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Improving Zoological Studies by use of a Taxonomic Databases: Utilising Library Science for Fish Identification.

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Abstract: - Biodiversity is a key aspect in living organism which is influenced on human society and habitat of that organism. It plays crucial role in each and every ecosystem. Biodiversity is a term that refers to the variety and variability of living species on earth like bacterial, plants, microorganisms etc. It includes variation between genes, species and functional traits. Out of all life forms, it is commonly measured in terms of richness (abundance), evenness (symmetry) and heterogeneity (variety or diverseness).

Key words: - ***Biodiversity, Taxonomic, species, Identification, Databases.***

1. Introduction: - India is an important country in the Asian continent with thousands of years of historical and cultural history. And at the same time we see that it is also rich in various geographical aspects. India is a 7th largest country in the world. And at the same time we find different geographical areas India stands different and remarkable properties aspects from the rest of Asia marked of as it is by mountain like Himalaya Mountain and the Sahyadri mountain range; and the seas like Bengal see and Arabian sea which give the country or distinct geographical entity bounded by the great Himalaya in the Northern region which state is South words and it is the tropic of Cancer tapers off into the Indian Ocean between the bio Bengal on the east and Arabian Sea on the west. India is a diverse country, with parts that are geographically unique while also displaying a blending of various cultures and histories; at the same time we see it divides different parts of regions. So that each and every part of regions has unique physical and chemical properties therefore we observed more diversity of living organism. As we know India is prosperous source of water bodies like River, dam, lake, streams etc.; and as its output revealed high diversity of aquatic creatures and fishes.

Fish contribute faintly more than one half of the total of vertebrates and India contributes to about 7.7% of global fish diversity (Kushal T., 2021). Fish is an important aquatic source which is obtained from water resource. So that fish population is influenced on earning and feeding habits of human. Many people are engaged in fish industry its about 500 million people worldwide are economically dependent on fisheries sector (Khole A., 2022). Every species that plays an important role in the ecosystem and diversity of species is beneficial to preserve a sustainable ecosystem (Kushal T., 2021). To plan a conservation strategy for species a proper identification of species is necessary. But without truthful taxonomy, it remains awkward to identify a species. In fish species identification, in term of classical taxonomy fish identification is usually based on morphological characters (Morphometry, colour, fin formula, scale counting etc.) (Kushal T., 2021).

Every species is play vital role in habitat so its study and necessity is important; and for this purpose species identification and its conservation are prior needs. Expert taxonomist, local knowledge holders, identification keys, image recognition software , scale and otolith body section analysis, auditory methods genetic identification via single nucleotide polymorphism, and DNA bar coding are employed in fish species identification Some web resources used for identification of species such as Fish Base (www.fishbase.org). Typically, the scientist identifies the fish by consulting standard literature or utilising a key. A taxonomic key is a systematic sequence of alternative choices offered by an organism's diagnostic (morphological) trait that leads to accurate identification. A key's formal or taxonomical scope is typically limited to printed materials or digital presentations however , due to considerable diversity and phenotypic

flexibility, it appears impossible to reliably identify a fish species based just on morphology. The morphological trait is difficult to identify in cryptic and morpho species, as well as in development phases. It is difficult for a less experienced person to identify a species accurately.

In this study, we will be analyzing the species of fish that are there, and in order to accomplish this, we will be making use of various apps and data that is available online. This is due to the fact that we will be generating data utilizing new technology rather that identifying species in the traditional manner.

2. Definition –

2.1 Zoological studies

Zoological studies refer to the scientific investigation of animals, encompassing their classification, structure, physiology, development, behavior, distribution, and ecology. This interdisciplinary field contributes to understanding biodiversity, evolutionary biology, and conservation.

"Zoological studies comprise a wide range of biological disciplines that explore animal life in all its forms, aiming to understand the biology, behavior, ecology, and evolution of animals." (Chapman, A. D. (2009).

