2. SYSTEMATIC CATALOGUE

2.1 Order HETERODONTIFORMES - Bullhead sharks

Order: [Group] Heterodonti Garman, 1885, *Bull. Mus. Comp. Zool. Harvard*, 12(1): 30, emended to Order Heterodontiformes.

Number of Recognized Families: 1.

Synonyms: [Part] 1 Squali, Abtheilung [Division] 2: Müller and Henle, 1838: 27; Müller and Henle, 1839: 27; also [Part] 1 Squali, Abtheilung [Division] 2, Unterabtheilung [Subdivision] 3: Müller and Henle, 1839: 66. Ordo Plagiostomi, Subordo Squalini, Sectio Proktopterides, Tribus Dinotopterini: Bleeker, 1859: xi. Order Squali, Suborder Squali: Gill, 1862b: 396. Order Squali, Suborder Galei: Gill, 1872: 23. Order Plagiostomi diplospondyli, Suborder Plagiostomi Asterospondyli, Group 3 Acrodonten: Hasse, 1879: 50. Order Selachii, Suborder Asterospondyli: Woodward, 1889: 157. Order Prosarthri: Gill, 1893: 129. Order Asterospondyli, Suborder Proarthri: Jordan and Evermann, 1896: 19. Order Euselachii, Suborder Pleurotremata, Division Squaloidei: Regan, 1906a: 723. Order Selachii, Group 2, Division A, Suborder Heterodonti: Goodrich, 1909 (in part): 143. Order Plagiostoma, Suborder Antacea, "Group" Centracoidei: Garman, 1913: 11, 13. Order Pleurotremata, Suborder Squaloidei: Engelhardt, 1913: 100. Order Centraciones, Suborder Prosarthri: Jordan, 1923: 95. Order Heterodontea, Suborder Heterodontida, Superfamily Heterodontoidea: White, 1936: 4; White, 1937: 37, tab. 1; Whitley, 1940: 69. Order Euselachii, Suborder Heterodontiformes: Bertin 1939a: 9. Order Heterodontiformes: Berg, 1940: 134, 135; Berg and Svetovidov, 1955: 61; Arambourg and Bertin, 1958: 2028; Patterson, 1967: 667; Lindberg, 1971: 8, 256; Rass and Lindberg, 1971: 303; Compagno, 1973: 28; Applegate, 1974: 743; Nelson, 1976: 32; Chu and Meng, 1979: 114, tab. 2; Compagno, 1984: 154; Nelson, 1984: 50; Gubanov, Kondyurin and Myagkov, 1986: 3, 42; Cappetta, 1987: 26, 69; Compagno, 1988: 382; Nelson, 1994: 45; Shirai, 1996: 32; Eschmeyer, 1998. Order Heterodontiformes, Suborder Heterodontoidei: Berg, 1940: 134, 135; Berg and Svetovidov, 1955: 61. Order Asterospondyli: Fowler, 1941: 4, 13; Smith, 1949: 37, 39. Order Selachii, Suborder Heterodontoidea: Romer, 1945: 576; Bigelow and Schroeder, 1948: 95; Romer, 1966: 349. Order Heterodontoidea: Schultz and Stern, 1948: 224. Order Pleurotremata, Suborder Heterodontiformes: Budker and Whitehead, 1971: 5, tab. 2. Order Heterodontida, Suborder Heterodontina, Superfamily Heterodonticae: Fowler, 1966: 321, 330, 331. Order Pleurotremata, Suborder Squaloidea: Norman, 1966: 24. Order Hexanchida, Suborder Heterodontoidei: Glikman, 1967: 214. Order Selachii: Blot, 1969: 702-776. Order Heterodontiformes, Suborder Heterodontoidea: Chu and Meng, 1979: 114, tab. 2. Order Galeomorpha, Suborder Heterodontoidea: Carroll, 1988: 598.

FAO Names: En - Bullhead sharks.

Field Marks: The only living sharks with two spined dorsal fins and an anal fin; also a pig-like snout, small anterior mouth, enlarged molariform teeth in the back of the mouth, supraorbital ridges, rough skin, paddle-like paired fins, and enlarged first gill slits.

