

FIRST REPORT OF FOUR DEEP-SEA CHONDRICHTHYANS (ELASMOBRANCHII AND HOLOCEPHALI) FROM ANDAMAN WATERS, INDIA WITH AN UPDATED CHECKLIST FROM THE REGION

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Kumar R.R., Venu S., Akhilesh K.V., Bineesh K.K., Rajan P.T. 2018. First report of four deep-sea chondrichthyans (Elasmobranchii and Holocephali) from Andaman waters, India with an updated checklist from the region. *Acta Ichthyol. Piscat.* 48 (3): 289–301.

Abstract. This paper confirms the new distributional records of four rare deep-water chondrichthyans viz. sharpnose sevengill shark, *Hepranchias perlo* (Bonnaterre, 1788); bluntnose sixgill shark, *Hexanchus griseus* (Bonnaterre, 1788); bramble shark, *Echinorhinus brucus* (Bonnaterre, 1788); and sicklefin chimaera, *Neoharriotta pinnata* (Schnakenbeck, 1931) from the Andaman waters in the Indian EEZ. The above-mentioned four fish species have not been reported earlier from this region. More exploratory surveys in the region are essential to understand the diversity and distribution pattern which is essential for critical management actions. An updated checklist of chondrichthyans known from Andaman and Nicobar waters of India is also presented.

Keywords: deep-sea Chondrichthyes, new record, morphometry, Andaman waters, India

INTRODUCTION

Chondrichthyan diversity in the Indian waters has been vaguely studied (Akhilesh et al. 2014). In comparison to oceanic, deep, or coastal waters off mainland India, chondrichthyan diversity in waters around its major island/archipelago systems i.e., Laccadive Islands in the Arabian Sea and the Andaman and Nicobar Islands in the Bay of Bengal are least known.

The Andaman and Nicobar Islands of India, just fall outside the well-known diversity hotspot, referred to as the Coral Triangle region (Randall 1998, Hoeksema 2007, Kimura et al. 2009), also supports a rich fish diversity. Though there were only few major studies in the region in the end of the 19th century (Alcock 1889), the Andaman and Nicobar Islands of India and their surrounding waters, constituting extremely diverse and rich marine habitat, still remain largely unexplored.

Except for checklists and few new reports from waters around the Andaman and Nicobar Islands of India (Soundararajan and Roy 2004, Rajan et al. 2012, 2013, 2016, Devi and Kumaralingam 2014) chondrichthyan diversity of this region is poorly known. However, considering large information gap in the region more concentrated studies are being conducted in the recent past and several ongoing studies are providing better understanding of faunal

diversity, fishery trends and improved catch and species composition (Kumar et al. 2015, 2016, Pradeep et al. 2016, 2017, 2018, Vinu et al. 2017, Shirke et al. 2017, Tyabji et al. 2018). There is an urgent need to explore this biodiversity hotspot for its better understanding and for conservation actions. Perpetual efforts for documentation of the diversity and updating the checklists with correctly identified species are important for conservation and management of the vulnerable fauna.

MATERIALS AND METHODS

Specimens for the present study were either collected during the deep-sea fishery exploratory survey by FORV *Sagar Sampada* equipped with HSDT (High Speed Demersal Trawl Net) during 2015–2016 in the Indian EEZ around Andaman waters or from commercial fishing vessels operating in Andaman waters and landed at Junglighat fish landing Centre, Port Blair. Species identification was based on Ebert (2013, 2014) and morphometric measurements following Compagno (2001). Collection locations for all materials are presented in Fig. 1. Details of materials examined are provided above description of each species. Collected specimens are deposited in the collection museum of Department of Ocean Studies and Marine Biology, Pondicherry University at Port Blair, India.

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RESULTS

Among the fish species surveyed we recorded four that have not been previously reported from the waters of the Andaman and Nicobar Islands. These were the sharpnose sevengill shark, *Heptranchias perlo* (Bonnaterre, 1788); the bluntnose sixgill shark, *Hexanchus griseus* (Bonnaterre, 1788); the bramble shark, *Echinorhinus brucus* (Bonnaterre, 1788); and the sicklefin chimaera, *Neoharriotta pinnata* (Schnakenbeck, 1931).

Order HEXANCHIFORMES
 Family HEXANCHIDAE
Heptranchias Rafinesque, 1810
Heptranchias perlo (Bonnaterre, 1788)
 Figs. 2–4

Material examined. Sharpnose sevengill shark, *Heptranchias perlo*: PUMB 3524, 246 mm TL, male; trawl, FORV *Sagar Sampada* cruise No. 349 leg-II, 11°09'90"N, 092°19'83"E to 11°03'56"N 092°22'53"E at a depth of 411 m; PUMB 3526, 354 mm TL, Female; trawl, FORV *Sagar Sampada* cruise No. 349 leg-II, 11°09'90"N, 092°19'83"E to 11°03'56"N, 092°22'53"E at a depth of 411 m; PUMB 3527, 281 mm TL, Female; commercial trawl, 10°52'27.40"N, 092°10'10.61"E at a depth of 300 m; PUMB 3525, 552 mm TL, Female; FORV *Sagar*

Sampada cruise No. 334 leg-I, bottom trawl, 535 m from 13°03'38"N, 093°10'28"E to 13°06'64"N, 093°11'22"E.