2.2 Taxonomic databases –

Taxonomic databases are structured digital repositories that store, manage, and provide access to information on the classification, nomenclature, and distribution of organisms. These databases support biological research by standardizing species data and enabling reliable identification and comparative studies.

"Taxonomic databases are essential tools that provide organized, authoritative information on the classification and nomenclature of organisms, facilitating biodiversity studies and ecological research." (Bisby, F. A., et al. 2002).

2.3 Library Science-

Library Science is the field of study that deals with the principles, practices, and management of library operations, including the organization, preservation, retrieval, and dissemination of information resources to meet the informational needs of users.

"Library science is the study of the principles and practices of library administration, organization of knowledge, and information services, aiming to facilitate access to information for education, research, and personal development." Rubin, R. E. (2010).

2.4 Fisheries science

Fisheries science is an interdisciplinary field that focuses on the understanding, management, and sustainable use of fishery resources. It integrates biological, ecological, economic, and environmental sciences to study fish populations, aquatic ecosystems, and human interactions with aquatic resources.

"Fisheries science is the academic discipline of managing and understanding fisheries. It draws on marine biology, ecology, oceanography, and economics to ensure the sustainable use and conservation of aquatic resources." (Lagler, K. F., Bardach, J. E., Miller, R. R., & May Passino, D. R. 1977).

3. Review of Literature

The integration of taxonomic databases into zoological research has significantly enhanced the accuracy and efficiency of species identification, particularly in ichthyology (the study of fish). Zoological studies rely heavily on precise

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classification, nomenclature, and documentation, and taxonomic databases serve as central repositories that provide standardized information about species. According to Bisby et al. (2002), taxonomic databases such as *Species 2000* and *Catalogue of Life* offer curated, authoritative data that support biodiversity research and global taxonomy initiatives.

Fish identification has historically posed challenges due to morphological similarities among species, regional naming inconsistencies, and a lack of access to reliable reference material. The emergence of databases such as *FishBase* has addressed many of these challenges. Froese and Pauly (2010) describe *FishBase* as a comprehensive, searchable online database that provides taxonomic, distributional, and ecological data on over 34,000 fish species, serving as a critical tool for researchers, educators, and policy-makers.

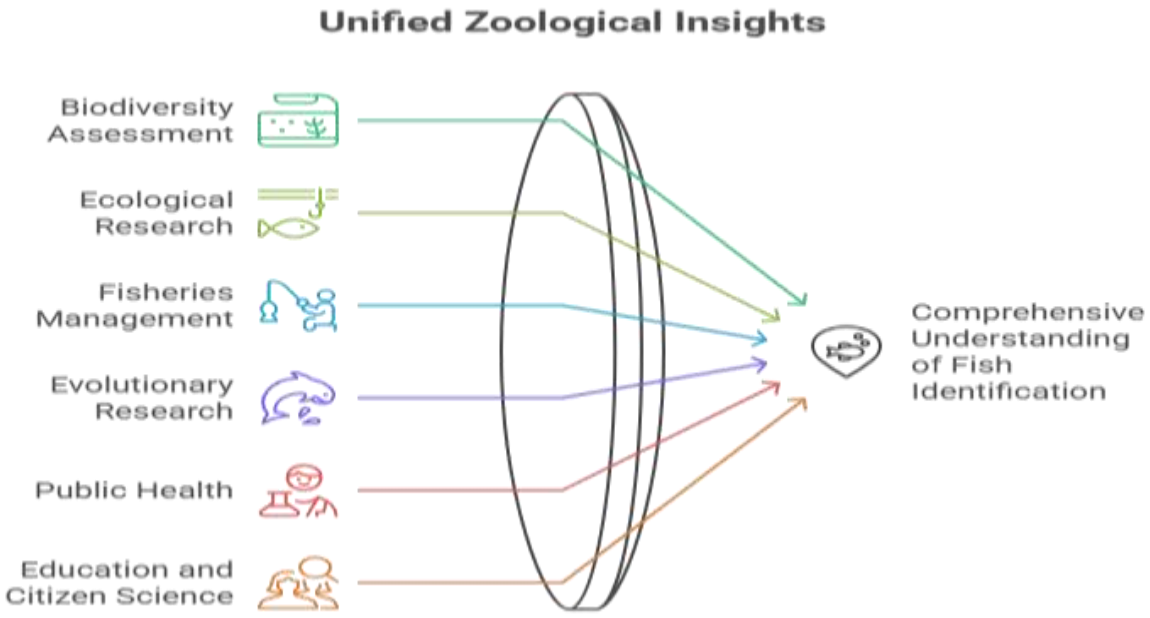
Library and Information Science (LIS) plays a crucial role in organizing and disseminating zoological information. Rubin (2010) emphasizes that library science fosters the development of classification systems, metadata standards, and digital cataloging tools that enhance the accessibility and interoperability of biological data. Through the application of LIS principles, taxonomic databases become not only scientifically accurate but also user-friendly and searchable.

