

CURRENT DEVELOPMENTS IN THE APPLICATION OF DNA BARCODING TO SOLVING BIODIVERSITY CONSERVATION PROBLEMS IN DEVELOPING COUNTRIES.

PAPER PRESENTED

AT

4TH BIENNIAL CONFERENCE OF THE ECOLOGICAL SOCIETY OF NIGERIA
THEME: OUR DESTINY IN OUR HANDS: ECOLOGICAL APPROACHES TO
NATIONAL DEVELOPMENT

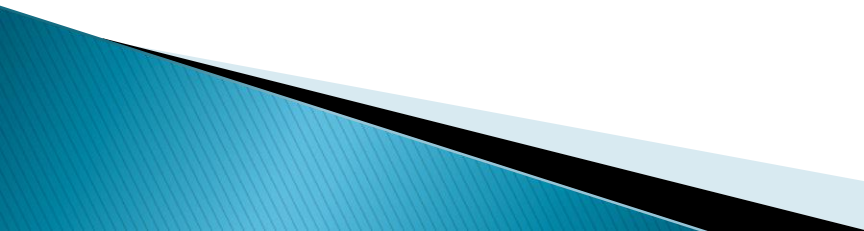
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INTRODUCTION

- ▶ Biological diversity and its related genetic resources are components of every country's national heritage.
 - ▶ Management, conservation, and development of these resources in sustainable manner require basic data gathering and documentation.
 - ▶ Taxonomical knowledge of bioresources is crucial.
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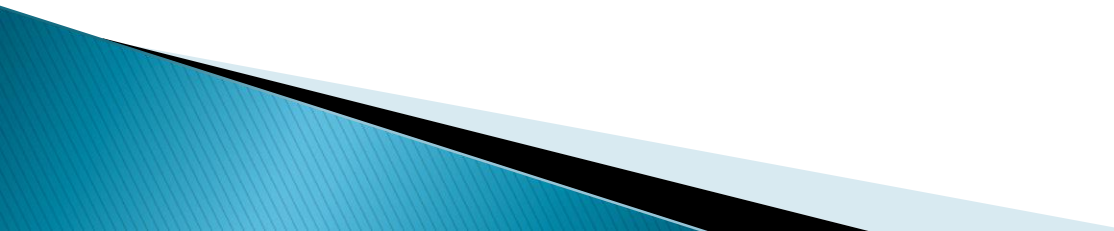
INTRODUCTION CONT'D

- ▶ Taxonomy is the science of classifying living things according to shared features.
 - ▶ Biological classification is a system of binomial nomenclature that assigns each organism a genus and species name;
 - ▶ Species identification and conservation are becoming more important with the current issues in global climate change, habitat destruction and genetic erosion;
 - ▶ According to Scientists, the yearly rate of extinction has increased from about one species per million to 100 –1,000 species per million;
 - ▶ Conventional taxonomists, are therefore facing the challenge of cataloging the huge biological diversity before it disappears.
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DNA BARCODING: INTRODUCTION

- ▶ DNA Barcode is a global initiative, which first came to the attention of the scientific community in 2003, when Paul Hebert`s research group at University of Guelph published a paper entitled “Biological Identification through DNA barcodes”
- ▶ It helps developing countries like Nigeria to:
 - Identify, recognize ownership and document their species biological diversity
 - Create enabling environment for documentation and *ex situ* conservation and utilization of the country`s biodiversity
 - Build and increase their scientific capacity to monitor, manage, use and protect their indigenous/native species diversity
 - Create avenue for commercial development of their genetic resources and benefit sharing

WHAT ARE DNA BARCODES?