Diagnostic Features: Head elevated with crests above eyes, not depressed or expanded laterally. Snout very short, slightly depressed and bluntly rounded, and without lateral teeth or rostral barbels. Eyes dorsolateral on head, without nictitating lower eyelids, secondary lower eyelids, or subocular pouches; upper eyelids not fused to eyeball. Spiracles very small, just behind or about opposite eyes but well below eye level. Five pairs of gill openings present on sides of head, with posteriormost two or three behind pectoral-fin origins. Nostrils diagonal on front of snout, without barbels but with prominent circumnarial grooves around incurrent apertures; nostrils with deep nasoral grooves connecting excurrent apertures to mouth, anterior nasal flaps moderately long and reaching mouth. Mouth small, almost terminal on head, broadly arched and short, ending in front of posterior corners of eyes. Labial furrows large and present on both jaws. Teeth strongly differentiated along the jaws, with small anterolateral teeth and enlarged molariform posterior teeth; no gap or small intermediate teeth between anterior and lateral teeth in the upper jaw; anterolateral teeth with orthodont histological structure but posterior teeth osteodont. Trunk cylindrical, not flattened and ray-like. Caudal peduncle without lateral dermal ridges or keels. Dermal denticles covering entire body, not enlarged as thorns or spines. Pectoral fins moderately large, not expanded and ray-like, without triangular anterior lobes that cover the gill openings. Pectoral girdle (scapulocoracoid) high, U-shaped, without a medial joint, and with superscapulae directed dorsally and not contacting vertebral column. Pectoral-fin skeleton primitively tribasal (dibasal with propterygium fused to mesopterygium in some species), with propterygium in contact with radials and metapterygium without a proximal segment; pectoral fins semiplesodic, with radials extending into the basal fin webs; radial count 15 to 19 with mostly 2 to 8 segments. Pelvic fins small, with vent continuous with their inner margins. Claspers with short siphons in the abdomen at the pelvic-fin bases but without clasper sacs; clasper glans with a large pseudosiphon, a cover rhipidion, a rhipidion and clasper spine; dorsal and ventral marginals of clasper skeleton well-developed but with only the dorsal marginal partially rolled into a tube for clasper canal. Two spine-bearing dorsal fins present, with origin of first well in front of pelvic-fin bases and over pectoral fins; dorsal-fin skeleton with segmented radials articulating with enlarged intermediate cartilages and a single basal plate that also carries the large fin spine. Anal fin present. Caudal fin with a long dorsal lobe and a short ventral lobe; vertebral axis elevated into the dorsal caudal lobe (heterocercal caudal fin). Vertebral calcification strong, secondary calcification in form of several radii that extend under the basals but without intermedial wedges, annuli, or diagonal calcifications. Total vertebral count 103 to 123, precaudal vertebrae 60 to 81. Neurocranium without a rostrum; nasal capsules trumpet-shaped and without subnasal fenestrae (basal communicating canals) or

antorbital cartilages; orbits with incomplete preorbital walls, strong supraorbital crests, strong suborbital shelves, separate foramina for hyomandibular nerves but no separate foramina for superficial ophthalmic nerves, and incomplete postorbital walls without lateral commissures for lateral head vein; occipital condyles low but broad, with a prominent occipital hemicentrum between them. Jaws elongated, upper jaws (palatoquadrates) with low, ridge-like orbital processes that articulate with nasal capsules and orbits in horizontal grooves contacting ethmoid region, basal plate and suborbital shelves; orbital processes not penetrating supraorbital crests. Hyobranchial skeleton with moderately broad, elongated basihyoid; posterior two pharyngobranchials and last epibranchial fused as a yoke-shaped element. Head muscles include broad enlarged vertical preorbitalis with cross-biased fibres; narrow levator palatoquadrati and separate first dorsal constrictor under postorbital process and not extending behind orbits; adductor mandibulae muscles not segmented and not notched anteriorly for mouth gape; a discrete craniomandibular muscle between the lower jaw and orbital walls; no mandibulocutaneous muscle between upper jaw and skin; and no postocular eyelid muscles. Intestinal valve of conicospiral type, with seven turns. Reproduction oviparous (egg laying), with unique screw-shaped egg cases.

Distribution, Habitat, Biology, Interest to Fisheries and Human Impact, and Local Names: See family Heterodontidae below.

Remarks: The Heterodontiformes are a small but highly distinctive group of sharks that have generally been recognized as a discrete taxon at the genus, family, and higher levels. They have a long fossil record extending to almost the beginning of the Mesozoic era and agree with hybodont sharks and other extinct euselachians in having stout dorsal-fin spines and an anal fin.