Dr. Rahul K. Deshmukh's study contributes to this growing field by conducting a bibliometric and scientometric analysis of Six Sigma literature indexed in the **Web of Science (WoS)** database from **2007 to 2018**. His investigation offers a comprehensive overview of research dynamics, including - **Productive authors**, **Document types**, **Institutional contributions**, **Publication sources**, **Geographic distribution**, **Subject areas and source types** The study builds upon earlier bibliometric works by integrating **affiliation analysis and source-type classification**, providing a nuanced understanding of the academic infrastructure supporting Six Sigma research. In doing so, Dr. Deshmukh not only charts historical publication patterns but also identifies potential **future research directions and collaboration opportunities**.

Dr. Rahul K. Deshmukh's & Dr. Vilas Kale study The present paper discusses the term "Democracy" as reflected in JGate during the period during 2013 to 2017. The present paper investigates the highly productive authors, Document Types; it aims to find out the top contributing institutions, the preferred sources for publications, documents by country, Subject area, Source Type, Affiliation, and Language etc. The result indicates that there were total 23721 documents on "Democracy" in JGate during 2013 to 2017.

4. Importance of Fish Identification in Zoological Studies

Fish identification plays a foundational role in zoological studies, enabling researchers to classify, catalogue, and understand aquatic biodiversity. Accurate species identification is essential for multiple domains within zoology and environmental science, and its importance can be viewed across several dimensions:



4.1 Biodiversity Assessment and Conservation

Correct identification of fish species is vital for documenting biodiversity in freshwater and marine ecosystems. It allows scientists to monitor species richness, detect the presence of endemic or endangered species, and identify areas requiring conservation. Misidentification can lead to underreporting or overestimation of biodiversity, affecting ecological assessments and policy decisions.

4.2 Ecological Research and Food Web Analysis

Ecologists rely on accurate taxonomic data to understand the roles species play in aquatic food webs, migration patterns, reproductive behaviors, and habitat preferences. Identifying fish correctly supports ecosystem modeling and helps detect changes in community composition due to climate change, pollution, or invasive species.

4.3 Fisheries Management

In fisheries science, the identification of commercially important species is crucial for sustainable harvesting. It enables the regulation of catch limits, helps prevent overfishing, and supports the enforcement of fishing laws. Correct species recognition also prevents market fraud where cheaper or illegal species are sold under false names.

4.4 Evolutionary and Taxonomic Research

Fish identification is key to understanding phylogenetic relationships and evolutionary history. Accurate classification informs studies in genetics, adaptation, and species divergence. It also ensures the consistency of nomenclature in scientific communication.

4.5 Public Health and Biosecurity

Some fish species may carry toxins or pathogens that affect human health. Proper identification helps in tracking and managing outbreaks caused by harmful species (e.g., ciguatera fish poisoning) and in preventing the introduction of invasive or disease-bearing species into new environments.

4.6 Education and Citizen Science

Clear identification guides and taxonomic databases empower educators, students, and citizen scientists to engage in biological monitoring. Community-based fish identification initiatives contribute valuable data to larger biodiversity projects and foster environmental awareness.

