

DEEP-SEA FISHES COLLECTED FROM THE ANDAMAN SEA BY R/V CHAKRATONG TONGYAI DURING 1996–2000. PART 9: ORDERS CHIMAERIFORMES, CARCHARHINIFORMES, TORPEDINIFORMES AND RAJIFORMES

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ABSTRACT: As a result of taxonomic studies based on cartilaginous fish specimens captured by BIOSHELF (Biodiversity of the Andaman Sea Shelf) project, those specimens were identified as *Neoharriotta pinnata* (Schnakenbeck, 1931) in the family Rhinochimaeridae Garman, 1901 (order Chimaeriformes), *Hydrolagus deani* (Smith and Radcliffe in Smith, 1912) in the family Chimaeridae Rafinesque, 1815 (order Chimaeriformes), *Bythaelurus hispidus* (Alcock, 1891) and *Apristurus macrostomus* Chu, Meng and Li in Meng, Chu and Li, 1985 in the family Pentanchidae Smith, 1912 (order Carcharhiniformes), *Benthobatis moresbyi* Alcock, 1898 in the family Narcinidae Gill, 1862 (order Torpediniformes), and *Sinobatis andamanensis* Last and Bussarawit, 2016 in the family Rajidae de Blainville, 1816 (order Rajiformes). *Hydrolagus deani*, which is sometimes synonymized under *Hydrolagus mitsukurii* (Jordan and Snyder, 1904), is separable by shape of second dorsal fin (deeply indented in the center in the former species vs. lacking intended in the latter), base of first dorsal fin (broad vs. narrow), and dorsal-spine length (usually slightly shorter than first dorsal-fin length vs. longer).

Key words: *Neoharriotta pinnata*, *Hydrolagus deani*, *Bythaelurus hispidus*, *Apristurus macrostomus*, *Benthobatis moresbyi*, *Sinobatis andamanensis*, BIOSHELF

INTRODUCTION

Following previous taxonomic studies regarding as deep-sea fishes captured by project of Biodiversity of the Andaman Sea Shelf [BIOSHELF, see Aungtonya *et al.* (2000)] (Kawai *et al.* 2017; 2020a; 2020b; 2020c; Kimura *et al.* 2019a; 2019b; Kishimoto *et al.* 2019; Senda *et al.* 2020; Obata *et al.* 2023), cartilaginous fishes are reported in this study. During our taxonomic examination, specimens of cartilaginous fishes were identified as two chimaeriform, two carcharhiniform, single torpediniform and single rajiform species. We report these six species in this study.

MATERIALS AND METHODS

All specimens, which were captured by BIOSHELF (Aungtonya *et al.* 2000; Fig. 1), have been kept in 70% ethyl alcohol after fixation by 10%

formalin, and have been deposited at the Reference Collection of Phuket Marine Biological Center, Phuket, Thailand (PMBC). Comparative specimen has been deposited at the Hokkaido University Museum, Hakodate, Japan (HUMZ). Measurements and terminology follow Didier and Stehmann (1996) for Chimaeriformes, Compagno (1984a) for *Bythaelurus* Compagno, 1988, Nakaya *et al.* (2008) for *Apristurus* Garman, 1913, Carvalho (1999a) for *Benthobatis* Alcock, 1898, and Hubbs and Ishiyama (1968) and Last and McEachran (2006) for *Sinobatis* Hulley, 1973. Metal rulers and digital calipers were used for measurements to the nearest 1 mm and 0.1 mm, respectively. Asterisks after catalog numbers mean specimens whose vertebrae and radials were counted by radiographs. Spiral valves were not examined in this study. Order and familial classification follow Nelson *et al.* (2016) and Fricke *et al.* (2024), respectively.