Bullhead sharks were first discovered in Australia in the late eighteenth century in the form of the Port Jackson shark (***Squalus portus jacksoni*** Meyer, 1793 and several synonyms). This species was initially classified in the Linnaean shark genus ***Squalus*** but soon was accorded two genus-group names, ***Heterodontus*** Blainville, 1816 and its junior synonym ***Cestracion*** Oken, 1817, which initially were proposed as subgenera of ***Squalus*** but were recognized as genera by most subsequent authors. Bonaparte (1838) proposed the new subfamily Cestraciontini (family Squalidae) and Müller and Henle (1839) proposed a new family Cestraciontes for ***Cestracion***, while Gray (1851) proposed the new tribe Heterodontina for ***Heterodontus*** which was raised in rank to the family Heterodontoidae by Gill (1862b).

Many nineteenth and early twentieth century writers used the genus ***Cestracion*** in favour of ***Heterodontus*** and recognized the family Cestracionidae (or variants), including Müller (1845, family Cestraciontes), Bleeker (1859, family Cestracionoidei), Dumeril (1865, family Cestraciontes), Owen (1866), Günther (1870), Woodward (1889, 1898), Zittel et al. (1902), Regan (1906a), Goodrich (1909), Garman (1913, family Centraciontidae), Engelhardt (1913), and Zittel, Broili and Schlosser (1923). Swainson (1839) placed ***Cestracion*** in the family Squalidae, subfamily Centrininae along with various squaloids and other sharks. Van der Hoeven (1858) placed ***Cestracion*** in the family Selachii along with all other sharks while Hasse (1879) placed it in his Group 3, Acrodonten without familial assignment. The use of ***Heterodontus*** as a senior synonym of ***Cestracion*** began in the second half of the nineteenth century and became universal for most of the twentieth century. The family Heterodontidae was recognized by Gill (1872, 1893), Jordan and Gilbert (1883), Jordan and Evermann (1896), Bridge (1910), Jordan (1923), White (1936, 1937), Bertin (1939a), Berg (1940), Whitley (1940), Fowler (1941, 1966), Romer (1945, 1966), Bigelow and Schroeder (1948), Schultz and Stern (1948), Smith (1949), Berg and Svedovidov (1955), Matsubara (1955), Arambourg and Bertin (1958), Norman (1966), Glickman (1967), Patterson (1967), Blot (1969), Bailey et al. (1970), Rass and Lindberg (1971), Budker and Whitehead (1971), Pinchuk (1972), Compagno (1973, 1981b, 1984), Nelson (1976, 1984, 1994), Chu and Meng (1979), McEachran and Compagno (1982), Gubanov, Kondyurin and Myagkov (1986), Cappetta (1987), Carroll (1988), Eschmeyer (1990, 1998), and Shirai (1992, 1996).

The Heterodontidae (or Cestraciontidae) were often grouped with various fossil shark groups by earlier authors, particularly the hybodonts, and with various families of living sharks including lamnoids, carcharhinoids, and squaloids. The concept of a separate ordinal-group for Heterodontidae dates from Garman (1885) as a “group” Heterodonti, while Gill (1893) included it in a separate order Prosarthri (suborder Proarthri of Jordan and Evermann, 1896 and of Jordan, 1923, who also recognized an order Centraciones). Goodrich (1909) included Heterodontidae in the suborder Heterodonti, and Garman (1913) included it in the “group” Centracoidei. White (1936, 1937) recognized the order Heterodontea, which was listed by Bertin (1939a) as the suborder Heterodontiformes, by Berg (1940) as the order Heterodontiformes, and by Bigelow and Schroeder (1948) as the suborder Heterodontoidea. Most subsequent writers tend to accord it a separate order Heterodontiformes, including the writer (Compagno 1973, 1977, 1984, 1988, 1999, and present work).

The anatomy of heterodontoids was described by Gegenbaur (1865, 1872), Haswell (1885), Daniel (1914, 1915, 1928), Holmgren (1941), Kesteven (1942), Compagno (1973, 1977), Shirai (1992, 1996), and de Carvalho (1996), while general morphology and systematics were summarized by Dumeril (1865), Miklouho-Maclay and Macleay (1879, 1886), Günther (1870), Regan (1908b), Garman (1913), Smith (1942), Taylor (1972), and Compagno (1984). It is likely that the heterodontoids are related to the lamnoids, carcharhinoids and orectoloboids, with the most likely hypothesis being that the heterodontoids are a sister group to the three ‘galeoid’ orders rather than to the orectoloboids alone (see discussions in Compagno, 1973, 1977, 1988; Shirai, 1996; and de Carvalho 1996).

