

COMMERCIALLY AND ECONOMICALLY IMPORTANT FISH SPECIES FROM AN OTTER TRAWLING VESSEL OF BAY OF BENGAL, BANGLADESH

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Abstract

The study was conducted on the commercially and economically important fish species in the Bay of Bengal (BoB) that were collected from an otter trawling vessel in March 2020. Within the study period, a total of 52 species were identified, including 17 orders, and 43 families. Perciformes were found to be the most dominant order over all others, contributing about 46.15% of the fish species (24 species under 23 families). A record of catching immature species has been found, which can reduce the sustainability of fisheries. We have found one critically endangered (CR), two near threatened (NT), twenty-five least concerned (LC), four data deficient (DD), and twenty not evaluated (NE) species among the fifty-two species in the BoB during the study period. Many commercially important fish species within the bay need to be exploited properly to get maximum economic benefits.

Keywords: Trawl catch, Sustainability, Conservation, Bay of Bengal.

Introduction

A warm tropical temperature, abundant rainfall, and land nutrients contribute to the marine environment and coastal area, making it one of the most productive areas on earth (Hossain, 2001; Islam, 2003). Bangladesh has a remarkably diverse range of fish and shrimp species (Quader, 2010). About 82-87% of the overall demersal exploitation is contributed by the 20 highly commercial fish families, which comprise about 100 commercial species (Quader, 2010). This exploitation contributes only 20% of national production (Hussain and Hoq, 2010). In 2015-2016, Bangladeshi industrial trawlers caught approximately 102,000 tons of finfish (MFO, 2016). A total of 344 marine fish, shark, ray, and skate species under 86 families and 49 species of shrimp, crab, lobster, and mentis were found in the survey of marine fisheries (Fanning *et al.*, 2019).

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A study assessed the abundance of commercially important fish species which includes the families of Ariidae, Siaeidae, Nemipteridae, Trichiuridae, Carangidae, Scombridae, Clupeidae, Pomadasyidae, Stromateidae, Harpadontidae, Lutjanidae, Cephalopoda, and Elasmobranchii (Barua, 2019). An area of 32,440 km² ranging from the shore and going down 40 meters (m) of water depth is accessible for 67,669 unauthorized boats, where about fifty percent of country boats are in the BoB (Shamsuzzaman *et al.*, 2020). Trawl nets are operated from mechanical vessels known as trawlers and are made to catch economically beneficial target species (Biju Kumar and Deepthi, 2006). The shrimp trawl and fish trawl are two variations of the bottom otter trawl, which is the primary equipment. The shrimp trawl uses more sinkers to scrape through the bottom, whereas the fish trawl uses more floats to lift itself slightly off the bottom (Vivekanandan, 2013). Fish resources of marine water in Bangladesh can be divided into three categories according to the range of catch: the first one is shore to 40 m water depth, where traditional fishing work is carried out; the second one ranges from 40 m to 200 m water depth, where trawling is operated; and the last one is the Exclusive Economic Zone (EEZ) of Bangladesh (Islam *et al.*, 2017). The size of the vessels ranges from shorter, 20 m long wooden craft to longer, 40 to 50 m long steel vessels (Barua and Karim, 2014). Only 242 trawlers are authorized by the government (MoFA, 2014), and different trawlers harvest beyond 40 m of depth for industrial fishing (Roy *et al.*, 2013). Fish trawlers catch targeted species of pomfret, grunter, croaker, catfish, Indian salmon, jewfish, ribbon fish, etc., from 15 to 100 m water depth in the BoB, where industrial trawlers catch nine groups, including catfish, jewfish, Bombay duck, pomfret, shrimp, and other fish (Hoq *et al.*, 2013). Fifteen major finfish groups comprise more than 90 species, most of them demersal, but there are also records of small pelagic species (hilsa, mackerel, and sardine) from trawl catches (Barua and Karim, 2014).