5. Role of Taxonomic Databases

Taxonomic databases such as FishBase, ITIS (Integrated Taxonomic Information System), and Catalogue of Life serve as repositories of scientific names, classification hierarchies, and species descriptions. Their benefits include:

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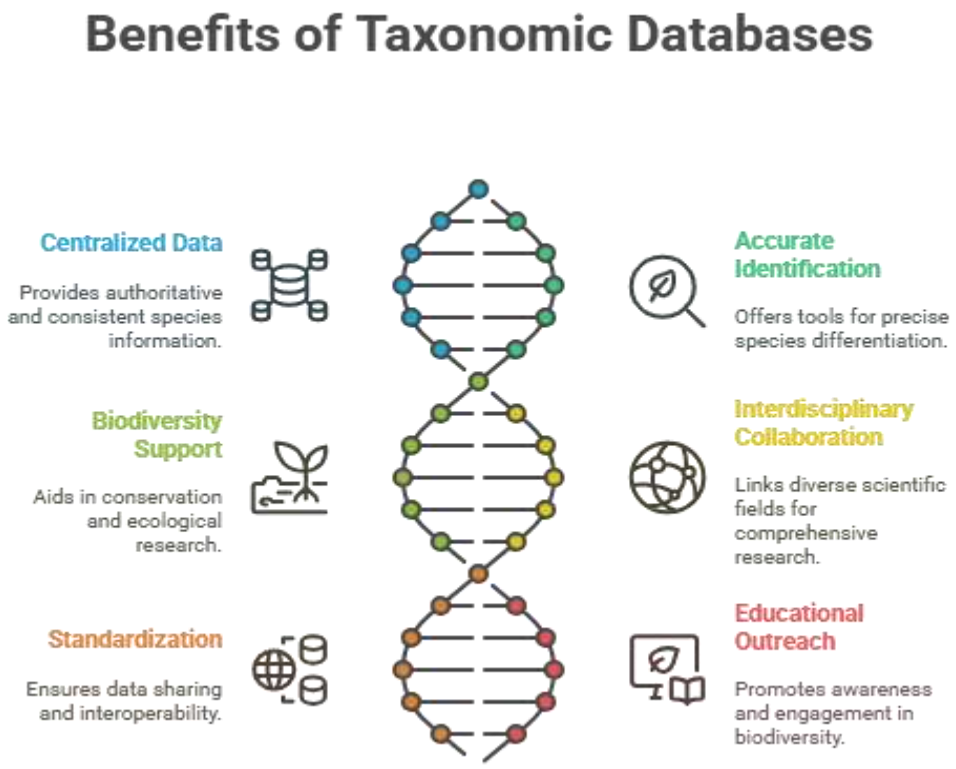

Taxonomic databases play a pivotal role in organizing and disseminating biological information, serving as vital tools for fish identification and zoological research. These databases are structured repositories that systematically catalog species data, enabling researchers, educators, and policymakers to access reliable and standardized information. Their role extends beyond storage, offering tools for analysis, cross-referencing, and integration with broader biodiversity systems.

5.1 Centralized Access to Validated Data

Taxonomic databases provide centralized, authoritative information about fish species, including scientific names, common names, synonyms, classification hierarchies, and diagnostic features. This ensures consistency in nomenclature and prevents confusion arising from outdated or incorrect terms.

5.2 Enhancing Accuracy in Species Identification

Many taxonomic databases offer identification tools such as dichotomous keys, image galleries, and morphological descriptors. These tools help users accurately distinguish between closely related species, especially in cases where external features are subtle or overlapping.

5.3 Supporting Biodiversity and Ecological Research

Databases like FishBase, ITIS, and the Catalogue of Life are essential for biodiversity inventories, conservation assessments, and ecological modeling. They enable researchers to track species distributions, assess conservation status, and analyze ecosystem changes over time.

5.4 Facilitating Interdisciplinary Collaboration

Taxonomic databases often link to genetic databases, environmental datasets, and literature repositories. This interconnectedness allows for interdisciplinary research that combines taxonomy, ecology, genetics, and climate science—enhancing the understanding of species and their environments.