2.1.1 Family HETERODONTIDAE

Family: Tribe Heterodontina Gray, 1851, *List Fish British Mus., Pt. 1, Chondropterygii, British Mus. (Nat. Hist.)*: 65 (Family Squalidae).

Type Genus: ***Heterodontus*** Blainville, 1816. Raised to the rank of Family Heterodontoidae by Gill, 1862b, *Ann. Lyceum Nat. Hist. New York,* 7(32): 403.

Number of Recognized Genera: 1.

Synonyms: Subfamily Cestraciontini Bonaparte, 1838: 211 (Family Squalidae). Family Cestraciontes Müller and Henle, 1839: 76. Type genus: ***Cestracion*** Cuvier = Oken, 1817. Family Centraciontidae Garman, 1913: 13, 180. Type genus: ***Centracion*** Gray, 1831, possible error for ***Cestracion*** Cuvier, = Oken, 1817. Family Heterondontidae Bass, D'Aubrey and Kistnasamy, 1975d: 17. Apparent error for Heterodontidae, repeated twice on the same page but correctly spelled elsewhere (title page and table of contents, p. 2).

FAO Names: En - Bullhead sharks, Horn sharks; **Fr** - Requins dormeurs; **Sp** - Dormilones.

Field Marks: See order Heterodontiformes above.

Diagnostic Features: See order Heterodontiformes above.

Distribution: Bullhead sharks occur in warm-temperate and tropical continental waters of the western Indian Ocean, western and eastern Pacific, but are absent from the Atlantic and from oceanic insular waters.

Habitat: These are warm-temperate and tropical bottom sharks of water above 21°C, mostly confined to the continental and insular shelves and uppermost slopes. They occur from the intertidal to 275 m depth, but most are found in water shallower than 100 m.

Biology: As far as is known, these are sluggish, rare to uncommon night-active sharks, slowly swimming and crawling on rocky, kelp-covered and sandy bottom. Some species at least favour rocky crevices and caves, where they spend the day resting. At least one species is migratory in coastal waters when adult, and returns to its breeding sites each year after long migrations.

These sharks are oviparous, producing eggs in unique, large, spiral-flanged egg cases. At least two species lay eggs in specific 'nesting' sites. Eggs may take over five months to hatch, and young hatch at a large size, over 14 cm.

Bullhead sharks primarily feed on benthic invertebrates. Sea urchins (echinoids) are a favourite food, but crabs, shrimp and other crustaceans, abalone, top shells (Trochidae; Gastropoda) and other marine gastropods, oysters, polychaetes, sipunculid worms and more rarely small fish are also eaten.

Interest to Fisheries and Human Impact: These sharks are of minimal interest to fisheries, being caught as a bycatch of bottom trawl and line fisheries and utilized for human consumption and for fishmeal or discarded. They are commonly caught by divers and sportsfishers and at least one species is prized by divers for its fin spines, which are made into jewellery.

Several species of bullhead sharks have been kept in aquaria, where they have proved to be extremely hardy and can live for over a decade. Mating, egg-laying, hatching of eggs, and growth to maturity can occur in captivity.

Some bullhead sharks are encountered by divers, who have commonly harassed them. Although regarded as harmless, these sharks can and do snap when provoked and occasionally pursue and bite their tormentors. One species is the subject of ecotouristic diving in California at present.

At least two species of bullhead sharks may be declining as a result of fishing pressure. Most bullhead sharks are caught as low-level bycatch of fisheries for abundant commercial species (such as shrimp). Their presence in tropical coastal waters with heavy fishing pressure and habitat destruction (such as dynamite and poison-fishing of coral reefs), makes for possible conservation problems in some areas where they occur, such as the Indo-West Pacific and the tropical eastern Pacific.

Local Names: Bullhead sharks, Port Jackson bull-head sharks, Port Jackson sharks, Horn sharks (English); Requin de Port Jackson (French); Husha k'o, Bulkophaaie (South Africa), Nekozame-ka (Japan); Akula rogataia, Rogatye akuly, Bych'i akuli (Russia); Tubarões dorminhocos (Mozambique).

Remarks: Most authors have recognized a single genus, ***Heterodontus*** or its synonym ***Cestracion***, but ***Gyropleurodus*** has been used as a separate genus by some authors for eastern Pacific species (***Heterodontus francisci*** and ***H. quoyi***) or species with carinate teeth, following Gill (1863). Whitley (1931, 1940) separated the distinctive crested bullhead shark (***H. galeatus***), in its own genus ***Molochophrys***, while Fowler (1934) coined a subgenus, ***Wuia***, for the zebra bullhead shark (***Heterodontus zebra***). The systematic arrangement of the family Heterodontidae with a single genus ***Heterodontus*** follows Taylor (1972) and Compagno (1984). There is possible scope for subgeneric allocations within the family, but this should follow an analysis of the phyletics of these sharks.

