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Fish species diversity in fish catch landed at Dholai Port Bilimora, Gujarat (India)

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ABSTRACT

The present study was carried out to collect, identify, and describe the fish diversity, verified using diversity indices and the conservation status (IUCN) of the finfishes and shellfishes landed at Dholai port, Bilimora, Gujarat (India) from July 2022 to April 2023. A total of 45 landed fish species was recorded, belonging to 20 orders, 29 families, and 40 genera. The findings showed that Class Actinopterygii (55%) was dominated. The main objective of the present study was to collect, identify, and describe the fish diversity verified using diversity indices and conservation status (IUCN) of the finfishes and shellfishes landed at Dholai Port, Bilimora, Gujarat (India), for a period from July 2022 to April 2023. A total of 45 landed fish species belonged to 20 orders, 29 families, and 40 genera. The findings depicted that Class Actinopterygii (55%) was dominant, followed by Chondrichthyes (20%), Cephalopoda (15%), and Malacostraca (10%). Among the 45 species, diversity indices were calculated Shannon–Wiener index (H) -1.102, Margalef Index (D) -0.7881, Evenness index (E) -0.524, and conservation status of IUCN categorized as Least Concern (46%), Near Threatened (7%), Vulnerable (7%), Not Evaluated (20%), Endangered (7%), Data Deficient (9%), and Threatened (4%), respectively. The study revealed that biodiversity indices indicate a moderate level of biodiversity within the ecosystem. The presence of threatened species demands the need for conservation efforts and implementation of sustainable management practices.

Keywords: Port, Bilimora, Diversity, Dholai, Finfish and Shellfish, Harvest, Marine

1. INTRODUCTION

The coastal region of Gujarat state is 1600 km largest coastline area have a several, minor ports, industrial establishments and also bestowed with crisp marine environments like fishes, coral reefs and mangroves, As huge infrastructure is located close to the coastline, even if only a small stretch of coastline is impacted due to predicted sea level rise, it can have a significant effect on the region (Mahapatra et al., 2015) and these regions are reflects the major economical contribution of aquaculture sector, growth and generate employment of rural peoples in financial support.

People residing along the coastal belt of the state, as well as near rivers, lakes, and reservoirs, have been traditionally engaged in fishing since time immemorial. In Gujarat, there are a total of 1,058 fishing villages, out of which 280 are marine fishing villages, 116 are inland fishing villages, and 82 are estuarine fishing villages. As per the 2007 census, the population of fishermen is 5.59 lakh, out of which 2.18 lakh are

active fishermen. For the smooth functioning of the fish landing process, 107 marine fish landing centers were developed by the state all along the coast. The marine catches of the state are mainly consisting of Bombay duck, Ribbon fish, Shrimp, Pomfrets, Cat fish, Squid cuttlefish, Jew fish, Lobster, Seer fish, Silver bar, Hilsa, Shark etc. (Ujjania et al., 2021) and Similarly, Dholai port of the Bilimora, Gujarat is one of the small ports and the fisher folk population is 3147; in which active fisherman 564 were used mechanised boat (66), non-mechanised (30) and outboard (10) for fishing purpose and earn their livelihood according to Marine Fisheries Census, 2010 report of Gujarat. To identify the marine biodiversity of fishes, need to calculate biodiversity indices such as dominance, richness, and evenness, which provides a powerful and flexible approach to analyzing biodiversity patterns.

Many researchers and scientists have published numerous articles on biodiversity patterns. For instance, specifically in India, a total of 2,358 finfishes were recorded; among them, 877 species are freshwater, while 113 species are brackish water, and 2,358 are marine species (Ayyappan et al., 2011). Another report in 2017 states that India contributes about 2,492 marine fishes, accounting for 7.4% of the total marine fish resources. Of the total fish diversity known from India, marine fishes constitute 75.6 %, comprising 2,492 species belonging to 941 genera, under 240 families of 40 orders (CMFRI, 2017), whereas the Andaman and Nicobar archipelago has the highest observed fish diversity (1,431 species), followed by the east coast (1,121 species) and west coast (1,071 species) of India (Joshi et al., 2017). In Gujarat, the ichthyofaunal diversity of Sutrapada, Gir Somnath district, has recorded 114 fish species across 55 families and 93 genera (Singh et al., 2021).