Diagnosis. Very distinct, medium sized deep-water shark with slender body and pointed snout. Head narrow with seven pairs of lateral gill slits. Single small, narrow, spineless dorsal fin separated from upper caudal origin by space much greater than its base length. Teeth wide and lower teeth comb shaped. Very large eyes, pelvic and anal fin small. Long dorsal lobe of caudal fin, ventral lobe with strong subterminal notch (Ebert 2013).

Description. Very distinctive and deep-water shark species with single dorsal fin, body slender, streamlined, sharp pointed conical snout and seven pairs of large gill slits representing unique characteristic. Head length 22.10%–22.76% TL. Single small dorsal fin with origin over inner margin of pelvic fins, dorsal total length 6.59%–8.88% TL, dorsal anterior margin length 6.16%–8.54% TL, dorsal base length 4.94%–6.50% TL, dorsal vertical height 3.99%–4.71% TL. Slightly curved small pectoral fins. Pectoral fin length 9.69%–11.10% TL. Pelvic and anal fin comparatively small. Pelvic height 2.54%–3.33% TL, anal fin vertical height 1.91%–2.54% TL. Prenarial length 2.71%–3.89% TL, eye very large, eye height 1.79%–2.69% TL, eye spiracle space 4.57%–5.25% TL. Gills broadly separated, inter gill length 5.52%–6.70% TL, first gill slit height 6.64%–8.23% TL. Abdomen long, pectoral pelvic space 14.23%–16.01% TL, pelvic anal space 5.65%–6.91% TL, anal caudal space 6.41%–9.32% TL. Dorsal lobe of caudal fin long, upper post ventral caudal margin length 18.08%–20.11% TL, dorsal caudal space 10.17%–12.68% TL. Teeth narrow with hook like cusp and small lateral cusp in upper jaw, teeth in lower jaw large comb-like, with large anterior cusp followed by few smaller (Fig. 4).

Coloration. Dorsal side of body varying from grey to brown; ventral side of body pale to white; black spot on dorsal fin and upper caudal lobe (prominent in young ones).

Remarks. *Heptranchias perlo* was previously reported from Kollam coast of Arabian Sea, India for the first time by Compagno and Talwar (1985). Since then it has been recorded in commercial fishery mostly in southern coasts of India (off Cochin, Kollam, Tuticorin), where deep-sea fishing operation were conducted and landed mostly as bycatch in deep-sea shrimp bottom trawlers or in longline fishery (AKV personal observation). *Heptranchias perlo* was reported from the depths of 27–720 m (Compagno 1984) and the presently reported collection depths of 300–535 m are consistent with the earlier reported depth range. This species is not commercially important in Indian fishery, and therefore, in most cases, it is discarded or used for fishmeal preparation. *Heptranchias perlo* is considered a rare species and it is considered **Near Threatened** by the IUCN red list of threatened species (Paul and Fowler 2003).

Distribution. Widely distributed in tropical and temperate oceans.

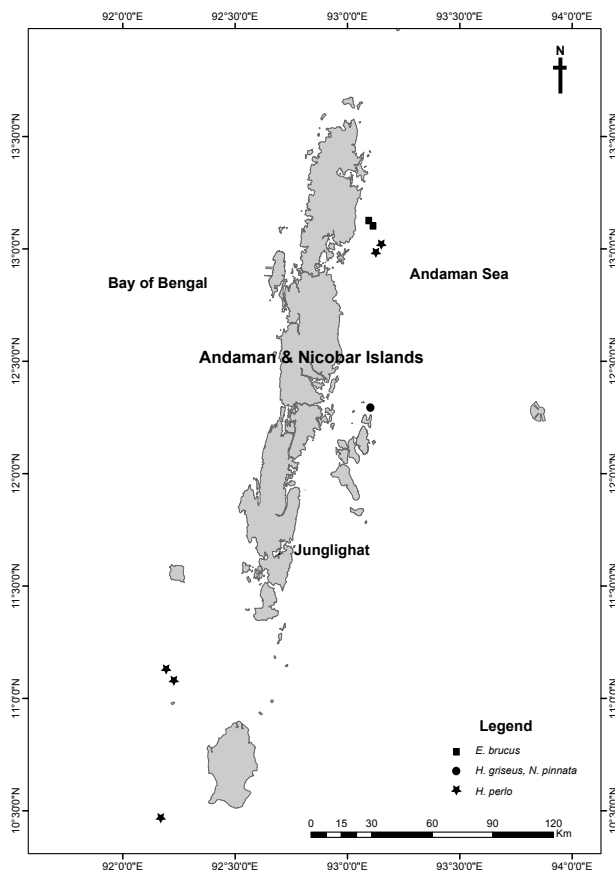


Fig. 1. Map showing collection sites of chondrichthyans (*Heptranchias perlo*, *Hexanchus griseus*, *Echinorhinus brucus*, *Neoharriotta pinnata*) from Andaman waters, India

Family HEXANCHIDAE
Hexanchus Rafinesque, 1810
Hexanchus griseus (Bonnaterre, 1788)
 Fig. 5

Material examined. Bluntnose sixgill shark, *Hexanchus griseus*: PUMB 3528, 770 mm TL, female, trawl, FORV *Sagar Sampada* between 12°30'104"N, 093°10'134"E and 12°30'530"N, 093°10'120"E at a depth of 300 m.

