

DNA Barcoding- Aims, Objectives, and Importance

Dr. Rupesh B. Yadav

Asst. Prof.

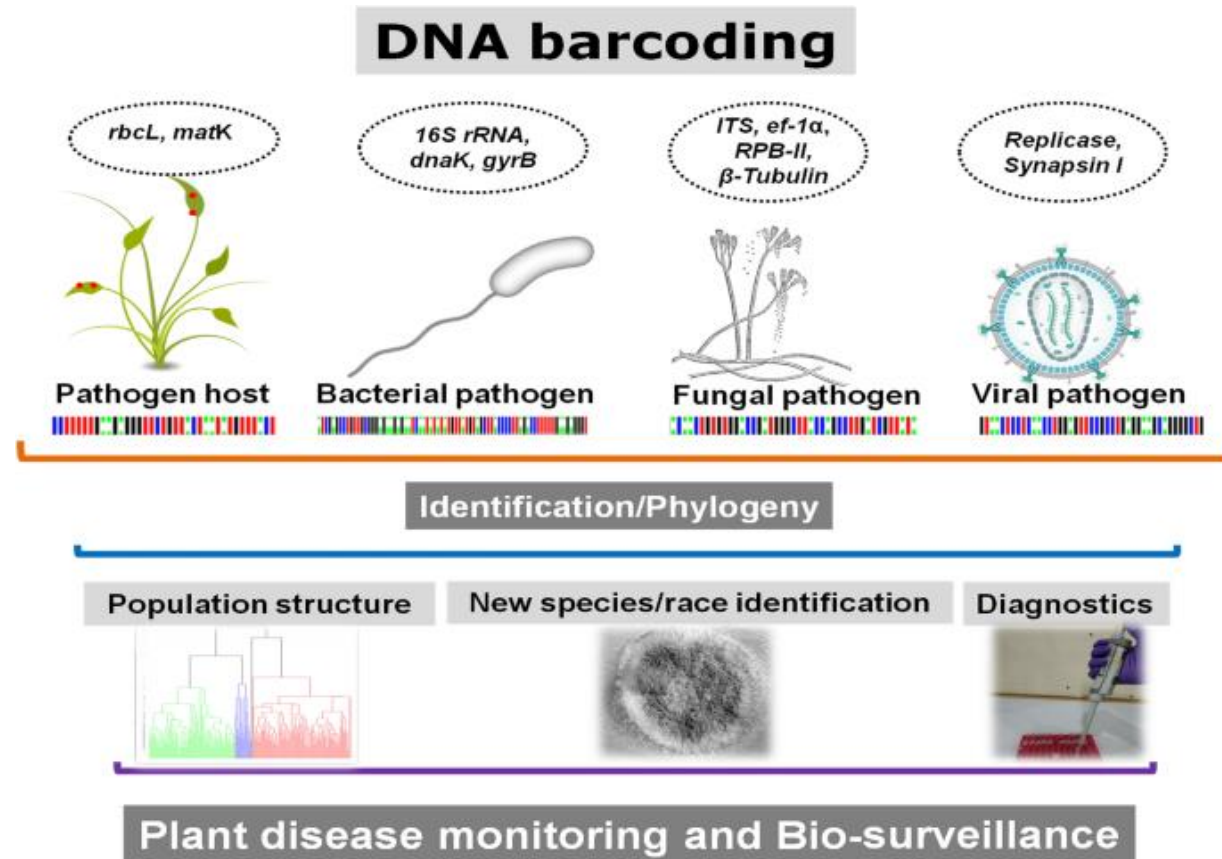
TCSC, Mumbai

Introduction

- **DNA barcoding is a method of species identification using a short section of DNA from** a specific gene or genes.
- DNA barcoding is a system for fast and **accurate species identification** that makes ecological system more accessible by using short DNA sequence instead of whole genome and is used for eukaryotes.
- The short DNA sequence is generated from standard region of genome known as marker.
- This marker is different for various species like CO1 cytochrome c oxidase 1 for animals, matK for plants and Internal Transcribed Spacer (ITS) for fungus.