The present investigation aims to determine landed fish diversity, diversity indices, and the conservation status (IUCN, 2020) at Dholai Port, Bilimora, Gujarat, India.

2. MATERIAL AND METHODS

Sample collection: Dholai port is a fishing harbor located in the South Gujarat region at latitude 20.739144° and longitude 72.895678°. Fortnightly fish samples were collected from July 2022 to April 2023 (Fig. 1).

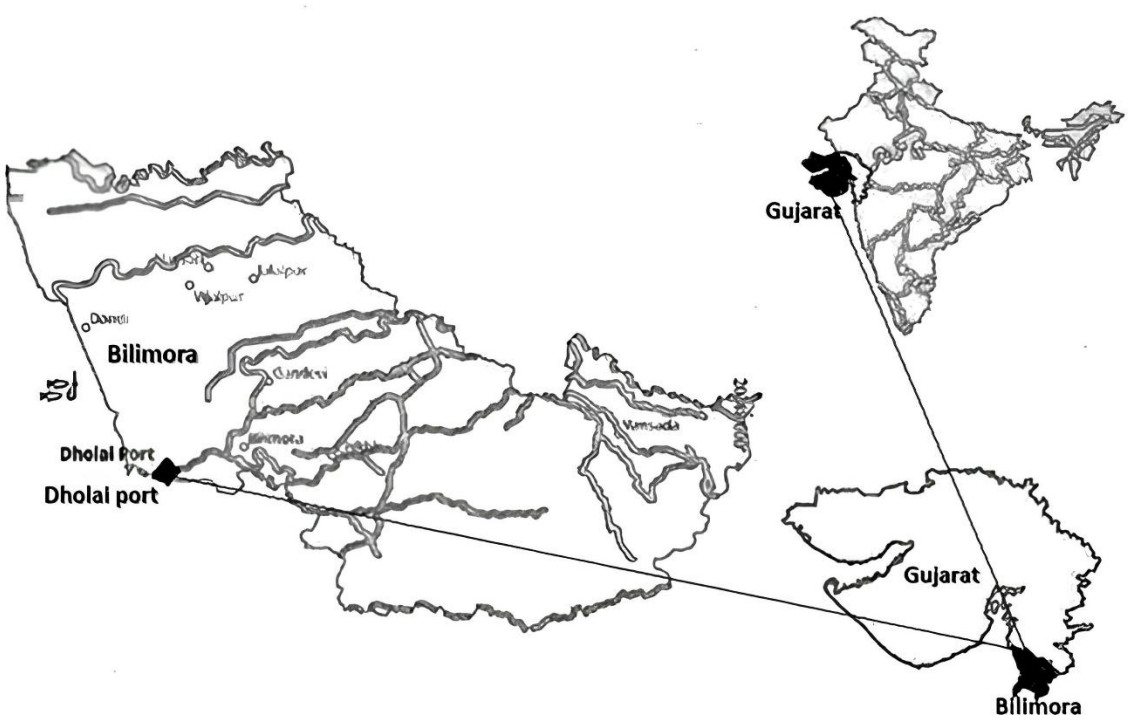

Figure 1. Map of study area

Sample collection and preservation

Thereafter, landed samples were sorted, recorded, and preserved in 2% neutralized formalin. The standard taxonomic keys (Talwar and Jhingran, 1991; Nelson et al., 2016; Day, 1878) were used to identify of fishes.

Statistical Analysis

To analyze fish diversity, the Shannon–Wiener Index (H), Margalef Index (D), and Evenness (E) were calculated using PAST software (version 4.10).