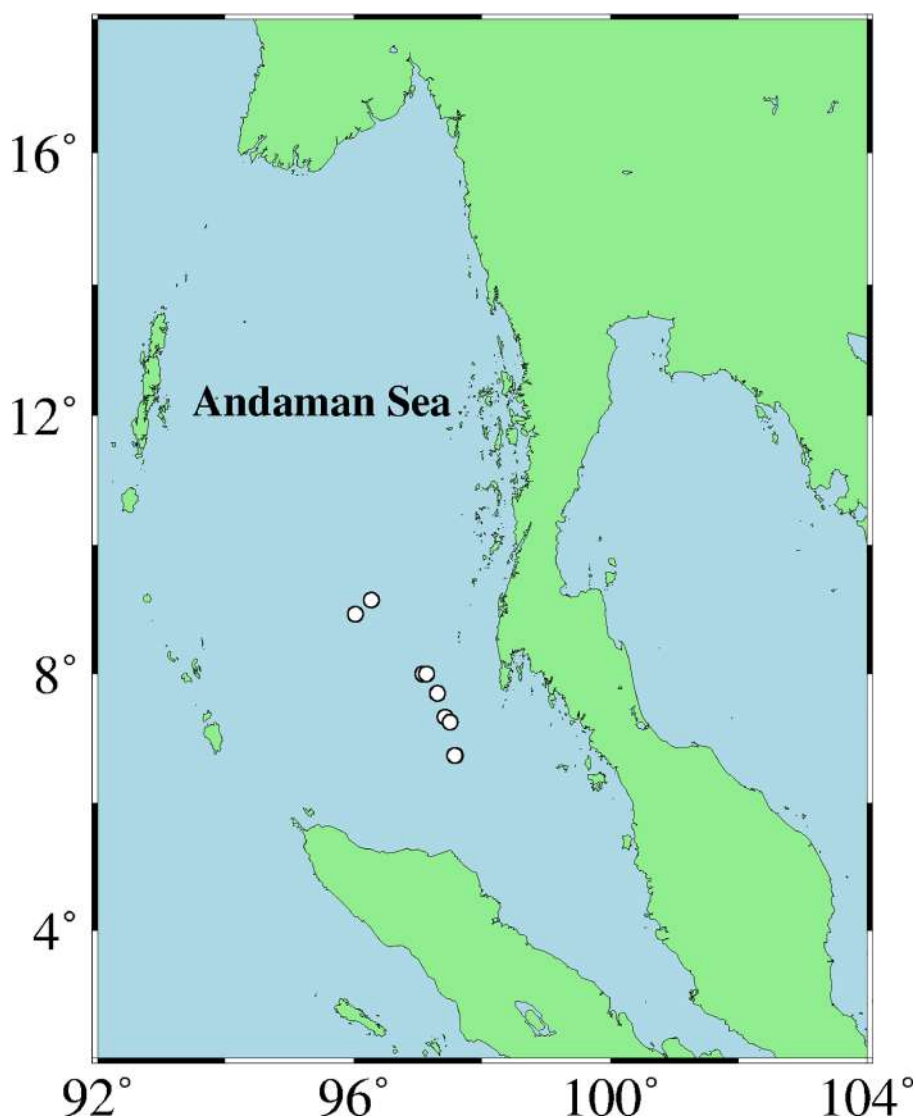


Figure 1. Sampling localities of the present study.

SPECIES LIST

Order Chimaeriformes

Family Rhinochimaeridae Garman, 1901

Neoharriotta pinnata (Schnakenbeck, 1931)

Fig. 2

Taxonomic characters. Snout remarkably long; anal fin distinct and curved; pelvic fin rounded; second dorsal fin uniform in height; caudal fin with short terminal filament; horizontal and preopercular lateral-line canals widely separated (Schnakenbeck

1931; Didier and Stehmann 1996; Nakabo 2002; Didier 2004; Didier *et al.* 2012; Ebert 2014).

Materials. PMBC 37445, 1 specimen, 360+ mm TL, male, St. L8, 6°46'N 97°33'E to 6°44'N 97°35'E, 513–501 m depth, otter trawl, 22 Feb. 2000.

Distribution. Southern Bay of Biscay and western coast of Africa from western Sahara to Namibia in the Atlantic, and South Africa and Arabian Sea to Andaman Sea in the Indian Ocean (Schnakenbeck 1931; Ebert 2014; Didier 2016; Diez and Mugerza



Figure 2. *Neoharriotta pinnata*, PMBC 37445, 360+ mm TL. Scale bar 10 mm.