Introduction

- Biological effects of global climate lead to **importance of identification of organisms** to preserve species because of increasing **habitat destruction**.
- About **5 to 50 million plants and animals** are living on earth, out of which **less than 2 million have been identified**.
- **Extinction of animals and plants** is increasing yearly means **thousand** of them are **lost each year** and **most of them are not identified yet**.



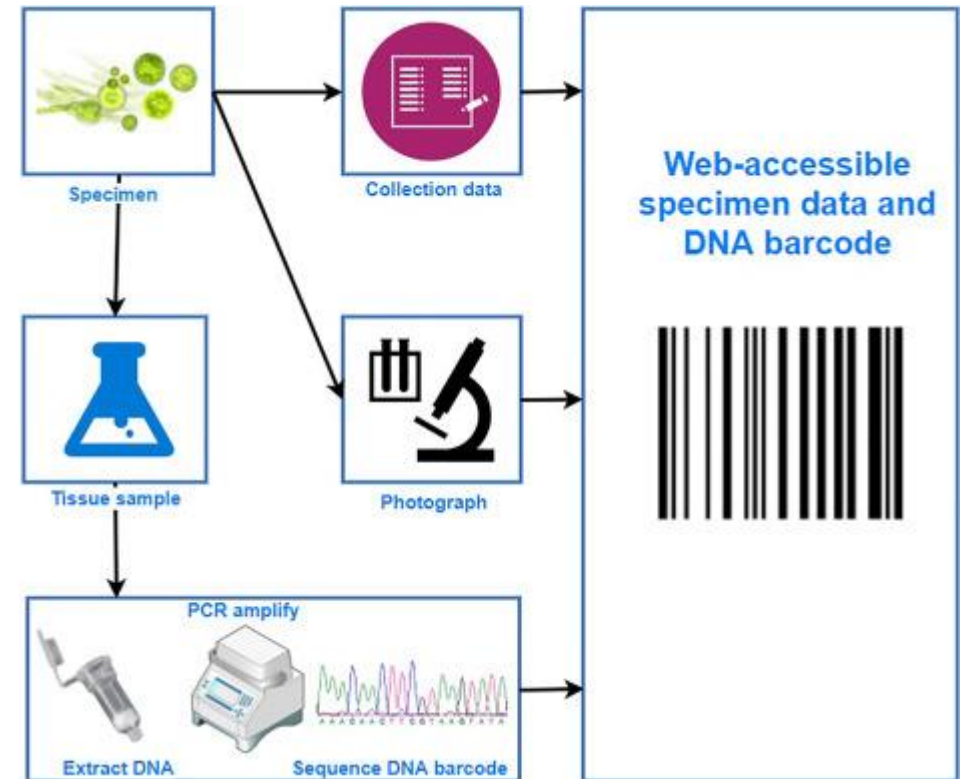
Introduction

- This destruction and endangerment of ecosystem has led to an **improved system for identifying species.**
- In recent years **new ecological approach called DNA barcoding** has been proposed to identify **species and ecology research.**
- DNA barcoding, a system for **fast and accurate species identification** which will make ecological system more accessible.



