High resolution mapping of riverine biodiversity in Iran & China

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- **Introduction:**

➢ DNA barcoding and meta-barcoding are methods used to identify and measure the diversity of macroinvertebrate communities (like insects and worms) in an ecosystem. They work by using short, standardized pieces of DNA to determine the species present in a sample. DNA barcoding identifies individual species, while meta-barcoding can analyze multiple species in environmental samples at once.

➢ Macroinvertebrates are small animals like insects, crustaceans, and mollusks that are important for aquatic ecosystems. Studying their variety and where they live is essential for keeping the environment healthy and for conservation efforts.

➢ The primary objective of this proposal is to provide essential knowledge required for wisely management of streams and rivers in the Karun (Iran) and Poyang lake (China) basins .

➢ **Specific Objectives:**

I. Establish a local DNA barcode library for macroinvertebrates in Iran and China.

II. Explore the effectiveness of meta-barcoding for detecting diverse macroinvertebrate communities.

III. Evaluate the performance of primers in accurately identifying species through DNA metabarcoding.

IV. Develop a pipeline for barcoding and metabarcoding of macroinvertebrate species for potential future project.

- **Methods:**

➢ Study area: This study was done at two catchments, Karun river basin in Iran and Poyang River basin in China.

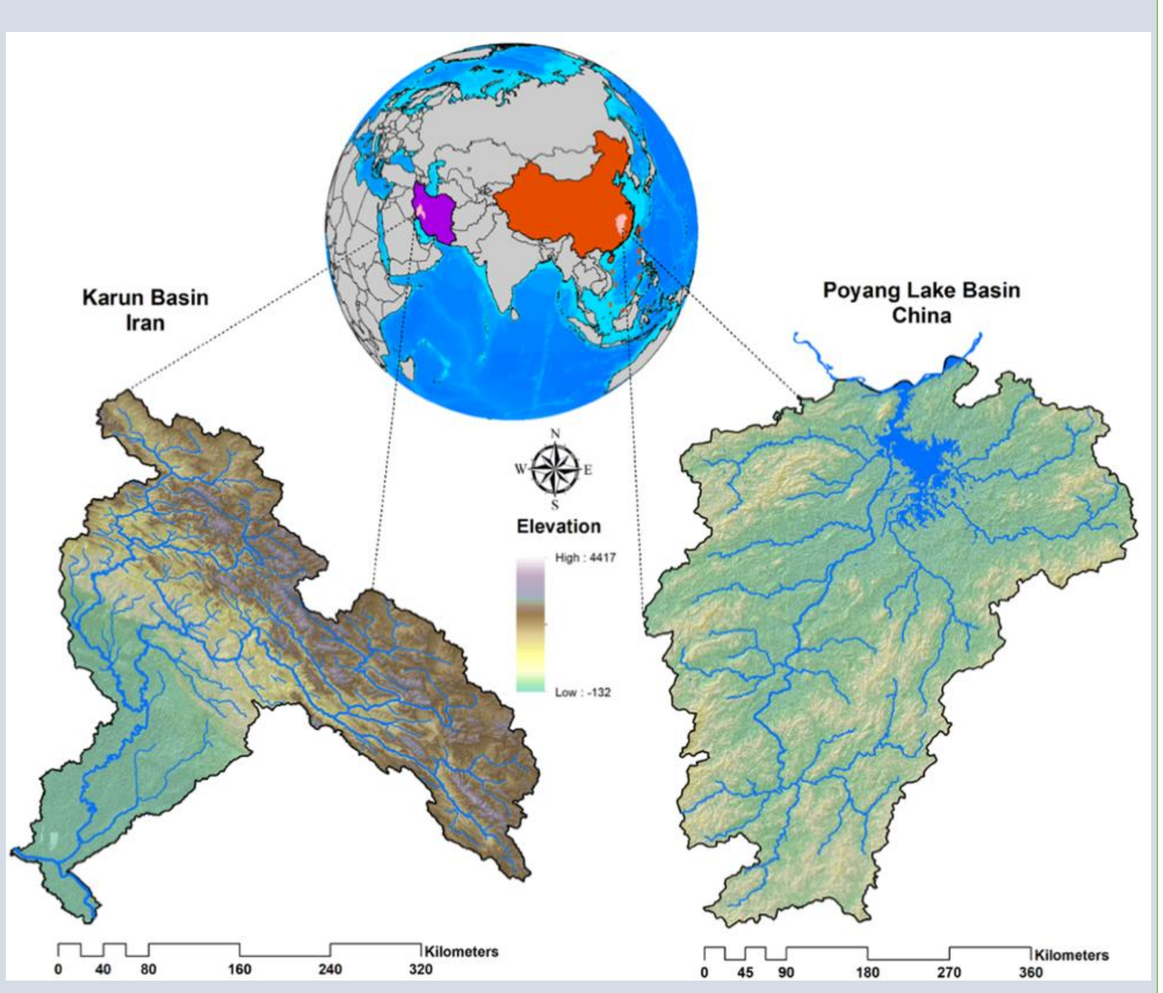

Fig. 1. Locations and river networks in the study area including the Karun (Iran) and Poyang lake basins (China).

- **Field sampling:**

➢ 54 sites in sampled in the Karun River Basin, Iran and 22 sites sampled in the Poyang lake basins (China).