Literature: Dumeril (1865); Günther (1870); Garman (1913); Fowler (1941, 1966); Smith (1942); Taylor (1972); Compagno (1984); Michael (1993); Last and Stevens (1994).

Heterodontus Blainville, 1816

Genus: Subgenus ***Heterodontus*** Blainville, 1816 (Genus ***Squalus*** Linnaeus, 1758), *Bull. Sci. Soc. Philomat. Paris*, (8): 121.

Type Species: "***Philippi***" = ***Squalus philippi*** Bloch and Schneider, 1801, by monotypy, a junior synonym of ***Squalus portus jacksoni*** Meyer, 1793.

Number of Recognized Species: 9.

Synonyms: Genus ***Cestracion*** Oken, 1817: 1183. Latinization of "Les Cestracions. Cuv." Cuvier, 1816: 129. Type species: ***Squalus philippi*** Bloch and Schneider, 1801, by monotypy? Genus ***Centracion*** Gray, 1831: 5. Type species: ***Centracion zebra*** Gray, 1831, by monotypy? Error or emendation of ***Cestracion*** Oken, 1817? Genus ***Cestralion*** Müller and Henle, 1838: 85. Probable error for ***Cestracion*** Oken, 1817. Genus ***Heterodontes*** Gill, 1862b: 403. Obvious error for ***Heterodontus*** Blainville, 1816, as name is spelled correctly on same page. Genus ***Gyropleurodus*** Gill, 1863: 331. Type species: ***Cestracion francisci*** Girard, 1854, by monotypy (or original designation). Genus ***Tropidodus*** Gill, 1863: 489. Type species: ***Cestracion pantherinus*** Valenciennes, 1846, by original designation. Genus ***Molochophrys*** Whitley, 1931: 310. Type species: ***Cestracion galeatus*** Günther, 1870, by original designation. Subgenus ***Wuia*** Fowler, 1934: 233 (Genus ***Heterodontus*** Blainville, 1816). Type species: ***Centracion zebra*** Gray, 1831, by original designation. Genus ***Tropidopus*** Beebe and Tee-Van, 1941: 118. Apparent error for ***Tropidodus*** Gill, 1863. Genus ***Cestraction*** Fowler, 1941: 17. Apparent error for ***Cestracion*** Oken, 1817. Genus ***Cetracion*** Fowler, 1941: 17. Error for ***Cestracion*** Oken, 1817 or ***Centracion*** Gray, 1831.

Diagnostic Features: See family Heterodontidae above.

Key to Species:

1a. Supraorbital ridges very high (Fig. 24) . . . . . ***Heterodontus galeatus***

1b. Supraorbital ridges moderate to low (Fig. 25) . . . . . → **2**

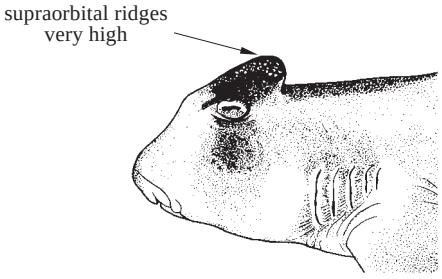


Fig. 24 ***Heterodontus galeatus***

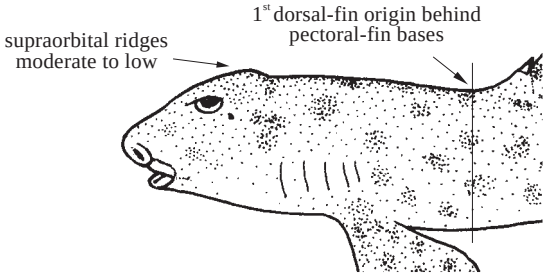


Fig. 25 ***Heterodontus quoyi***

2a. First dorsal-fin origin behind pectoral-fin bases (Fig. 25) . . . . . ***Heterodontus quoyi***

