FISH FAUNA OF PAKISTAN: POTENTIAL APPLICATIONS OF DNA BARCODING

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PMNH
### Fresh Water Fish Fauna of Pakistan

- **190** species
- **1** Class
- **1** Sub-class
- **3** Cohorts
- **6** Superorders
- **13** Orders
- **30** Families
- **86** Genera
Fresh Water Fish Fauna of Pakistan

- 12 Exotic species
- 43 Endemic species (22.75% of the total)
- Cyprinidae most speciose with 72 species
- Cobitidae, Sisoridae, Bagridae having 38, 14 and 9 species respectively.
- 20 species of Economic importance
### IUCN Threatened Status

- Critically endangered: 1
- Endangered: 1
- Vulnerable: 2
- Near threatened: 8
- Data deficient: 2
- Not Evaluated: 76
- Least Concerned: 100
River Systems of Pakistan

Pakistan can be divided into three river systems

- The Indus drainage
- Balochistan coastal drainage
- Land locked river system
- Indus drainage, the largest river system
- Originates from Kailas range in western Tibet (China)

- Length: 3,100 km
- Average discharge: $5.6 \times 1000 \text{ m}^3 \text{ sec}^{-1}$
- Drainage area: 1,165,500 km$^2$
Richness of species across different zones:

- Zone I: 15
- Zone II: 19
- Zone III: 104
- Zone IV: 140
- Zone V: 26
- Zone VI: 18

Species Richness

Zones
Marine Fish Fauna

- Fish species: 800
- Commercially important: 120
- Endemic: None
- Sharks: 38 species
- Saw Fishes: 4
# Pristidae (Saw Fishes)

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>IUCN Listing</th>
<th>CITES Listing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anoxypristis cuspidata</td>
<td>Knifetooth Sawfish</td>
<td>Critically Endangered</td>
<td>I</td>
</tr>
<tr>
<td>Pristis pectinata</td>
<td>Smalltooth Sawfish</td>
<td>Critically Endangered</td>
<td>I</td>
</tr>
<tr>
<td>Pristis pristis</td>
<td>Common Sawfish</td>
<td>Critically Endangered</td>
<td>I</td>
</tr>
<tr>
<td>Pristis zijsron</td>
<td>Narrowsnout Sawfish</td>
<td>Critically Endangered</td>
<td>I</td>
</tr>
</tbody>
</table>
**Conservation status of Sharks**

<table>
<thead>
<tr>
<th>Category</th>
<th>2</th>
<th>3</th>
<th>11</th>
<th>16</th>
<th>2</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critically endangered</td>
<td>2 (5%)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Endangered</td>
<td>3 (8%)</td>
<td></td>
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<tr>
<td>Vulnerable</td>
<td>11 (29%)</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Near threatened</td>
<td>16 (42%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data deficient</td>
<td>2 (5%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Least concerned</td>
<td>4 (11%)</td>
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</tbody>
</table>
Issues in Fish Taxonomy

- Taxonomic complexes (genus *Schistura*, *Triplophysa*, *Labeo*, *Puntius*).
- Variable colour patterns in juveniles and adults
- Sometimes identification on the basis on Osteology/anatomy or hidden characters
- Differentiation between fries, fingerlings and adults
- Identification of habitat use by multiple species
- Difficulty in identifying stomach contents
- Difficulty in understanding hybridization
Importance of DNA Barcoding in Fish Taxonomy

- Barcoding provides rapid assessment without detailed morphological expertise
- Rapid resolution of species complexes
- Morpho-species approach with DNA barcoding can be used to undertake rapid assessment of new biodiversity.
- DNA barcoding can provide a test of conspecificity.
- Linking adult and juvenile stages is often difficult in groups such as marine and freshwater fishes.
Mitochondrial DNA with Cytochrome Oxidase subunit I (COI).
Importance of DNA Barcoding in Fish Taxonomy

- Understanding of dispersal patterns of adults and juveniles.
- Identifying larvae of pest species and monitoring freshwater quality.
- Documenting taxonomic diversity need not rely only on adult specimens.
- In species with complex life-cycles, especially fish parasites with multiple hosts, barcoding can be an invaluable tool.
Importance of DNA Barcoding in Fish Taxonomy

- Morphological keys are for a particular life stage or gender
- DNA barcoding best solution for identifying species when morphology is of limited use.
- Even if morphological identification of a species is possible, DNA barcoding might enhance biodiversity inventories by being faster and cheaper, and by overcoming the taxonomic impediment.
Monitoring illegal trade

