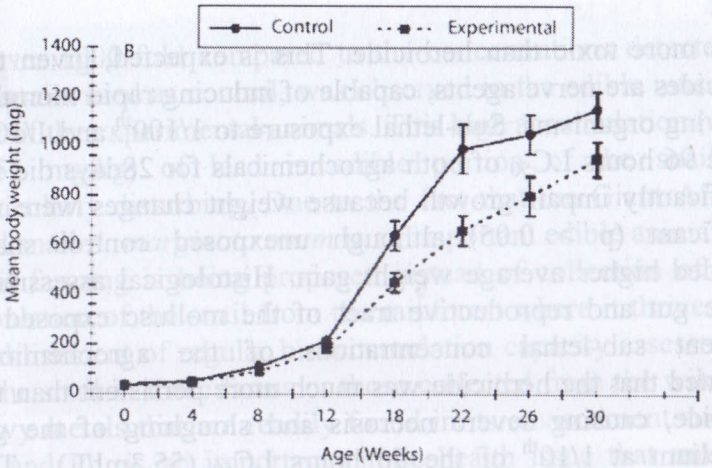


Figure 15: The mean growth of garden snail, *Limicolaria flammea* reared in a group of 50 snails with calcium supplement (Control) and without calcium supplement (Experimental) **(Egonmwan, 1991)**

10.2 EFFECTS OF SELECTED AGROCHEMICALS ON A NON–TARGET GIANT AFRICAN LAND SNAIL

Mr. Vice-Chancellor Sir, a major threat to wild snail species besides increased pressure by gatherers is the spate of application of agrochemicals on farmlands. I carried out, with my past students, series of studies on the effect of agrochemicals on the edible Giant African land snails in Nigeria. Amaeze, Ugwoeje and Egonmwan (2011) conducted toxicity studies to determine the effects of agrochemicals on the Giant African land snail. In one of our studies, the results of 96 hours acute toxicity test indicated significant differential toxicity of both agrochemicals (LC_{50}: Cypercot (Cypermethrin) = 74.286ml/L, Boost Xtra (Herbicide) = 250.935ml/L) to the Giant African land snail, *A. marginata ovum* (Amaeze *et al.*, 2011). Based on the calculated 96 hours LC_{50}, the Cypermethrin pesticide was found to be approximately three

times more toxic than herbicide. This is expected, given that pesticides are nerve agents, capable of inducing rapid mortality on living organisms. Sub-lethal exposure to $1/100^{th}$ and $1/100^{th}$ of the 96 hours LC_{50} of both agrochemicals for 28days did not significantly impair growth because weight changes were not significant ($p > 0.05$) although unexposed control snails recorded higher average weight gain. Histological assessment of the gut and reproductive tract of the mollusc exposed to different sub-lethal concentrations of the agrochemicals indicated that the herbicide was much more persistent than the pesticide, causing severe necrosis and sloughing of the gut epithelium at $1/10^{th}$ of the 96 hours LC_{50} (55.3ml/L). The Cypermethrin pesticide, Cypercot, induced no visible lesion in the gonadal epithelium while the sub-lethal exposure to the herbicide initiated massive necrosis in the gonadal duct. Sub-lethal concentrations of both chemicals induced aestivation but this was not always concentration dependent. This result is very worrisome because Giant African land snail is edible and the accumulation of agrochemical in the edible muscular foot is of public health concern.

The Giant African land snail, *Archachatina marginata ovum* was exposed to two heavy metals, Copper (Cu) and Lead (Pb) (Otitololoju, Ajikobi & Egonmwan, 2008). Exposure to sub-lethal Copper concentrations for 28 days resulted in a five-fold and three-fold accumulation of the metal, respectively, in the hepatopancreas and muscular foot of the Giant African land snail compared to the snails in the control experiment (Otitoloju *et al.*, 2008). The bioaccumulation studies also indicated the ability of the snail to regulate and excrete excess level of Cu from its body. The exposure of the snails to sub lethal concentrations of Pb revealed that the snails had high capacity to accumulate the metal in both the hepatopancreas and muscular foot. While accumulation in the hepatopancreas was found to be up to 375-fold, an unprecedented accumulation

of over 1000-fold compared to the concentrations detected in the snails used as control, was observed in the edible muscular foot of the experimental animals. This high accumulation (up to 71.55 mg/kg) of lead in edible portion of the snails is particularly disturbing. Due to the fact that the Giant African land snail *A. marginata ovum* is an important edible animal and snail farming is being proposed instead of collection of wild population of the snail from the rainforest where it thrives, the establishment of regular bioaccumulation capacity assessments of the snail in these farms or those collected from the wild, for heavy metals that are readily found in its environment such as Cu and Pb, is an important public health issue that must be considered

11.0 WILDLIFE CONSERVATION OF ENDANGERED AND THREATENED SPECIES

Mr. Vice-Chancellor Sir, I have devoted the last 10 years with my students to surveying wildlife and wildlife trade in Nigeria, trying to capture the knowledge of the local population to help in the conservation of the unique habitats of our wildlife. The ultimate goal of our research group is improving animal welfare and the development of a nature reserve in our zoological garden in the University of Lagos. A "protected area" is a location set aside for protection because of its high conservation value due to its importance as a natural ecological or cultural site. Protected areas are used as measurable indicator of progress in conserving the world's remaining biodiversity, or at least slowing the rate of loss of biodiversity (Chape *et al.*, 2005) and our only hope of stopping many threatened or endemic species from becoming extinct (Dudley *et al.*, 2010). There are several kinds of protected areas, which vary by level of protection depending on the enabling laws of each country or the regulations of the international organisations involved.

12.0 LEKKI CONSERVATION CENTRE

Lekki Conservation Centre (LCC), a privately owned nature reserve was established in 1990 to protect a representative of the biodiversity of the Lekki Peninsula (Plate 9), educate and create awareness on natural resources and environmental management in Nigeria. The Centre is exceptional for their fauna and flora quality that is kept in their wild state and the facilities there are used regularly by our post graduate students. A study carried out by Omoregie, Fasona and Egonmwan (2014) in LCC, to assess management effectiveness of the Centre revealed that the unsustainable adjacent land use, isolation and inadequate funding were the major threats to the effective management of the Centre's conservation objectives (Omoregie *et al* 2014). Legal status, resource inventory, boundary demarcation, protected area design and objectives, security of budgeted fund, regular work plan, awareness education and resource management were some of the strengths of LCC. The overall management effectiveness score for LCC was 75.3%. Recruitment of more staff, drafting and implementation of a management plan and seeking additional sources of funding are ways LCC can improve their management effectiveness.

