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REVIEW **Open Access**

Marine fish diversity and nutritional insights from the East Coast of India

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Abstract

Background The investigation of marine fish biodiversity has become fundamental for a reliable database supporting the conservation and sustainable use of marine resources. The east coast regions of India are found suitable for a diverse range of marine fish species. Understanding this biodiversity is necessary for both biological conservation and economic development. The objective of this present study is to assess the marine fish diversity and their nutritional insights across different zones of the east coast of India.

Methods This review synthesizes information from various review and research papers regarding marine fish diversity and nutritional profiling of coastal regions in India. This analysis aimed to explore the evolution of scientific understanding and identify key contributors to the field of marine fish diversity.

Results The eastern coastline of India, stretching from West Bengal to Tamil Nadu, hosts a diverse range of marine fish species due to its diverse climatic conditions, habitats, and ecological zones. This region is rich with commercially important species such as Indian mackerel, ribbonfish, tuna, snappers, sparidae, carangidae, pomacentridae, and clupeidae. Fish resources are a vital source of macronutrients and micronutrients. A total of 4752 marine fish species were recorded across four states, i.e. Odisha (2611), Tamil Nadu (1656 species), West Bengal (314), and Andhra Pradesh (171), reflecting the region's ecological richness across estuarine, mangrove, and coral reef habitats. Family-level diversity was particularly high in groups such as Carangidae, Mugilidae, and Pomacentridae. Nutritionally, several species including, *Lates calcarifer*, *Scomberomorus commerson*, *Rachycentron canadum*, and *Trichiurus lepturus* were identified as rich sources of omega-3 fatty acids, protein, vitamin D, calcium, selenium, and zinc. Small pelagic fish like, Indian mackerel and Indian anchovy are especially valuable for micronutrients, benefiting vulnerable populations such as children and pregnant women. These findings underscore the critical role of regional species in addressing nutritional security. However, conservation assessments reveal that while many species are listed as Least Concern, including *Epinephelus fuscoguttatus* and *Harpadon nehereus* face population declines. This study highlights the urgent need for integrated strategies promoting sustainable harvesting, nutritional profiling, and artificial propagation of key species, aligning biodiversity conservation with aquaculture development and long-term food security in the East Coast region of India.

Conclusion The current reports highlight nutritionally valuable marine fish species rich in omega-3 fatty acids, proteins, Vitamin D, Selenium, and Zinc along East coast of India. Species such as *Lates calcarifer* and *Scomberomorus commerson* exhibit high potential for enhancing nutritional security. Their availability and suitability for aquaculture underscore the need for sustainable management to balance nutrition, biodiversity, and long-term marine resource use.

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Keywords Marine fish diversity, East coast of India, Nutritional profiling, Omega-3 fatty acids, Sustainable aquaculture, Biodiversity conservation, Food and nutritional security

Background

Coastal regions play a critical role in human society due to their proximity to major harbours, their rich biodiversity, and abundant natural resources. Around one-third of the global population resides in these coastal zones, which also serve as hubs for trade, culture, and economic activity (Queiros et al., 2024). However, rapid urbanization, industrialization, and developmental projects along these areas are causing significant environmental stress, coastal erosion, habitat loss, coral bleaching, and other threats to biodiversity (Fricke et al., 2025).

Understanding the ecological importance of marine fish is fundamental in this context, especially given their role in sustaining healthy marine ecosystems. Marine fish communities, particularly demersal species, are directly influenced by habitat features. They act as key components of marine food webs and play essential roles in nutrient cycling, prey-predator dynamics, and maintaining ecosystem stability (Torabi et al., 2024). Understanding the spatial distribution and ecological roles of these species is therefore crucial for effective marine conservation and resource management.

In addition to their ecological roles, marine fish also offer substantial nutritional value and are an important part of human diets globally. Marine fish contribute significantly to human nutrition as they are rich in omega-3 fatty acids, which support cardiovascular health, improve brain function, and reduce inflammation (Kris-Etherton et al., 2002). Additionally, they provide high-quality protein, which is essential for muscle repair and overall health (Tang & Phillips, 2009). Minerals such as calcium, phosphorus, and iodine, along with vitamins particularly vitamin D and B12 are crucial for bone strength, immune function, and thyroid health (Hejazi et al., 2020; Vieira et al., 2025). Fish protein is also rich in essential amino acids like lysine and methionine, and its fat content provides a significant source of metabolic energy. Furthermore, the biochemical composition of fish, including moisture content, fat, and protein levels, directly influences its nutritional value (Anthony et al., 2024). These characteristics vary based on species, size, habitat, and seasonal fluctuations, making it important to assess how environmental factors affect the nutritional quality of fish species.

While the global nutritional significance of marine fish is well recognized, there remains a distinct regional knowledge gap. Despite extensive research on fish composition in various regions, the nutritional profiles of fish species along the eastern coast of India are not well understood. Many previous studies have focused on global fish species and their nutritional components; however, specific data from the eastern coast of India remain limited. Moreover, studies rarely integrate both ecological and nutritional perspectives in this region, limiting our understanding of how environmental and ecological factors influence the nutritional quality of locally important species (Byrd et al., 2021).

This gap in knowledge is particularly critical considering the environmental pressures that coastal areas in India, especially along the east coast are currently facing. Pollution from sewage discharge, industrial effluents, and overfishing has increasingly disrupted marine ecosystems in the region. Overfishing also has a significant impact on marine ecosystems in these regions. With declining global fish stocks and rising food security concerns, understanding the link between environmental stressors and fish nutritional quality becomes essential for both sustainability and public health.

Thus, there is an urgent need for region-specific studies that bridge the ecological and nutritional aspects of marine fish species. Understanding the variability in fish composition across different habitats and seasons can provide insights into the sustainability of fisheries as well as the long-term health of marine ecosystems. Moreover, this research can inform marine resource policies to maintain healthy fish stocks and ensure the availability of high-quality fish for human consumption.

In this context, the present review aims to address the existing knowledge gap by developing a comprehensive list of ichthyofaunal species found along the eastern coast of India's continental shelf. This study provides a detailed analysis of the nutritional profiles and ecological distributions of these marine fish species. Additionally, it covers species richness and offers crucial data for future conservation and management initiatives related to fisheries resources (Ahmad et al., 2021; Joshi et al., 2016; Silva et al., 2021).

Material and methods

For this review, we conducted a comprehensive literature search across multiple academic databases, including Scopus, Web of Science, and Google Scholar, using search terms such as "*regional diversity of marine fish*," "*nutritional profiling of marine fish*," and "*marine fish species in India*." Studies were selected based on their relevance to the regional diversity of marine fish and their nutritional content, with an emphasis on fish found along the East Coast of India, including the coastal regions of West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, and Puducherry. This analysis aimed to explore the development of scientific themes and identify key contributors to the field of marine fish diversity. To identify species-specific data, specialized databases such as FishBase, Catalog of Fishes, World Register of Marine Species (WoRMS), IUCN Red List, Marine Species Identification Portal, and iNaturalist were consulted. A narrative synthesis approach was adopted to summarize the findings from the included studies. Nutritional profiling data were also compiled from various sources, and trends in nutrient availability across species were analysed.

Results

Global marine fish diversity and regional patterns

The diversity of marine fish plays a crucial role in maintaining global biodiversity by offering essential ecological services and food sources. Tropical and subtropical regions are home to coral reefs. Hotspots for marine biodiversity are also present (Gordó-Vilaseca, 2024). The Caribbean Sea, the Coral Triangle, and the Great Barrier Reef are examples of major reef systems. These areas are home to notable species such as groupers, parrotfish, surgeonfish, and clownfish. Many marine species use mangroves and estuaries as plant sales outlets; these habitats are found in tropical and subtropical regions (Idowu et al., 2024). The Gulf of Mexico, the Sundarbans, and Southeast Asia all have sizable mangrove forests. Numerous species are present, including mullets, mudskippers and snapper. Kelp forests, which are found mostly in temperate coastal locations, are essential to marine life along the coasts of Australia, South Africa, and California (Lalas et al., 2024). Important species in these areas include marine otters, kelp bass, and rockfish. The pelagic zone, which spans all major oceans is inhabited by migratory animals such as swordfish, tuna and different kinds of sharks (Brosset et al., 2015). The deep sea is made up of seamounts, hydrothermal vents, and abyssal plains that support specialized and frequently endemic species. The noteworthy species in these sea environments include bioluminescent species, deep-sea grenadiers, and anglerfish (Bela-Ong et al., 2024).