- **We measured and sampled:**

➢ Physical and chemical parameters of waters

➢ Physical habitat characteristics of waters

➢ Fish communities

➢ Macroinvertebrate communities

- **Proposed Research Methods:**

➢ The proposed project were employed the following research methods

Project planning	Collect required data	Diagnose	Identify	Use
• Study areas key characteristics and sampling scheme • Overview of the current biodiversity status and its main drivers	• The main point source pollutions • Collect fish and macroinvertebrates • Collect eDNA samples • Measure physical habitat quality • Measure water quality	• The biodiversity pattern and its main drivers • The main threats lead to biodiversity loss • The role of main actors in protecting biodiversity and ecosystems	• The data and information gaps about biodiversity and its main drivers • Data quality control	•Prioritize and monitor restoration actions •Support protection of endangered species •Increasing public awareness about importance of biodiversity for human wellbeing

Fig. 2. General framework of the project.

- **Data Collection Methods**

➢ The research were utilized a mirrored study design, comparing the biodiversity and main drivers of ecosystem change in the Karun River basin and the Poyang lake basin.

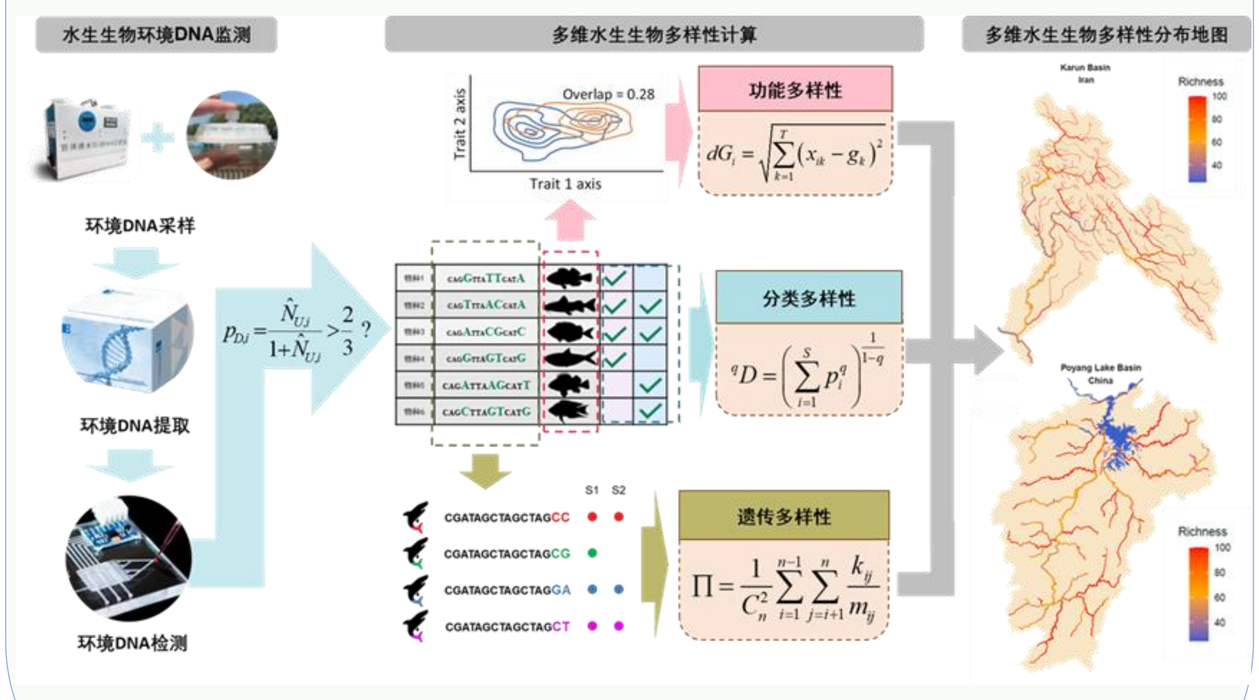

Fig. 3. Flow diagram of multi-dimensional aquatic biodiversity distribution mapping in watershed by environmental DNA technologies.

- **Key findings:**

Increased Species Detection: DNA barcoding has significantly improved the identification and cataloging of species in areas where traditional methods are difficult. In this study 30 macroinvertebrate species identified and documented based on DNA barcoding and morphological identification in Iran and 20 species in the China.

Biodiversity Assessment: Metabarcoding allows for rapid assessment of biodiversity by analyzing environmental samples (such as soil, water, or gut contents) to detect multiple species simultaneously.

Ecosystem Monitoring: These techniques facilitate the monitoring of changes in biodiversity over time, helping to assess the impacts of environmental changes, habitat destruction, and climate change.

Discovery of Rare Species: In many cases, metabarcoding has led to the discovery of rare or previously unrecorded species, highlighting the importance of sampling and documenting biodiversity in neglected regions.

Conservation Implications: Findings from DNA barcoding and metabarcoding can inform conservation strategies by identifying hotspots of biodiversity, assessing the presence of invasive species, and guiding ecosystem management practices.

Efficacy in Remote Locations: These techniques are particularly valuable in remote or difficult-to-access habitats where traditional sampling methods may be impractical or ineffective.

Data Integration: DNA barcoding can be integrated with other data types (e.g., ecological, geographical) to provide a comprehensive understanding of biodiversity patterns and processes.

- **Conclusion:**

➢ Overall, DNA barcoding and metabarcoding are transforming our understanding of biodiversity, particularly in regions that have historically been neglected by traditional taxonomic approaches.

➢ The implementation of DNA barcoding and meta-barcoding in both countries enhances species identification and community analysis, which is vital for monitoring environmental health amidst ecological challenges.

➢ Future collaborations and the integration of molecular data with traditional assessments will strengthen biodiversity conservation efforts. Additionally, increasing public awareness and training in these methods will further help protect the rich aquatic resources of Iran and China.