Diagnosis. Heavily bodied shark with broad head with six pairs of long gill slits and mouth placed ventrally having

6 rows of lower bladelike comb-shaped teeth on each side (Fig. 5). Short and blunt snout. Single dorsal fin placed posterior of body separated from upper caudal fin origin by distance equal or slightly greater than its length (Ebert 2013).

Description. Heavily bodied shark with broad head and mouth placed ventrally having 6 rows of lower bladelike comb-shaped teeth on each sides (Fig. 5). Six pairs of lateral long gill slits. Short and blunt snout. Single dorsal fin placed posterior of body separated from upper caudal fin origin by distance equal or slightly greater than its



Fig. 2. Lateral view of *Heptranchias perlo* (PUMB 3527, 281mm TL female) from Andaman waters



Fig. 3. Ventral view of the head region showing seven pairs of gill openings of *Heptranchias perlo*



Fig. 4. Comb-shaped dentition of *Heptranchias perlo*



Fig. 5. Lateral view of *Hexanchus griseus* (PUMB 3528, 770 mm TL, female) from Andaman waters

length. Precaudal length 62.34% TL, predorsal length 48.70% TL, head length 20.78% TL, prebranchial length 16.88% TL, prespiracular length 11.82% TL, preorbital length 5.71% TL, prepectoral length 22.73% TL, prepelvic length 42.86% TL, snout anterior vent length 46.10% TL, preanal fin length 50.65% TL, dorsal caudal space 7.79% TL, pectoral pelvic space 16.62% TL, pelvic anal space 4.42% TL, anal caudal space 4.68% TL, pelvic caudal space 14.94% TL, anterior vent caudal tip length 31.17% TL, preanarial length 2.99% TL, preoral length 5.84% TL. Eye length 2.60% TL, eye height 1.95% TL, inter gill length 4.55% TL, first gill slit height 7.79% TL, second gill slit height 6.23% TL, third gill slit height 5.97% TL, fourth gill slit height 5.71% TL, fifth gill slit height 5.45% TL, sixth gill slit height 5.19% TL. Pectoral fin anterior margin length 11.04% TL, pectoral fin base length 7.53% TL, pectoral fin inner margin length 5.19% TL, pectoral fin posterior length 8.05% TL, pectoral fin height 10.39% TL, pectoral fin length 11.69% TL, dorsal caudal margin length 30.52% TL, preventral caudal margin length 8.18% TL, upper post ventral caudal margin length 18.18% TL, lower post ventral caudal margin length 4.94% TL, Caudal fork width 7.79% TL, caudal fork length 7.53% TL, subterminal caudal margin length 5.84% TL, subterminal caudal width 4.16% TL, terminal caudal margin length 4.16% TL, terminal caudal lobe length 7.66% TL. Dorsal fin total length 8.83% TL, dorsal fin anterior margin length 7.14% TL, dorsal fin base length 6.62% TL, dorsal fin vertical height 4.29% TL, dorsal fin inner margin length 2.47% TL, dorsal fin posterior margin length 5.32% TL. Pelvic fin total height 9.74% TL, pelvic fin anterior margin length 1.69% TL, pelvic fin base length 7.53% TL, pelvic fin height 4.81% TL, pelvic fin inner margin length 1.43% TL, pelvic fin posterior margin length 7.27% TL. Anal fin total length 6.88% TL, anal fin anterior margin length 5.19% TL, anal fin base length 5.19% TL, anal fin vertical height 3.77% TL, anal fin inner margin length 1.82% TL, anal fin posterior margin length 5.19% TL, head height at pectoral origin 7.14% TL, trunk height at pectoral base end 8.44% TL, tail height at pelvic base end 5.84% TL, caudal peduncle height at caudal origin 4.03% TL, dorsal mid-point pectoral base end 8.44% TL. Mouth length 7.14% TL, mouth width 11.30% TL, nostril width 1.43% TL, internarial width 4.68% TL, eye spiracle space 4.81% TL, head width at gill slits 12.73% TL, trunk width at pectoral base end 12.86%

TL, abdomen width at dorsal base end 11.04% TL, tail width at pelvic base ends 3.64% TL, caudal peduncle width at caudal origin 2.47% TL.

Colour. Brown above, paler below and fins white edged.

Remarks. *Hexanchus griseus* has circumglobal distribution in marine tropical and temperate waters as well as continental and insular shelves and slopes of the Atlantic, Indian and Pacific oceans (Nelson 2006). The size at birth of this species is 650–740 mm TL and the maximum reported size is at least 482 cm TL (Compagno et al. 2005). The present specimen (770 mm TL) can be considered a neonatal. Its IUCN Red List status is **Near Threatened** (Cook and Compagno 2009). Records of *H. griseus* and its reproductive observations were reported from the Mediterranean Sea (Hemida and Capapé 2002, Capapé et al. 2003, 2004). In India *H. griseus* has been reported for the first time from Kerala coast (Akhilesh et al. 2010) and since then it has been recorded off southern Indian coasts occasionally as bycatch in trawl or longline fishery (AKV personal observation).