Regional diversity

The East Coast of India, along the Bay of Bengal, exhibits distinct marine fish diversity patterns compared to other Indian marine regions, such as the West Coast along the Arabian Sea. While both coasts support a rich array of species, the East Coast is influenced more by freshwater input from major river systems like the Ganges, Godavari, and Mahanadi, leading to greater estuarine and brackish water diversity. Fish species such as *Sardinella longiceps*, *Rastrelliger kanagurta*, *Liza parsia*, and *Penaeus monodon* are commonly reported along the eastern coast, particularly in regions like the Chilika Lagoon, Palk Bay, and the Krishna-Godavari delta (Silva et al., 2021). In contrast, the West Coast benefits from stronger seasonal upwelling and higher salinity, supporting a slightly different composition of pelagic and demersal fish, including species like *Thunnus albacares* and *Etroplus suratensis*. Additionally, the continental shelf along the East Coast is broader and shallower, influencing the types and abundance of species available to local fisheries. Importantly, the East Coast's location within the northeastern Indian Ocean, particularly the Bay of Bengal, imparts unique ecological conditions compared to other global oceanic regions. The Bay of Bengal is characterized by lower salinity, higher sediment load, and seasonal monsoonal dynamics, all of which shape the region's ichthyofaunal composition (Rakib et al., 2022). Unlike the western Indian Ocean and other basins like the Atlantic or Pacific, the Bay of Bengal supports a higher proportion of estuarine and brackish water species adapted to turbid and nutrient-rich environments.

For example, key regional habitats such as estuaries, lagoons, and deltas contribute to the abundance of euryhaline species, and the nutrient influx from riverine systems supports productive food webs that sustain economically important fish populations. These regional differences underscore the importance of localized biodiversity assessments and highlight the unique ecological and economic role of the East Coast in India's marine landscape. Therefore, focusing specifically on the environmental characteristics of the Bay of Bengal rather than generalized global ocean conditions provides more relevant insight into species diversity, resource management, and conservation strategies for the eastern Indian coast (Gordo-Vilaseca, 2024).

Marine fish resources on the East Coast of India

Marine biodiversity is abundant along India's east coast, which includes the coastal states of West Bengal, Odisha, Andhra Pradesh, and Tamil Nadu. This coastline borders the Bay of Bengal, one of the world's most productive marine environments. Seasonal variations also influence the nutritional composition of fish. Previous research found that nutrient contents in various fish species like Hilsa, Indian oil sardine and spotted seer fluctuate with breeding or migration-related cycles, affecting moisture, ash, protein, carbohydrate, and lipid levels (Bavan et al., 2024). In *Tenualosa ilisha*, moisture content varies significantly from approximately 74.2% (January) to 58.8% (September), while lipid content shows an inverse trend, being lowest in January–April and peaking during July–September (average lipid ~ 12%) (Majumdar & Basu, 2009). During its upstream spawning migration, Hilsa mobilizes lipid and carbohydrate reserves, resulting in significantly lower lipid levels in freshwater than in seawater, even though protein and ash contents remain comparatively constant. Similarly, among *Sardinella longiceps*, protein, lipid, carbohydrate, and ash decrease during the summer (breeding) season and rise during monsoon and post-monsoon periods (Chakraborty et al., 2013). These patterns underscore that lipids and moisture are most affected by seasonal reproductive cycles, and to a lesser extent carbohydrates, while protein and ash tend to be more stable (Jeyasanta & Patterson, 2023). Marine fish support ecosystem balance and provide essential nutrients like omega-3 s, proteins, vitamins, and minerals, benefiting and addressing numerous health issues (Fig. 1). Sustainable fisheries management, conservation initiatives, and socioeconomic development need to comprehend the marine fish resources in East Coast of India.

Estuaries and Mangroves

Important habitats include the Godavari and Krishna estuaries in Andhra Pradesh, the Sundarbans in West Bengal, and the Mahanadi estuary in Odisha. Mangroves, which are vital for climate adaptation and coastal protection, are under severe threat due to human activity and lack of effective policies, making immediate conservation and restoration efforts essential for their survival (Venkateswarlu & Venkatrayulu, 2023). Many economically and economically important fish species use these environments as their spawning, feeding and nidification sites (Yennawar et al., 2017; Das and Bora et al., 2024). The Ganges, Brahmaputra, and Meghna rivers converge to form the world's largest mangrove forest, the Sundarbans Mangrove Forest, located along the eastern coast of India and Bangladesh (Das et al., 2023). The Mahanadi River formed the Mahanadi Estuary in Odisha, which supports significant fisheries and provides critical habitat for various fish species (AM et al., 2024). Furthermore, fish biodiversity in Andhra Pradesh is strongly reliant on the Godavari and Krishna estuaries (Yennawar et al., 2017). Furthermore, Tamil Nadu's mangroves in Pichavaram and Muthupet, support a diverse range of fish and other marine species, contributing to the region's unique marine biodiversity (Natarajan & Muthukumaravel, 2024). Table 1 summarizes the fish variety and main families present in India's East Coast estuaries and mangroves, emphasizing their dispersion across these distinct ecosystems (Natarajan & Muthukumaravel, 2024; Yennawar et al., 2017).

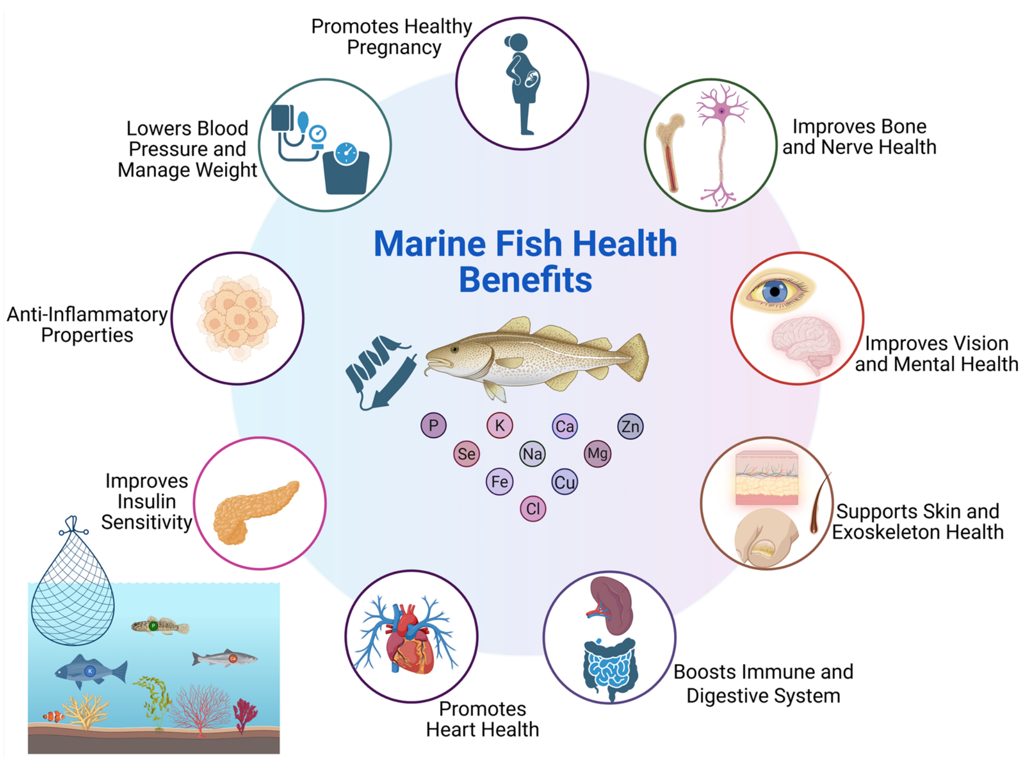

Fig. 1 Numerous health benefits of Marine fish highlighting their essential role in ecosystem sustainability and human nutrition

Table 1 Fish diversity and major families in the estuaries and mangroves of India's east coast (Natarajan & Muthukumaravel, 2024; Yennawar et al., 2017)

Families	Fish species	Habitat	Common name
Carangidae (Jacks and Pompanos)	*Caranx hippos*	Estuaries	Crevalle jack
Engraulidae (Anchovies)	*Stolephorus indicus*	Estuaries	Indian anchovy
Mugilidae (Mullets)	*Mugil cephalus*	Estuaries	Flathead grey mullet
Sciaenidae (Croakers)	*Umbrina roncador*	Estuaries	Yellowfin croaker
Ariidae (Sea Catfishes)	*Arius maculatus*	Estuaries	Spotted catfish
Gobiidae (Gobies)	*Glossogobius giuris*	Estuaries, mangrove	Tank goby
Gobiidae (Gobies)	*Trypauchenichthys sumatrensis*	Estuaries, mangrove	Burrowing goby
Apogonidae (cardinalfishes)	*Apogonichthyoides sialis*	Mangrove	Twinbar Cardinalfish
Butidae (Gudgeon gobies)	*Oxyeleotris urophthalmus*	Estuaries, mangrove	Tail-spotted sleeper goby
Serranidae (Groupers)	*Epinephelus coioides*	Mangrove	Orange-spotted grouper
Cepolidae (Bandfishes)	*Acanthocepola limbate*	Mangrove	blackspot bandfish
Blenniidae (Combtooth blennies)	*Entomacrodus thalassinus*	Mangrove	Sea blenny
Pomacentridae (Damselfishes)	*Pomacentrus similis*	Mangrove	Similar damsel
Holocentridae (Squirrelfishes, soldierfishes)	*Myripristis berndti*	Mangrove	Blotcheye soldierfish
Holocentridae (Squirrelfishes, Soldierfishes)	*Myripristis seychellensis*	Mangrove	Seychelles soldier
Lutjanidae (Snappers)	*Lutjanus argentimaculatus*	Estuaries, mangrove	Mangrove red snapper
Soleidae (Soles)	*Pardachirus pavoninus*	Mangrove	Peacock sole
Labridae (Wrasses)	*Thalassoma lunare*	Mangrove	Moon wrasse
Tetraodontidae (Puffers)	*Canthigaster papua*	Mangrove	Papuan toby
Hemiscylliidae (Bamboo sharks)	*Chiloscyllium griseum*	Mangrove	Grey bambooshark
Terapontidae (Grunters or tigerperches)	*Terapon puta*	Mangrove	Small-scaled terapon
Cichlidae (Cichlids)	*Etroplus suratensis*	Estuaries	Green chromide