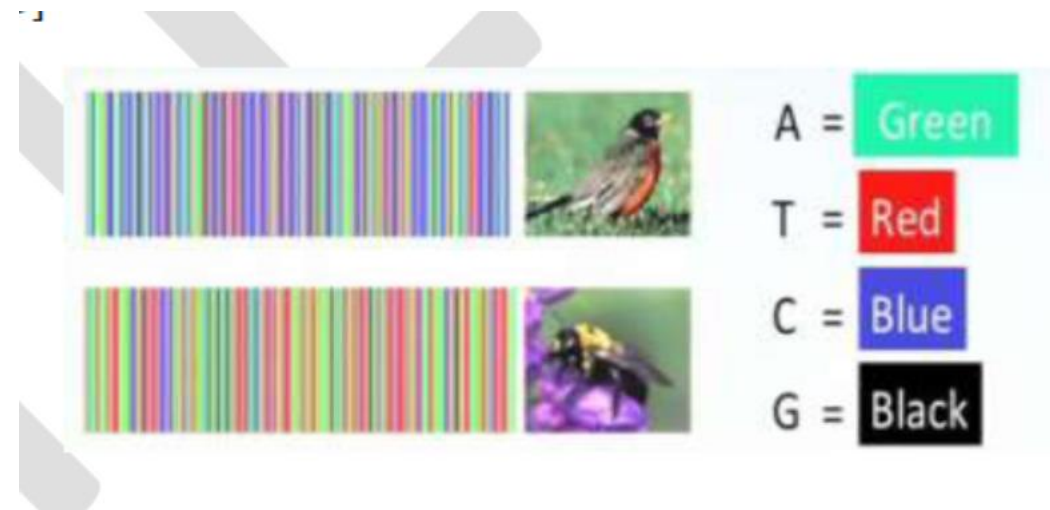
Introduction

- It first came to attention of the scientific community in 2003 when science research group of Paul Hebert at university of Guelph published a paper titled “biological identifications through DNA bar codes”.
- DNA barcoding is a new tool for identification of species and for taxonomic research.
- It is not a new concept as Carl Woese used rRNA and molecular markers like rDNA and mtDNA to discover archea i.e. prokaryotes and then for drawing evolutionary tree.



Introduction

- But **DNA barcoding** uses **short DNA sequence** instead of whole genome and it is used for eukaryotes.
- The **short DNA sequence** is taken from **standard region of genome** to generate **DNA barcode**.
- DNA barcode is short DNA sequence made of **four nucleotide bases A (Adenine), T (Thymine), C (Cytosine) and G (Guanine)**.
- Each base is represented by a **unique color** in DNA barcode as shown in figure.
- Even **non experts** can identify species from **small, damaged or industrially processed material**.



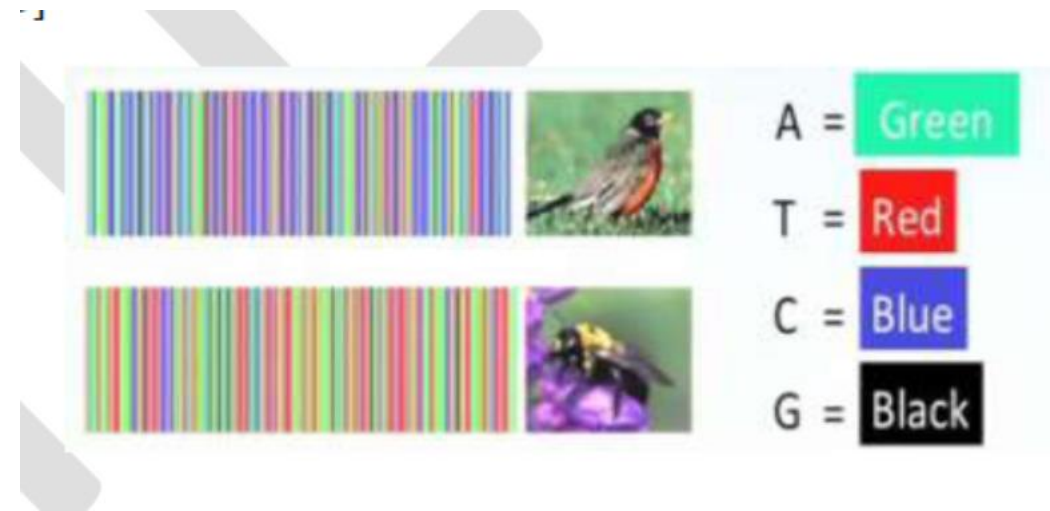
Introduction

- The standard region used to generate DNA barcode is known as marker.
- This marker is different in different species like **COI or cox1 (Cytochrome C Oxidase 1) present in mitochondrial gene in animals proposed** by Paul Hebert and recognized by International Barcode of Life (IBOL) as official marker for animals, because of its small intra specific and large inter specific differences in animals.