Distribution. Reports of this shark from the Indian Ocean includes Madagascar, Mozambique, South Africa, Maldives, and southern India. The reported depth range of this species is from the surface down to 2500 m (Carey and Clark 1995).

Family ECHINORHINIDAE

Echinorhinus Blainville, 1816

Echinorhinus brucus (Bonnaterre, 1788)

Fig. 6

Material examined. Bramble shark, *Echinorhinus brucus* (not retained): Single live female specimen (~4 feet length), of *E. brucus* was captured from 332 m depth between 13°15'32"N, 093°10'41"E and 13°11'75"N, 093°08'55"E.

Diagnosis. *Echinorhinus brucus* is characterized by pair of closely arranged spineless dorsal fins of almost similar size adjacent to caudal fin, first dorsal fin slightly anterior than pelvic fin origin. Anal fin absent. Ventral caudal lobe poorly developed, nose short and curved, snout and head flat, body heavy and cylindrical. Enlarged, tack like denticles conspicuously scattered over entire body and fins. Five gills opening in front of pectoral fin, fifth slit larger than others (Ebert 2013).

Colour. Body light grey to brown. Brownish or blackish on dorsal surface, often lighter ventrally. Red or black

spots or blotches over entire body. Fin edges marginalized with black thin line.

Distribution. *Echinorhinus brucus* have wide range of distribution and found throughout the Atlantic, western Indian, and Pacific oceans and as well as in Mediterranean Sea. Earlier distributional record of *E. brucus* comes from the continental slopes, shelves, and sea mounts of tropical and temperate region. The distributional records of *E. brucus* from Indian water extend from the deep waters of south-west coast (Venu 2013), Veraval, (Thangavelu et al. 2009) through the Laccadive Islands (Ramachandran et al. 2014) to deeper waters off Tuticorin (Patel et al. 2005). *Echinorhinus brucus* is possibly abundant in deep sea and can be found at the depths of 160–770 m in Bay of Bengal region (Sreedhar et al. 2007).

Remarks. Deep-sea shark family Echinorhinidae is represented by a single genus *Echinorhinus* with two species *E. brucus* and *Echinorhinus cookei* Pietschmann, 1928. The presence of few, sparse and relatively large dermal denticles over the body differentiate *E. brucus* from *E. cookei* which is characterized by numerous, closely packed and relatively small denticles with stellate bases (Ebert 2013). *Echinorhinus brucus* has been categorized as **Data Deficient** by IUCN (Paul 2003). It has been regularly caught as bycatch in deep sea shrimp trawl

operation or longlines in southern India and consumed in the form of liver oil and salted meat (Akhilesh et al. 2011).

Order CHIMAERIFORMES

Family RHINOCHEMAERIDAE

Neoharriotta Bigelow et Schroeder, 1950

Neoharriotta pinnata (Schnakenbeck, 1931)

Fig. 7

Materials examined. Sicklefin chimaera, *Neoharriotta pinnata* (not retained): 1440 mm TL, female, 1505 mm TL female, trawl, FORV *Sagar Sampada*, 12°30'104"N, 093°10'134"E to 12°30'530"N, 093°10'120"E at a depth of 300 m.

Diagnosis. Large sized longnose chimaera with narrow elongated, slightly flattened, medium size and tapering tail with elongated body. Long pointed snout, dorsoventrally flattened and blunt edged. Mouth small and positioned ventral side of head. Oral and preopercular lateral line canals separated by large space. First dorsal fin erected with strong spine; second dorsal fin long, low and not falcate, nearly uniform in height. Pectoral fins short and broad. Pelvic fins rounded along distal margin. Dorsal fin spine serrated, caudal fin with no tubercles on upper edge but with short terminal filament. Short anal fin present (Ebert 2014).



Fig. 6. Dorsal lateral view of *Echinorhinus brucus* from Andaman waters



Fig. 7. Dorsal-lateral view of *Neoharriotta pinnata* from Andaman waters

Description. Body length 75.69%–76.08% TL, head length 32.23%–33.33% TL, head width 6.25%–7.31% TL. First dorsal fin base 15.28%–16.74% TL, dorsal fin spine length 13.95%–14.58% TL, preorbital length 21.67%–21.93% TL, second dorsal fin base 25.25%–28.47% TL. Anal fin length 5.17%–6.64% TL, caudal fin length 24.58%–25.69% TL, anal fin base 3.99%–4.86% TL, trunk width 13.89%–14.95% TL. Pectoral fin base 4.51%–4.65% TL, pectoral fin length 14.31%–15.28% TL, eye diameter 1.67%–2.66% TL. Pelvic fin base 2.19%–2.43% TL, pelvic fin length 8.75%–9.97% TL, mouth width 5.56%–6.65% TL, pectoral to snout length 32.64%–34.22% TL.

Colour. Brown or dark brown (chocolate colour) without any distinctive blotches, spots or stripes.

Distribution. Indian Ocean: Arabian Sea and off south-western India.

Remarks. *Neoharriotta pinnata* was reported from deep water of southwest and east coasts of India (Silas 1969, Silas et al. 1969, Silas and Selvaraj 1980, Suresh and Raffi 2012, Venu 2013). It has been regularly caught as bycatch in deep-sea shrimp trawl operation or longlines in southern India and consumed in the form of liver oil and salted meat (Akhilesh et al. 2011). The IUCN Red List of Threatened Species list the status of *Neoharriotta pinnata* as **Data Deficient** (Dagit 2006).