The marine waters of the BoB offer a lot of fish potential (Barua and Karim, 2014), but the potential of the coastal fisheries sector has not been sensibly harvested; instead, the resources have been overexploited, and as a result, the fish stocks have decreased (Hussain and Hoq, 2010). Due to environmental degradation and several anthropogenic activities, including overfishing of coastal fisheries, indiscriminate juvenile capturing, and building barrages and dams, the availability of fish has drastically decreased. The overfishing of all fish stocks and populations, the usage of even prohibited gear and techniques, pollution, siltation, and other factors, cause the decline of fishery resources (Quader, 2010). The stakeholders related to fishing must bring in ocean literacy projects to build up massive awareness to conserve the threatened fish fauna. Bangladesh's economy could be benefited significantly from the exploration, exploitation, and

management of the BoB of living and non-living resources (Shamsuzzaman *et al.*, 2017). There are many studies on the identification and exploration of commercially and economically important marine species in the BOB; most are based on landed data, some from fish research vessels or artisanal fishing vessels. This study was operated on board steel-haul mechanized fishing vessel with freezing facilities that start their voyage from Chittagong but operate trawling in the offshore area of Cox's Bazar, Bangladesh, and fish species are identified along with the trawling sites of the fishing vessel. Hence, the study's objective was to investigating the commercially and economically important fish species from an otter trawling vessel of BoB.

Materials and Methods

Study area:

Bangladesh, which has an extensive coastline of 710 km facing the BoB, supports diverse ecological features. The study area covers the potential fishing grounds along the east coast of Bangladesh. The study was conducted in the BoB near the eastern coast of Cox's Bazar, Bangladesh, located between 20°45' and 21°03' N latitudes and between 91°45' and 92°00' E longitudes (Fig. 1).

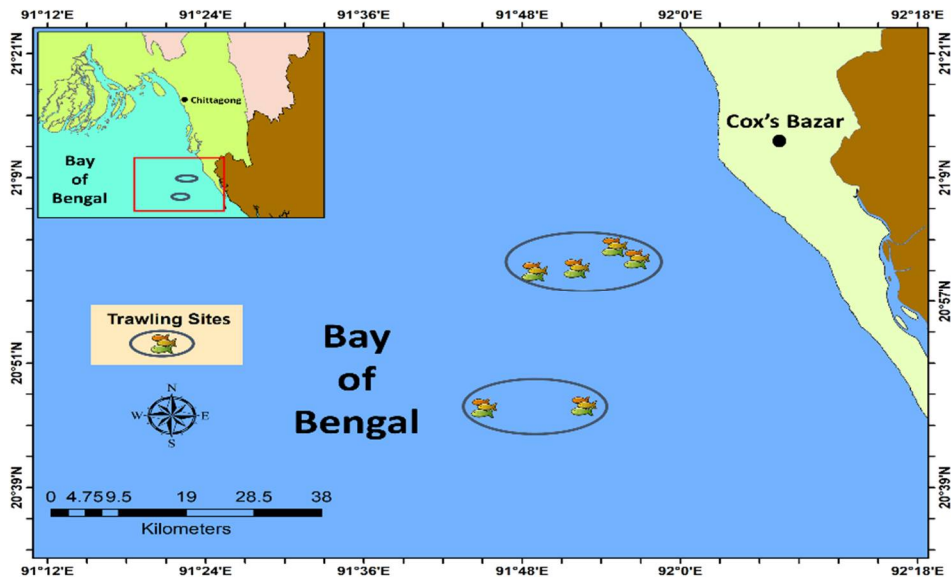


Fig. 1. Map of the study site in the BoB where oval shape circles have marked indicative trawling sites.

Data collection:

The trawler was operated over a wide area in March 2020 along the north-eastern BoB. Trained crews carried out the trawling operation aboard a steel-bodied otter trawling fishing vessel that was 46 m long and 8.5 m wide. The vessel was facilitated with RADAR (Radio Detection and Ranging), Eco Sounder, and SONAR (Sound Navigation and Ranging) and had a 200-ton freezing capacity. A trawl net was hauled at about 4-4.5 knots per hour in depth between 10 m and 65 m for 2–3 hours. Once the haul was taken on board, each species was measured for its standard length (SL) or total length (TL), depending on the species at the selected sampling site. Species were identified locally by evaluating their morphometric and meristic characteristics, sometimes their color, to determine the lowest taxonomic level with an encyclopedia, reference book, and fish base. The physicochemical characteristics of the trawling sites are presented in Table 1.

Table 1. Physicochemical parameters of March 2020 within the trawling site (Masud-Ul-Alam *et al.*, 2020).