2017; Kumar *et al.* 2018; Psomadakis *et al.* 2019; Krajangdara *et al.* 2021; Kemper and Ebert 2022).

Family Chimaeridae Rafinesque, 1815

Hydrolagus deani

(Smith and Radcliffe in Smith, 1912)

Figs. 3–5

Taxonomic characters. Dorsal spine with feeble serrations on distal half; dorsal-spine length almost equal to first dorsal-fin length or slightly shorter than its length; first dorsal-fin base broad; second dorsal fin deeply indented in the center; second dorsal fin highest anteriorly; anal fin absent; caudal filament very long; trunk lateral line nearly straight; snout short; body without spots and stripes (Smith 1912; Compagno 1999; Nakabo 2002; Didier 2004; Didier *et al.* 2012; Ebert 2014; Krajangdara *et al.* 2021; present study).

Material. PMBC 37446, 2 specimens, 430+ mm TL, male, 610 mm TL, female, St. L8, 6°46'N 97°33'E to 6°44'N 97°35'E, 513–501 m depth, otter trawl, 22 Feb. 2000; PMBC 37447, 2 specimens, 533 mm TL, female, 605+ mm TL, male, St. J8, 7°21'N 97°26'E to 7°20'N 97°25'E, 520–531 m depth, otter trawl, 27 Jan. 1999; PMBC 37448, 1 specimen, 575 mm TL, male, St. B8, 9°10'N 96°18'E to 9°09'N 96°16'E, 489–504 m depth, otter trawl, 11 Feb. 1999; PMBC 37449, 1 specimen, 529 mm TL, male, St. Z3, 7°42'N 97°20'E to 7°42'N 97°18'E, 493–322 m depth, otter trawl, 24 Jan. 1999.

Distribution. Philippines and Andaman Sea (Smith 1912; Iwamoto and McCosker 2014; Krajangdara 2019; Krajangdara *et al.* 2021).

Remarks. The length of the dorsal spine in PMBC 37446 (610 mm TL) is almost the same as the first dorsal-fin length (vs. the former slightly shorter than the latter in *Hydrolagus deani*: Smith 1912; Compagno 1999) (Fig. 4). Those differences were regarded as an intraspecific variation of the species in this study because the other taxonomic characters are well corresponded to those of the species (Smith 1912; Compagno 1999). *Hydrolagus deani* was thought to be a junior synonym of *H. mitsukurii* (Jordan and Snyder, 1904) by Compagno *et al.* (2005) on the basis of D. Didier-Dagit's personal communication to R. Cavanagh in 2002. However, they did not show any evidence for this synonymy. The former species is separable from the latter by second dorsal fin deeply indented in the center (vs. lacking indented) (Fig. 5), broad first dorsal-fin base (vs. narrow) (Fig. 4), and dorsal-spine length usually slightly shorter than first dorsal-fin length (vs. longer) (Fig. 4) (Jordan and Snyder 1904; Dean 1904; Smith 1912; Nakaya 1984; Compagno 1999; Iwamoto and McCosker 2014; this study). *Hydrolagus cf. deani* (*sensu* Krajangdara *et al.* 2021) is thought to be *Hydrolagus deani* judging from their description in having taxonomic characters of the species (see Taxonomic characters of *Hydrolagus deani*). *Hydrolagus mitsukurii* (*sensu* Shen and Wu, 2011) collected from Taiwan looks like *H.*



Figure 3. *Hydrolagus deani*, PMBC 37446, 610 mm TL. Scale bar 10 mm.



Figure 4. First dorsal fin. Left: *Hydrolagus deani*, PMBC 37446, 610 mm TL; right: *Hydrolagus mitsukurii*, HUMZ 231724, 730 mm TL. Scale bars 10 mm.



