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Applied Zoology, Profitable Animal Production, and Health: Current Status and Future Progress (NSAZ-2022) 23rd & 24th September- 2022

Recent Trends in Applied Zoology

Dr.D.S.Rathod
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Chapter -07

A Review on Importance of DNA Bar-coding in Genomic diversity of Freshwater fish

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Abstract:

DNA barcoding is a method of identifying species that uses short DNA from one or more specific genes. The premise of DNA barcodes is that by comparing such a range of DNA (also called a "sequence") with a reference library, a well-known black man uses Stip in a supermarket using one sequence. Globally, there are roughly 450 families of freshwater fish. There are about 40 represented in India. (Species of warm freshwater). About 25 of these families contain commercially important species. There are around 544 endemic species in warm water. Remarkably, in India, many researchers examined Ichthyofaunal diversity using DNA barcoding as a molecular appliance both for marine as well as freshwater fishes.

Key word: DNA Bar-coding, fish.

Introduction:

Fish are an significant part of biodiversity in the composition of animal groups Because of their wide sharing and rich species diversity, fish not only have great nutritional worth but also play an significant role in ecological conservation though, human activities such as in excess of fishing, sewage release, and river dam building have adversely affected the fish's survival recently . Consequently, the classification and recognition of fish species are basic obligations for diversity conservation. DNA barcoding is a method of identifying species that uses short DNA from one or more specific genes. The premise of DNA barcodes is that by comparing such a range of DNA (also called a "sequence") with a reference library, a well-known black man uses Stip in a supermarket using one sequence.

The variety of plants, animals and microorganisms on Earth, along with the tremendous diversity of genes in these species and the high variety of ecosystems on the globe are all constitutive parts of what is called "biodiversity". It is globally recognized that the conservation of nature and of its biological diversity should represent one of the priorities of the current human society. An important number of factors, sometimes interconnected, like climate change, pollution, anthropic activities destroying habitats for agriculture or logging, excessive exploitation of species with economic importance, hunting or poaching, represent serious treats for biodiversity.

Mittermeier RA et.al have shown that, India ranks ninth in the list of countries with the highest levels of biodiversity in the world in terms of mega biodiversity in freshwater [1]. 11.72% of the world's fish population is in India. Species, 23.96% of genera, 57% of families, and 80% of all fish species worldwide are represented [2] among the 2200 the cold freshwater regime, 73 (3.32%) and 544 (24.73%), respectively, of the species that have been listed so far.143 (6.50%) belong to the warm freshwater domain, 1440 (65.45%)to the brackish waters, and aquatic ecosystem

Globally, there are roughly 450 families of freshwater fish. There are about 40 represented in India. (Species of warm freshwater). About 25 of these families contain commercially important species. There are around 544 endemic species in warm water [3, 4]. The earth is a planet; there are four parts to the ecosphere. The hydrosphere is one of them. In the biosphere, water is a crucial element that can be found in gaseous, liquid, and solid forms states. On the entire planet, there are thought to be 1350 km2 of water, of which 97.4% is liquid is found in oceans by volume. The biological production and physico- chemical composition of aquatic body are directly correlated to the status that has the potential for fisheries resources and tropic status [5]. Aquatic life Physical and chemical properties of the environment play a significant role in determining the biota's ability to create numerous adaptations that enhance long-term productivity and control lake metabolism [6].

In India biodiversity among animals are like 7.6% of all mammalian, 12.6% of all avian, 6.2% of all reptilian, 4.4% of all amphibian, 11.7% of all Pisces group, and 6.0% of all flowering plant species [7]. Sampling, identifying and arranging a species systematically are the pioneer work toward protection of biodiversity. Thus, it is a duty of researcher to precisely identify a species for the purpose of conservation and sustainable use.

An understanding of the taxonomy and systematic of fish species is a pre-requisite for sustainable management of genetic resources. DNA bar-coding enhances the prospects for species-level identifications globally using a standardized and authenticated DNA based approach [8]. The application of cytochrome C oxidase I (COI) gene for species identification in fish triggered the international initiative for barcoding all fishes [9, 10]. DNA barcoding provides an accurate and automated species identification system through the use of molecular tags based on short and standardized mitochondrial genes [11].

The knowledge of fish diversity is essential for adopting proper conservation strategies. Accurate identification of fish is the major task for a taxonomist to develop appropriate conservation management. Every fish species has individual genetic distances depending upon the environmental stress and water quality which play an important role in its minor morphometric variations. Many species have been considered cryptic that mean they are morphologically indistinguishable so that their status remains argumentative. [12]. Consequently, classification and identification of fishes through classical taxonomy have various barriers and limitations.