Coral reefs

Important coral reef habitats may be found on India's east coast, specifically in the Palk Bay and Gulf of Mannar, Tamil Nadu (Kar et al., 2022). These reefs support a wide variety of fish species and are essential to the marine biodiversity of the area (Quigley & Baird, 2024). The Gulf of Mannar is home to 21 islands and a vast network of coral reefs. Palk Bay is located between Sri Lanka's and India's southeast coasts, features both seagrass beds and surrounding coral reefs that enhance overall biodiversity. Fish like surgeonfish and parrotfish assist in regulating the growth of algae on reefs, preventing it from becoming too large and suffocating the corals (Jones et al., 2004). Predatory fish, such as groupers, moray eels, and others, regulate the numbers of smaller fish and invertebrates, preserving the equilibrium of the reef environment (Anto et al., 2024). West Bengal's marine ornamental fish biodiversity, notably around the Bay of Bengal's coastal reefs, comprises both established aquarium species and those with decorative potential. This contrasts with the continuous bioerosion of coral reefs, which is promoted by species such as parrotfish (Mahapatra & Lakra, 2015). Table 2 presents the major fish families and species associated with coral reefs along the East Coast of India, highlighting their distribution across different types of coral reefs (Kar et al., 2022; Saroj et al., 2016). This process breaks down dead coral and produces sand, which is necessary for reef construction and maintenance (Topor et al., 2019).

Continental shelf

The east bank of India's continental shelf is home to a diverse collection of fish species (Table 3). Numerous fish species on the continental shelf of the east coast of India are essential to local fisheries and marine ecosystems (Gros et al., 2023; Simpson et al., 2011). These species live in a variety of natural niches, such as those associated to reefs, demersal habitats, and pelagic (large bodies of water) (Maureaud et al., 2024).

Biodiversity and species composition

The eastern coast of India is renowned for being one of the richest regions in marine biodiversity along the country's coastline (Fig. 2). Its proximity to the Gangetic mouth provides a unique habitat of shallow muddy beach with a high sedimentation load from the Ganga riverine system (Rout et al., 2024; Mokhtar et al., 2023). It is also a significant marine fish landing facility and a popular beach resort on India's eastern coast. Many studies have been already conducted

Table 2 Major fish families and fish species of coral reefs along the East Coast of India (Kar et al., 2022; Topor et al., 2019)

Families	Fish species	Habitat	Common name
Pomacentridae (Damselfishes)	*Amphiprion ocellaris*	Coral reef	Clownfish
Blenniidae (combtooth blennies)	*Entomacrodus thalassinus*	Coral reef	Indo-Pacific combtooth blenny
Apogonidae (cardinalfishes)	*Jaydia queketti*	Coral reef	Spotfin cardinalfish
Apogonidae (cardinalfishes)	*Ostorhinchus fasciatus*	Coral reef	Striped cardinalfish
Apogonidae (cardinalfishes)	*Ostorhinchus fleurieu*	Coral reef	Flower cardinalfish
Holocentridae (Squirrelfishes, soldierfishes)	*Sargocentron cornutum*	Coral reef	Threespot squirrelfish
Plotosidae (Eeltail catfishes)	*Paraplotosus albilabris*	Coral reef	Whitelipped eel catfish
Chaetodontidae (Butterflyfishes)	*Heniochus diphreutes*	Coral reef	False moorish idol
Lutjanidae (Snappers)	*Lutjanus quinquelineatus*	Coral reef	Five-lined snapper
Carangidae (Jacks and pompanos)	*Naucrates ductor*	Coral reef	Pilotfish
Carangidae (Jacks and pompanos)	*Scomberoides lysan*	Coral reef	Doublespotted queenfish
Torpedinidae (Electric rays)	*Torpedo fuscomaculata*	Coral reef	Black-spotted torpedo
Tripterygiidae (Triplefin blennies)	*Helcogramma ellioti*	Coral reef	Elliot's triplefin
Pomacentridae (Damselfishes)	*Chrysiptera cyanea*	Coral reef	Blue damselfish
Acanthuridae (Surgeonfishes)	*Acanthurus leucosternon*	Algal	Powder blue tang
Labridae (Wrasses)	*Labroides dimidiatus*	Sand	Cleaner wrasse
Scaridae (Parrotfishes)	*Cetoscarus bicolor*	Coral reef	Bicolor parrotfish
Serranidae (Groupers)	*Cephalopholis argus*	Coral reef	Peacock grouper
Chaetodontidae (Butterflyfishes)	*Forcipiger flavissimus*	Coral polyps	Longnose butterflyfish
Muraenidae (Moray Eels)	*Gymnothorax javanicus*	Reef crevices	Giant moray
Balistidae (Triggerfishes)	*Balistoides conspicillum*	Coral reef	Clown triggerfish
Holocentridae (Squirrelfishes)	*Myripristis berndti*	Coral reef	Bigeye squirrelfish
Tetraodontidae (Pufferfishes)	*Arothron manilensis*	Coral reef	Striped puffer
Blenniidae (Combtooth blennies)	*Cirripectes auritus*	Coral reef	Blackflap blenny
Blenniidae (Combtooth blennies)	*Cirripectes polyzona*	Coral reef	Barred blenny
Blenniidae (Combtooth blennies)	*Ecsenius bicolor*	Coral reef	Bicolor blenny
Blenniidae (Combtooth blennies)	*Glyptoparus delicatulus*	Coral reef	Delicate blenny
Gobiidae (Gobies)	*Amblyeleotris wheeleri*	Coral reef	Gorgeous prawn-goby
Gobiidae (Gobies)	*Eviota punyit*	Coral reef	Punyit dwarfgoby
Gobiidae (Gobies)	*Eviota teresae*	Coral reef	Viridescent dwarfgoby
Cirrhitidae (Hawkfishes)	*Cirrhitichthys falco*	Coral reef	Dwarf hawkfish
Labridae (Wrasses)	*Halichoeres leucoxanthus*	Coral reef	Canarytop wrasse
Labridae (Wrasses)	*Pseudocheilinus evanidus*	Coral reef	Striated wrasse
Labridae (Wrasses)	*Coris latifasciata*	Coral reef	Broad banded wrasse
Pomacentridae (Damselfishes)	*Pomacentrus xanthocercus*	Coral reef	Yellowtail damsel
Pomacentridae (Damselfishes)	*Plectroglyphidodon luteobrunneus*	Coral reef	Indian gregory
Pomacentridae (Damselfishes)	*Pomacentrus indicus*	Coral reef	Indian damsel

investigations to inventory the ichthyological faunal variety of the Digha coast. The earlier collection of the region's ichthyofauna included 212 species from 145 genera and 88 families, as well as 238 species from 72 families (Yennawar et al., 2017). A brief analysis of the ichthyotaxonomic data of Pondicherry's coastal marine waters revealed 56 species belonging to 33 groups. There were 113 marine ornamental fish species identified in West Bengal. On the Nagapattinam coast of Tamil Nadu, 101 species from 25 orders and 44 families were discovered (Bhanja et al., 2023; Joshi et al., 2016). The Gulf of Mannar ecology had 476 genera, 39 orders, and 144 families. The overall number of marine fish species in West Bengal is still being updated as new discoveries and taxonomic revisions (Yennawar et al., 2017). However, estimations imply that around 250 marine fish species have been reported in West Bengal's coastal and estuary waters (Bhattacharya et al., 2018; Chini et al., 2023; Majhi et al., 2024). Odisha's coastline is approximately

Table 3 Common fish species of continental shelf of east coast of India (Gros et al., 2023; Maureaud et al., 2024; Simpson et al., 2011)