DISCUSSION

The presently reported investigation disclosed new distributional records of sharks *Heptranchias perlo*, *Hexanchus griseus* and *Echinorhinus brucus* from the region and confirmed the occurrence of *Neoharriotta pinnata* from Andaman waters. Rajan et al. (2012) has enlisted 64 species of chondrichthyans, subsequently several new sharks and batoids were recorded from exploratory surveys and monitoring catch landing of commercial fishing vessels operated in the region and landed in A&N, Islands, India (Rajan et al. 2013, 2016, Devi and Kumaralingam 2014; Kumar et al. 2015, 2016, Pradeep et al. 2016, 2017, 2018, Vinu et al. 2017, Shirke et

al. 2017) and one recent noteworthy study from the region added 12 sharks to Andaman fauna and added 2 sharks to Indian elasmobranch fauna (Tyabji et al. 2018). However, these studies does not include currently reported species. The present study increases the chondrichthyans faunal diversity of Andaman waters of Indian EEZ and provides an updated checklist for the region (Table 1) which also includes, recently collected/observed/photographed several species new to the archipelago during the commercial fishery landing surveys for preparing an updated checklist from region (These records will be published elsewhere). In preparation of this checklist, order of classification arrangement and revised family, genus and species name for some of the sharks, batoids and chimaeras followed Compagno et al. (2005), Ebert (2013, 2014), Last et al. (2016), Weigmann (2016), and the Catalog of fishes (Eschmeyer et al 2018). The checklist consists of a total 117 chondrichthyan species covering 10 orders and 36 families from Andaman and Nicobar waters with 3 chimaeras, 68 sharks, 3 skates, 34 rays, 3 sawfishes, and 6 guitar fishes. The checklist provided in this paper (Fig. 8) contains also the conservation status of the recorded species of which 10% are listed as Least Concern (9%), Data Deficient (19%), Critically Endangered (4%), Endangered (8%), Vulnerable (33%), Near Threatened (26%)..

Specimens representing the majority of the earlier recorded species from the region have not been deposited in national collection, which makes difficult a proper identification of newly recorded species. Because of the lack of the reference specimens, identification is performed in many cases based on the photographic reports and reports of other authors which also have doubtfulness of correct identification (Rajan et al. 2012, 2016) Due to taxonomic ambiguities, the validity of some fish records needs confirmation and requires further taxonomic studies. Herewith, we would like to emphasize an urgent need for detailed taxonomic studies of chondrichthyans fauna from deep waters of the Andaman Islands of India. More extensive taxonomic studies are needed for better management, planning, and understanding this diverse ecosystem.

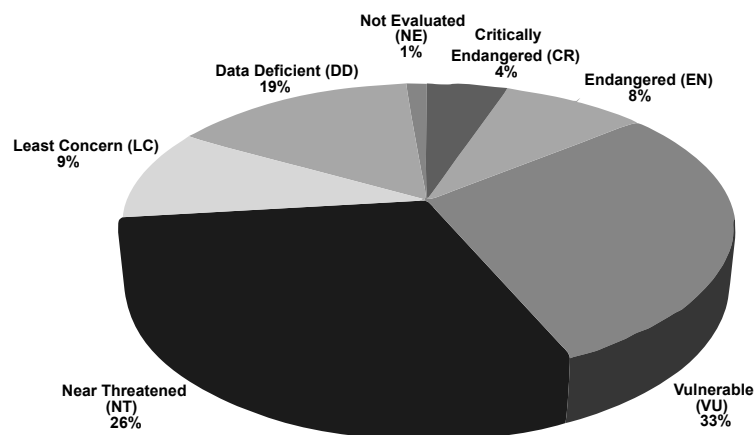


Fig. 8. Conservation status of chondrichthyans from waters around the Andaman and Nicobar Islands, India

Table 1

Updated checklist of chondrichthyans caught around the Andaman and Nicobar Islands