2b. First dorsal-fin origin over pectoral-fin bases (Fig. 26) . . . . . → **3**

3a. Body and fins spotted (Fig. 26) . . . . . → **4**

3b. Body and fins striped or banded (Fig. 27) . . . . . → **6**

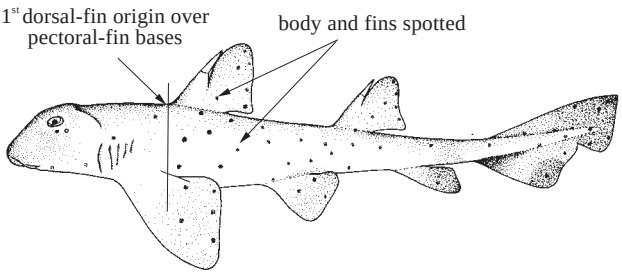


Fig. 26 ***Heterodontus francisci***

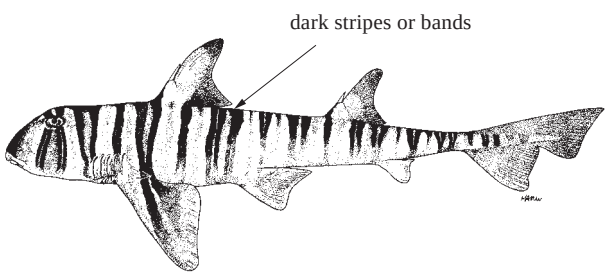


Fig. 27 ***Heterodontus zebra***

4a. Body and fins with white spots in adults and subadults (Fig. 28); hatchlings with thin curved parallel lines on body . . . . . ***Heterodontus ramalheira***

4b. Body and fins with dark spots and (particularly in young), darker saddles (Fig. 29) . . . . . → **5**

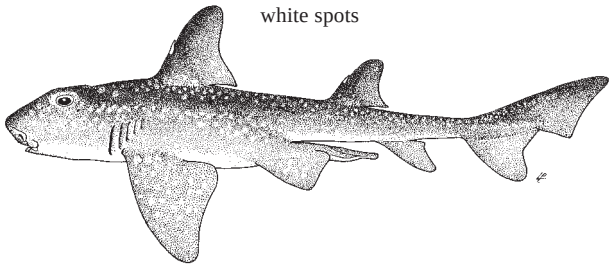


Fig. 28 ***Heterodontus ramalheira***

5a. Back and sides with small dark spots less than a third of eye diameter (Fig. 26); no light-coloured bar on interorbital surface of head . . . . . ***Heterodontus francisci***

5b. Back and sides with larger dark spots a half eye diameter or more (Fig. 29); a light-coloured bar on interorbital surface of head . . . . . ***Heterodontus mexicanus***

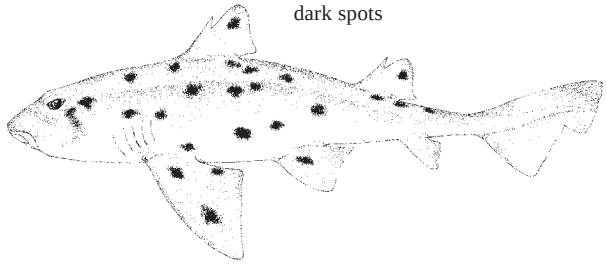


Fig. 29 ***Heterodontus mexicanus***

6a. Body with a harness pattern of dark stripes (Fig. 30) . . . ***Heterodontus portusjacksoni***

6b. Body with vertical dark bands or saddles, not arranged in a harness pattern (Fig. 27) . . . . . → **7**

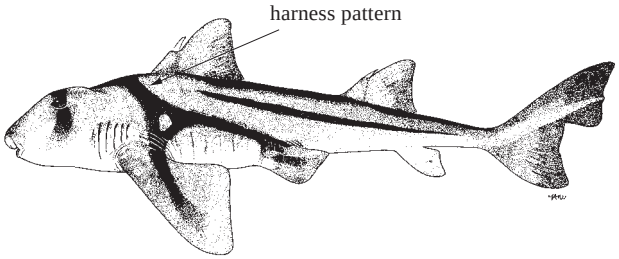


Fig. 30 ***Heterodontus portusjacksoni***

7a. Background colour of dorsal surface white or cream with a zebra pattern of 22 to 36 narrow dark markings from snout to origin of caudal fin; anal-caudal space over twice anal-fin base (Fig. 27) . . . . . ***Heterodontus zebra***

7b. Background colour of dorsal surface tan to brown with 5 to 14 broad or narrow, diffuse-edged markings from snout to origin of caudal fin; anal-caudal space less than twice anal-fin base (Fig. 31) . . . . . → **8**