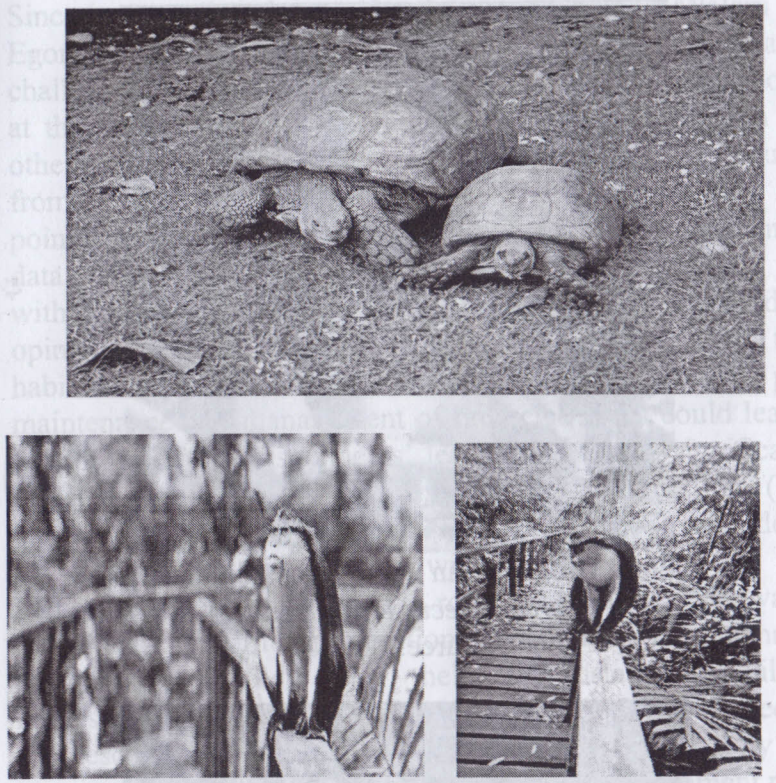


Plate 9: Giant Turtle (Top); Alpha males of Mona monkey at Lekki Conservation Centre (Middle and bottom)
(Sourch: NCF)

12.1 Wildlife Conservation Challenges in Okomu National Park, Nigeria

Okomu National Park is a rainforest ecosystem known for its endemic white-throated monkey (*Cercopithecus erythrogaster*) (Plate 10), the rare red-capped mangabey (*Cercocebus torquatus*) (Plate 11) and a host of other forest mammals, some of which are endangered.

Plate 10: Nigerian white-throated monkey (*Cercopithecus erythrogaster*)
Source: IUCN

Plate 11: Red-capped mangabey (*Cercocebus torquatus*) caught on camera trap at Omo-Shasha-Oluwa Forest Reserve

Since its inception the area has been encroached. Olaleru and Egonmwan (2014) carried out a study on wildlife conservation challenges in Okomu National Park, Nigeria. This study looked at the challenges of conserving the Park's wildlife fauna and other resources. The Park's record of arrests and prosecution from 1999 to 2011 was used as secondary data, while a four point Likert-scale questionnaire was used to obtain primary data. Farming was the main offence (67%) in 1999, the year with the highest recorded offence. Exactly 84% respondents opined that wild animals could only be conserved if their habitats were protected, while 91.1% believed that poor maintenance and management of protected areas could lead to loss of wildlife. Respondents' level of education significantly affected their attitude towards wildlife conservation ($P = 0.021$). Age also significantly affected the respondents' orientation about poaching on wildlife ($P = 0.035$), and their perception about government's roles on wildlife conservation ($P = 0.024$). Wildlife conservation education and enlightenment programmes would likely help in sustainable wildlife harvesting. Park staff could be more committed to protecting the resources when they are catered for appropriately and creation of buffer zone could reduce Park's encroachment rate.

12.2 MONA MONKEYS IN UNIVERSITY OF LAGOS

Mr. Vice-Chancellor Sir, it is noteworthy that Mona monkey (*Cercopithecus mona*) (Plate 12) is the only non-human primate (NHP) in the University of Lagos campus that has been in existence on the site before the establishment of the institution in 1962. The species is under serious threats, especially in its urban habitats such as our University, due to habitat fragmentation and in many instances, complete loss of its natural habitat. This has not only affected their population but also their diet. The natural diet of Mona monkey is majorly fruits, flowers, and insects (Olaleru & Egonmwan, 2012).

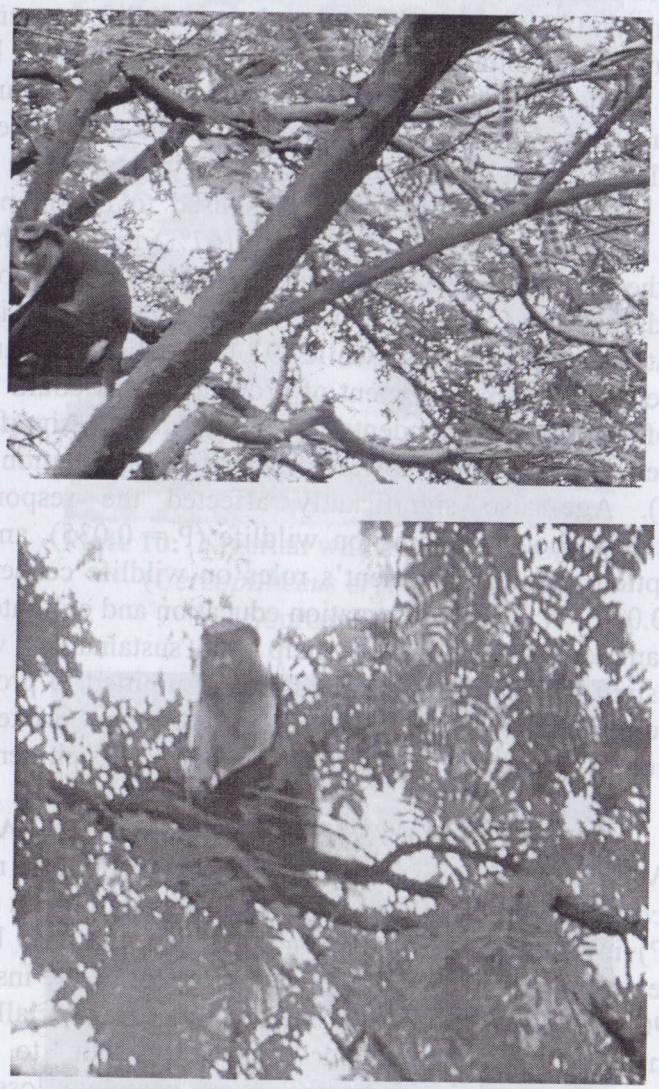


Plate 12: Alpha male of Mona monkey, sitting on *Albizia lebbeck* tree in the place now occupied by Tayo Adenirokun Hall, near UNILAG Guest Houses.
(Olaleru & Egonmwan (2012)