Order/Family	Species	Validity	IUCN	Reference	Registration no./specimen detail
CHIMAERIFORMES					
Rhinochimaeridae	<i>Neoharriotta pinnata</i> (Schnakenbeck, 1931)	DD		Presently reported study	Not retained, Photograph
Chimaeridae	<i>Hydrolagus</i> sp.			Rajan et al. 2012	Listing
	<i>Chimaera</i> sp.			Under investigation by AKV	Retained, Photograph
HEXANCHIFORMES					
Hexanchidae	<i>Hexanchus griseus</i> (Bonnaterre, 1788)	NT		Presently reported study	PUMB 3528
	<i>Heptranchias perlo</i> (Bonnaterre, 1788)	NT		Presently reported study	PUMB 3524 - PUMB 3527
SQUALIFORMES					
Echinorhinidae	<i>Echinorhinus brucus</i> (Bonnaterre, 1788)	DD		Presently reported study	Not retained, Photograph
Squalidae	<i>Squalus hemipinnis</i> White, Last et Yearsley, 2007	NT		Tyabji et al. 2018	Photograph
	<i>Squalus megalops</i> (MacLeay, 1881)	DD		Soundarajan and Roy 2004	Published report
Centrophoridae	<i>Centrophorus granulosus</i> (Bloch et Schneider, 1801)	DD		Soundarajan and Roy 2004	Published report
	<i>Centrophorus atromarginatus</i> Garman, 1913	DD		Tyabji et al. 2018	Photograph
	<i>Centrophorus moluccensis</i> Bleeker, 1860	DD		Pradeep et al. 2017	MUS.FSI.PB/EB/07/2016
	<i>Centrophorus zeehaani</i> White, Ebert et Compagno, 2008			Kumar et al. (in prep.)	Retained, Photograph
Somniosidae	<i>Scymnodon ichiharai</i> Yano et Tanaka, 1984	DD		Kumar et al. (in prep.)	Retained, Photograph
	<i>Zameus squamulosus</i> (Günther, 1877)	DD		Kumar et al. (in prep.)	Retained, Photograph
ORECTOLOBIFORMES					
Hemiscylliidae	<i>Chiloscyllium griseum</i> Müller et Henle, 1838	NT		Rao 2003	Photograph
	<i>Chiloscyllium hasseltii</i> Bleeker, 1852	NT		Tyabji et al. 2018	Photograph
	<i>Chiloscyllium indicum</i> (Gmelin, 1789)	NT		Rao 2003	Photograph
	<i>Chiloscyllium punctatum</i> Müller et Henle, 1838	NT		Rajan et al. 1993	Photograph, Reg. 2489
Ginglymostomatidae	<i>Nebrius ferrugineus</i> (Lesson, 1831)	VU		Tyabji et al. 2018	Photograph
Stegostomatidae	<i>Stegostoma fasciatum</i> (Hermann, 1783)	EN		Rao et al. 2000	Photograph, Reg. 1666
Rhincodontidae	<i>Rhincodon typus</i> Smith, 1828	EN		Rajan et al. 2016	Photograph
LAMNIFORMES					
Odontaspidae	<i>Carcharias taurus</i> Rafinesque, 1810	VU		Tyabji et al. 2018	Photograph
Pseudocarchariidae	<i>Pseudocarcharias kamoharui</i> (Matsubara, 1936)	NT		Pradeep et al. 2016	MUS.FSI.PB/EB/06/2015
Alopiidae	<i>Alopias pelagicus</i> Nakamura, 1935	VU		Rajan et al. 2012	Listing
	<i>Alopias superciliosus</i> Lowe, 1841	VU		Rajan et al. 2012	Listing
	<i>Alopias vulpinus</i> (Bonnaterre, 1788)	VU		Rajan 2003	Listing
Lamnidae	<i>Isurus oxyrinchus</i> Rafinesque, 1810	VU		Rajan 2003	Listing
CARCHARHINIFORMES					
Scyliorhinidae	<i>Apristurus investigatoris</i> (Misra, 1962)	DD		Misra 1962	ZSIF:1 627/2

Table continues on next page.

Table 1 cont.

Order/Family	Species	Validity	IUCN	Reference	Registration no./specimen detail
Proseylliidae	<i>Apristurus microps</i> (Gilchrist, 1922)	Q	LC	Hashim 2012	Listing
	<i>Apristurus</i> sp.			Under investigation	Retained, Photograph
	<i>Bythaelurus hispidus</i> (Alcock, 1891)		DD	Wood-Mason and Alcock 1891	Listing
	<i>Cephaloscyllium silasi</i> (Talwar, 1974)		DD	Kumar et al. 2016	PUMB 3522, PUMB 3523, NBFGR CH 1150
Triakidae	<i>Eridacnis radcliffei</i> Smith, 1913		LC	Misra 1950, Hashim 2012	Listing
	<i>Proscyllium magnificum</i> Last et Vongpanich, 2004		NE	Kumar et al. 2015	CMFRI GA 1.4.2.2, 328; PUMB 3521
	<i>Hemitriakis indroyonoi</i> White, Compagno et Dharmadi, 2009		NE	Tyabji et al. 2018	Photograph
	<i>Iago</i> sp.			Under investigation	Retained, Photograph
Hemigaleidae	<i>Mustelus mosis</i> Hemprich et Ehrenberg, 1899		DD	Tyabji et al. 2018	Photograph
	<i>Chaenogaleus macrostoma</i> (Bleeker, 1852)		VU	Rao 2009	Listing
	<i>Hemigaleus microstoma</i> Bleeker, 1852		VU	Rajan et al. 2016	Photograph
	<i>Hemipristis elongata</i> (Klunzinger, 1871)		VU	Tyabji et al. 2018	Photograph
	<i>Paragaleus randalli</i> Compagno, Krupp et Carpenter, 1996		NT	Tyabji et al. 2018	Photograph
	<i>Carcharhinus albimarginatus</i> (Rüppell 1837)		VU	Rajan 2003	Photograph
	<i>Carcharhinus altimus</i> (Springer, 1950)		DD	Tyabji et al. 2018	Photograph
	<i>Carcharhinus amblyrhynchos</i> (Bleeker, 1856)		NT	Talwar 1990	Photograph
	<i>Carcharhinus amboinensis</i> (Müller et Henle, 1839)		DD	Tyabji et al. 2018	Photograph
	<i>Carcharhinus brevipinna</i> (Valenciennes, 1839)		NT	Rao 2009	Listing
Carcharhinidae	<i>Carcharhinus dussumieri</i> (Valenciennes, 1839)		NT	Herre 1941, Rao 2003	Photograph
	<i>Carcharhinus falciformis</i> (Müller et Henle, 1839)		VU	Varghese et al. 2015	Photograph
	<i>Carcharhinus hemiodon</i> (Müller et Henle, 1839)		CR	Rajaram and Nedumaran 2009	Listing
	<i>Carcharhinus leucas</i> (Valenciennes, 1839)		NT	Tyabji et al. 2018	Photograph
	<i>Carcharhinus limbatus</i> (Valenciennes, 1839)		NT	Rao 2003	Photograph
	<i>Carcharhinus longimanus</i> (Poey, 1861)		VU	Rao 2003	Photograph
	<i>Carcharhinus macloiti</i> (Müller et Henle, 1839)		NT	Talwar 1990	Listing
	<i>Carcharhinus melanopterus</i> (Quoy et Gaimard, 1824)		NT	Day 1870, Rao 2003	Photograph, Reg. 2732
	<i>Carcharhinus sealei</i> (Pietschmann, 1913)		NT	Talwar 1990	Photograph
	<i>Carcharhinus sorrah</i> (Valenciennes, 1839)		NT	Talwar 1990	Photograph
	<i>Carcharhinus plumbeus</i> (Nardo, 1827)		VU	Rajan et al. 2016	Photograph
	<i>Galeocerdo cuvier</i> (Péron et Lesueur, 1822)		NT	Rao 2003	Photograph
	<i>Glyphis gangeticus</i> (Müller et Henle, 1839)		CR	Rajan et al. 2012	Listing
	<i>Loxodon macrorhinus</i> Müller et Henle, 1839		LC	Talwar 1990, Rao 2003	Photograph
<i>Negaprion acutidens</i> (Rüppell, 1837)		VU	Rao 2009	Listing	