- ▶ A DNA barcode is a genetic signature that occurs naturally within the genome of every living species.
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THE BARCODE PRODUCTION PIPELINE – FOUR (4) COMPONENTS:

▶ **Specimen collection from:**

- the field, National Parks, Botanical Gardens, zoological Gardens / Zoos, seed banks, National Herbaria and Gene Banks,

Laboratory Analysis:

- DNA extraction – DNA is isolated from the specimen
- DNA amplification with PCR machine
- The PCR product sequencing – the sequence is represented by series of letters C A T G representing the nucleic acids – Cytosine, Adenine, Thymine, Guanine

THE BARCODE PRODUCTION PIPELINE CONT'D

▶ Data Base:

- The sequence is placed in the Barcode of Life Data Systems (BOLD) database (a reference library of DNA Barcodes) that can be used to assign identities to unknown specimens.
- BOLD is searchable repository for barcode records, storing specimen data images as well as sequences and trace files.
- It provides an identification engine based on current barcode library and monitors the number of barcode sequence records and species coverage.

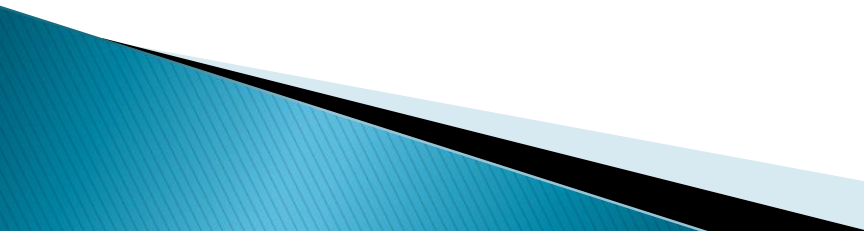
▶ Data Analysis

- Specimens are identified by finding the closest matching reference record in the database.

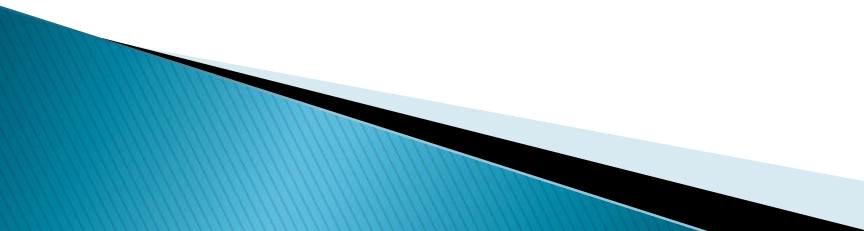
WHO NEEDS DNA BARCODES?

- ▶ Taxonomists and Museum Scientists in Cataloguing hidden diversity
 - DNA Barcoding tells apart cryptic species. *E.g. Lumbricus terrestris*, an invasive common earthworm, named by Linnaeus has been revealed by barcoding to be two distinctive species, previously recognized as one due to overlapping variation in size and shape.
- ▶ Farmers and Foresters
 - Rapid identification of agricultural and forestry pests,
 - Finding new biological controls and protecting pollinator species.