In order to start the process of *in situ conservation* of Mona monkey in the University of Lagos, Olaleru & Egonmwan (2012) examined the food types and feeding habit of Mona monkey in the University. Anthropogenic activities in the University of Lagos have seriously affected Mona monkeys' natural food so much, that they now eat *gala*, *eba*, *amala* and other left over human foods from the numerous canteens and food vendors in the University (Olaleru & Egonmwan, 2012). There were reported cases where Mona monkey raided some of these canteens but with dire consequences to the animal. Their close proximity to human habitation, has also led to their scavenging dump sites and raiding nearby farms for food. Food availability is higher during the rainy season than dry season, with 31 and 17 types of food respectively for each season. A population size of 60 monkeys was estimated from four ranges along the Lagos lagoon mangrove swamp. These were: St. Augustine College of Education, back of Guest Houses/Faculty of Arts Block, New Hall/Chapel area and Faculty of Environmental Sciences. As the only surviving large mammal that pre-existed the creation of the University of Lagos (when others such as antelope and deer have disappeared), there is the need to conserve this resilient animal by protecting its present residual and depleted habitat. This includes not only providing their natural foods, but also protecting them from poachers. Mona monkey can be useful for restoring ecological processes, education and ecotourism when protected and conserved.

12.3 THE NUTRIENT CONTENTS OF PLANT FOOD SOURCES OF MONA MONKEYS IN OKOMU NATIONAL PARK

There is an ongoing study on the nutrient content of natural food consumed by the primates, Mona monkey in Okomu National Park, seasonally. The results obtained so far (Olaleru and Egonmwan, 2019) shows that Mona monkeys consumed different parts of 31 plant species in 22 families; 56% of the

plant parts consumed were fruits. These included *Gmelina arborea* fruit and *Jateorhiza macrantha* seed which are new to literature on plants consumed by Mona monkeys. Mona monkeys obtained 79% of their diets within the Park, while 21% were raided farm produce (Olaleru and Egonmwan, 2019). The nutrient contents of the food plants were higher during dry season than rainy season. Park Managers are encouraged to take management actions to ensure that these monkeys source their entire food within the Park, to avoid human-wildlife conflict which could decimate their populations.

13.0 CONSERVATION GENETICS OF NIGERIAN FOREST ELEPHANTS

Savanna elephants (*Loxodonta africana*) can be found in the Northern part of Nigeria while Forest elephants (*Loxodonta cyclotis*) are found in few locations in Rainforests in Southern Nigeria, (Blanc *et al.*, 2007., Thouless *et al.*, 2016), which to a large extent are protected. The 2016 African Elephant Study Report (AESR) recorded only about 267 forest elephants remaining in the wild in Southern Nigeria (Thouless *et al.*, 2016), therefore there is an urgent need for these lucky ones to be protected as much as possible, because if nothing is done for their conservation, the wild population of forest elephants may go extinct in the next 10 to 20 years. Forests and man are like Siamese twins, they cannot be separated for life: forests provide sources of food and support for man and provide habitat for animals. Until recently, man did not realise the damage the over exploitation of forest resource had caused to the forest animals.

A PhD project supervised by Professor Bola Oboh and my humble self, to create a reference genetic data base which will be used to accurately estimate the population status of forest elephants in Southern Nigeria forests such as Omo Forest Reserve in Ogun State. Oban and Okwango Divisions of Cross River National Park in Cross River State and Okomu National

Park in Edo State was successfully defended in our PG school recently by Dr. Queen Omoregie (Figure 16). The aim of the study was to assess the variability and determine the viability of *Loxodonta cyclotis* populations in Southern Nigeria, using faecal genetic methods. The study revealed estimates of the populations, sex ratio, age structure and the genetic variation of the elephants. We hope that this pioneering research will contribute to the data base being created for the remaining forest elephants in the wild by the "Elephant initiative project" which is managed by the Nigerian Conservation Foundation (NCF) and be included in the next report to be released by the African Elephant Study Group (AfESG) (Plates 13 to 19). The DNA database of elephants when put to use will assist in the management and conservation of the few remaining wild populations of the World's largest terrestrial mammal and their habitats in Southern Nigeria.

Figure 16: Map showing the study sites, Okomu National Park, Omo Forest Reserve and the Oban and Okwango Divisions of Cross River National Park

Plate 13: A hunter's hut in Okomu National Park, this is a common sight in National Parks
Omoregie & Egonmwan, 2017

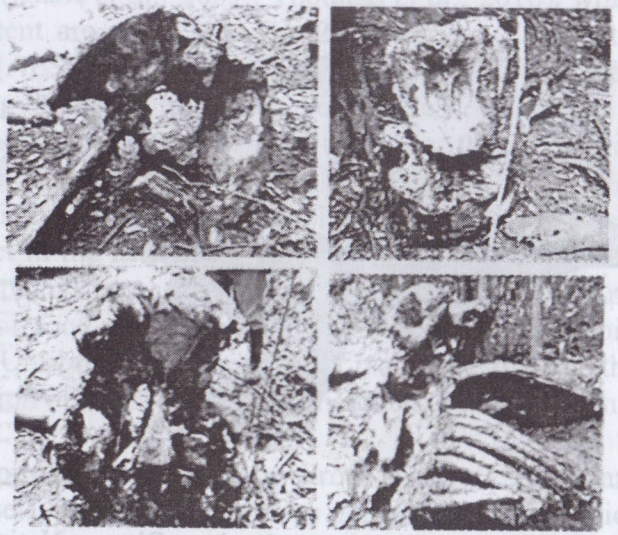


Plate 14: Charred bones of an elephant, poached in Omo Forest Reserve in August 2013
Omoregie & Egonmwan, (2017)

Plate 15: Forest Elephant sighted in Elephant transect, Erokut, Oban Division, Cross River National Park, on 31st January, 2015 **(Omoregie & Egonmwan, 2017)**