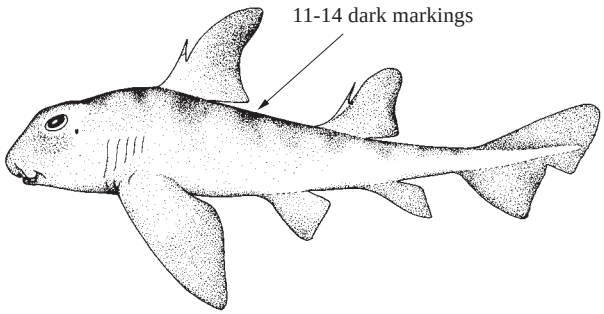


Fig. 31 ***Heterodontus japonicus***

8a. Dorsal, pectoral and caudal fins without abruptly black tips or white apical spots; about 11 to 14 dark markings from snout to origin of caudal fin, including broad dark saddles and narrow bands between them . . . . . ***Heterodontus japonicus***

8b. Dorsal and pectoral fins, and ventral caudal-fin lobe, with abruptly black tips, dorsal fins with white apical spots; 4 or 5 broad dark saddles from snout tip to origin of caudal fin, without narrow dark bands between them (Fig. 32) . . . . . ***Heterodontus* sp. A (Oman)**

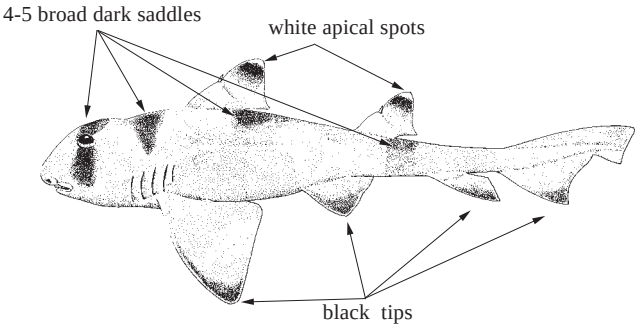


Fig. 32 ***Heterodontus* sp. A**

Heterodontus francisci (Girard, 1854) Fig. 33

Cestracion francisci Girard, 1854, *Proc. Acad. Nat. Sci. Philadelphia*, 7(6): 196. Holotype: U.S. National Museum of Natural History, apparently lost according to Taylor (1972, Rev. shark fam. Heterodontidae: 47). Type locality, Monterey Bay, California. Not listed in catalogue of USNM shark types by Howe and Springer (1993, *Smiths. Contr. Zool.*, [540]: 1-19). Syntypes possibly USNM 933 (2) according to Eschmeyer (1998, *Cat. Fish.*: CD-ROM).

Synonyms: ***Heterodontus californicus*** Herald, 1961: 49. Apparent error for ***H. francisci***, which was cited correctly by Herald on p. 32.

Other Combinations: ***Gyropleurodus francisci*** (Girard, 1854).

FAO Names: En - Horn shark; **Fr** - Requin dormeur cornu; **Sp** - Dormilón cornudo.

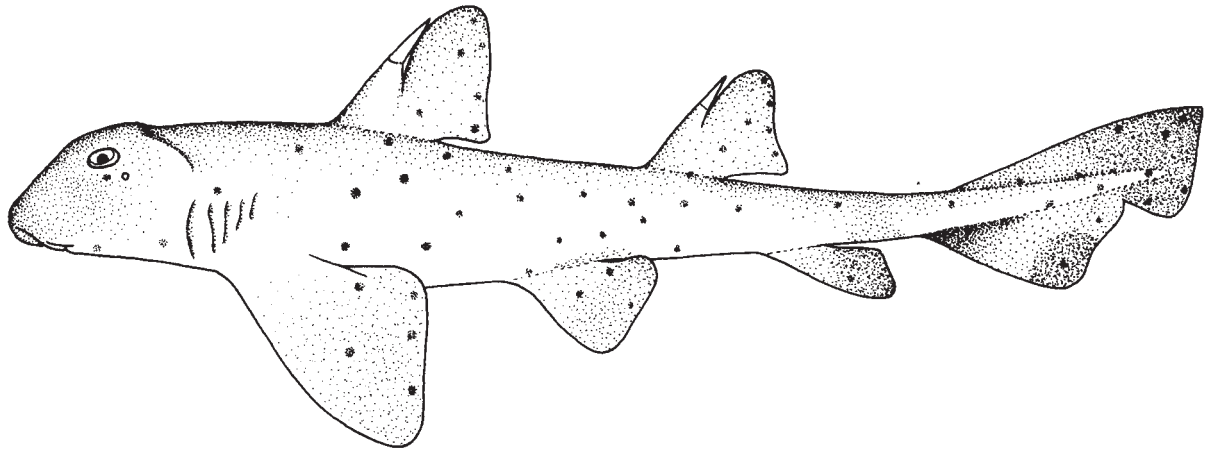
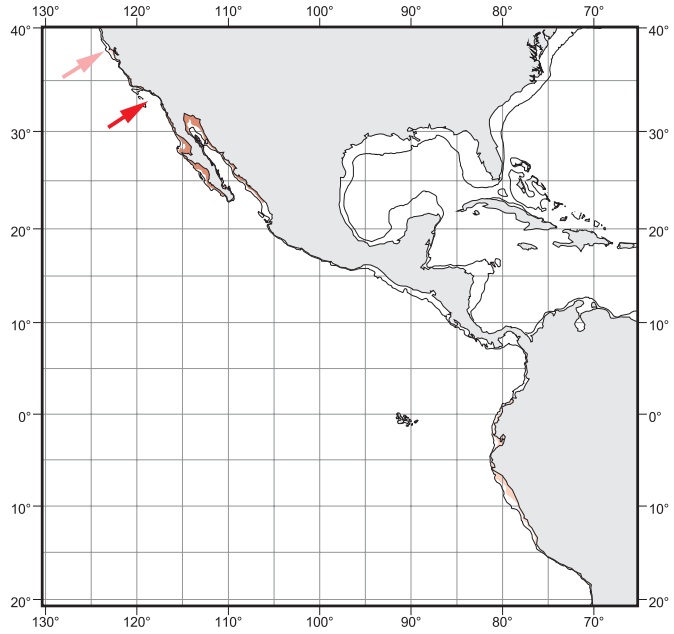