Latitude	longitude	Wind speed (ms ⁻¹)	Temperature (°C)	Salinity (PSU)	Density (kgm ⁻³)	Mixed layer depth (m)
20.51 N	90.58 E	09	24.7	32.795	1.28	7.13
20.85 N	92.14 E	24	24.87	32.956	1.126	1.14
20.976 N	91.834 E	24	15.10	32.706	1.094	6.45
21.13 N	91.09 E	25	25.05	32.502	1.274	5.76

Interviews and a questionnaire were carried out among 3 of the officers and 7 crew members. A random sampling method was carried out for the questionnaire and interview data. The questions were about what they called the species locally, what they do with bycatch, how many times they trawl in a day, and for how long they operate. The interview of fishermen was conducted on the vessel during fishing or in their leisure time. Data collected from different sites are logged, analyzed, and graphically represented by Microsoft Excel. The study area was produced with the help of ArcMap 10.7.1 using open-source data.

Result and Discussion

Types of species:

A total of 52 trawl catch species were identified in the study period, which included 17 orders, and 43 families. Forty-two vertebrate species from 36 families and 10 invertebrate

species from 7 families were recorded from the catch samples, of which two were elasmobranchs. Perciformes was the most dominant order over all others, contributing about 46.15% of the fish species (24 species under 23 families), followed by Decapoda (6 species under 3 families), Anguilliformes (3 species under 3 families), Clupeiformes (3 species under 1 family), Scombriformes (3 species under 3 families), and Pleuronectiformes (2 species under 2 families); these were comprised of 11.54, 5.77, 5.77, 5.77 and 3.85% of the total catch during the study period, respectively (Fig. 2). The identified species that were collected from trawling are listed in Tables 2 and 3.

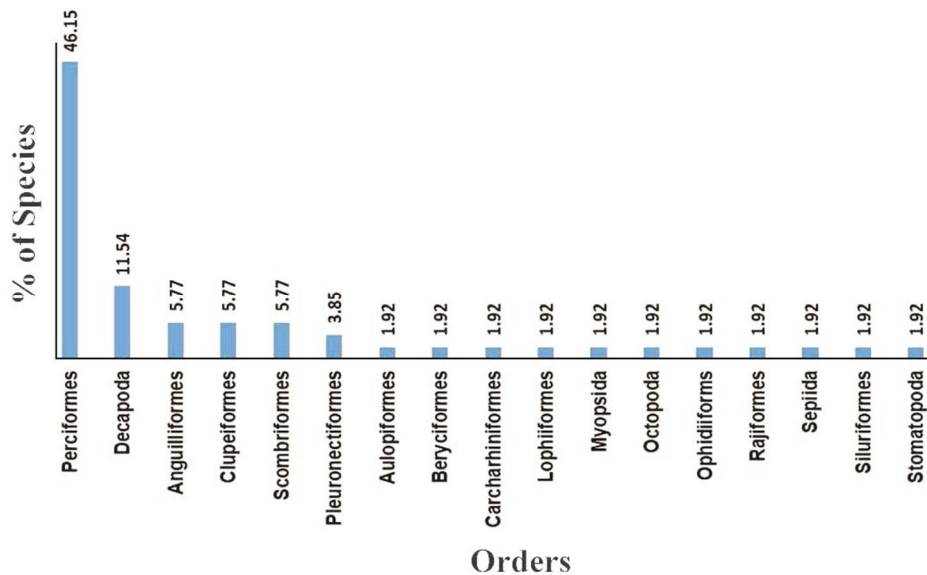


Fig. 2. Order-wise species distribution of identified marine fishes of BoB.

Commercially important species:

Twenty-two commercially important fish species from 7 orders under 16 families were identified from the catch samples, which were cross-checked with the literature of Rahman *et al.*, 1995; Ahmed *et al.*, 2009 and Fishbase, 2004, an online database. Among them, eight highly priced and demanded species were found: the Bombay duck, Hilsha shad, Seabass, Four-finger threadfin, Yellowtail barracuda, Large headed ribbon fish, Indian mackerel, and Catfish. Commercially important species included *Amblygaster leiogaster*, *Anodontostoma chacunda*, *Ariosoma anago*, *Arius arius*, *Auxis rochei*,

Table 2. List of identified vertebrate species during the study period.