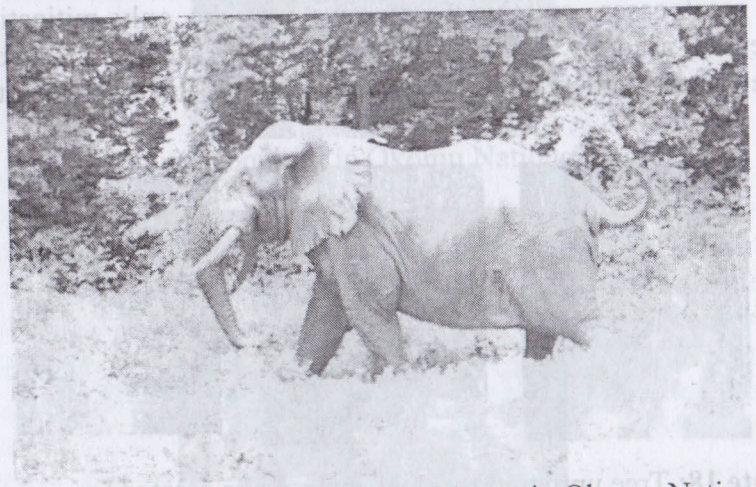


Plate 16: Elephant sighted at Lake 94 area in Okomu National Park on March 17, 2017
Omoregie & Egonmwan, (2017)

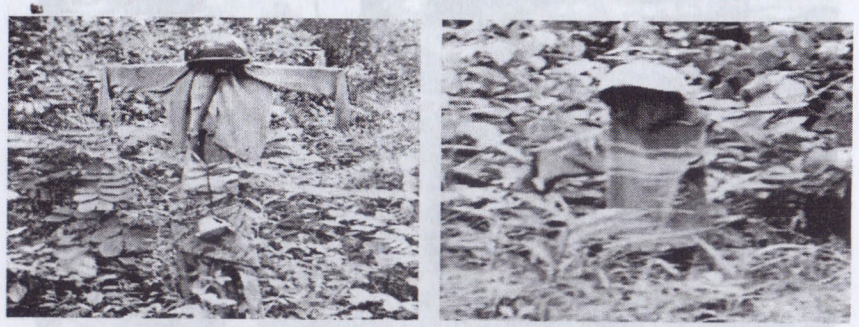
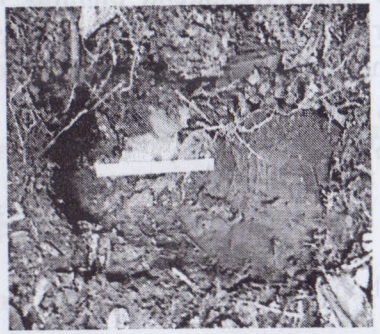


Plate 17: Scarecrows on farmlands on the fringes of Okomu National Park
Omoregie & Egonmwan (2017)

In most cases, erecting scarecrows was the only mitigation method used by farmers to combat crop raiding - A very inefficient method against large mammals especially elephants.

Plate 18: Tree uprooted by elephant in paths created by elephants in Okomu National Park
Omoregie & Egonmwan (2017)

Fresh elephant dung in Okomu National Park



Elephant footprint in Okomu National Park

Elephant mud bath in Oban and Okwango Division, Cross River National Park

Plate 19: Images from Okomu National Park and Oban and Okwango Divisions of Cross River National Park (from our visit) **(Omoregie & Egonmwan , 2017)**

14.0 DIVERSITY OF EDIBLE FROGS AND TOADS IN NIGERIA

Mr. Vice-Chancellor Sir, my former research student (Dr. Onadeko) and I have also extensively investigated the diversity of edible Anurans in Nigeria (Onadeko, Rodel, Egonmwan, and Saliu, 2010) and (Onadeko, Egonmwan, and Saliu, 2013). We also carried a survey of edible anuran species in South-western Nigeria (Onadeko, Egonmwan, and Saliu, 2011) and the results revealed that seven species of frogs are edible in Nigeria, however, 3 of the species - *Hoplobatrachus occipitalis*, *Xenopus muelleri* and *Ptychadena pumilio* were the species most sought after. *Hoplobatrachus occipitalis*, because of its large size, was the most commercialised species followed by *Xenopus muelleri* and were seen being sold in Oyingbo Market in Lagos (Onadeko *et al.*, 2011). Nutritionally, edible frogs are very important in the diets of their consumers, serving as cheap source of protein as the amino acid composition of frog meat can be compared to those of the *Clarias* sp. and *Tilapia* sp. worked on by Osibona (2005).

In addition to the economic value of anurans, there is also a cultural value. Certain frog species have medicinal importance, i.e. they are used to cure specific illnesses. Traditional medication is especially important in areas where western medicine is either not available or hardly affordable (Van der Geest, 1997). Anuran species specially used for medicinal purposes were the toads, e.g. *Amietophrynus regularis* and *A. maculates*.

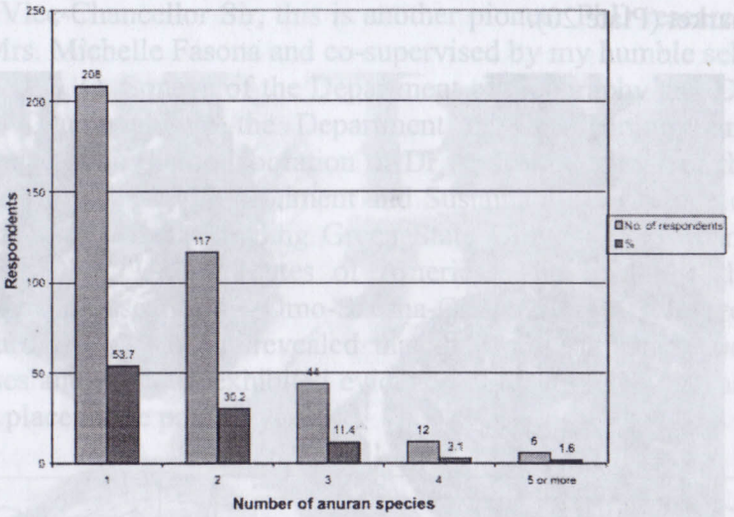


Figure 17: Popularity and awareness of Edible Frogs in Nigeria
(Onadeko, Egonmwan, and Saliu, 2011)

We interviewed 900 respondents as part of our extensive survey of edible Anurans in South-western Nigeria (Figure 17). It will amaze you to know how many people eat frogs in several villages and towns in Nigeria. Our results indicated that 92.8% of the respondents were aware of edible frogs being consumed by humans. Six hundred and sixty (73.3%) respondents had seen various individuals eating frogs. Examining the respondents themselves, 387 (43.0%) has eaten frogs. The occupation with the highest consumption of amphibian species was the farmers (64.1%) followed by the secondary school teachers (57.0%) and the least being the housewives (27.3%). From the respondents, the age group mostly associated with the eating of anuran species were 11–20 years of age. Comparing the occupation of the respondents in relation to the consumption of edible frogs, the farmers were

the highest consumers (64.1%) and the least were the housewives. The frogs are often sold in dried forms in the open market (Plate 20).