Shannon–Wiener Index (H)

The Shannon–Wiener diversity index was used within a community or habitat to determine the abundance of fish species (Nolan and Callahan, 2006).

$$H = SUM\ [Pi \log (Pi)] \text{ ---------- (1)}$$

Where,

H = Shannon-Wiener index,

Pi = ni/N,

ni = no. of individuals of a species,

N = Total number of individuals

The diversity index criteria are as follows: H ≤ 1 = Low diversity; 1 < H≤ 3 = Moderate diversity; H ≥ 3 = High diversity.

Margalef Index (D)

In order to calculate the Margalef diversity index (D), the following formula was used (Margalef, 1958).

$$D = (S-1)/\log (N) \text{ ---------- (2)}$$

Where,

S = Total species,

N = Total individuals

Margalef Index (D) measures species richness. A value below < 2.5 indicate low diversity. A value from 2.5 to 4 shows medium diversity. A value above >4 show high diversity.

Evenness Index (E)

The evenness index (E) describes the number of individuals between species in a fish community. The more evenly distributed individuals between species, the more balanced the ecosystem will be. The formula used is (Odum, 1971).

$$E' = H/Hmax \text{ ---------- (3)}$$

Where,

E: Is the evenness index,

H: Is the Shannon diversity index,

Hmax: Is the natural log of the richness

The evenness index value ranges from 0-1.

Furthermore, the evenness index by Krebs (1989) is grouped into three categories: A depressed community (0< E≤ 0.5), an unstable community (0.5 <E ≤ 0.75), and a stable community (0.75 <E≤1).

3. RESULTS & DISCUSSION

The scientific names and IUCN (2020) statuses of fish and shellfish are depicted in Table 1. A total of 45 fish and shellfish species, belonging to 29 families and 20 orders, were identified in the landings at Dholai Port, Bilimora, Gujarat, India (Table 1).

The species composition indicated the dominance class was dominant Actinopterygii (55%) followed by Chondrichthyes (20%), Cephalopoda (15%), Malacostraca (10%) respectively, (Fig. 2) due to the total number of individuals caught in a trap is an indication of biomass, However, more care has to be taken in its interpretation than for diversity as the size of a light trap catch can be influenced

significantly by the setting of the trap, interference from other lights, and lunar cycles (Barlow and Woiwod, 1989). Similar results were also reported by in the Peruvian seafood sector (Marin et al., 2018).

The Shannon-Wiener index (H) is based on species richness and evenness. Species richness represents the number of species in an area, and evenness refers to the proportion that each species comprises of the whole, which reflects the abundance of the community (Nolan and Callahan, 2006).

The Shannon-Wiener index value (H = 1.102) was highest, where H ≤ 1 indicates low diversity (Table 2). Devi and Jahan (2024) reported a similar finding for Ami River water in Gorakhpur, Uttar Pradesh, India.

Margalef index (D), considering either the absolute number of individual species or the density (Gamito, 2010), was calculated as 0.7524 under the category < 2.5, Low diversity (Table 2), due to the environmental conditions such factors as temperature fluctuation, heavy rainfall, siltation, and also anthropogenic activities can reduce fish diversity (Aziz et al., 2021).

Evenness index (E) represents the number of individuals between species in a fish community, and the more evenly distributed individuals between the species (Pir et al., 2019) the more balanced the ecosystem. The observed value of 0.7881 falls under the stable community category 0.75 <E ≤ 1 (Table 2). This classification reflects minimal disturbances, low environmental variations, and strong resistance to invasive species (Lembrechts et al., 2018). According to Ulfah et al. (2019), a similar evenness value (0.78) was recorded in the waters of Benteng Inong Balee, indicating that the ecosystem remains in a stable condition.

According to IUCN red list of conservation status, among 45 species were categorized under IUCN 2020 as Least Concern (46%), Near threatened (7%), Vulnerable (3%), Not Evaluated (20%), Endangered (7%), Data Deficient (9%) and Threatened (4%) respectively, (Fig. 3) and results were referred by the findings of Coastal Andhra Pradesh, Southeast Coast of India (Chatla and Pamavathi, 2021).