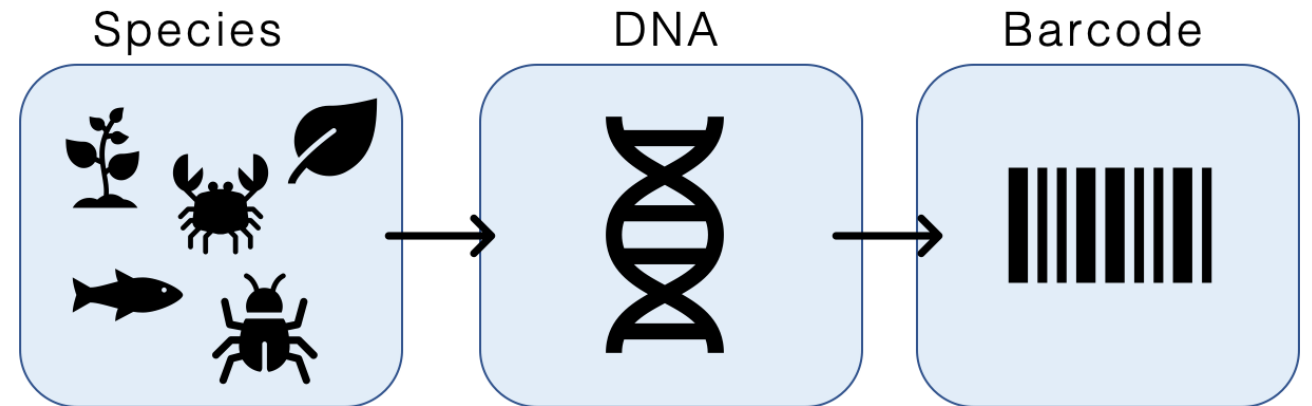
Introduction

- It is not suitable for other group of organisms because it is uniform in them.
- So, **ITS (Internal Transcribed Spacer) for fungus** and two genes **rbcl** and **matK**, from chloroplast genome are recognized as barcode markers for plants by IBOL.
- The sequence data generated from standardized region is used for identification of organism and to construct a phylogentic tree.
- **In this tree related individuals are clustered together and can provide large amount of information about specie.**



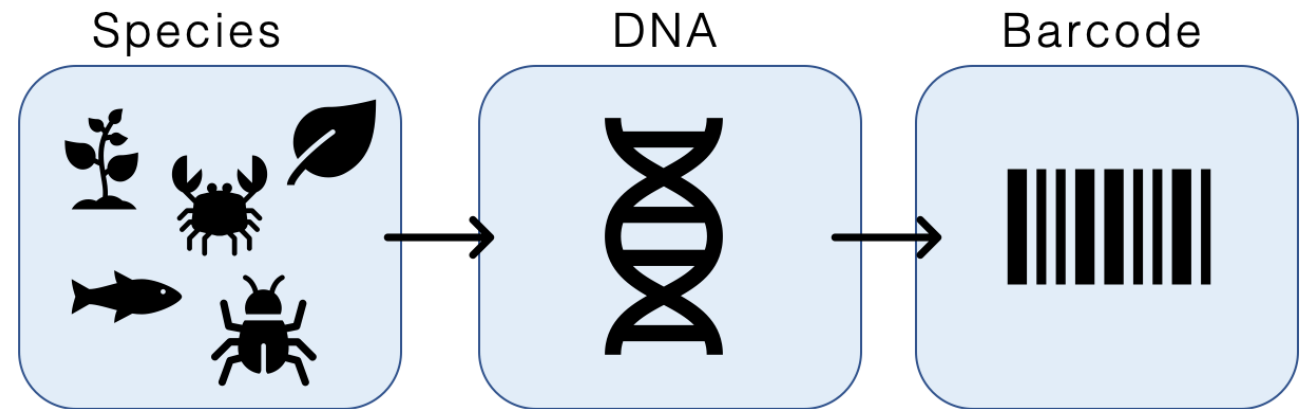
Aim

- DNA barcoding aims to use the information of one or a few gene regions to identify all species of life.
- The aim of DNA barcoding is to establish a shared community resource of DNA sequences that can be used for identification, discrimination or taxonomic classification of organisms.