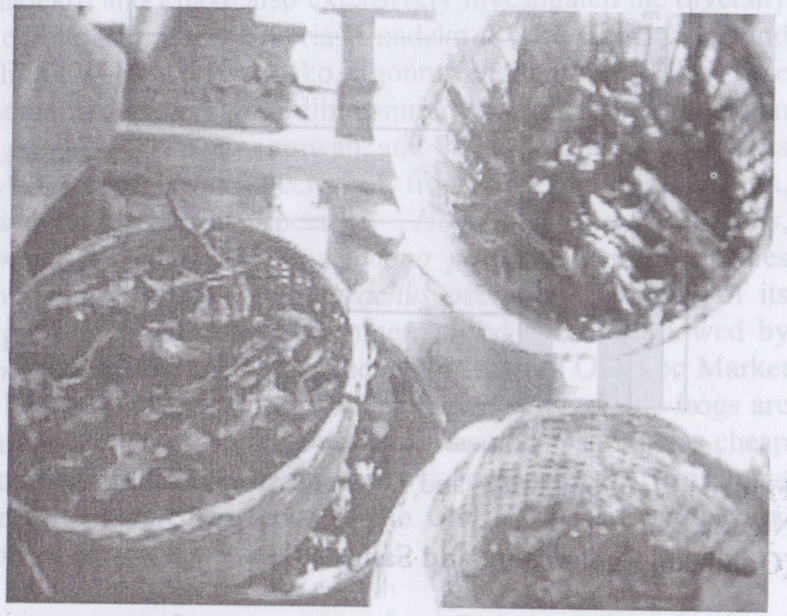


Plate 20: Dried edible anurans on display in some markets in South-West, Nigeria
(Onadeko, Egonmwan, and Saliu, 2011)

14. 2 Diversity of Anurans in South West Nigeria

A total of 35-38 amphibian species were recorded in South-Western Nigeria and over 49 species in the South-East, Nigeria (Onadeko *et al.*, 2013). Higher amphibian diversity was observed in the South-East Nigeria, most likely due to the diversity of habitat types. The difference in species diversity may indicate that the primary forests are being degraded, hence the emergence of these invasive species. The lower amphibian diversity observed in South-West Nigeria is believed to have resulted from the high amount of degradation and conversion of the natural forests into the impoverished faunal region

15.0 LARGE MAMMALS ENDEMIC TO OMO-SHASHA-OLUWA FOREST RESERVES

Mr. Vice-Chancellor Sir, this is another pioneer PhD research, by Mrs. Michelle Fasona and co-supervised by my humble self, Prof. A.S. O. Soneye of the Department of Geography and Dr. L.A. Ogunkanmi in the Department of Cell Biology and Genetics, with the collaboration of Dr Andrew Gregory of the Department of the Environment and Sustainability, College of Arts and Sciences, Bowling Green State University, Bowling Green, Ohio, United States of America. The result of the pioneering research in Omo-Shasha-Oluwa Forest Reserves (Figure 18) has so far revealed that there are six landscapes classes and these all exhibited evidence of drastic changes that took place in the past 30 years.

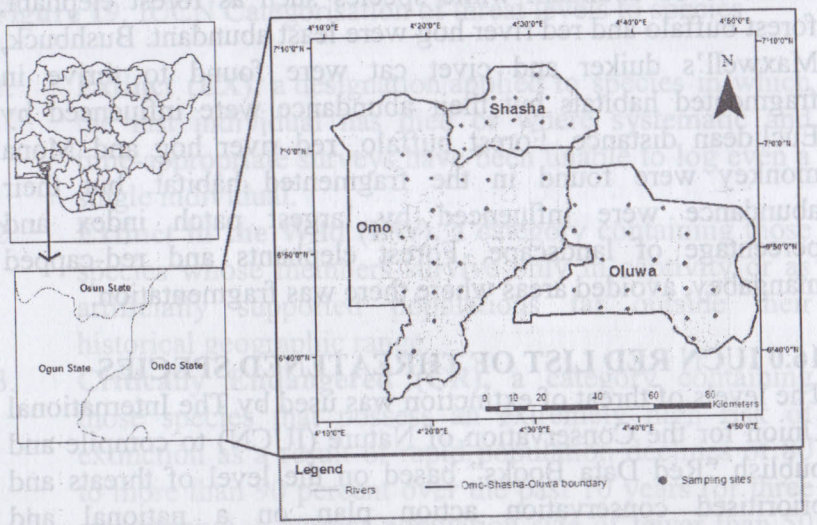


Figure 18: Omo-Shasha-Oluwa Forest Reserves Landscape

In particular, the natural forest has deteriorated very badly. Six mammalian families were identified: Bovidea, Suidae, Vivveridae, Elephantidea, Cercopithecidae and Hominidae. Based on the IUCN red list, the large mammals include the

endangered chimpanzees (*Pan troglodytes*), vulnerable species like the Nigerian white-throated monkey (*Cercopithecus erythrogaster*), red-capped Mangabey (*Cercocebus torquatus*), African forest buffalo (*Syncerus caffer nanus*), the African forest elephant (*Loxodonta cyclotis*), the near threatened yellow backed duiker (*Cephalophus silvicultor*), and the least concerned species included Mona monkey (*Cercopithecus mona*), putty-nosed monkey (*Cercopithecus nictitans*), Maxwell duiker (*Philantomba maxwellii*), Bushbuck (*Tragelaphus scriptus*), Red River Hog (*Potamochoerus porcus*), and African Civet (*Civettictis civetta*). Eight large mammal species with sufficient data were used for canonical analysis. Large mammal's species such as Maxwell duiker, civet cat, bushbuck, red river hog and Mona monkey were found to be abundant while species such as forest elephant, forest buffalo and red river hog were least abundant. Bushbuck, Maxwell's duiker and civet cat were found to thrive in fragmented habitats but their abundance were influenced by Euclidean distance. Forest buffalo, red river hog and Mona monkey were found in the fragmented habitat, but their abundance were influenced by largest patch index and percentage of landscape. Forest elephants and red-capped mangabey, avoided areas where there was fragmentation.