5.5 Promoting Standardization and Data Sharing By adhering to internationally recognized standards (e.g., Darwin Core, GBIF protocols), taxonomic databases facilitate data sharing and interoperability across institutions and countries. This standardization is crucial for global biodiversity monitoring and collaborative conservation efforts.

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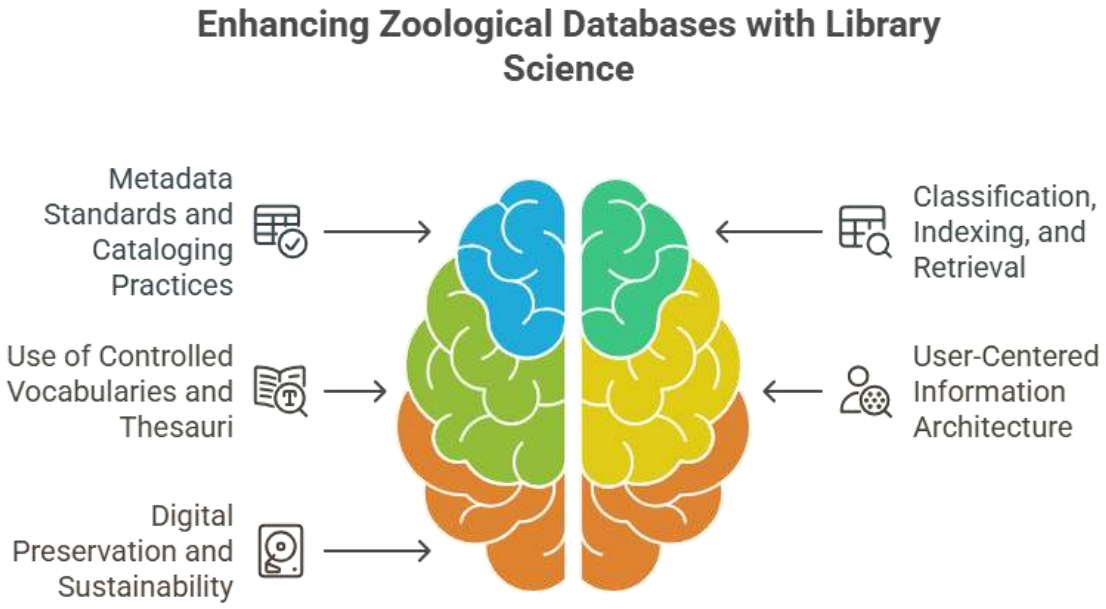
5.6 Educational and Outreach Applications

Accessible online taxonomic databases serve as excellent educational resources for students, teachers, and the general public. They promote awareness of aquatic biodiversity and foster engagement in citizen science and environmental stewardship programs.

6. Integrating Library Science into Zoological Databases

The field of Library and Information Science (LIS) provides a robust foundation for organizing, retrieving, and managing knowledge. When applied to zoological taxonomic databases—particularly those used for fish identification—LIS principles greatly enhance their effectiveness, usability, and accessibility. This integration addresses challenges such as inconsistent terminology, poor metadata practices, and user interface limitations, all of which can hinder research efficiency and data accuracy.

Library science contributes to taxonomic databases through:



6.1 Metadata Standards and Cataloguing Practices

Library science emphasizes the creation and application of standardized metadata schemas for consistent information description and retrieval. In biological databases, metadata standards such as Darwin Core (DwC) help structure species-related data—such as taxonomy, habitat, geographic location, and collection date—making them easily searchable and interoperable.

LIS cataloguing techniques, comparable to MARC (Machine-Readable Cataloguing) in libraries, help maintain structured records in taxonomic databases. These enable precise classification, effective indexing, and long-term preservation of biological data.