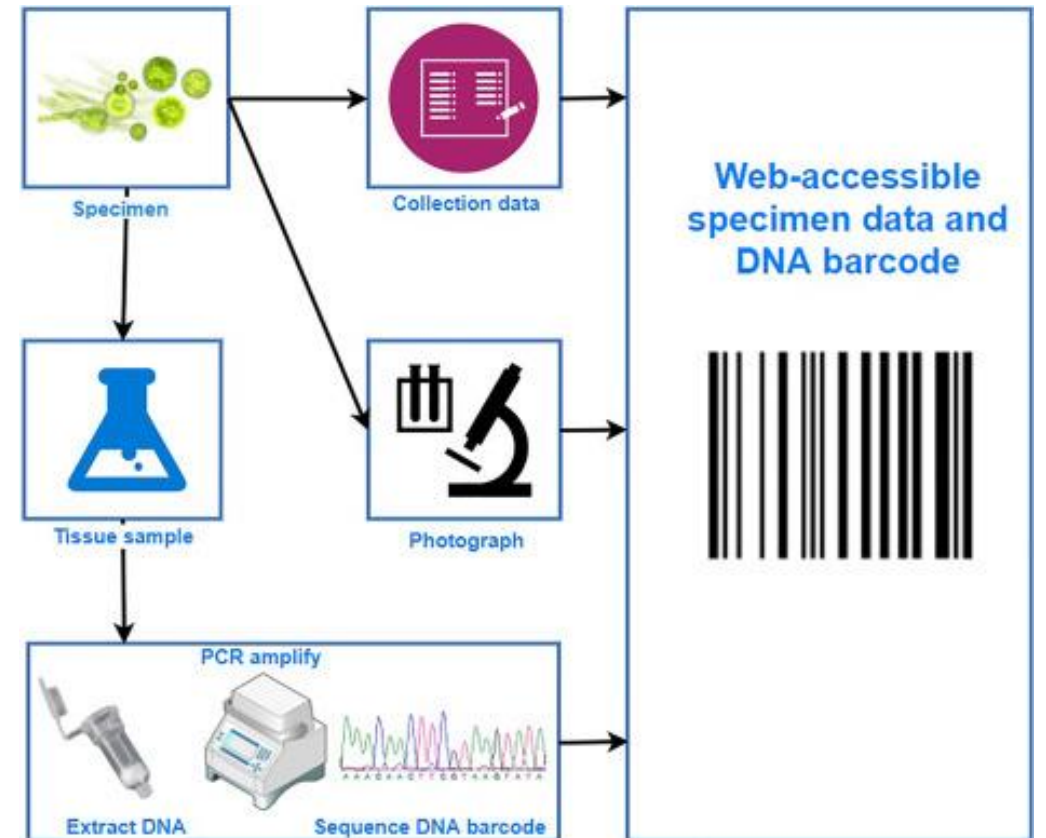
Objective

- To extract DNA from tissue/ leaves.
- To select the gene primer
- To amplify extracted DNA from the tissue/ leaves.
- To purify the amplified DNA.
- To get the DNA sequence from the DNA sequencer.



Applications

- DNA barcoding has many applications in various fields like
- ✓ Preserving natural resources,
 - ✓ Protecting endangered species,
 - ✓ Controlling agriculture pests,
 - ✓ Identifying disease vectors,
 - ✓ Authentication of natural health products
 - ✓ Identification of medicinal plants.