Types	Species	Common name	Description	Habitat	Importance
Pelagic Fish	*Rastrelliger kanagurta*	Indian mackerel	Small, metallic blue-green body, yellowish fins	Continental shelf	Highly nutritional
	Sardinella longiceps	Oil sardine	Slender, silver-colored, single dorsal fin	Coastal	Nutritional
	Thunnus albacares	Yellowfin tuna	Large, torpedo-shaped, yellow dorsal, anal fins	Open ocean	Commercial
	Decapterus russelli	Indian scad	Silver body, lateral line	Coastal	Commercial
Demersal Fish	*Umbrina roncador*	Yellowfin croaker	Medium-sized, robust body, sensory pores on the head	Continental shelf	Commercial
	Nemipterus japonicus	Japanese threadfin bream	Elongated body, pinkish hue, long, trailing fin	Continental shelf	Commercial
	Epinephelus coioides	Orange-spotted grouper	Stout body, dark spots, a large mouth	Rocky and coral reef areas	Commercial
	Psettodes erumei	Flatfish, Indian halibut	Flattened body with both eyes on one side	Sandy and muddy bottoms	Commercial
Reef-Associated Fish	*Cetoscarus bicolor*	Bicolor parrotfish	Brightly colored with beak-like teeth for scraping algae off coral	Continental shelf	Maintaining coral health
	Acanthurus leucosternon	Powder blue tang, Surgeonfish	Oval-shaped body with vibrant blue and yellow coloration	Coral reefs and rocky areas	Popular in the aquarium trade
	Lutjanus argentimaculatus	Mangrove red snapper	Robust body with a large mouth and sharp teeth	Coral reefs, mangroves, estuarine	Commercial
	Priacanthus tayenus	Purple-spotted bigeye	Reddish bigeye with pink tinges, purple spots on pelvic fins	Coral reefs	Nutritional
	Priacanthus hamrur	Moontail bullseye	Body red, with red bars; long pelvic fins, emarginate tail	Coral reefs	Maintaining coral health
	Forcipiger flavissimus	Longnose butterflyfish	Small, brightly colored with elongated snouts for feeding on coral polyps	Coral reefs	Aquarium trade

485 km long and includes key estuaries, rivers, and coastal regions that support a broad range of marine fish species (Table 4). Given the significant study and recording conducted by local and national research organizations, the total number of marine fish species reported in Odisha is projected to exceed 300 (Gros et al., 2023; Patra et al., 2024). Andhra Pradesh's coastline spans for around 972 km, making it one of India's longest. Different national databases documented a total of 171 marine species (Ramu et al., 2015). The overall number of marine fish species identified in Tamil Nadu is above 1656 (Table 5), based on substantial study and biodiversity recording in the region, as well as the state fisheries report (Shalini et al., 2025).

Fisheries and socioeconomic impact

Coastal states such as Tamil Nadu, Andhra Pradesh, Odisha, and West Bengal heavily rely on the marine fishing industry for economic and social growth. This sector has an impact on a number of socioeconomic development factors, including job and revenue generation, cultural significance, and food security (Das et al., 2020). The fishing sector makes a major contribution to the Gross Domestic Product (GDP) of coastal nations. Selling fish and fish products serves as the principal source of income for many families (Gan et al., 2024). Many marine fish species are exported, bringing in foreign cash for the government, particularly high-value species like shrimp, tuna, and pomfret. The

Fig. 2 Map showing the marine ecoregions along the eastern coast of India, highlighting reviewed coastal and marine areas across the four eastern states: West Bengal, Odisha, Andhra Pradesh, and Tamil Nadu.

fisheries industry promotes auxiliary businesses that add value to core goods and generate additional job opportunities, such as fish processing, packaging, and transportation (Muhala et al., 2024). Many individuals find indirect employment in peripheral industries such as net making, boat construction, ice production,

Table 4 List of some Standard pharmacologically important marine fish species found in East coast, India (Bhattacharya et al., 2018; Chini et al., 2023; Majhi et al., 2024)

Fish species	Location
Lates calcarifer (Asian sea bass or Barramundi)	West Bengal, Odisha, Andhra Pradesh
Scomberomorus commerson (King mackerel)	Andhra Pradesh, Kerala, Maharastra, Tamil Nadu
Trichiurus lepturus (Ribbon fish)	Andhra Pradesh, Kerala, Maharastra
Rachycentron canadum (Cobia)	Kerala, Odisha, Andhra Pradesh
Fistularia commersonii (Pipefish)	Tamil Nadu, Odisha, West Bengal
Acanthopagrus latus (Black Sea bream)	Odisha, West Bengal, Andhra Pradesh
Sardinella longiceps (Indian oil sardine)	Odisha, West Bengal, Andhra Pradesh
Pampus argenteus—Silver pomfret	Odisha, West Bengal, Andhra Pradesh
Mugil cephalus (Flathead grey mullet)	Odisha, West Bengal, Andhra Pradesh
Lutjanus russellii (Russell's snapper)	Odisha, West Bengal, Andhra Pradesh
Pampus argenteus (Silver Pomfret)	Odisha, West Bengal, Andhra Pradesh
Channa striata (Stripped Snakehead)	Odisha, West Bengal, Andhra Pradesh
Periophthalmus barbarus (Mudskipper)	Odisha, West Bengal, Andhra Pradesh
Scatophagus argus (Brackish water scat)	Odisha, West Bengal, Andhra Pradesh
Cynoglossus semilaevis (Solefish)	Odisha, West Bengal, Andhra Pradesh
Siganus canaliculatus (Rabbitfish)	Odisha, West Bengal, Andhra Pradesh
Bodianus axillaris (Wrasse Fish)	Odisha, West Bengal, Andhra Pradesh
Epinephelus malabaricus (Malabar grouper)	Odisha, West Bengal, Andhra Pradesh
Thunnus thynnus (Atlantic Bluefin Tuna)	Odisha, West Bengal, Andhra Pradesh
Lutjanus sanguineus (Blood Snapper)	Odisha, West Bengal, Andhra Pradesh
Pterophyllum scalare (Angel Fish)	Odisha, West Bengal, Andhra Pradesh
Lethrinus harak (Harlequin Sweetlips)	Odisha, West Bengal, Andhra Pradesh
Leptomelanosoma indicum (Indo-Pacific Threadfin)	Odisha, West Bengal, Andhra Pradesh
Coryphaena hippurus (Mahi-mahi or Dolphin Fish)	Odisha, West Bengal, Andhra Pradesh
Carcharhinus melanopterus (Blacktip Reef Shark)	Odisha, West Bengal, Andhra Pradesh
Sphyraena barracuda (Great Barracuda)	Odisha, West Bengal, Andhra Pradesh
Arius thalassinus (Blue Catfish)	Odisha, West Bengal, Andhra Pradesh
Rhinomuraena quaesita (Ribbon Eel)	Odisha, West Bengal, Andhra Pradesh

Table 5 Summary of marine and brackish fish diversity along the east coast of India (Bhattacharya et al., 2018; Mogalekar et al., 2018; Pati et al., 2018; Ramu et al., 2015)

Region	No. of species	Fish landing station	References
West Bengal	314	Digha, Digha Mohana, Shankarpur, Petuaghat, Sagar, Fresergunge, Namkhana, Kakdwip and Diamond Harbour	Bhattacharya et al. (2018)
Odisha	2611	Balasore, Cuttack, Puri, Chilika, and Ganjam districts of Odisha	Pati et al. (2018)
Andhra Pradesh	171	Coastal districts of Andhra Pradesh	Ramu et al. (2015)
Tamil Nadu	1656	Gulf of Mannar, Mangrove, Estuary	Mogalekar et al. (2018)

and market vending. Migrant and seasonal workers who travel to coastal areas during peak fishing seasons account for a significant portion of the sector's employment (Rajeev & Bhandarkar, 2022). Fish is an essential source of animal protein and other nutrients for coastal communities, helping to improve nutritional diversity and food security. When compared to other animal protein sources, fish is an inexpensive, high-quality protein source for many low-income families. To guarantee the long-term health of marine ecosystems and the species they support, a balance must be established between resource extraction and sustainable practices (Yu et al., 2024). Fisheries must continue to contribute to socioeconomic progress via effective management, community participation, and adaptable measures to address environmental changes.

Conservation and management practices

Effective conservation and management practices are essential for maintaining the sustainability of marine fish populations and their habitats. Namely, fishery closures during vital spawning and breeding seasons to promote fish population growth and reproduction (Carrillo-Barragán et al., 2024). Defining minimum and maximum size restrictions to safeguard large, reproducing animals and prevent the harvesting of youngsters. The establishment of no fishing zones promote the recovery and health of ecosystems. To strike a balance between community needs and conservation, some regions allow restricted, regulated fishing activities (Liu et al., 2024). Safeguarding vital environments, such as seagrass beds, mangroves and coral reefs is also essential as these serve as important fish breeding and nidification sites. Utilizing a comprehensive management strategy for fisheries must consider interactions between species and the environment as well as the overall ecosystem (Damora et al., 2020). Revising management plans regularly in light of new scientific findings and evolving environmental circumstances. include nearby fishing communities in the decision-making process to guarantee that management initiatives are workable and supported by the local population (Encarnacion et al., 2017). To keep an eye on fishing activity and enforce laws, satellite technology, drones, and patrol boats are used. Putting in place mechanisms to keep track of and record every catch to guarantee adherence to quotas and other rules. Conservation and management practices should adhere to traditional sample techniques and imagery technologies. Traditional sampling techniques should be continued in conservation as they leverage local knowledge, are sustainable, cost-effective, and have minimal environmental impact. When combined with modern technologies, these methods enhance community engagement, adapt to local biodiversity, and ensure long-term ecosystem preservation (Bosch et al., 2017).

Traditional sampling methods

Fewer research have been conducted in such places because of the difficulty in surveying deep subtidal ecosystems. In particular, the lack of technologically sound sampling equipment has rendered in-depth examinations of these locations impossible until now (Liczkovich et al., 2024). Traps, trawls, grabs, and hook and line are all typical traditional tactics. Although it is now clear that none of these approaches can achieve the fine-scale precision possible with modern methodology, they provide a basic understanding of the interactions between fish habitats (Fricke et al., 2025).