- DNA barcoding is used for monitoring illegal trade in animal byproducts.
- Shark fins is a billion Dollar trade world over.
- Fins of Endangered species of sharks are being traded while rest of the specimens thrown in sea.
- DNA barcoding has been successfully used to identify these species from their body parts.
- In the field of biosecurity, the reliable and fast identification of eggs or larvae stage cannot be recognizable without DNA identification.
Shark finning is the brutal practice of slicing off a shark's fins, often for use in shark fin soup, an Asian delicacy. The shark -- sometimes still alive -- is thrown back into the water to bleed to death.
Shark finning only utilizes one to five percent of the shark’s body weight, between 26 and 73 million sharks are finned each year.
Fin removed - what a waste
Removed Shark Fins
Look at the beauty, Look at the misery
Thousands of Sharks sacrificed for fins
Hong Kong- A face
Hong Kong
Hong Kong
Shark fin soup is now becoming common fare at weddings, banquets and business meetings.
Anoxypristis cuspidata
(knifetooth sawfish)
Pristis pectinata
(smalltooth sawfish)
Pristis pristis
(Common sawfish)
Pristis zijsron
(Longcomb sawfish)
Carcharhinus hemiodon
(Pondicherry shark)
Glyphis gangeticus
(Ganges Shark)
Lamiopsis temminckii
(broadfin shark)
*Sphyra lewini*
(Scalloped Hammerhead)
declined 98%, caught for fin soup

**Fin price** £150 a kilo.
Sphyrna mokarran
(Great Hammerhead)
4.4 % of Hong Kong hammerhead trade declined 89% in 20 yrs
Why barcode fish

- Largest vertebrate group, about 35,000 species, about 50% of all vertebrate species.
- 20,000 marine species
- 15,000 freshwater species
Why barcode fish

Global value:

- Capture fisheries: US$ 81 billion
- Aquaculture: US$ 52 billion
- Ornamental fish: US$ 3 billion (in US alone)
- Sports fishing: US$ 2 billion
ISSUES AND CHALLENGES

- Networking of groups/individuals and meeting their funding requirements
- Duplication of efforts etc.

- Qualified Taxonomists

- Maintenance of voucher specimens in the vast network of Universities, Colleges and Research Institutes

- Use of alternate genes for different groups

- Common user-friendly software from sequence editing to phylogenetic analysis.

- Formalizing linkages with international organizations & projects
## Biodiversity of Pakistan at a Glance

<table>
<thead>
<tr>
<th>Major Groups</th>
<th>No. of species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algae</td>
<td>775</td>
</tr>
<tr>
<td>Fungi</td>
<td>&gt;4500</td>
</tr>
<tr>
<td>Pteridophytes</td>
<td>189</td>
</tr>
<tr>
<td>Gymnosperms</td>
<td>21</td>
</tr>
<tr>
<td>Angiosperms</td>
<td>5700</td>
</tr>
<tr>
<td>Annelids (Marine)</td>
<td>105</td>
</tr>
<tr>
<td>Crustaceans (Marine)</td>
<td>290</td>
</tr>
<tr>
<td>Molluscs (Marine)</td>
<td>770</td>
</tr>
<tr>
<td>Echinoderms</td>
<td>25</td>
</tr>
<tr>
<td>Insects</td>
<td>&gt;5000</td>
</tr>
<tr>
<td>Fishes (Freshwater)</td>
<td>200</td>
</tr>
<tr>
<td>Fishes (Marine)</td>
<td>800</td>
</tr>
<tr>
<td>Amphibians</td>
<td>25</td>
</tr>
<tr>
<td>Reptiles (Lizards, snakes, turtles, crocs)</td>
<td>198</td>
</tr>
<tr>
<td>Birds</td>
<td>668</td>
</tr>
<tr>
<td>Mammals</td>
<td>198</td>
</tr>
</tbody>
</table>
Role of museums

- Barcoding must validate existing taxonomy before it can be offered as an identification tool.
- One has to be careful while discovering new species, as it deals with one gene not with one species/specimen.
- Pilot projects like CBOL, FISH-BOL can utilize museum specimens.
- New inventory efforts will yield large numbers of vouchers, which must be properly accessioned, databased, and stored.
- Results will flag many new species requiring formal description.
# Reference Collection at PMNH

<table>
<thead>
<tr>
<th>Animals in repositories</th>
<th>NOS</th>
</tr>
</thead>
</table>
| Plants (higher + Lower)         | 200,000+
| Mammals                         | 5556    |
| Birds                           | 4500    |
| Reptiles                        | 3900    |
| Amphibian                       | 2000    |
| Fish                            | 45,000  |
| Insects                         | 102,700 |
| Other Invertebrates             | 300,000+|