Order	Family	Scientific name	Common name	Bangla/Local name
Anguilliformes	Muraenesocidae	<i>Congresox talabon</i>	Yellow pike conger	Holud Kamila
	Congridae	<i>Ariosoma anago</i>	Silvery conger	Rupali kamila
	Muraenidae	<i>Echidna nebulosa</i>	Moray	Moray kamila
Aulopiformes	Harpadontidae	<i>Harpadon nehereus</i>	Bombay-duck	Laittya
Beryciformes	Holocentridae	<i>Sargocentron rubrum</i>	Redcoat	Lalcoat
Carcharhiniformes	Carcharhinidae	<i>Scoliodon laticaudus</i>	Spadenose shark	Thutti hangor
Clupeiformes	Clupeidae	<i>Amblygaster leiogaster</i>	Smooth-belly sardine	Takia
		<i>Anodontostoma chacunda</i>	Chacunda gizzard shad	Koi puti
		<i>Tenulosa ilisha</i>	Hilsha shad	Ilish
Lophiiformes	Lophiidae	<i>Lophiomus setigerus</i>	Blackmouth angler	Samudra cheka
Ophidiiformes	Ophidiidae	<i>Brotula multibarbata</i>	Goatsbeard brotula	Shamuddro magur
Perciformes	Gobiidae	<i>Awaous guamensis</i>	Goby	Baila
	Caranginae	<i>Decapterus kurroides</i>	Redtail scad	Narkeli mach
	Drepaneidae	<i>Drepane longimana</i>	White sickle fish	Sada Pann machh
	Polynemidae	<i>Eleutheronema tetradactylum</i>	Fourfinger threadfin	Tailla
	Serranidae	<i>Epinephelus morrhua</i>	Grouper	Bol mach
	Leiognathidae	<i>Gazza minuta</i>	Toothed ponyfish	Dati tekchanda
	Cepolidae	<i>Acanthocephala indica</i>	Deep sea snake fish	N/A
	Sciaenidae	<i>Otolithes ruber</i>	Tigertooth croaker	Baghadati poa
	Latidae	<i>Lates calcarifer</i>	Seabass	Coral
	Lutjanidae	<i>Lutjanus erythropterus</i>	Crimson snapper	Crimson ranga koi
	Callionymidae	<i>Callionymus margaretae</i>	Margaret's dragonet	Dragonet mach
	Nemipteridae	<i>Nemipterus japonicus</i>	Japanese threadfin bream	Rupban
	Priacanthidae	<i>Priacanthus macracanthus</i>	Red bigeye	Boro akhi lal mach
Chaetodontidae	<i>Roa jayakari</i>	Indian golden-barred butterfly fish	Tilok projapoti	

	Leiognathidae	<i>Secutor insidiator</i>	Pugnose ponyfish	Kuijja tekchanda
	Sphyraenidae	<i>Sphyraena forsteri</i>	Yellowtail barracuda	Sada dharkuta
	Terapontidae	<i>Terapon jarbua</i>	Crescent perch	Borguni
	Trichiuridae	<i>Trichiurus lepturus</i>	Large headed ribbon fish	Churi machh
	Sillaginidae	<i>Sillago maculata</i>	Trumpeter sillago	Sundra
	Scombridae	<i>Auxis rochei</i>	Bullet tuna	Bullet tuna
	Scatophagidae	<i>Scatophagus argus</i>	Spotted scat	Bisshtara
	Nemipteridae	<i>Nemipterus randalli</i>	Threadfin breams, Redfish	Lal mach
	Haemulidae	<i>Pomadasys kaakan</i>	Javelin grunter	Sada datina
	Priacanthidae	<i>Priacanthus tayenus</i>	Purple-spotted big- eye	Pari mach
Pleuronectiformes	Cynoglossidae	<i>Cynoglossus arel</i>	Tongue sole	Kukur jeeb
	Paralichthyidae	<i>Pseudorhombus elevatus</i>	Deep flounder	Fali serboti
Rajiformes	Glaucostegidae	<i>Glaucostegus granulatus</i>	Granulated guitarfish	Guti pitambori
Scombriformes	Ariommatidae	<i>Ariomma indicam</i>	Indian driftfish	Makhon chanda
	Stromateidae	<i>Pampus argenteus</i>	Chinese pomfret	Rup chada
	Scombridae	<i>Rastrelliger kanagurta</i>	Indian mackarel	Kauwa maitta
Siluriformes	Ariidae	<i>Arius arius</i>	Cat fish	Kata machh