Table 1. Identified fishes, classification and conservation status during the present study

Class	Order	Family	Genus	Species	IUCN 2020
Actinopterygii	Perciformes	Serranidae	*Epinephelu*	*diacanthus*	LC
	Perciformes	Sciaenidae	*Johnius*	*dussumieri*	LC
	Perciformes	Sciaenidae	*Johnius*	*macrorhynus*	LC
	Perciformes	Sciaenidae	*Otolithes*	*cuvieri*	LC
	Perciformes	Sciaenidae	*Protonibea*	*diacanthus*	NT
	Scombriformes	Scrombridae	*Rastrelliger*	*kanagurta*	LC
	Scombriformes	Scrombridae	*Rastrelliger*	*brachysoma*	VU
	Scombriformes	Stromateidae	*Pampus*	*argenteus*	VU
	Scombriformes	Trichiuridae	*Lepturacanthus*	*savala*	NE
	Clupeiformes	Clupeidae	*Sardinella*	*gibbosa*	LC
	Clupeiformes	Clupeidae	*Tenualosa*	*ilisha*	LC
	Clupeiformes	Engraulidae	*Coilia*	*dusuumieri*	LC
	Clupeiformes	Pristigasteridae	*Ilisha*	*megaloptera*	LC
	Siluriformes	Bagridae	*Tachysurus*	*dussumieri*	LC
	Siluriformes	Bagridae	*Sperata*	*seenghala*	LC
	Siluriformes	Ariidae	*Nemapteryx*	*caelata*	NE
	Pleuronectiformes	Cynoglossidae	*Paraplagusia*	*bilineta*	LC
	Pleuronectiformes	Paralichthyidae	*Pseudorhombus*	*arsius*	LC
	Gobiiformes	Gobiidae	*Aulopareia*	*ocelli*	NE
	Gobiiformes	Oxudercidae	*Boleophthalmus*	*dussumieri*	LC

	Anguilliformes	Muraenesocidae	*Congresox*	*talabonoides*	LC
	Anuguilliformes	Muraenesocidae	*Muraenesox*	*cinereus*	LC
	Aulopiformes	Synodontida	*Harpadon*	*nehereus*	NT
	Aulopiformes	Synodontidae	*Saurida*	*tumbil*	LC
	Mugiliformes	Mugilidae	*Mugil*	*cephalus*	LC
	Tetraodonitiformes	Tetraodontidae	*Lagocephalus*	*lunaris*	LC
	Carangiformes	Polynemidae	*Eleutheronema*	*tetradactylum*	EN
Chondrichthyes	Carcharhiniformes	Carcharhinidae	*Scoliodon*	*laticaudus*	NT
	Torpediniformes	Torpedinidae	*Torpedo*	*sinuspersici*	DD
	Orectolobiformes	Hemiscylliidae	*Chiloscyllium*	*indicum*	VU
	Rajiformes	Dasyatidae	*Himantura*	*uranak*	EN
	Rajiformes	Dasyatidae	*Himantura*	*bleekeri*	EN
Malacostraca	Decapoda	Portunidae	*Charybdis*	*feriatus*	NE
	Decapoda	Portunidae	*Portunus*	*pelagicus*	NE
	Decapoda	Portunidae	*Portunus*	*sanguinolentus*	NE
	Decapoda	Portunidae	*Scylla*	*serrata*	NE
	Decapoda	Penaidae	*Metapenaeus*	*brevicornis*	NE
	Decapoda	Penaidae	*Metapenaeus*	*affinis*	NE
	Decapoda	Matutidae	*Matuta*	*planipes*	NE
	Stomatopoda	Squillidae	*Squilla*	*mantis*	TH
Cephalopoda	Myopsida	Loliginidae	*Uroteuthis*	*duvaucelii*	DD
	Myopsida	Loliginidae	*Loligo*	*duvaucelii*	DD
	Sepiida	Sepiidae	*Sepiella*	*inermis*	DD
	Sepiida	Sepiidae	*Sepia*	*Pharanoic*	TH
	Octopoda	Octopodidae	*Cistopus*	*indicus*	LC