Figure 5. Second dorsal fin. Upper: *Hydrolagus deani*, PMBC 37446, 610 mm TL; lower: *Hydrolagus mitsukurii*, HUMZ 231724, 730 mm TL. Scale bars 10 mm.

deani in having second dorsal fin deeply indented in the center (fig. in Shen and Wu 2011). In addition, *Hydrolagus deani* is also distinguished from *H. africanus* (Gilchrist, 1922), which is known from western Indian Ocean, in having deeply indented second dorsal fin in the center (vs. weakly indented), broad first dorsal-fin base (vs. narrow), and slightly shorter dorsal spine, dorsal-spine length almost equal to first dorsal-fin length or slightly shorter than its length (vs. dorsal-spine length almost equal to first dorsal-fin length or longer than its length) (Smith 1912; Didier *et al.* 2012; Walovich *et al.* 2015; this study).

Comparative material. *Hydrolagus mitsukurii*, HUMZ 231724, 1 specimen, 730 mm TL, male, Heda, Numazu, Shizuoka, Japan, 11 Jan. 2021

Order Carcharhiniformes
Family Pentanchidae Smith, 1912
***Bythaelurus hispidus* (Alcock, 1891)**

Fig. 6

Taxonomic characters. Eyes in adults less than 14 times in distance from snout to first dorsal-fin origin; head with distinct lateral indentation anterior to outer nostrils; anterior nasal flaps subtriangular; oral papillae present in pharynx; short labial furrow present along both upper and lower jaws; first dorsal-fin origin over last third of pelvic-fin bases; second dorsal fin slightly smaller than first, origin over or slightly in front of anal-fin midbase; second dorsal-fin base about 1.4–2.2 in length of anal-fin base; length of anal-fin base slightly shorter than distance between dorsal-fin bases; total vertebral counts 122–131; monospondylous vertebral counts 35–38; dermal denticles densely set, their surface structured by reticulations only in basal fourth; claspers abruptly narrowing before tip with knob-like apex; 8–10 spiral valve turns; ventral head usually uniformly yellowish or whitish (Compagno 1984b; Ebert 2013; Weigmann *et al.* 2016; 2018; Psomadakis *et al.* 2019).

Material. PMBC 37450, 1 specimen, 302 mm TL, female, St. L8, 6°45'N 97°36'E to 6°44'N 97°34'E, 482–507 m depth, Agassiz trawl, 22 Feb. 2000; PMBC 37451*, 3 specimens, females, 220–285 mm TL, St. G8, 8°00'N 97°06'E to 8°00'N 97°04'E, 508–518 m depth, otter trawl, 20 Nov. 1999; PMBC 37452, 9 specimens, females, 273–320 mm TL, St. J8, 7°21'N 97°26'E to 7°20'N 97°25'E,

520–531 m depth, otter trawl, 27 Jan. 1999; PMBC 37453, 1 specimen, female, 306 mm TL, St. G8, 8°00'N 97°08'E to 8°00'N 97°08'E, 500–504 m depth, triangular dredge, 9 Feb. 2000.

Distribution. Kenya to Oman, southern India and Andaman Sea (Alcock 1891; Pokapunt *et al.* 1983; Compagno 1984b; Satapoomin 2011; Rajan *et al.* 2012; 2013; Akhilesh *et al.* 2013; Ebert 2013; Ebert *et al.* 2013; 2021; Krajangdara 2017; Weigmann *et al.* 2018; Psomadakis *et al.* 2019).

Remarks. Eyes in the present specimens (220–320 mm TL) show relatively smaller than those in the previous studies of the species based on specimens which is less than 290 mm TL [eyes 12.8–16.3 in distance from snout to first dorsal-fin origin vs. less than 14 (Compagno 1984b; Ebert 2013; Psomadakis *et al.* 2019)]. These differences are thought to be differences with growth (Fig. 7).

***Apristurus macrostomus* Chu, Meng and Li**
in Meng, Chu and Li, 1985

Fig. 8

Taxonomic characters. Upper labial furrows longer than the lowers; size of first dorsal fin less than half of second dorsal fin; origin of first dorsal fin well behind pelvic-fin bases; interdorsal space greater than first dorsal-fin base; second dorsal-fin insertion anterior to anal-fin insertion; snout rather long; tip bell-shaped; interspace between pectoral and pelvic fins much shorter than anal-fin base; pectoral-fin tip always extending beyond midpoint of pectoral-fin and pelvic-fin space; no modified dermal denticles on the dorsal margin of the caudal fin; intestinal spiral valves 18–21; monospondylous vertebrae 33–37; precaudal diplospondylous vertebrae 31–40 (Meng *et al.* 1985; Nakaya and Kawauchi 2013; Psomadakis *et al.* 2019).