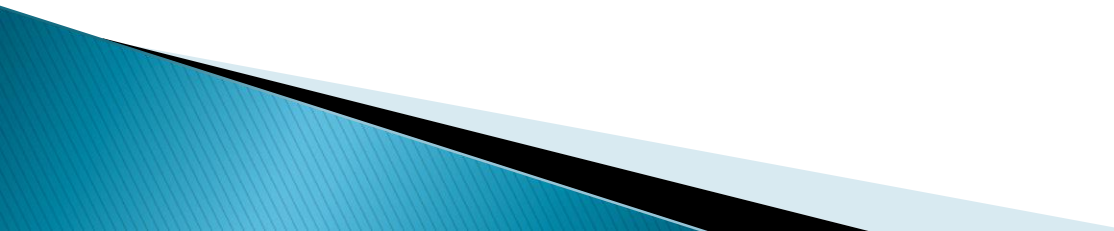
WHO NEEDS DNA BARCODES? CONT'D

- ▶ **Conservationists**
 - Tracking species populations to monitor the environmental impacts of urbanization / development, climate change and pollution.
 - ▶ **Food Inspectors and Retailers**
 - Detecting potential health risks and exposing fraud such as mislabeled meat or fish in the food supply chain.
 - ▶ **Boarder Officials**
 - Identifying invasive species and fighting the trade in endangered plants and animals.
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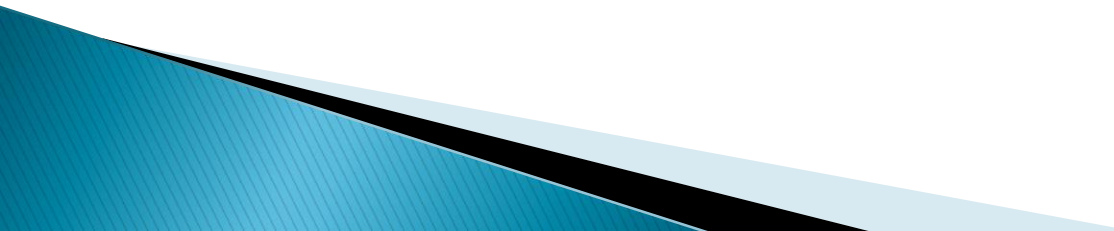
GENE REGIONS FOR BARCODE: ANIMALS

- ▶ The gene region used for all animal groups are 648 base pair nucleotides in the mitochondrial cytochrome oxidase 1 gene (CO1).
 - ▶ CO1 is effective in identifying birds, flies, butterflies, fish and many other animal groups.
 - ▶ CO1 is short enough to be sequenced quickly and cheaply, and long enough to identify variations among species.
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GENE REGIONS FOR BARCODE: PLANTS

- ▶ CO1 is not effective in identifying plants because it evolves too slowly,
 - ▶ The two gene regions in the chloroplast, **MatK** and **rbcl** have been approved as the barcode region for land plants.
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RBCL

- ▶ RBCL is an acronym for Ribulose-1,5-bisphosphate carboxylase oxygenase, abbreviated as RuBisCO
 - ▶ RBCL is an enzyme involved in the first step of carbon fixation, a process by which atmospheric carbon dioxide is converted by plants to energy-rich molecules such as glucose
 - ▶ It catalyzes the carboxylation of ribulose-1,5-bisphosphate and probably the most abundant protein on earth.
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MatK

- ▶ **Megakaryocyte-associated tyrosine-protein kinase** is an enzyme that in humans is encoded by the *MATK* gene

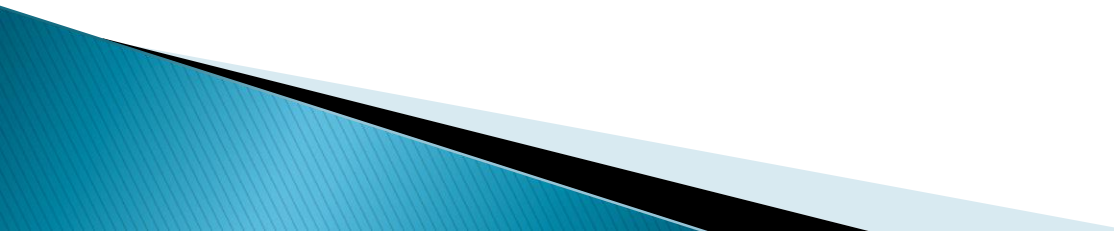
BIOINFORMATICS: CONSTRUCTION OF PUBLIC REFERENCE LIBRARIES.

- ▶ Once the barcode sequence has been received, place it in the Barcode of Life Data Systems (BOLD) database, a reference library of DNA barcodes .
 - ▶ BOLD is a searchable repository for barcode records, storing specimen data and images, including sequences and trace files.
 - ▶ It provides an identification engine based on current barcode library and monitors the number of barcode sequences and species coverage.
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CONSTRUCTION OF PUBLIC REFERENCE LIBRARIES.

- ▶ BOLD was created and maintained by University of Guelph, housing iBOL. It offers researchers a way to collect, manage, and analyze DNA barcode data.
- ▶ Other Databases include:
 - The International Nucleotide Sequence Database Collaborative – a partnership among GenBank in the USA, the Nucleotide Sequence Databank of the European Molecular Biology lab in Germany, and the DNA Data Bank of Japan.