Imagery-based approaches

To collect data in the deep subtidal marine environment, imagery-based systems such as towed camera sleds, human-occupied submersibles, and remotely controlled vehicles have been used for a long time (Smith and Lindholm et al., 2016). These approaches provide a thorough understanding of the behavior, variety, depth distribution, relative abundance, and fine-scale habitat connections of demersal fish. These devices are outfitted with underwater camera systems that provide still and moving photos of the sea floor environment, as well as habitat associations for benthic and motile creatures. Conventional trawling methods cannot create complete spatial scales with precision of two meters, as offered by on-board Global Positioning Systems (GPS) (Feuilloley et al., 2020). Furthermore, gauges monitoring conductivity, temperature, and depth (CTD) provide specific chemical properties associated with each documented observation.

Threats to marine fish diversity

Anthropogenic threats to coastal wetlands have shifted from localized disturbances to widespread impacts from local, regional, and global stressors. Human activities like fishing, bait digging, livestock grazing, and plant harvesting degrade wetland quality, while light, noise, and plastic pollution are emerging threats that may intensify (Debnath et al., 2024; He et al., 2025). Overfishing, particularly the loss of migratory aquatic predators, further exacerbates these issues (Chini et al., 2023). Regionally, infrastructure disrupts hydrology and biodiversity, and globally, climate change accelerates these threats through rising sea levels and storms (He et al., 2025). Many protected areas fail to offer adequate protection due to insufficient enforcement, including the continuation of fishing activities during critical spawning periods, undermining their effectiveness, leading to increased vulnerability of continuing shifts in aquatic biota (Debnath et al., 2024). Approximately, 69% of the 68 evaluated fish species, including Bombay duck, tuna, sharks, and shrimp, are vulnerable to climate change and overfishing. The spinycheek grouper (*Epinephelus diacanthus*) faces increased fishing pressure, raising sustainability concerns (Chini et al., 2023).

Over fishing

Sharks, cod, and tuna are particularly at risk. Unsustainable fishing practices decrease fish populations, reducing population size and genetic diversity. Catching and discarding non-target animals, such as juveniles and endangered species, harms marine biodiversity (Aguirre et al., 2021). Combating overfishing requires a comprehensive plan that includes sustainable fishing practices, effective management and regulation, financial incentives, and community engagement. By implementing these strategies, we can protect fish populations in the long run, conserve marine ecosystems, and ensure the survival of individuals who rely on fishing (Das et al., 2020).

Habitat destruction

Mangroves, seagrass meadows, and coral reefs are particularly vulnerable to human activities such as pollution and coastal development. Habitat loss endangers the overall health of marine ecosystems as well as the populations of marine fish that live there (Maureaud et al., 2024). It can result from a range of human actions that alter, damage, or destroy the natural habitats that marine creatures use to breed, feed, and find refuge. To offset the consequences of habitat degradation and assure the long-term survival of marine resources, comprehensive policies that include habitat conservation, sustainable practices, regulation, and community participation are required (Hajji & Lucas, 2024).

Climate change

Fish populations and marine ecosystems are impacted by shifting currents, rising sea temperatures, and ocean acidification. Marine ecosystems are greatly impacted by climate change, and marine fish populations are particularly heavily impacted. Sea level rise, acidification, temperature changes in the water, and modifications to weather patterns and ocean currents are some of the ways that these effects show up. In quest of colder waters, many fish species are migrating in the direction of the poles (Aguirre et al., 2021; Talbot et al., 2024). Fisheries and ecosystems in the area may be affected because of this, as species that were before common may become scarce in some locations. The behaviour and accessibility of certain fish species to fishermen are changing as a result of their migration to deeper waters with more stable temperatures (Oehlert et al., 2024). Corals' capacity to form their calcium carbonate skeletons is hampered by acidification, which results in weakened reef structures and less habitat for a variety of fish species (Queiros et al., 2024). Fish's senses can be compromised by acidic environments, making it more difficult for them to obtain food, evade predators, and navigate. Reduced rates of egg and larval survival can result from acidification's effect on reproductive success (Encarnacion et al., 2017). The dispersal patterns of fish larvae can be changed by changes in currents, which can have an impact on population connectivity and fish stock replenishment. But the threat that climate change presents to marine fish species is intricate and varied (Krishnan & Mishra, 2004). The effects include everything from altered distributions and disturbed food webs to physiological stress and habitat loss.

Ocean acidification, rising sea temperatures, and shifting currents all have an influence on fish populations and marine ecosystems. Climate change has a significant influence on marine ecosystems, especially marine fish populations. Many fish species migrate to the poles in search of cooler waters (Aguirre et al., 2021; Talbot et al., 2024). This may have an impact on local fisheries and ecosystems, since once common species may become uncommon in some areas. The behaviour and accessibility of some fish species to fisherman are altering as they migrate to deeper seas with more stable temperatures (Oehlert et al., 2024). Warmer temperatures can alter the timing of spawning episodes, resulting in discrepancies between larval availability and food supplies. Warmer temperatures have the potential to accelerate some species' development rates, but they can also cause adult fish to grow smaller in total size, limiting their capacity to reproduce and live (Queiros et al., 2024). Mollusks and crustaceans, which rely on calcium carbonate for their shells, endanger both the supply of prey for fish and the food chain's integrity. Acidification can reduce egg and larval survival rates (Encarnacion et al., 2017). However, the threat that climate change poses to marine fish species is complex and diverse (Krishnan & Mishra, 2004). The repercussions range from changed distributions and disrupted food webs to physiological stress and habitat loss.

Pollution

Plastic pollution, oil spills, and chemical contaminants all have an adverse impact on marine life. Plastic trash and chemical pollution pose major threats to fish populations and marine environments (Arthington et al., 2016). These contaminants endanger the overall integrity of the ecosystem, as well as food safety and marine life health. Plastic pollution is created by industrial operations, shipping, discarded fishing gear, urban runoff, improper waste disposal, and recreational boating (Aguirre et al., 2021). Metagenomic approaches have shown significant potential for monitoring and understanding microbial responses to pollutants in aquatic environments (Rout et al. 2025). Certain fish species ingest plastics debris due to its visual and olfactory resemblance to natural prey items (Curren et al., 2021). The progressive buildup of harmful substances throughout the body. When fish swallow plastic, harmful chemicals accumulate in their tissues. As predators devour diseased animals, the concentration of these toxic substances grows up the food chain, potentially affecting people who eat seafood and bigger marine creatures. Factory and industrial operations discharge inadequately or insufficiently treated waste into bodies of water. Nutrients, fertilizers, and pesticides flow into rivers and oceans. Chemicals can interfere with fish's senses, making it more difficult for them to navigate, get food, and avoid predators. Contamination exposure can produce behavioural changes such as reduced foraging activity, altered predator–prey interactions, and increased illness susceptibility (Ivar Do Sul et al., 2014). As a result, chronic pollution exposure can cause long-term declines in fish populations, affecting the overall health of the marine environment.

Comprehensive overview of marine fish nutritional profiles

Humans depend on marine fish as a significant source of nutrients, including high-quality proteins, omega-3 fatty acids, essential vitamins, and minerals. Due to their rich nutritional content, marine fish contribute substantially to overall health (De Silva, 1989). A clear understanding of the nutritional profile of marine fish enables consumers to make informed dietary choices.

The extraction of peptides from marine fish highlights their nutritional value and reveals bioactive components with potential health benefits. The detailed isolation procedure is illustrated in Fig. 3. The eastern coast of India supports several key fish species that are vital to human nutrition. However, many of these species are becoming vulnerable due to overfishing, some are now listed as endangered or protected (Table 5). Conservation efforts are urgently required to preserve these species for both ecological balance and human health. Figure 4 presents a comprehensive nutritional analysis of marine fish, examining various components such as flesh, skin, scales, bones, and internal organs to identify those with the highest concentrations of beneficial nutrients. These findings contribute to the development of improved diets and functional food products.

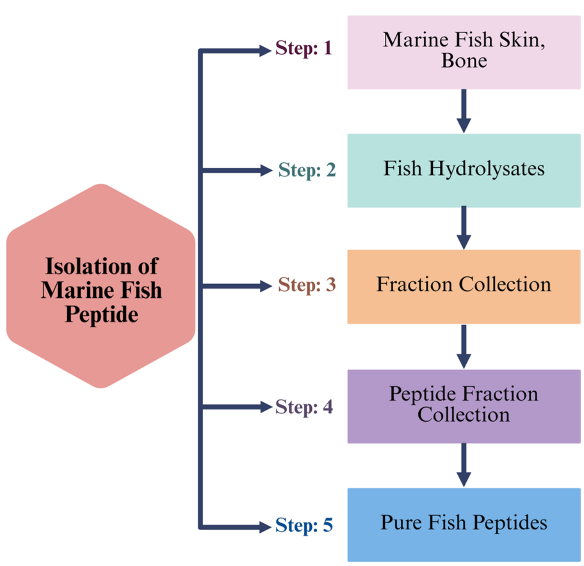

Fig. 3 The standard procedure for isolating marine fish peptides, presented sequentially, emphasizing the critical phases of peptide extraction, purification, and characterization

Macronutrients (proteins, fats)

Proteins

Marine fish are a rich source of myofibrillar proteins, such as actin, tropomyosin, and myosin, which are essential for muscle contraction and movement (Pateiro et al., 2020). Myosin hydrolyzes ATP to produce force, while actin translocates within muscle fibers during contraction (Mohanty et al., 2019; Ivar Do Sul & Costa, 2014). These proteins contain critical amino acids i.e. valine, isoleucine, and leucine that support muscle protein synthesis and repair (Pateiro et al., 2020).