16.0 IUCN RED LIST OF THREATENED SPECIES

The levels of threat of extinction was used by The International Union for the Conservation of Nature (IUCN) to compile and publish "Red Data Books" based on the level of threats and prioritised conservation action plan on a national and international scale in 1994. The Red Data Book contains explicit criteria and categories to classify the conservation status of individual species on the basis of their probability of extinction. The Red Book is reviewed regularly, in order to remove or add new species under threat or to change the

categorisation of animals and plants. The original categories of threat at the species level defined by IUCN are as follows:

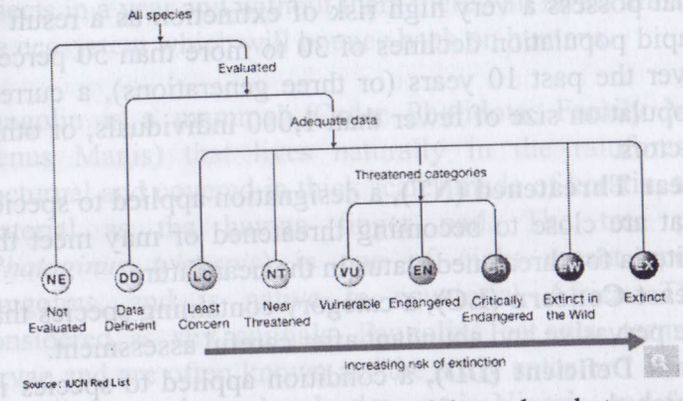


Figure 19: IUCN Categorisation of threat levels to species

1. **Extinct (EX),** a designation applied to species in which the last individual has died or where systematic and time-appropriate surveys have been unable to log even a single individual.
2. **Extinct in the Wild (EW),** a category containing those species whose members survive only in captivity or as artificially supported populations far outside their historical geographic range.
3. **Critically Endangered (CR),** a category containing those species that possess an extremely high risk of extinction as a result of rapid population declines of 80 to more than 90 percent over the past 10 years (or three generations), a current population size of fewer than 50 individuals, or other factors.
4. **Endangered (EN),** a designation applied to species that possess a very high risk of extinction as a result of rapid population declines of 50 to more than 70 percent over the past 10 years (or three generations), a current

population size of fewer than 250 individuals, or other factors

5. **Vulnerable (VU),** a category containing those species that possess a very high risk of extinction as a result of rapid population declines of 30 to more than 50 percent over the past 10 years (or three generations), a current population size of fewer than 1,000 individuals, or other factors.
6. **Near Threatened (NT),** a designation applied to species that are close to becoming threatened or may meet the criteria for threatened status in the near future.
7. **Least Concern (LC),** a category containing species that are pervasive and abundant after careful assessment.
8. **Data Deficient (DD),** a condition applied to species in which the amount of available data related to its risk of extinction is lacking in some ways. Consequently, a complete assessment cannot be performed. Thus, unlike the other categories in this list, this category does not describe the conservation status of a species.
9. **Not Evaluated (NE),** a category used to include any of the nearly 1.6 million species described by science but not assessed by the IUCN.

16.1 SAVE NIGERIAN TREE PANGOLIN (*PHATAGINUS TRICUSPIS*) FROM EXTINCTION

Mr. Vice-Chancellor Sir, the Department of Zoology of the University of Lagos recently collaborated with the Pangolin Conservation Working Group Nigeria (PWGN) and successfully held the first ever "World Pangolin Day" in the Faculty of Science, University of Lagos, on 14th February, 2019. It was a very successful event which aim was to bring awareness to Nigerians of this unknown animal, on the verge of extinction and the crisis that it is going through. Speaking at the event tagged "Saving the Nigerian Pangolin from extinction", to mark World Pangolin day, the Chairperson of "Pangolin

Conservation Working Group Nigeria (PWGN)" informed the audience that in the wild the pangolin serves as a natural controller of pests in the soil, consuming up to 70 million insects in a year and without them there will be an imbalance in the ecosystem which will bounce back on humans.

Pangolin is a mammal (Order Pholidota; Family Manidae; Genus Manis) that lives naturally in the rainforest; it is nocturnal and covered in thick scales made of keratin, the same material as the human finger nail. The tree pangolin (*Phataginus tricuspis*) is one of eight extant species of pangolins, and is native to equatorial Africa. They are considered as shy animals. Pangolins eat ants, termites and larvae and are often known as "the scaly anteater." In the past, pangolins were hunted as bush meat in Nigeria, and the scales were discarded. Then at the beginning of this millennium, things changed when the bush meat hunters were told that the scales are important in Chinese medicine, and that there was a huge market for pangolin and the scales globally.

Plate 20: Coiled up Pangolin – described as a "shy" mammal

This shy mammal is under serious threat and may go into extinction in no distant date if commercial poaching of pangolin and pangolin scales is not stopped. Many of us have never seen a pangolin, and many participants, including school children at our "pangolin awareness day" saw this harmless animal for the first time. Pangolin produces only one young per year and feeds on ants and termites. All eight species of pangolin are classified by the IUCN as being threatened with extinction, while two are classified as being critically endangered because pangolin is the most legally trafficked mammal in the world even before the elephant tusks. "Nigeria is a point of transit of the pangolin and since the year 2000, more than one million pangolins have been removed from their natural habitats in Nigeria (IUCN)". We also had representatives from Nigerian Customs in attendance who confirmed to the audience that they have intercepted and seized several shipments of pangolin and pangolin scales worth millions of Naira, at the Nigeria border, for export to other countries.

17.0 CONCLUSIONS AND RECOMMENDATIONS

I have tried to bring to this esteemed audience, some of the activities going on in our world today and in Nigeria in particular. During the World Environmental Day in 2009, the late Professor Emmanuel Obot, Executive Director of the Nigerian Conservation Foundation (NCF), while talking on "Worsening Environmental Disorder" identified lifestyles and unwillingness as key to change and as a big problem in many societies; and if people talk about development and then begin to cut down trees which increases the probability of climate change, then they should realise that such acts do not promote development.

With more than 7.6 billion humans, 200 x 7.6 billion insects currently in the world (2018) and with 80 million more humans

added to the world every year means the impact of so many organisms (humans inclusive) on the natural resources, and ecological systems is a cause for serious concern. In 2013, the Nigerian Tropical Biology Association (NTBA) successfully hosted the 4th Annual Biodiversity Conference in University of Lagos, tagged "Sustaining the Remaining Tropical Diversity", which symbolises the overall aim of the association - TBA, to manage and safeguard biodiversity, long-term.

Periwinkles snails (*Tympanotonus* and *Pachymealania*) are not cultivated but they are in fact cultivable. The ecological studies carried out over the years could contribute immensely to commercial breeding of periwinkles, to save the fishery from total collapse and to reduce pressure on the wild populations. The long-term solution to making the edible terrestrial snails, *Archachatina marginata ovum* and *Limicolaria flammea* available and affordable will be to proceed to the establishment of commercial snail farms, from the experimental types now being set up (as it is now being done for fish), that can meet the shortfall between the demand and supply from the wild during the rainy season so that the snails will be left in peace to breed. That is, if you like snail meat, buy those harvested from commercial farms or from your garden.