6.2 Classification, Indexing, and Retrieval

Taxonomic classification mirrors the library classification systems (e.g., Dewey Decimal, Library of Congress) by organizing species into hierarchical categories like kingdom, phylum, class, order, family, genus, and species. LIS professionals apply indexing strategies (like keyword indexing, faceted classification, and subject headings) to biological terms, enabling quicker and more accurate data retrieval.

For instance, fish identification can be enhanced through controlled indexing using scientific names, vernacular names, habitat types, and morphological features.

6.3 Use of Controlled Vocabularies and Thesauri

LIS promotes the use of controlled vocabularies, authority files, and taxonomic thesauri to ensure consistency in terms across databases. In fish taxonomy, this is especially important due to frequent changes in nomenclature and the existence of synonyms.

Controlled vocabularies reduce ambiguity by:

- Mapping synonyms to accepted names.
- Resolving regional name differences.
- Ensuring uniform usage across platforms.

Tools like the Integrated Taxonomic Information System (ITIS) and FishBase utilize such mechanisms to align user queries with standardized entries.

6.4 User-Centered Information Architecture

Library science principles stress the importance of user-centered design to improve interface navigation and accessibility. LIS-trained professionals contribute to:

- Designing intuitive search systems.
- Implementing filters and faceted browsing.
- Enhancing mobile accessibility.
- Supporting multilingual interfaces.

These features are crucial in fish identification tools used by scientists, students, conservationists, and policymakers worldwide.

6.5 Digital Preservation and Sustainability

LIS plays a key role in digital preservation—ensuring that digital resources remain accessible, authentic, and usable over time. For zoological databases, this involves:

Regular backups and version control.

Persistent identifiers (like DOIs for species pages).

Compliance with digital archiving standards.

7. Case Example: FishBase and LIS Tools

FishBase is one of the most comprehensive and widely used global databases for fish species. Developed collaboratively by marine biologists and information scientists, FishBase exemplifies how the integration of **Library and Information Science (LIS) tools and principles** enhances the usability, reliability, and outreach of a taxonomic database. This case illustrates how LIS contributes to data structuring, retrieval, and educational outreach in zoological databases.

7.1 Overview of FishBase

Launched in 1990 and continuously expanded, FishBase provides detailed information on over **34,000 fish species**, including:

- Taxonomic classification
- Morphological data
- Habitat and ecological information
- Distribution maps

- Photographic references
- Bibliographic citations
- Synonyms and common names in multiple languages

It serves researchers, educators, students, fishery professionals, and environmental policymakers across the world.

7.2 Application of LIS Tools and Methods in FishBase

a. Metadata and Cataloging

FishBase uses **Darwin Core metadata standards**, ensuring uniformity in how data is recorded across species records. Each entry is cataloged with attributes such as species author, year of discovery, ecological data, and references—mimicking bibliographic cataloging in libraries.

b. Controlled Vocabularies and Synonym Management

FishBase handles a vast number of fish synonyms and regional names. LIS principles of authority control are used to:

- Maintain a **master record** with accepted names.
- Redirect searches from synonyms to standard entries.
- Link vernacular names in over 250 languages to scientific names.

c. Indexing and Search Features

LIS-based indexing supports powerful **search and filter options**. Users can search by:

- Scientific or common names
- Ecosystem or country
- Morphological features (length, fin count, etc.)
- Commercial relevance

This functionality mirrors advanced catalog search systems used in academic libraries.

d. Citation Management and Bibliographic Linking

FishBase includes **extensive literature references**, many linked to external databases like Google Scholar or PubMed. The citations follow academic standards and allow users to track the original sources of species descriptions and studies.

e. User Interface and Information Architecture

The platform offers a **user-centered design**, influenced by LIS usability principles:

- Multilingual interface
- Hyperlinked taxonomic trees
- Visual aids (photos, drawings, graphs)
- Easy navigation through structured categories

7.3 Educational and Collaborative Impact

FishBase serves as an **educational resource**, widely used in universities and schools. Its LIS-informed structure makes it suitable for:

- Integrating into library e-resources
- Supporting distance learning modules
- Assisting citizen science projects