Fish proteins also enhance calcium absorption, promoting bone health and reducing the risk of osteoporosis (Rout & Behera, 2025; Kendler et al., 2023). As complete proteins, they support various metabolic processes and tissue repair, supplying all essential amino acids not synthesized by the human body (Shalini et al., 2025).

Fish Protein Isolates (FPIs), obtained through filtration or centrifugation, are used in food and pharmaceutical applications due to their high protein content (Das et al., 2020). Enzymatic hydrolysis improves their bioavailability and digestibility, resulting in Fish Protein Hydrolysates (FPHs) that are more easily absorbed by the body.

Marine fish protein concentrate

Fish Protein Concentrate (FPC) provides an economical source of high-quality protein. Early research into the nutritional composition of fish products focused on FPC. It is typically produced by dehydrating surimi made from species such as *Priacanthus hamrur*, *Priacanthus tayenus*, *Nemipterus japonicus*, and *Harpadon nehereus*. Spray drying yields a powder containing up to 65% protein and 24% carbohydrates (Quigley & Baird, 2024). This protein powder is also rich in potassium, phosphorus, magnesium, and essential amino acids. It can be incorporated into diets and supplement formulations to enhance protein intake and provide comprehensive nutritional support (Aguirre et al., 2021). FPHs attract interest in food biotechnology due to their balanced amino acid profiles and bioactive peptides, making them suitable for use in functional food production (Jones et al., 2004).

Marine fish peptides

Marine fish generate bioactive peptides during protein hydrolysis, which are vital for human health (Feng et al., 2024). For instance, *Sardinella longiceps* produce bioactive peptides when hydrolyzed using the enzyme alcalase

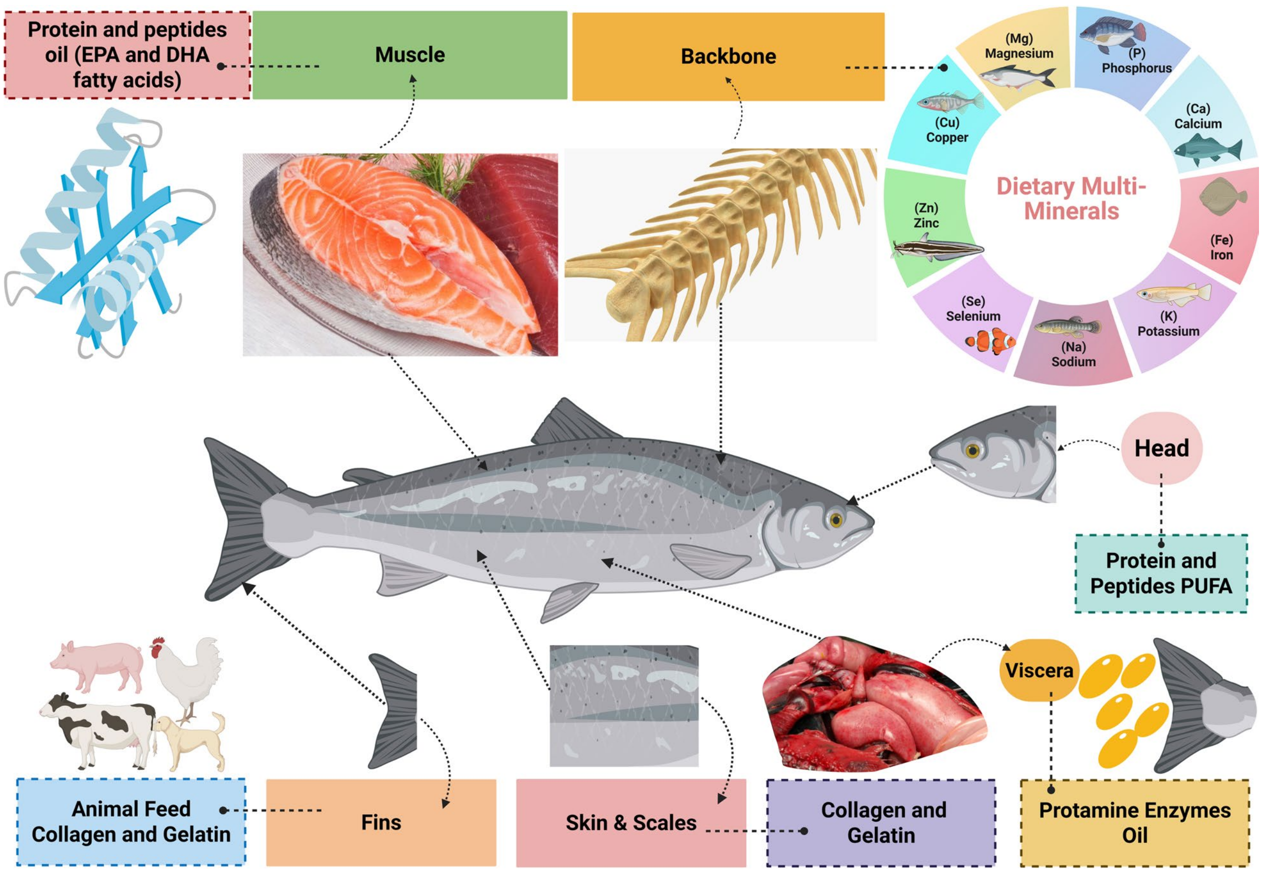

Fig. 4 Nutritional profile of marine fishes, emphasizing the composition of different parts (flesh, skin, scales, bones, and internal organs) for identifying areas with the highest concentration of beneficial nutrients, hence aiding in the formulation of healthier diets and functional food production

(Maureaud et al., 2024). These peptides can also serve as indicators of fish quality.

Small fish such as mola and anchovies, commonly consumed in Asian diets, are notable sources of calcium and can serve as valuable dietary supplements, especially for populations with low dairy consumption (Wu et al., 2024).

Omega-3 fatty acids

Fatty fish like *Eleutheronema tetradactylum*, *Rastrelliger kanagurta*, *Sardinella longiceps*, and *Tenualosa ilisha* are abundant in omega-3 fatty acids particularly EPA and DHA. These fatty acids contribute to cardiovascular and cognitive health by reducing blood triglyceride levels and lowering the risk of heart disease (Rout & Behera, 2025; Khawar et al., 2024). Regular intake of omega-3 s is also associated with a reduced risk of cognitive decline and Alzheimer's disease.

DHA plays a key role in maintaining vision, as it is a major structural component of the retina. Omega-3 s also exhibit anti-inflammatory properties, helping to manage conditions like rheumatoid arthritis and inflammatory bowel disease (Rebollo et al., 2024). Additionally, they support skin health by reducing inflammation and improving hydration.

Micronutrients (vitamins, minerals)

Vitamins

Marine fish provide essential vitamins such as A, D, B6, B12, E, and other B-complex vitamins. These nutrients support immune function, skin health, bone strength, vision, and cognitive performance (Mokhtar et al., 2023). Fish liver oils especially cod liver oil are rich in vitamin A, mainly in the form of retinoids and beta-carotene, which is metabolized into retinol.

Tuna, mackerel, herring, and cod liver oil are among the richest sources of vitamin A (Guo et al., 2024). Marine fish also offer cholecalciferol (vitamin D3), which plays a role in immune regulation and reducing the risk of autoimmune disorders. Vitamin B12 is crucial for red blood cell formation and the prevention of anemia (Yuan et al., 2024).

Minerals
Marine fish are excellent sources of calcium, phosphorus, magnesium, iron, zinc, iodine, selenium, potassium, fluoride, copper, and manganese. These minerals support energy production, immunity, cardiovascular function, and skeletal maintenance (Impellitteri et al., 2024).

Calcium absorption is enhanced by consuming fish that feed on crustaceans and mollusks (Nguyen et al., 2024). Hormones like calcitonin and parathyroid hormone-related peptide (PTHrP) regulate calcium and phosphorus levels in the body (Gong et al., 2024). Fish such as *Harpadon nehereus*, *Rastrelliger kanagurta*, and *Thunnus albacares* are particularly rich in iodine and selenium, which support thyroid health (Jiang et al., 2024).

Bioactive compounds
Antithrombin
Marine fish like Atlantic salmon (*Salmo salar*) produce antithrombins that mimic the activity of human antithrombin. Their function is influenced by heparin concentrations and is effective across a broad pH (7.8–8.4) and temperature range, with notable activity even at 3 °C (Salte et al., 1995). These properties suggest potential applications in anticoagulant therapies (Dwivedi et al., 2020).