The international CITES – Convention on International Trade in Endangered Species of Wild Flora and Fauna came into force in 1975. In Nigeria, Endangered species (control of international trade and traffic) Act, Decree No 11 was enacted in 1985. I don't want to call this decree a toothless bull dog, but the Nigeria's borders for air and land travels, used for the illicit trade should be better monitored.

Mr. Vice-Chancellor Sir, in 2010, the Department of Zoology was invited by the Sub Committee on Environment (a sector of the University Strategic Plan Committee) by a letter; reference

AD/VC/USP/01 so as to discuss the potentials of conserving available Mona monkey population and wildlife in the University for Tourism. Under my Chairmanship, we prepared and submitted a beautiful proposal for the development of conservation/biodiversity sites on Akoka ecotourism potential of University of Lagos, which will serve as protection zones for Mona monkeys and the development of a more diverse zoological garden, which will help in developing the ecotourism potential of the University campus. We submitted our report as instructed but it has not seen the light of day. Briefly, our report recommended the setting up of a conservation site and diverse zoological garden with detailed cost and benefit of the project.

Sir, in 2014, the University of Lagos Management set up another committee, "Committee on Conservation of Natural Resources" with my humble self as Chairman. On Tuesday, 22nd April 2014, the Committee submitted a "University of Lagos Draft Conservation Policy" to the University Management and I invited to the Management meeting held at 1pm on 18th August 2014, to deliberate on the Report. I attended the meeting and the Minutes of the Meeting is available to the May be made to Mr. Vice-Chancellor Sir, and I have a copy of the Report, because it is not too late to implement the decisions taken by the Management. Thank you sir

CONCLUSION

Mr. Vice-Chancellor Sir, this inaugural lecture highlights the pressure our animals are experiencing and many species will not live to tell the tale or story. Their survival and eventual reproduction, which we as man take for granted, are big issues . We as human beings must live with nature and not alone because life without nature is meaningless. The Theme for the 2015 United Nations Environmental Programme (UNEP)

World Environment Day (WED) held 5th June 2015 was "SEVEN BILLION DREAMS. ONE PLANET. CONSUME WITH CARE". The theme asks everyone to evaluate our consumer habits: how we shop, eat and travel. Imagine if every one of the 7 billion people on earth makes an effort to consume with care, for example, less bush meat in Nigeria means there will be biodiversity abundance.

This inaugural lecture highlights the pressure our wild animals are experiencing. Their survival and eventual reproduction, which man takes for granted, is a big issue. I have listed key points for this esteemed audience to take away from this lecture; these include:

1. Being selective of the type of bush meat we buy to eat and to realiee that we may knowingly or unknowingly eat endangered animals as bush meat; many of us eat wild monkey meat as bush meat.
2. Please do not keep monkeys as pets; the wild population is dwindling and the single monkey in your home will never have the opportunity to reproduce and add to the population.
3. Buy snails from snail farms instead of wild snails; be assured that whether from the farm or from the wild, the two types taste the same.
4. Do not buy and sell ivory from elephants, which have to be extracted and result in their death.

All of us here can help in our own little way in preserving our wildlife for the future generation yet unborn. Mankind is only one small part of the planet's biodiversity. If we adopt sufficient humility and care, we might just avoid our residence on Earth from being abruptly terminated (Bruges, 2008), and we may not be alive to tell the story, just as our ancestors could not tell their tale.

Mr. Vice-Chancellor Sir, Nigeria's ENDANGERED SPECIES (CONTROL OF INTERNATIONAL TRADE AND TRAFFIC) ACT enacted 20th April, 1985 prescribes for any person who, in contravention of the provisions of this Act, trades in, or is in possession of or otherwise deals with a specimen specified in the First and Second Schedules to this Act, shall be guilty of an offence and liable on conviction- in respect of any specimen under the First Schedule to this Act, a fine of ₦1,000 for a first offence and for a second and subsequent offence to imprisonment for one year without the option of a fine; and in respect of any specimen under the Second Schedule to this Act, to a fine of ₦500 for a first offence and for a second or subsequent offence, to imprisonment for six months without the option of a fine.

I will end this inaugural lecture with a little prayer titled "*Livesimply*'(www.livesimply.org.uk)

Creator God, You gave us responsibility for the earth, a world of riches and delight. Create in us a desire to live sustainably, so that those who follow after us may enjoy the fruit of your creation, Amen.

ACKNOWLEDGEMENTS

Mr. Vice-Chancellor Sir, first, I will like to thank God Almighty and our Blessed Mother Mary, for making this day possible in my life and granting me good health of mind and body to deliver this lecture. I thank you Lord for the beauty of creation of this great Earth may God's blessings, protection and goodness continue to be with us all. Amen.

I want to thank Professor Tolu O. Odugbemi, under whose tenure as a Vice-Chancellor I became a Professor some 12 years ago, as well as Professor Oluwole B. Familoni who was the then Dean of the Faculty of Science.

My profound gratitude to my maternal grandparents, His Royal Majesty, Uku Akpolokpolo, Akenzua II, Oba of Benin and my grandmother, Her Royal Highness, Oloi Obazuaye Akenzua (Oka'Erie) who were responsible for my upbringing in the palace after my mother, Princess Oluabo Akenzua passed on at a tender age, when I was 4 years old and my brother Utete, 18 months old. My appreciation also to my uncle and Daddy, His Royal Majesty, Uku Akpolokpolo, Erediauwa, Oba of Benin, a king with a heart of gold, and my cousin His Royal Majesty, Ewuare II, Oba of Benin, the current Head of the Bini Royal Family and all the members of the Bini Royal family. *Oba gha to Kpere, ise!* I appreciate my mentors, Their Royal Highnesses Professor G.I. Akenzua, late Prince Frank Akenzua and late Princess Usunobun Idah (nee Akenzua) whom I was particularly close to in my formative years.

I appreciate my father, Baba David Obazee, and his family, the Obazee family of Idokpa and the family of Agbonifi Irughe, the former Oshodin of Benin. I also acknowledge here the family of my maternal grandmother, Eribo family of Benin and the family of my husband, the Egonmwan family of Use, Benin, all of whom contributed in various ways to what I am today. It is a

great privilege to be associated with these great families and I thank God for it.

I cannot forget the love of my aunt Late Princess Idugie Tokunboh, and her late husband Mr. M.A. Tokunboh. She brought me to Lagos and it was from her house in Surulere that I attended the Federal School of Science for my A/Level, and later as an undergraduate of the University of Lagos. They provided me a home away from home and with their children, Modupe, Taiwo, Kehinde and Idowu, we all bonded as members of one family.

I appreciate all my teachers from Ogbe Baptist Primary School (situated behind the palace in Benin) to my secondary school, especially the Principal of St Maria Goretti Girls Grammar School, Benin City, Reverend Sister Henrietta Power, who laid the foundation for my academic and moral development. Today, St Maria Goretti Old Girls are shining beacons in their different professions all over the world.