Cynoglossus arel, *Drepane longimana*, *Eleutheronema tetradactylum*, *Gazza minuta*, *Harpadon nehereus*, *Lates calcarifer*, *Lutjanus erythropterus*, *Nemipterus japonicus*, *Nemipterus randalli*, *Priacanthus macracanthus*, *Priacanthus tayenus*, *Rastrelliger kanagurta*, *Secutor insidiator*, *Sphyraena forsteri*, *Tenualosa ilisha*, *Terapon jarbua*, *Trichiurus lepturus*.

A few photographs of identified marine species were taken during data collection with scale (Fig. 4). A study showed that some important finfish are commercially exploited, like Jewfish/croakers (*Johnius* sp., *Otolithus* sp.), pomphrets (*Pampus* sp.), mackerals (*Scomberomorus* sp./*Rastrelliger* sp.), tunas (*Euthynnus affinis*) catfish (Ariidae), carangids (Scad, Trevally), clupeids (anchovy, sardine), sharks, skates and rays and shrimps (Penaeidae) (Hussain, 2010). Another study found 15 highly commercially important species: *Pampus argenteus*, *P. chinensis*, *Pomadasys hasta*, *Lutjanus johni*, *Polynemus indicus*, *Lepturacanthus savala*, *Arius* spp., *Johnius belangerii*, *Otolithoides*

argentiis, *Namipterus japonicus*, *Upeneus sulphurus*, *Saurida tumbil*, *Ilisha filigera*, *Sphyraena barracuda*, *Muraenesox telabonoides* (Hoq *et al.*, 2013).

Table 3. List of identified invertebrate species during the study period.

Order	Family	Scientific Name	Common Name	Bangla/Local Name
Decapoda	Penaeidae	<i>Penaeus monodon</i>	Tiger shrimp	Bagda chingri
		<i>Penaeus indicus</i>	Indian white prawn	Sada chingri
		<i>Penaeus semisulcatus</i>	Green tiger prawn	Baghtara chingri
	Portunidae	<i>Portunas sanguinolentus</i>	Threespot swimming crab	Tin fota kankra
		<i>Charybdis feriata</i>	Crucifix crab	Shil kankra
	Grapsidae	<i>Varuna litterata</i>	Peregrine crab	Gulli kankra
Myopsida	Loliginidae	<i>Loligo duvaucelli</i>	Indian squid	Squid
Octopoda	Octopodidae	<i>Cistopus indicus</i>	Octopus	Octopus
Sepiida	Sepiidae	<i>Sepia aculeata</i>	Cuttle fish	Cuttle fish
Stomatopoda	Squillidae	<i>Oratosquilla nepa</i>	Squilla mantis	Mantis

Length of species:

The above chart shows that around eleven catch species Total Length (TL) in the present study best matched those species Common Length (CL). Still, the TL of some species are deviated from the CL (Fig. 3). The deviation indicated the catching of immature species. Exploitation patterns are fundamental to management, and using fishing gear that keeps large fish in the catch while allowing juveniles to escape is a significant component of good management (Vasilakopoulos *et al.*, 2011). A literature review reveals that the stock evaluation approach has remained unchanged. Generally, the length frequency approach is used to determine growth parameters (Pauly, 2000). Other techniques for reorganizing gear include avoiding the use of heavy otterboards, shortening headropes across the board, and narrowing trawlnet mouths, which would significantly lessen the damaging impact of trawling (Vivekanandan, 2013).

Threatened species status:

According to the Red List of IUCN Bangladesh, we have found one critically endangered, two near threatened, twenty five least concern, four data deficient, and twenty not evaluated species in the BoB during the study period (Fig. 5). A major part of it is not evaluated, which is comprised of 38.46% and 7.69% species, have lack of data (Fig. 5). From the IUCN red list of marine fishes of Bangladesh, 50 species are globally threatened, of which 10 species are critically endangered (CR), 14 species are endangered (EN), and 26 species are vulnerable (VU), where , 30 fish species were categorized as near threatened (NT), 405 species were of least concern (LC), 54 species were data deficient (DD), and the rest 201 species were not evaluated (NE) globally.