Calcitonin
Salmon calcitonin is significantly more potent than human thyroid calcitonin. It reduces bone resorption by inhibiting osteoclast activity and promotes calcium retention in bones. This compound is widely used to treat osteoporosis in postmenopausal women who cannot undergo estrogen therapy (Ramu et al., 2015). Synthetic salmon calcitonin offers a cost-effective alternative for pharmaceutical production (Simpson et al., 2011).

Astaxanthin
Astaxanthin is a carotenoid pigment found in wild salmon through their diet of crustaceans. It is also added to the feed of farmed salmon (Elbahnaswy & Elshopakey, 2024). Some indigenous populations consuming large amounts of salmon exhibit lower cancer rates, possibly due to the combined effects of EPA and astaxanthin (Kendler et al., 2023; Pateiro et al., 2020). Although current evidence is largely from animal studies, astaxanthin shows promise as a chemopreventive agent (Alimba & Faggio, 2019).

Syngnathusin
Syngnathusin is a unique anticancer protein extracted from the entire body of *Hippocampus fuscus*, *Hippocampus trimaculatus*, *Hippocampus spinosissimus*, *Hippocampus kuda*, *Hippocampus kelloggi*, traditionally used for cancer treatment along the Tamil Nadu coast (Murugan et al., 2008). It contains 16 amino acids, has an isoelectric point of 4.57, and a molecular weight of 67.3 kDa. Syngnathusin has shown potential to inhibit S180 tumor growth in mice and may be developed into a novel anticancer agent (Maureaud et al., 2024).

Fish collagen and gelatines (FCG)
Fish collagen is a structural protein used in the food, cosmetic, and pharmaceutical industries. It offers properties similar to mammalian collagen, such as solubility, gel strength, and viscosity (Jones et al., 2004). Biomaterials derived from sea prawn byproducts (SPBs) are also widely used due to their excellent biocompatibility, biodegradability, and low antigenicity (Mohanty et al., 2019). Fish species like *Sardinella longiceps*, *Rastrelliger kanagurta*, *Tenualosa ilisha*, and *Harpadon nehereus* have been employed as drug carriers in cancer (Mohanty et al., 2016).

Nutritional variations of marine fish species along the East Coast of India
Fish from cold water, such cod, mackerel, and salmon, have different nutritional profiles. They range greatly in terms of lipid content, vitamin and mineral levels, and general health advantages. While cod has lower fat and omega-3 levels but is still a great source of protein and other nutrients, salmon and mackerel are especially rich in omega-3 fatty acids and vitamin D (Bogard et al., 2015). Darwin and Padmavathi et al. (2020) discovered that the diversity and present state of the grouper fish, Epinephelus, coincides with an increase in grouper landings and output. However, there is a risk of overfishing, with several species on the verge of extinction. The nutritional advantages of tropical fish vary greatly depending on the species. Although mahi-mahi and grouper also contain vital nutrients, they do so in different quantities than tuna, which stands out for having a high protein and omega-3 fatty acid content (Silva et al., 2021). The East Coast of India has a diverse range of marine fish species, each of which contributes to nutritional security in its own unique way (Mohanty et al., 2016). Table 6 describes the most nutritious commercial marine fish species from India's east coast, as well as their current IUCN status and population trends (De Silva, 1989; Kendler et al., 2023; Usydus et al., 2011). These fish provide an essential source of protein, healthy fats, and micronutrients, which can help support the health and well-being of coastal populations (Usydus et al., 2011). Species like sardines, grouper, pomfret, and snapper can help combat micronutrient deficiencies in coastal communities. As fish populations are a crucial part of local diets, their sustainable management is necessary to ensure that these valuable

Table 6 List of species-specific nutritional variations and therapeutic potential of East coast, India (De Silva, 1989; Kendler et al., 2023; Usydus et al., 2011)

Species Name	Nutritional value	IUCN status	Current population trend
Tenualosa Ilisha (Ilisha)	Oleic acid, Linoleic acid, linolenic acid, High Omega -3 fatty acid, Vitamins (A,D,E,K)	Least Concern	Decreasing
Sardinella longiceps (Indian sardine)	High Omega -3 fatty acid, Sodium, Potassium, Calcium, Phosphorus, Iron, Zinc, Manganese, Selenium, Vitamins (A, D, E, K)	Least Concern	Unknown
Epinephelus fuscoguttatus (Brown-marbled grouper)	Sodium, Potassium, Calcium, Phosphorus, Iron, Zinc, Manganese, Selenium, Vitamins (A,D,E,K)	Vulnerable	Decreasing
Epinephelus coioides (Orange-spotted grouper)	Sodium, Potassium, Calcium, Phosphorus, Iron, Zinc, Manganese, Selenium, Vitamins (A,D,E,K)	Least Concern	Decreasing
Epinephelus malabaricus (Malabar grouper)	Sodium, Potassium, Calcium, Phosphorus, Iron, Zinc, Manganese, Selenium, Vitamins (A,D,E,K)	Least Concern	Decreasing
Epinephelus tukula (Potato grouper)	Sodium, Potassium, Calcium, Phosphorus, Iron, Zinc, Manganese, Selenium, Vitamins (A,D,E,K)	Least Concern	Unknown
Epinephelus bleekeri (Duskytail grouper)	Sodium, Potassium, Calcium, Phosphorus, Iron, Zinc, Manganese, Selenium, Vitamins (A,D,E,K)	Data Deficient	Decreasing
Euthynnus affinis (Kawakawa)	Calcium, Iron, Zinc, Selenium, Sodium, Potassium, Eicosapentaenoic acid (EPA), Docosahexaenoic acid (DHA), Protein, Lipid	Least Concern	Unknown
Harpadon nehereus (Bombay Duck Lizardfish)	High Omega-3 fatty acid, Protein, Carbohydrate, Fats, Vitamins (A, B2, B3, B12, C), Calcium, Phosphorus, Iron, Zinc, Magnesium	Near Threatened	Decreasing
Katsuwonus pelamis (Skipjack Tuna)	Sodium, Potassium, Calcium, Phosphorus, Iron, Zinc, Manganese, Selenium, Vitamins (A, D, E, K)	Least Concern	Decreasing
Leiognathus splendens (Splendid Ponyfish)	Sodium, Potassium, Calcium, Phosphorus, Iron, Zinc, Manganese, Selenium, Vitamins (A, D, E, K)	Least Concern	Stable
Nemipterus japonicus (Japanese Threadfin Bream)	High Omega -3 fatty acid, Sodium, Potassium, Iron, Copper, Zinc	Least Concern	Unknown
Rastrelliger kanagurta (Indian Mackerel)	Protein, Highest Omega -3 fatty acid, highest potassium, Sodium, Iron, Copper, Zinc	Least Concern	Stable
Stolephorus commersonnii (Commerson's anchovy)	Protein, high potassium, Sodium, Iron, Copper, Zinc	Least Concern	Stable
Stolephorus waitei (Waite's Anchovy)	Protein, Sodium, Potassium, Iron, Copper, Zinc	Data Deficient	Unknown
Thunnus albacares (Yellowfin Tuna)	Linoleic acid, High Omega-6 fatty acid, Sodium, Potassium, Iron, Copper, Zinc	Least Concern	Decreasing
Trichiurus lepturus (Largehead Hairtail)	High Omega -3 fatty acid, Sodium, Potassium, Calcium, Phosphorus, Iron, Zinc, Manganese, Selenium, Vitamins (A, D, E, K)	Least Concern	Stable
Sardinella fimbriata (Sardine)	Omega-3 fatty acids, Protein, Calcium, Phosphorus, Vitamin D	Least Concern	Unknown
Sardinella melanura (Blacktip sardinella)	Omega-3 fatty acids, Protein, Calcium, Phosphorus, Vitamin D	Least Concern	Unknown
Hilsa kelee (Hilsa shad)	Omega-3 fatty acids, Protein, Vitamins (B12, D)	Least Concern	Stable
Coilia dussumieri (Indian Coilia)	Protein, Omega-3 fatty acids, Vitamins	Least Concern	Stable
Amblygaster clupeoides (Clupeoid fish)	Omega-3 fatty acids, Protein, Vitamin B12	Least Concern	Unknown
Chanos chanos (Milkfish)	Protein, Omega-3 fatty acids, Vitamins (D, B12), Calcium	Least Concern	Unknown
Escualosa thoracata (White sardine)	Omega-3 fatty acids, Protein, Essential vitamins, Minerals	Least Concern	Unknown
Amblygaster sirm (Spotted sardinella)	Omega-3 fatty acids, Protein, Vitamins (B12, D)	Least Concern	Unknown
Sardinella albella (White sardinella)	Omega-3 fatty acids, Protein, Calcium, and Vitamin D	Least Concern	Unknown
Leptomelanosoma indicum (Indian Threadfin)	Protein, High Omega -3 fatty acid, Calcium, Iron, Zinc, Selenium	Not Evaluated	Decreasing

Table 6 (continued)

Species Name	Nutritional value	IUCN status	Current population trend
Pagrus major (Red seabream)	High Fat, High Protein, Low Carbohydrates, Calcium, Magnesium, Phosphorus, Selenium, Vitamin B6, B12	Least Concern	Unknown

resources remain available for future generations (De Silva, 1989; Kendler et al., 2023).