Material. PMBC 37454*, 2 specimens, 173.6 mm TL, male, 236.8 mm TL, female, St. L8, 6°46'N 97°33'E to 6°44'N 97°35'E, 513–501 m depth, otter trawl, 22 Feb. 2000.

Distribution. Shikoku Island (Japan), East and South China Seas, Sulu Sea, Sumatra and Java Islands, Papua New Guinea and Andaman Sea (Meng *et al.* 1985; Nakaya and Kawauchi 2013; Ebert *et al.* 2013; 2021; White and Ko'ou 2018; Psomadakis *et al.* 2019).



Figure 6. *Bythaelurus hispidus*, PMBC 37450, 302 mm TL. Scale bar 30 mm. Photo by Thiwapakot Panbow.

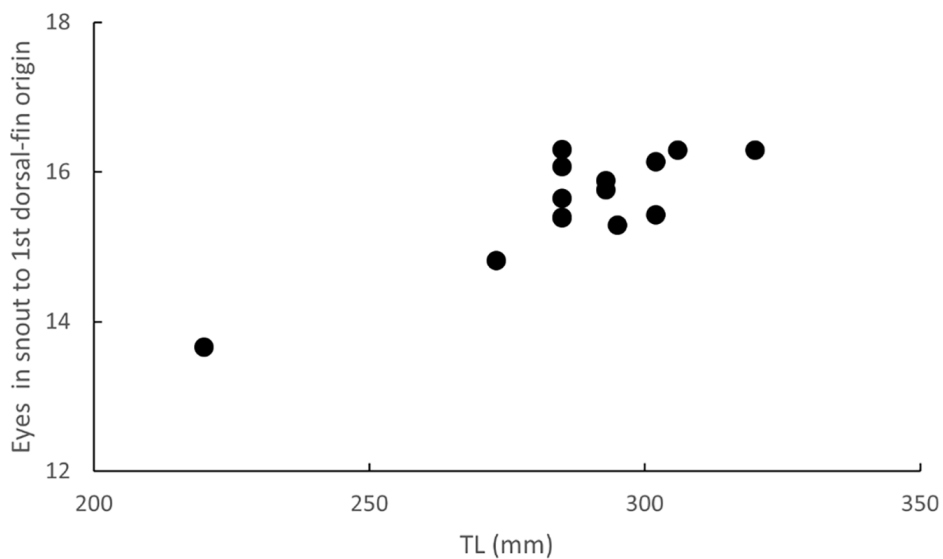


Figure 7. Comparison of eyes in snout to first dorsal-fin origin of *Bythaelurus hispidus* against total length.



Figure 8. *Apristurus macrostomus*, PMBC 37454, 236.8 mm TL. Scale bar 10 mm.

Order Torpediniformes
Family Narcinidae Gill, 1862
Benthobatis moresbyi Alcock, 1898
 Fig. 9

Taxonomic characters. Disc length almost 2.0–2.4 in TL; disc width 2.5–3.0 in TL; preorbital length 4.7–7.4 in TL; eyes extremely reduced; rostral cartilage of snout broad and stiff; nasal curtain wide and short; mouth wide with thick lips and shallow circumoral groove; first dorsal fin similar to second dorsal fin in shape; bases of first and second dorsal fins fleshy, respectively; pelvic fin with fleshy, rounded apices; uniformly dark brown ventrally without any areas of lighter color (Carvalho 1999b; Carvalho *et al.* 2003; Carvalho and Last 2016; McEachran *et al.* 2016; Psomadakis *et al.* 2019; present study).