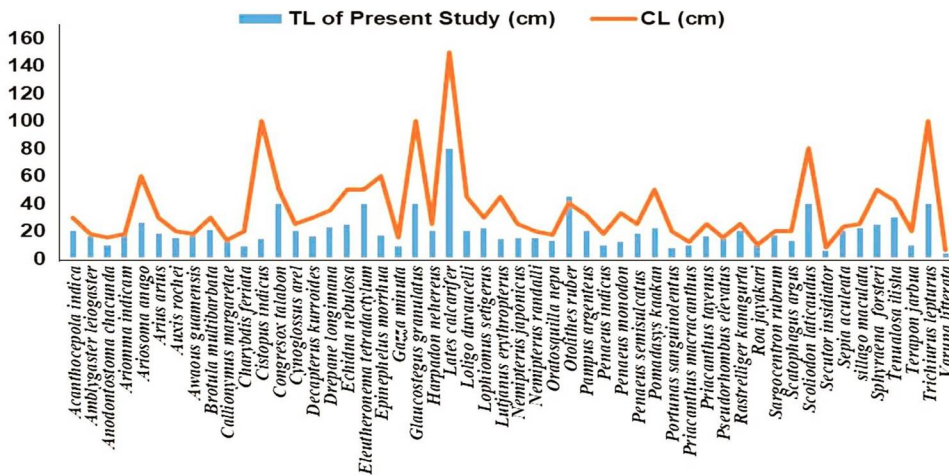


Fig. 3. Comparison of TL of the present study with CL.

Non-targeted species:

Besides economically important targeted species, thirty non-targeted species were also found, which included *Congresox talabon*, *Echidna nebulosa*, *Sargocentron rubrum*, *Scoliodon laticaudus*, *Varuna litterata*, *Penaeus indicus*, *Penaeus monodon*, *Penaeus semisulcatus*, *Charybdis feriata*, *Portunas sanguinolentus*, *Lophiomus setigerus*, *Loligo duvaucelli*, *Cistopus indicus*, *Brotula multibarbata*, *Callionymus margaretae*, *Decapterus kurroides*, *Acanthocephala indica*, *Roa jayakari*, *Awaous guamensis*, *Scatophagus argus*, *Otolithes ruber*, *Epinephelus morrhua*, *Sillago maculate*, *Pomadasy kaakan*, *Pseudorhombus elevates*, *Glaucostegus granulatus*, *Ariomma indicam*, *Pampus argenteus*, *Sepia aculeata*, *Oratosquilla nepa*.