I am indebted to late Professor V.L Yoloye, who supervised my B.Sc. Project and under whose tutelage I learnt the first rudiments of research. Late Professor Yoloye started the supervision of my M.Sc. project which was later taken over by Professor W.O. Odiete following the departure of the former to the University of Ilorin. Professor W.O. Odiete kindled my interest in physiology. To Professors T.V.I. and E.S. Akpata, O.S. Adegoke, Distinguished Professor Jide Alo, I am grateful sirs and ma for your friendship.

I want to appreciate Emeritus Professor T.A. Emokpae and his wife Mrs. P.E Emokpae (both deceased) for helping to look after my son, Esosa, who daily had to accompany me to the campus from the age of 6 months. As I was resuming in the Department of Biological Sciences, on the first day, Esosa also

resumed at the Ozolua Road residence of the Emokpaes and for a long time, Mrs Emokpae and her children were there for my bundle of joy. The care was so intense and complete that whenever there was an emergency, without informing me, he was always taken to the University of Lagos Health Centre for treatment, as was the case when I suddenly found him covered with calamine lotion (an indication that he had measles), when I went to collect him to take him back home.

I am grateful to my lecturers in the University of Oxford, especially Late Professor Sir Richard E. Southwood (Head of Department of Zoology) and my two supervisors, Professors David Spencer Smith and Sarah Randolph, and her husband, Professor David Rogers. Also to Professors Pat Wilmer, Alan Grafen, Steve Simpson, all of whom contributed their expertise to my research analysis and interpretation of research findings. I am eternally grateful to Professor Sarah Randolph, her husband, and children, Emily, Thea, Jack who after the successful defense of my DPhil. thesis and I had to move out of Wolfson College, Oxford, where I was resident, provided me and my twin babies accommodation, after their birth at John Radcliffe Hospital, Oxford. I appreciate also my friends in Oxford: Mr. Kevin and Dr. Joyce Francois; Dr. Tony Akinola; late Dr.. Hansel Erhie, who taught mathematics in the University of Lagos before his death and who I met in Oxford on my arrival. He became 'Uncle Fix it" to my children, especially Esosa, as Dr. Hansel often helped to fix his broken toys effortlessly.

My thanks also go to a former Pro-Chancellor of this University, Chief Arthur Mbanefo without who's intervention I probably may not have attended the prestigious University of Oxford as the University of Lagos authorities tried to compel me to attend the University of London, just as my admission to

the University of Cambridge was awaiting the receipt of one of my referees recommendation.

I appreciate all my friends and colleagues in the great Faculty of Science, both present and past, in particular the present Dean, Professor Adedotun Adekunle, Professor J.K. Saliu (The Head of the Department of Zoology) for their support and also Zoology happy family of academic and non-academic staff. I thank all of us for being there for one other and for the unflinching support and encouragement especially when I was the Acting Head of Department (1995 – 1996) and Head of Department (2012 – 2015). I apologise if your name is not listed in this book, it is not because I forgot you, please be rest assured that your name is written in the bigger book within my heart.

I acknowledge the friends I made in the University of Lagos as a student, Professor Olusimbo Aboaba, and Professor Olukayode Amund, now Vice-Chancellor Elizade University who matriculated with me and has been my friend since then. I remain grateful to Dr. Dele and Professor Winifred Ayinke Makanjuola for their uncommon friendship. My appreciation goes to Professor Joy Okpuzor and Professor Caroline Umebese for their friendship. I remember also my late friends and colleagues, Professors Kio N. Don Pedro, Cyril Nwachukwu, Monilola Taiwo, Edith Elenwo and Grace Adeoye. Eternal Rest Grant them O Lord and May Light perpetual shine on them, Amen.

Mr. Vice-Chancellor Sir, Let me appreciate all my academic children, undergraduate and postgraduate students, those I mentored at master and doctoral levels: Dr. Abiodun Onadeko, Dr. Richard Uwadiae, Dr. Anthony Okafor, Dr. Mrs Ngozi Okwo, Dr. Adelaja Adesina. Dr. Nnamdi Amaeze, Dr. Fatsuma Olaleru, Dr. Queen Omoregie, Mrs. Mojisola Adaramaja, Mrs.

Michelle Iyabo Fasona and the colleagues in my research team; Dr. Excellence Akeredolu, Dr. Soladoye Iwajomo and Mr. Sulaiman Lawal.

To my fellow collaborators, with whom I co-supervised researches of our students, or jointly authored publications in learned journals, Professors Adebayo Otitoloju, J.K. Saliu, and Bola Oboh, I appreciate the opportunities of our working together. I remember also Late Professor. E.A. Obot, who was the Executive Director of Nigerian Conservation Foundation (NCF), who lost his life tragically in the ill-fated Dana airline crash in 2012. The collaboration and partnership the Department of Zoology has today with the Nigerian Conservation Foundation (NCF), which is the premier NGO dedicated to nature, conservation, and sustainable development in Nigeria, was initiated by my humble self and supported by Professor Obot.

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Mr. Vice-Chancellor Sir, I will like to use this medium to also appreciate institutions, other very close family friends and relatives for their love and support: Management and Staff of Vitafoam Nigeria Plc., where I am a non- Executive Director; Mr and Mrs Tunde Lawal; my uncle, Rtd. Colonel Victor Ogbomoh and his wife Mary; Prince Aghatise and his amiable wife, Princess Abieyuwa Erediauwa; Professor Unionmwan Edebiri, and my childhood friend, Mrs Joyce Osagie (nee Enaigbe). Also my adopted mothers Mrs. Esther Segun-Smith; Mrs. Esther Erunse; Alhaja Bintu Fatima Tinubu, the Iyalode of Lagos; Mrs. Ivie Ejiwunmi and Princess Wura Eweka. My sincere gratitude also to friends of my nuclear family, Chief Jonathan Adio Obafemi Olopade; Chief Kessington Adebutu, the Asoju Oba of Lagos and Balogun of Remo Kingdom; Late Chief Solomon Adebayo Ayoku of the Golden Gate fame and late former Vice-President of the Federal Republic of Nigeria, Admiral Augustus Aikhomu and his wife, Mrs. Rebecca Aikhomu.

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Finally, I wish to bring this lecture to a close with a verse from a well-known hymn "I will enter his Gate with thanksgiving".
I will enter His gates with thanksgiving in my heart
I will enter his court with praise
I will say, this is the day that the Lord has made
I will rejoice for he has made me glad.

May this be so for each and every one of us. Amen.
Distinguished ladies and gentlemen, I thank you all for your attention.

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