DATA ANALYSIS

- ▶ Specimens are identified by locating the closest matching reference record in the database.
 - ▶ Constructing the phylogenetic tree
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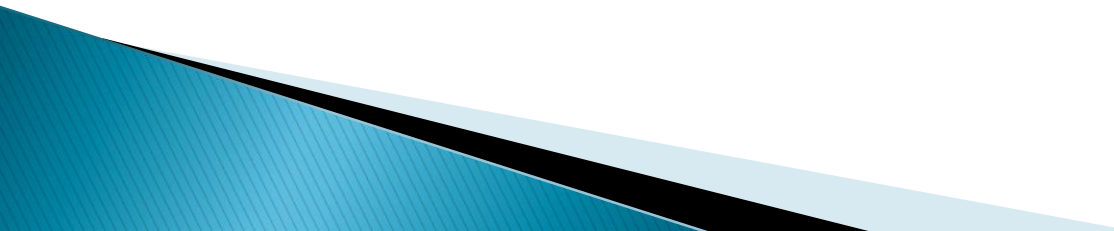
ADOPTION OF DNA BARCODING

- ▶ Many developed countries adopted DNA Barcoding technique as a molecular tool for species identification shortly after the Paul Herbert's publication in 2003.
- ▶ Subsequently, groups and outreach programs emerged such as:
 - International Barcode of Life (iBOL),
 - Consortium for Barcode of Life (CBOL);
 - Organized Projects like, Encyclopedia of all butterflies / all pollinators project
 - Fish BOL, Fungi / Tree BOL etc.

ADOPTION OF DNA BARCODING IN NIGERIA

- ▶ CBOL had an outreach visit to Nigeria in 2005 to sensitize the government of the use of DNA barcoding for rapid species identification for the purpose of protecting her biodiversity.
- ▶ A number of Research Institutes / Universities in the country became members of CBOL from 2006 and a few joined the iBOL
- ▶ Nigeria organized the first Regional workshop on DNA barcoding of national biodiversity for West and Central Africa in October 2008.

DNA BARCODING PROJECTS IN NIGERIA

- ▶ Individual Scientists and institutions have been carrying out research projects and collaborative projects which have DNA applications.
 - ▶ One of such projects is 'DNA Barcoding of Arid Plants' being carried out by University of Lagos in collaboration with NABDA and others;
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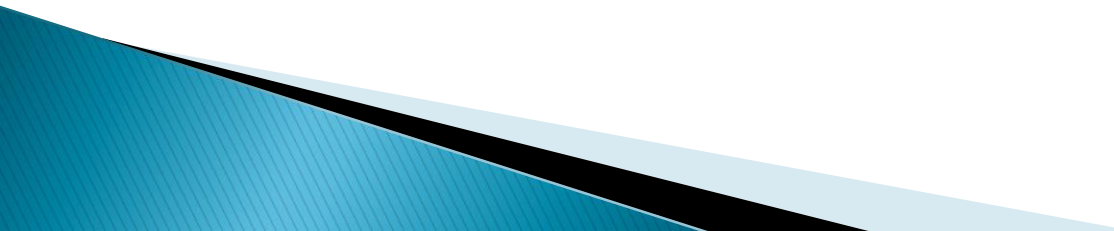
ENDANGERED SPECIES PROJECT

- ▶ The first national DNA barcoding project, which is on-going is:
 - DNA barcoding of Wild Life (Plants and animals) listed in CITES, referred to as “Barcode of Wild Life Project (BWP).
 - The project is being sponsored by Google Give Award and coordinated, world in 6 countries of the by CBOL
 - Nigeria is one the beneficiary countries

HISTORY

- ▶ Nigeria joined other 5 countries of the world in the project in January 2013;
 - ▶ Planning meeting was held by interested parties and government Institutions with mandate for conservation and enforcement in February, 2013;
 - ▶ Legal Standards Workshop was held in May/June 2013;
 - ▶ Nigeria's List of CITES species and species of national interest were selected, compiled and forwarded.
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CURRENT STATUS

- ▶ SELECTION OF LABORATORIES AND REPOSITORIES
 - ▶ BIO-INFORMATICS TRAINING
 - ▶ DNA BARCODING TRAINING AT IITA
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ULTIMATE GOAL

- ▶ ESTABLISHMENT OF FORENSIC LABORATORY FOR NESREA IN LAGOS

▶ **THANK YOU FOR
PROTECTING
OUR SPECIES**



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