LC- Least Concern, NT- Near threatened, VU- Vulnerable, NE- Not Evaluated, EN- Endangered, DD- Data Deficient, TH- Threatened

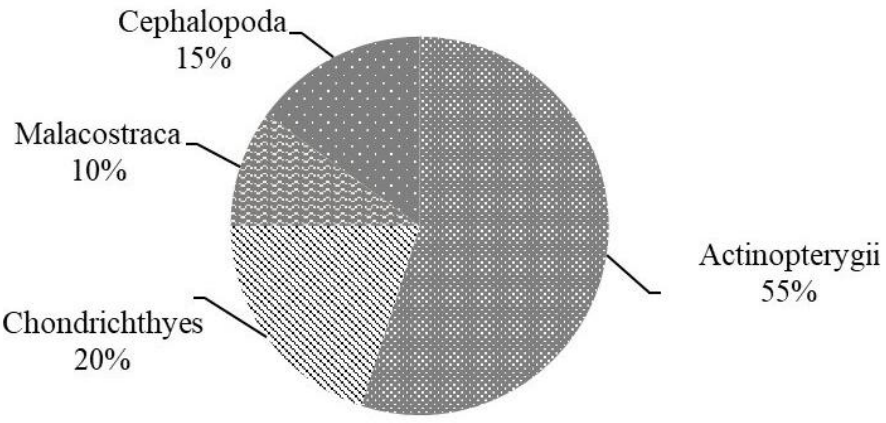

Figure 2. Percentage wise class of landed fish

Table 2. Diversity indices used in this study to calculate fish species of Shannon–Wiener index (H'), Margalef index (D) and Evenness (E').

Diversity index	Index value	Categories
Shannon–Wiener index (H')	1.102	1 < H'≤ 3 = Moderate diversity
Margalef index (D)	0.7524	<2.5 Low diversity
evenness index (E')	0.7881	0.75 <E ≤ 1 = Stable community

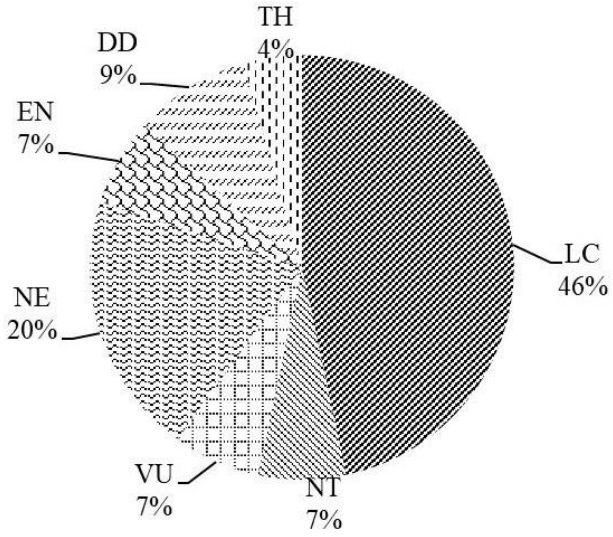

Figure 3. Percentage wise IUCN, 2020 red lists of landed fish

4. CONCLUSION

Based on the study, it can be concluded that this marine fish fauna has a rich edible fish catch and diverse species richness. To sustain these resources over the long term, good fishing practices must be followed while the fauna is in a flourishing stage.

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Author Contributions

All authors contributed equally to this evaluation's conceptualization, literature synthesis, evaluation, interpretation and authorized the final manuscript.

Informed consent

Not applicable.

Conflicts of interests

The authors declare that they have no conflicts of interest, competing financial interests or personal relationships that could have influenced the work reported in this paper.

Ethical approval & declaration

I hereby confirm that this study complies with requirements of ethical approvals from the institutional ethics committee for the conduct of this research. Adhered to the ethical guidelines for the use of animals in research. This study involved no clinical trial; hence, clinical trial registration is not applicable.

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Data and materials availability

All data associated with this study will be available based on the reasonable request to the corresponding author

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