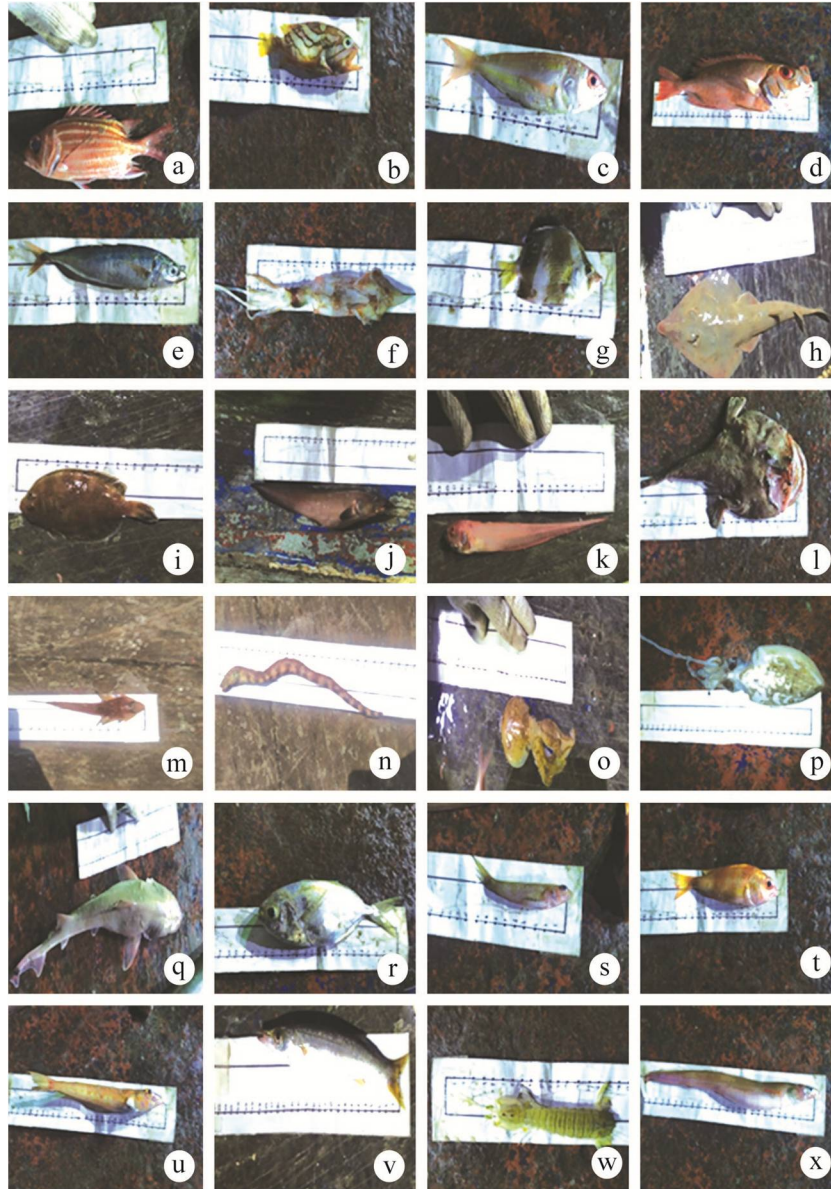


Fig. 4. Photographs of some trawled species identified from the Bay of Bengal by the authors: a. *Sargocentron rubrum*; b. *Epinephelus morrhua*; c. *Nemipterus japonicus*; d. *Priacanthus tayenus*; e. *Decapterus kurroides*; f. *Loligo duvaucelli*; g. *Roa jayakari*; h. *Glaucostegus granulatus*; i. *Pseudorhombus elevates*; j. *Brotula multibarbata*; k. *Acanthoche indica*; l. *Lophiomus setigerus*; m. *Callionymus margaretae*; n. *Echidna nebulosa*; o. *Cistopus indicus*; p. *Sepia aculeata*; q. *Scoliodon laticaudus*; r. *Ariomma indicam*; s. *Awaous guamensis*; t. *Lutjanus erythropterus*; u. *Sillago maculata*; v. *Sphyræna forsteri*; w. *Oratosquilla nepa*; x. *Ariosoma anago*.

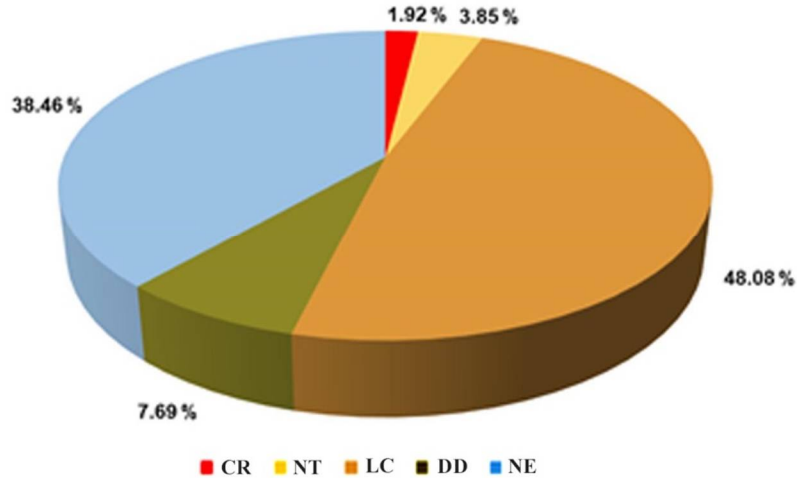


Fig. 5. Threatened species status of the present study.

Conclusions

Traditional and modern harvesting practices put a lot of strain and harm on marine life and fishery resources as they move toward profitability. Before putting more effort into the existing trawlers, new surveys and stock information are needed to adopt the correct management approach with reference to sustaining sustainability. Since its inception in 1972, trawl fishing in Bangladesh has focused chiefly on capturing demersal fish and shrimp. However, in recent years, the government has approved the purchase of new, cutting-edge mid-water trawlers and long liners to promote pelagic fishing.

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