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

PAPER PRESENTED

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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.

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.

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.

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.

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.

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.

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.

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.

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

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;

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, complied and forwarded.

CURRENT STATUS

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

ULTIMATE GOAL

- ESTABLISHMENT OF FORENSIC LABORATORY FOR NESREA IN LAGOS

- THANK YOU FOR PROTECTING OUR SPECIES

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