Additionally, its open-access model aligns with **LIS values of knowledge sharing**, allowing collaboration with other biodiversity platforms such as:

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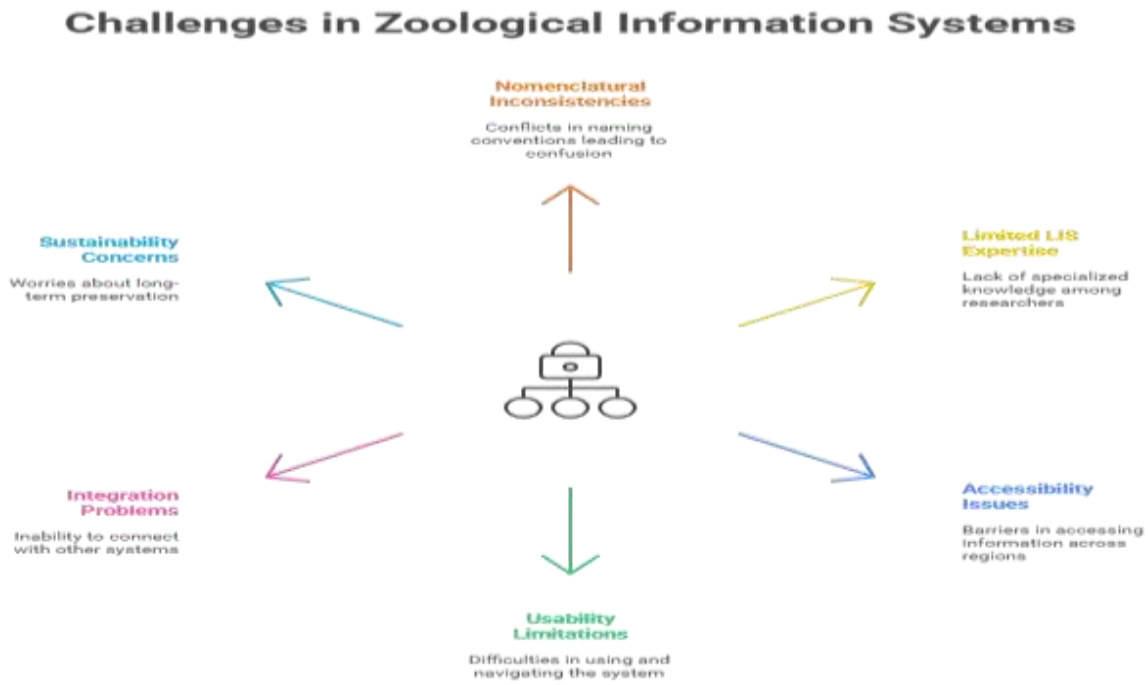
- SeaLifeBase (for non-fish marine life)
- GBIF (Global Biodiversity Information Facility)
- OBIS (Ocean Biogeographic Information System)

8. Challenges and Recommendations

8.1 Challenges:

While taxonomic databases like FishBase have significantly improved the accessibility and accuracy of zoological data, especially in fish identification, several challenges persist. These issues span technical, informational, and human dimensions. By recognizing these challenges and applying targeted recommendations—particularly through the lens of Library and Information Science (LIS)—we can further enhance the utility and sustainability of taxonomic databases.



a. Nomenclatural Inconsistencies and Synonym Conflicts

Frequent changes in fish taxonomy, including reclassifications and synonym usage, often result in confusion or duplication within databases. Users may encounter outdated or conflicting names without clear guidance toward accepted terminology.

b. Limited LIS Expertise Among Zoological Researchers

Most taxonomic databases are developed by biologists who may not be trained in metadata structuring, indexing, or user interface design—areas where LIS professionals excel. This gap can affect the quality of data organization and user accessibility.

c. Multilingual and Regional Accessibility Issues

Despite global relevance, many databases lack support for local languages, indigenous knowledge systems, or region-specific names, limiting participation by non-English speakers and local researchers.

d. Usability and Search Limitations

Some taxonomic platforms feature complex interfaces or lack robust filtering and search options. This makes it difficult for users—especially students, educators, and citizen scientists—to find relevant data efficiently.