Consumption patterns among coastal and low-income communities

On the east coast of India, low-income and coastal populations depend heavily on marine fish as a primary and affordable source of nutrition. Commonly consumed species in these regions include *Sardinella longiceps* (Indian oil sardine), *Rastrelliger kanagurta* (Indian mackerel), *Tenualosa ilisha* (Hilsa shad), *Harpadon nehereus* (Bombay duck), and species of *Johnius* (croakers). These fish are not only widely available and relatively inexpensive, but also rich in essential nutrients such as omega-3 fatty acids, high-quality protein, and calcium (Pradhan et al., 2023).

A study conducted in low-income urban neighbourhoods of Chennai revealed that over 90% of households consume marine fish at least twice per week, with nearly 80% reporting that they rarely or never consume freshwater fish, underscoring the preference for marine species among coastal populations (Subramanian et al., 2022). Small pelagic species like *S. longiceps* and *R. kanagurta* are particularly important due to their abundance, low cost, and minimal processing requirements. Dried fish commonly prepared from *H. nehereus* and anchovies plays a crucial role in food and nutrition security for households without refrigeration, particularly in Odisha and West Bengal (Pradhan et al., 2023).

Despite the dietary significance of fish, economic constraints remain a barrier. Recent national survey data show that although fish consumption has increased over the past decade, low-income households still face price as a major limiting factor (Bandyopadhyay et al., 2023). Households in this income group spend a disproportionately high share of their food budget on fish, even though their absolute consumption remains lower than higher-income groups (Paramasivam & Malaiarasan, 2021). These findings highlight the dual challenge of nutritional dependency and economic vulnerability, necessitating fishery policies that safeguard both ecological sustainability and access to affordable fish protein for marginalized communities.

The review includes data from six datasets on the family-level richness, ecological groupings, geographic distribution, nutritional content, and conservation status of marine fish throughout the eastern Indian coast (Table 7). Estuarine, mangrove (e.g., Carangidae, Mugilidae, Ariidae, Lutjanidae), and coral reef systems (e.g., Pomacentridae, Apogonidae, Blenniidae, Labridae) have a high family diversity, with over 45 species spread over 20 families. Pelagic, demersal, and reef-associated fishes were classified ecologically, with each contributing uniquely to nutrition, fisheries, and ecosystem health. Species richness varies by region, with Odisha recording 2,611 species, followed by Tamil Nadu recording 1,656 species, West Bengal (314), and Andhra Pradesh (171). *Lates calcarifer*, *Scomberomorus commerson*, *Rachycentron canadum*, and *Trichiurus lepturus* were commercially significant species with a wide distribution. Nutritional profiling found that numerous species are high in omega-3 fatty acids, protein, vitamins, and minerals, all of which are essential for human health and food security. Although most species are classified as Least Concern, significant taxa like *Epinephelus fuscoguttatus* and *Harpadon nehereus* are endangered or decreasing, emphasizing the importance of integrated methods that balance nutritional advantages with conservation goals.

Discussion

Marine fish diversity along the East Coast of India plays a pivotal role in sustaining the functional integrity of coastal and marine ecosystems while also serving as a key source of nutrition for local communities. This diversity underpins essential ecological processes such as nutrient cycling, food web stability, and habitat connectivity, particularly within estuarine and deltaic systems such as the Krishna-Godavari basin, Palk Bay, and Chilika Lagoon (Das et al., 2020; Topor et al., 2019). Our findings indicate that these regions host a high abundance of small pelagic and estuarine-resident species including *Sardinella longiceps*, *Liza parsia*, and *Mugil cephalus* which are critical not only to ecosystem functioning but also to the nutritional well-being of coastal populations.

As documented in this review, species harvested from these areas exhibit substantial nutritional quality, particularly in terms of essential fatty acids, calcium, and protein. *Rastrelliger kanagurta* and *Sardinella longiceps* demonstrated high omega-3 content during post-monsoon periods, aligning with previous observations that

Table 7 Summary of nutritional composition and key findings from reviewed marine fish studies along the East Coast of India

Category	Key findings	No. of Species/families	Habitat/region	Importance	References
Family-level richness (Tables 1 and 2)	Estuarine and mangrove systems: Carangidae, Mugilidae, Ariidae, Lutjanidae, etc. Coral reef systems: Pomacentridae, Apogonidae, Blenniidae, Labridae, etc	~45 representative species across > 20 families	Estuaries, mangroves, coral reefs	Biodiversity support, ecological functions	Derived from Tables 1 and 2
Ecological grouping (Table 3)	Pelagic, demersal, reef-associated fishes with varied ecological and commercial roles	12 highlighted species	Continental shelf, coral reefs, coastal waters	Nutrition, trade, reef health maintenance	Table 3
Geographic distribution (Table 4)	Commercially important species distributed across Odisha, West Bengal, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra	~30 key species	Coastal and estuarine zones of eastern India	Fishery resources, livelihoods	Table 4
Regional richness (Table 5)	West Bengal: 314 spp.; Odisha: 2611 spp.; Andhra Pradesh: 171 spp.; Tamil Nadu: 1656 spp.	> 4700 species collectively	Fish landing stations (Digha, Balasore, Chilika, Gulf of Mannar, etc.)	Regional biodiversity inventories	Bhattacharya et al., (2018), Pati et al., (2018), Ramu et al., (2015), Mogalekar et al., (2018)
Nutritional and conservation status (Table 6)	High nutritional value (Omega-3, proteins, minerals, vitamins). IUCN: Mostly LC; some Vulnerable/NT; several with declining trends	> 25 species assessed	Marine and estuarine habitats	Nutritional security, fishery economy	IUCN Red List, derived from Table 6

seasonal phytoplankton productivity influences lipid accumulation (Anthony et al., 2024). Similarly, demersal species such as *Johnius dussumieri* and *Nemipterus japonicus* contribute significantly to micronutrient intake, offering calcium, phosphorus, and B vitamins essential for maternal and child health.

These results affirm prior global studies (Rifat et al., 2023) but provide localized evidence specific to India's eastern seaboard, where artisanal fisheries dominate. The prevalence of nutrient-dense small pelagic species in coastal catches offers a unique opportunity to combat regional malnutrition through sustainable, community-based fisheries. For vulnerable groups such as pregnant women, children, and the elderly, these species can fulfil a substantial portion of daily dietary needs when consumed regularly through local food systems.

From a conservation perspective, our review highlights the critical role of estuarine and mangrove-linked habitats as spawning and nursery grounds for many of the aforementioned species. However, these systems face acute pressures from anthropogenic activities, including industrial discharge, habitat encroachment, and climate-induced salinity shifts. In the Krishna-Godavari and Mahanadi deltas, habitat degradation correlates with observable shifts in species composition and reduced nutritional quality in certain fish during pre-monsoon sampling periods. Such ecological disruptions compromise both biodiversity and food security of dependent populations.

This region-specific evidence underscores the need for integrated, nutrition-sensitive marine management. Incorporating seasonal and habitat-based nutritional data into fisheries policy can optimize harvest timing and conservation zoning. For instance, encouraging post-monsoon harvesting of lipid-rich species can enhance both dietary benefits and ecological sustainability.

As Mohanty et al. (2019) suggest, recognizing the ecological and financial value of diverse fish stocks and their habitats can support policy alignment with Sustainable Development Goals (SDGs), especially SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), and SDG 14 (Life Below Water). Our findings reinforce this by demonstrating how localized data can guide evidence-based interventions.

Usefully, an integrated approach combining scientific monitoring and community participation can enhance sustainable marine resource management. This includes empowering local fishers to participate in biodiversity assessments, enhancing value chains for nutrient-rich species, and ensuring regulatory enforcement in ecologically sensitive zones.

Ultimately, interpreting marine fish diversity and nutritional profiles through a socio-ecological lens rooted in specific data from India's East Coast can drive more resilient and equitable marine food systems.

Conclusion

This study underscores the critical role of marine fish diversity along India's East Coast in supporting the nutritional security of coastal communities. Rich in protein, essential fatty acids, and key micronutrients, these species serve as a vital dietary resource in a region where food and livelihood security are deeply intertwined with marine ecosystems. The ecological importance of estuaries, mangroves, coral reefs, and the continental shelf, each sustaining distinct fish assemblages highlights the need for spatially nuanced, ecologically informed management strategies. Yet, persistent gaps in long-term ecological data, particularly regarding population dynamics, habitat degradation, and climate change impacts, continue to constrain evidence-based decision-making. Moreover, uniform conservation policies often overlook the heterogeneity of local ecosystems and socio-economic contexts, limiting their effectiveness. Addressing underlying socio-economic drivers such as poverty, livelihood vulnerability, and limited educational access is essential for achieving sustainable and equitable resource use. Empowering coastal communities through participatory governance and inclusive management practices offers a promising pathway toward reconciling biodiversity conservation with human well-being. To ensure long-term ecosystem resilience and food system sustainability, policy frameworks must prioritize integrated, community-based fisheries management, complemented by habitat restoration and marine spatial planning. Such approaches are essential to safeguarding marine biodiversity while securing access to critical nutritional resources for future generations.

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