Applications

1. Protecting Endangered Species:

- Primate Population is reduced in Africa by 90% because of bush meat hunting.
- DNA barcoding can be used by law application to bush meat in local markets which is obtained from bush meat.

2. Identifying Disease Vectors:

- DNA barcoding allows non ecologists to identify the vector species that can cause serious infectious diseases to animals and humans, to understand these diseases and cure them.
- A global mosquito barcoding initiative in building a reference barcode library that can help public health officials to control these diseases causing vector species more effectively and with very less use of insecticides.

Applications

3. Controlling Agricultural Pest:

- DNA barcoding can help in identifying pests in any stage of life making easier to control them saving farmers from cost of billion dollars from pest damage.
- The global tephritid barcoding initiative contributes to management of fruit flies by providing tools to identify and stop fruit flies at border.

4. Sustaining Natural Resources:

- Using DNA barcoding, natural resource managers can monitor illegal trade of products made of natural resources like hardwood trees.
- Fishbol is reference barcode library for hardwood trees to improve management and conservation of natural resources.

Applications

5. Monitoring Water Quality:

- Drinking water is a process resource for living being. By studying organism living in lakes, rivers and streams, their health can be measured or determined.
- DNA barcoding is used to create a library of these species that can be difficult to identify. Barcoding can be used by environmental agencies to improve determination of quality and to create better policies which can ensure safe supply of drinking water.

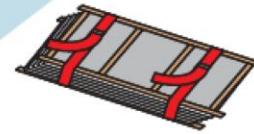
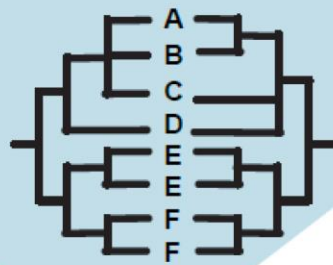
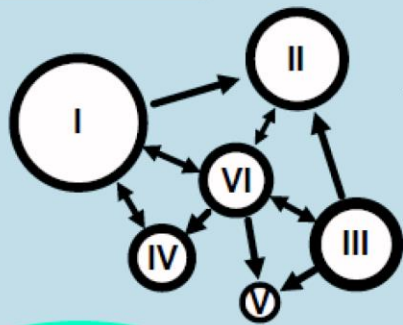
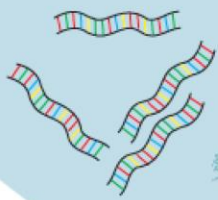
6. Routine Authentication of Natural Health Products:

- Authenticity of natural health products is an important legal, economic, health and conservation issue.
- Natural health products are often considered as safe because of their natural origin..

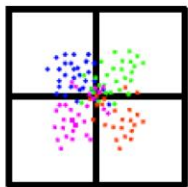
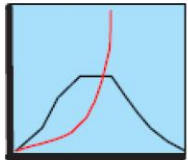
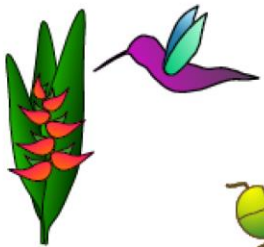
Applications

7. Identifying of plant leaves even if flowers or fruit are not available:
8. Identification of medical plants

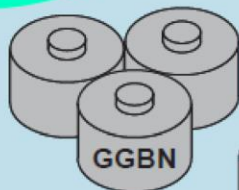
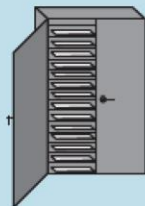
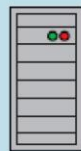
Evolution



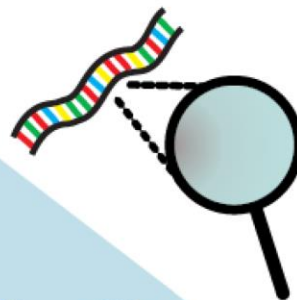
Ecology



Collections, data, & informatics



Conservation



Thank You