Table continues on next page.

Table 1 cont.

Order/Family	Species	Validity	IUCN	Reference	Registration no./specimen detail
	<i>Prionace glauca</i> (Linnaeus, 1758)	NT		Talwar 1990	Listing
	<i>Rhizoprionodon acutus</i> (Rüppell, 1837)	LC		Day 1870, Rao 2003	Photograph, Reg. 1738
	<i>Rhizoprionodon oligotrix</i> Springer, 1964	LC		Talwar 1990, Rao 2003	Photograph
	<i>Scoliodon laticaudus</i> Müller et Henle, 1838	NT		Rao 2003	Photograph
	<i>Triaenodon obesus</i> (Rüppell, 1837)	NT		Rao et al. 1997	Photograph, Reg. 2253
Sphyrnidae	<i>Eusphyrna blochii</i> (Cuvier, 1816)	EN		Rao 2003	Listing
	<i>Sphyrna lewini</i> (Griffith et Smith, 1834)	EN		Rajan 2003	Photograph
	<i>Sphyrna mokarran</i> (Rüppell, 1837)	EN		Rao 2003	Photograph
	<i>Sphyrna tudes</i> (Valenciennes, 1822)	N/C		Rao 2009	Listing
	<i>Sphyrna zygaena</i> (Linnaeus, 1758)	VU		Devi and Rao 2003	Photograph
RHINOPRISTIFORMES					
Pristidae	<i>Anoxypristis cuspidata</i> (Latham, 1794)	EN		Rajan et al. 2013	Listing
	<i>Pristis pristis</i> (Linnaeus, 1758)	CR		Rajan et al. 2013	Listing
	<i>Pristis zijsron</i> Bleeker, 1851	CR		Rajan et al. 2013	Listing
Rhinidae	<i>Rhina ancylostomus</i> Bloch et Schneider, 1801	VU		Rao 2003	Photograph
	<i>Rhynchobatus australis</i> Whitley, 1939	VU		Bineesh et al. (in prep.)	Photograph
	<i>Rhynchobatus djiddensis</i> (Forsskal, 1775)	VU		Rao 2003	Photograph
Glaucostegeidae	<i>Glaucostege granulatus</i> (Cuvier, 1829)	N/C		Rao 2003	Photograph, Reg. 1629
	<i>Glaucostege thouin</i> (Anonymous [Lacépède], 1798)	VU		Rajan et al. 2012	Listing
	<i>Glaucostege typus</i> (Anonymous [Bennett], 1830)	VU		Bineesh et al. (in prep.)	Photograph
TORPEDINIFORMES					
Narcinidae	<i>Benthobatis moresbyi</i> Alcock, 1898	DD		Hashim 2012	Listing
	<i>Narcine</i> sp.			Under investigation	Retained, Photograph
	<i>Narke</i> sp.			Rajan et al. 2012	Photograph, Reg. 2844
RAJIFORMES					
Gurgesiellidae	<i>Cruriraja andamanica</i> (Lloyd, 1909)	DD		Lloyd 1909	ZSI F1129/1
Rajidae	<i>Dipturus</i> sp. A			Bineesh et al. (in prep.)	Retained, Photograph
	<i>Orbiraja cf. powelli</i>			Under investigation	Retained, Photograph
MYLIOBATIFORMES					
Hexatrygonidae	<i>Hexatrygon bickelli</i> Heemstra et Smith, 1980	LC		Bineesh et al. (in prep.)	Photograph
Gymnuridae	<i>Gymnura poecilura</i> (Shaw, 1804)	NT		Rao 2003	Photograph
	<i>Gymnura zonura</i> (Bleeker, 1852)	VU		Kumar et al. (in prep.)	Retained, Photograph
	<i>Bathytoshia lata</i> (Garman, 1880)	LC		Rao 2003	Photograph, Reg. 2921
Dasyatidae	<i>Brevitrygon imbricata</i> (Bloch et Schneider, 1801)	DD		Rajan et al. 2012	Listing
	<i>Himantura uarnak</i> (Gmelin, 1789)	VU		Rao 2003	Photograph