Nowadays, many researchers use morphological analysis and DNA barcoding work collaboratively for species identification. DNA barcoding as a molecular approach provides an effective tool in fish identification. After the establishment of global barcode databasefor fishes, even inexpert or less experienced user by accessing DNA sequences will be able to distinguish all fish species and the identification sustained by it could be used to evaluatefish biodiversity, monitor fish conservation and manage fisheries. FISH-BOL (the Fish barcode of life campaign), international research collaboration, collected DNA barcode records for the entire world's fishes with the aim to develop COI gene sequences library [13].

In India, DNA barcoding is in the infancy period and should be focused on in the sampling of marine and freshwater species. Other than the COI barcode marker (mitochondrial gene), the effort should be targeted to develop a nuclear barcode because sometime COI fails to distinguish fishes formed through introgressive hybridization. Thus, this may help to develop fish DNA barcoding more easily as well as quickly. But the challenge is to find out 600-1000 bp long nuclear coding region undisrupted by introns, with fast rates of evolution [14]. However, researches from interdisciplinary sciences are desirable in this direction to fulfill that goal.

The concept of DNA barcoding as a genomic identification system was developed by Paul Hebert andit is a well-accepted taxonomic method to facilitate species identification even by a non-specialist.

In DNA barcoding, a short standardized nucleotide sequence of DNA is used for the identification of fish. Generally, cytochrome oxidase subunit 1 (cox 1), which is a mitochondrial DNA gene used as a global bio-identification system for an animal [15].

The process of DNA barcoding includes the following steps: DNA extraction i.e.isolation of DNA from the sample, PCR amplification of the target DNA barcode region, DNA sequence of PCR products and analysis. The basic principle behind DNA barcoding is that the interspecies variations are more than intraspecies variation, which helps to differentiate the species using short standardized nucleotide sequences. The main objectiveof DNA barcoding emphasis on the gathering of reference libraries of barcode sequences for known species so that after assembly a consistent molecular tool is developed for species identification. DNA barcoding has been effectively used for both marines and freshwater species. Ward and Robert D. in 2005 had shown that, first of all discriminated Australian marine fish through DNA barcoding. They generated 754 barcodes for 207 species. They sequenced multiple specimens of 3 species of Chimaerids, 61 species of sharks and ray, and143 species of teleost for the barcode region of cox1 [16]. Moura et al. (2008) attempted to test the competence of the DNA barcode approach to discriminate deepwater shark species: Centrophorus squamosus, Centrophorus granulosus, Centroscymnus coelolepisand Centroscymnus owstoni and their study revealed a low level of haplotypic and genetic diversities [17].

Holmes et al. (2009)) identified shark species from dried fins in Australian water. They examined 211 left pectoral fins, 193 fins out of them provided a chondrichthyan sequence which when matched with reference specimen in a DNA barcode database identified 27 species of shark and rays among them, twenty species were sharks while seven were rays. They found that

Carcharahinus dussumieri was the most abundant fish [18]. Additionally, Steinke et al. (2009) constructed a DNA barcode reference sequence library for introduced ornamental fish species in North America [19].

The mega diverse neotropical freshwater fish fauna was examined by Pereira et al. (2013) using DNA barcoding. They analyzed 254 species, out of which 252 were correctly identified by DNA barcode sequences (99.2%). They tested the competence of the COI gene in identifying freshwater fish fauna from the neotropical region. Genetic divergence, measured by using K2P, was 0.3% and 6.8% for intra and inters specific diversity, respectively [20].

Remarkably, in India, many researchers examined Ichthyofaunal diversity using DNA barcoding as a molecular appliance both for marine as well as freshwater fishes. Khedkar etal. (2014) constructed firstly a DNA barcode library for freshwater fishes of Narmada River. They collected 820 fish specimens from different locations across the river basin. They generated a 314 different COI sequence and revealed that the specimens belonged to 85 species representing 63 genera, 34 families and 10 orders. Their study revealed that, out of 85 species, 5 species were endemic to India whereas 3 were exotic [21]

In addition, Lakra et al. (2011) barcoded the Indian marine fishes for the first time using mitochondrial COI gene. They characterized 115 marine fish species belonging to 7 orders and 37 families including Carangids, Clupeids, Scombrids, Groupers, Sciaenids, Silverbellies, Mullids, Polynemids and Silurids of Indian marine fishes for the generation of DNA barcodes.

The average Kimura two-parameter (K2P) distances increased hierarchically from within species to orders [22]. Sachithanandam et al. (2012) carried out the identification of Epinephelus spp. in the Andaman coastal region by DNA barcoding using the COI gene. They evaluated the mean genetic distances using Kimura 2 parameter (K2P) between the studied Epinephelus spp. from Andaman coastal region and same species from the world over. Genetic divergences among Epinephelus longispinis, Epinephelus ongus and Epinephelus aerolatus were 0.0004, 0.0183, and 0.0437, respectively [23]. While, Sadurudeen et al. (2017) generated DNA barcodes for 32 fish species, delineating 13 families of order Perciformes in the Indian Coast [24].

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