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e. Inadequate Integration with Other Information Systems Interoperability between taxonomic databases and other platforms (e.g., genetic repositories, conservation tools, GIS systems) is often weak, restricting holistic biodiversity research and data reuse.

f. Sustainability and Digital Preservation Concerns

Maintaining up-to-date, open-access databases requires ongoing funding, technical support, and preservation protocols—areas that are frequently under-resourced.

8.2 Recommendations:

a. Collaborate with LIS Professionals

Encourage interdisciplinary collaboration between taxonomists and LIS experts to:

- Improve metadata quality and consistency.
- Design user-friendly interfaces.
- Implement advanced classification and indexing systems.

b. Implement Authority Control and Synonym Mapping

Adopt LIS techniques like **authority files** and **controlled vocabularies** to manage nomenclatural changes. Cross-link synonyms and regional names with accepted scientific names to improve discoverability.

c. Enhance Multilingual Access and Community Involvement

Support multilingual user interfaces and involve local communities in data enrichment. Include vernacular names and traditional ecological knowledge through **community tagging and crowdsourcing** tools.

d. Improve Search Functionality and Data Visualization

Incorporate LIS-informed search features such as:

- Faceted search and Boolean operators.
- Visual filters (by habitat, geography, size).
- Dynamic maps, graphs, and comparative tools for better data interaction.

e. Strengthen Interoperability and Open Standards

Adopt international standards like **Darwin Core**, **Open Archives Initiative Protocols**, and **Persistent Identifiers (PIDs)** to facilitate integration with broader scientific and library systems.

f. Ensure Long-term Sustainability

Apply LIS preservation practices including:

- Digital preservation strategies (e.g., LOCKSS, version control).
- Open-access policies aligned with FAIR principles (Findable, Accessible, Interoperable, Reusable).
- Institutional partnerships and funding proposals to ensure database longevity.

9 . Conclusion

Taxonomic databases have become indispensable tools in modern zoology. Their effectiveness is significantly enhanced through the application of library science principles, which improve data organization, retrieval, and usability. Integrating LIS into zoological research ensures that resources like FishBase are not only scientifically robust but also user-friendly, promoting broader engagement in biodiversity studies.

References:-

- Bisby, F. A., et al. (2002). *Species 2000: The Catalogue of Life Concept, Checklists and Database.* In: Bisby, F. A., et al. (Eds.), *Taxonomy and Biodiversity in the Global Information Society.* Species 2000 Secretariat, University of Reading, UK.
- Chapman, A. D. (2009). *Numbers of Living Species in Australia and the World.* Report for the Australian Biodiversity Information Services, p. 12.
- Chakraborty, S., & Jadhav, V. (2019). “Role of Digital Taxonomic Tools in Zoology Education.” *Journal of Biological Education*, 53(3), 267–275.
- Dr. Rahul k Deshmukh (2018), “Analyses on the “Six Sigma” Methodological Approaches Tram in Web of Science database during 2007-2018” International Journal of Scientific Research in Computer Science, Engineering and Information Technology, Vol- 3, Issue -3, p-128-134
- Dr. Rahul k Deshmukh (2018)” Analysis of "Democracy" Term in JGate”, CURRENT GLOBAL REVIEWER, Vol- 1, Special Issue -, p-1-6
- Froese, R., & Pauly, D. (2010). *FishBase*. www.fishbase.org
- Godfray, H. C. J., et al. (2007). “The Web and the Structure of Taxonomy.” *Systematic Biology*, 56(6), 943–955.
- Lagler, K. F., Bardach, J. E., Miller, R. R., & May Passino, D. R. (1977). *Ichthyology* (2nd ed.). John Wiley & Sons, p. 489.
- Rubin, R. E. (2010). *Foundations of Library and Information Science* (3rd ed.). Neal-Schuman Publishers.