Table continues on next page.

Table 1 cont.

Order/Family	Species	Validity	IUCN	Reference	Registration no./specimen detail
	<i>Himantura undulata</i> (Bleeker, 1852)	VU		Bineesh et al. (in prep.)	Photograph
	<i>Maculabatis gerrardi</i> (Gray, 1851)	VU		Rao 2003	Photograph, Reg. 2846
	<i>Neotrygon indica</i> Pavan-Kumar, Kumar et Borsa, 2017				
	<i>Neotrygon kuhlii</i> (Müller et Henle, 1841)	DD		Bineesh et al. (in prep.)	Photograph, Reg. 2847
	<i>Pastinachus ater</i> (Macleay, 1883)	LC		Rao 2003	Photograph
	<i>Pastinachus sephen</i> (Forsskål, 1775)	DD		Bineesh et al. (in prep.)	Photograph, Reg. 2499
	<i>Pateobatis jenkinsii</i> (Anandale, 1909)	VU		Rao 2003	Photograph
	<i>Peroplatytrigon violacea</i> (Bonaparte, 1832)	LC		Bineesh et al. (in prep.)	Photograph
	<i>Taeniura lymna</i> (Forsskål, 1775)	NT		Rao 2003	Photograph
	<i>Taeniurops meyeri</i> (Müller et Henle, 1841)	VU		Rao 2003	Photograph
	<i>Telatrygon zugei</i> (Müller et Henle, 1841)	NT		Rajan et al. 2012	Listing
	<i>Urogymnus asperrimus</i> (Bloch et Schneider, 1801)	VU		Bineesh et al. (in prep.)	Photograph
	<i>Urogymnus granulatus</i> (Macleay, 1883)	VU		Devi and Kumaringam 2014	Photograph
Plesiobatidae	<i>Plesiobatis daviesi</i> (Wallace, 1967)	LC		Akhilesh et al. 2009	CMFRI, GA.7.6.1.1
Myliobatidae	<i>Aetomylaeus nichofii</i> (Bloch et Schneider, 1801)	VU		Rajan et al. 2012	Listing
	<i>Aetomylaeus vespertilio</i> (Bleeker, 1852)	EN		Bineesh et al. (in prep.)	Photograph
Aetobatidae	<i>Aetobatus narinari</i> (Euphrasen, 1790)	NT		Rao 2003	Photograph, Reg. 1213
	<i>Aetobatus ocellatus</i> (Kuhl, 1823)	VU		Rajan et al. 2013	Listing
Rhinopteridae	<i>Rhinoptera javanica</i> Müller et Henle, 1841	VU		Rajan et al. 2013	Listing
	<i>Rhinoptera jayakari</i> Boulenger, 1895	NE		Pradeep et al. 2018	MUS/FSI/PB/EB/09/2016
Mobulidae	<i>Mobula birostris</i> (Walbaum, 1792)	VU		Rao 2003	Listing
	<i>Mobula kuhlii</i> (Valenciennes, 1841)	DD		Bineesh et al. (in prep.)	Photograph
	<i>Mobula mobular</i> (Bonnaterre, 1788)	EN		Rajan et al. 2012	Listing
	<i>Mobula tarapacana</i> (Philippi, 1892)	VU		Bineesh et al. (in prep.)	Photograph
	<i>Mobula thurstoni</i> (Lloyd, 1908)	NT		Shirke et al. 2017	MUS.FSI.PB/EB/09/2016

IUCN = IUCN global conservation status, N/C = needs confirmation, Q = questionable; LC = least concern, DD = data deficient, CR = critically endangered, VU = vulnerable, NT = near threatened, NE = not evaluated.

ACKNOWLEDGEMENTS

The Centre for Marine Living Resources and Ecology (CMLRE), Kochi, Ministry of Earth Sciences, is acknowledged for granting opportunity to participate in FORV *Sagar Sampada* cruise No. 334 leg-I and cruise No. 349 leg-II. We also thank the chief scientist, other scientific participants, and crew members for their help during onboard collection. The Pondicherry University is thankfully acknowledged for providing facilities to carry out this research. Thanks to Mr. Mohsim H.D, Disaster Management for designing the map. Thanks are also due to Rajiv Gandhi National Fellowship (RGNF-UGC) for Ravi Ranjan Kumar. The fishers and traders of Junglight fish landing Centre, Port Blair is also acknowledged for their support.

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Received: 2 November 2017

Accepted: 27 March 2018

Published electronically: 30 September 2018