Materials. PMBC 37455, 1 specimen, 383 mm TL, female, St. Z3, 7°42'N 97°20'E to 7°42'N 97°18'E, 493–322 m depth, otter trawl, 24 Jan. 1999; PMBC 37456, 1 specimen, 276 mm TL, male, St. L8, 6°46'N 97°33'E to 6°44'N 97°35'E, 513–501 m depth, otter trawl, 22 Feb. 2000; PMBC 37457, 4 specimens, 113 mm TL, female, 149 mm TL, female, 159 mm TL, male, 268 mm TL, female, St. G8, 8°00'N 97°06'E to 8°00'N 97°04'E, 508–518 m depth, otter trawl, 20 Nov. 1999; PMBC 37458, 1 specimen, 133 mm TL, female, St. J8, 7°21'N 97°26'E to 7°20'N 97°25'E, 520–531 m depth, otter trawl, 27 Jan. 1999; PMBC 37459, 1 specimen, 241 mm TL, male, St. J8, 7°15'N 97°30'E to 7°15'N 97°32'E, 490–479 m depth, Agassiz trawl, 18 Feb. 2000; PMBC 37460, 1 specimen, 143 mm TL, female, St. C12, 8°59'N 96°03'E to 8°56'N 96°01'E, 930–962 m depth, Agassiz trawl, 4 Feb. 2000; PMBC 37461, 1 specimen, 128 mm TL, female, St. L8, 6°45'N 97°36'E to 6°44'N 97°34'E, 482–507 m depth, Agassiz trawl, 22 Feb. 2000; PMBC 37462, 6 specimens, 135 mm TL, male, 222 mm TL, male, 241 mm TL, male, 269 mm TL, male, 271 mm TL, male, 360 mm TL, female, St. J8, 7°21'N 97°26'E to 7°20'N 97°25'E, 520–531 m depth, otter trawl, 27 Jan. 1999.

Distribution. Somali, Arabian Sea, southwestern India and Andaman Sea (Alcock 1898; Carvalho 1999b; Ebert, 2014; Carvalho and Last 2016; Psomadakis *et al.* 2019).

Remarks. Disc width (2.5–3.0 in TL) and preorbital length (4.7–6.4 in TL) are slightly different from those in previous studies (2.5–2.7 in the former, 5.2–7.4 in the latter: Carvalho 1999b; Carvalho *et al.* 2003; Psomadakis *et al.* 2019), whereas only 3 specimens of the species have been known (Carvalho 1999b; Carvalho *et al.* 2003). Measurements of the interdorsal space and second dorsal-caudal space should be excluded from the diagnoses of the species, because origins of second dorsal and caudal fins are not determined from external morphology even roughly in the species.

Order Rajiformes
Family Rajidae de Blainville, 1816
Sinobatis andamanensis Last and Bussarawit, 2016
 Fig. 10

Taxonomic characters. Mouth width 3.7–4.9 in disc width at anterior orbit; very long snout with slightly bulbous tip and a short filament; postcloacal length 127–157% of disc length; orbit diameter 6.6–10.3 in horizontal snout and 8.2–12.8 in head lengths, respectively; distal portion of tail not expanded laterally; length of anterior pelvic-fin lobe 14.3–16.1% TL; width of base of anterior pelvic-fin lobe 2.7–5.0 in distance between pelvic-fin origins; caudal fin long-based and very low; 23–29 tooth rows in each jaw; teeth of adult males with short subconical cusps; pectoral-fin radials 66–72; abdominal vertebral centra 26, total centra to caudal-fin origin 125–131; dorsal and ventral surfaces both bluish when fresh, skin on dorsal surface darker and opaque, almost transparent ventrally (Last and Bussarawit 2016).

Materials. PMBC 37463*, 1 specimen, 249+ mm TL, female, St. L8, 6°46'N 97°33'E to 6°44'N 97°35'E, 513–501 m depth, otter trawl, 22 Feb. 2000.

Distribution. Andaman Sea (Last and Bussarawit 2016; Séret *et al.* 2016; Krajangdara 2017; Psomadakis *et al.* 2019).

Remarks. PMBC 37463 additionally found in PMBC collection was identified as *S. andamanensis* in this study.



Figure 9. *Benthobatis moresbyi*, PMBC 37456, 276 mm TL. Scale bar 10 mm.



Figure 10. *Sinobatis andamanensis*, PMBC 37463, 249+ mm TL. Scale bar 10 mm.

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