Fig. 33 ***Heterodontus francisci***

Field Marks: Dorsal fins with spines, anal fin present, colour pattern of small dark spots less than one-third eye diameter on light background, no light bar on interorbital space between supraorbital ridges, first dorsal-fin origin over pectoral-fin bases.

Diagnostic Features: Supraorbital ridges moderately low, abruptly truncated posteriorly; interorbital space deeply concave, depth between ridges less than one-fourth eye length. Anterior holding teeth with a cusp and a pair of cusplets in adults, posterior molariform teeth strongly carinate and not greatly expanded and rounded. Pre-first dorsal-fin length 22 to 27%, and anal-caudal space 4 to 8%, of total length. Lateral trunk denticles small and smooth, area behind first dorsal fin with about 200 denticles per cm^2 in adults. Propterygium separate, not fused to mesopterygium. First dorsal-fin spine directed obliquely posterodorsally in juveniles and adults; first dorsal-fin origin anterior to pectoral-fin insertions, over or slightly behind midbases of pectoral fins and well posterior to fifth gill openings; first dorsal-fin insertion well anterior to pelvic-fin origin and well behind pectoral-fin insertion; first dorsal-fin free rear tip opposite or somewhat anterior to pelvic-fin origins; first dorsal fin moderately high and semifalcate in adults, height 9 to 14% of total length, slightly larger than pelvic fins. Second dorsal-fin origin over or slightly in front of pelvic-fin rear tips, second dorsal fin somewhat falcate and nearly as large as first dorsal fin. Anal fin subangular and weakly falcate, with apex reaching lower caudal-fin origin when laid back; anal-caudal space about equal to anal-fin base. Total vertebral count 103 to 123, precaudal count 65 to 76, monospondylous precaudal count 30 to 38, diplospondylous precaudal count 32 to 46, pre-first dorsal-fin spine count 12 to 16, count from diplospondylous transition to second dorsal-fin spine 7 to 16. Egg cases with flat thin spiral flanges diagonal to case axis and no tendrils on case apices; flanges with five turns. A large species, mature between 59 and 122 cm. **Colour**: background colour of dorsal surface dark to light grey or brown with dark brown or black spots on body and fins, spots generally less than one-third eye diameter; body without a dark harness pattern; head without a light bar on interorbital surface; small dark spots present below eye on a dusky patch; fins without abrupt dark tips and white dorsal-fin apices; hatchlings without whorls on fins and body, colour pattern as in adults although brighter.



Distribution: Warm-temperate and subtropical waters of the eastern Pacific: USA (Central and southern California), Mexico (Baja California, Gulf of California), and probably Ecuador and Peru. Off the USA it is most common off southern California but ranges to Monterey Bay and may occasionally penetrate as far north as San Francisco Bay (where it is not resident) during northern influxes of warm water.

Habitat: A common benthic and epibenthic shark, found on the eastern Pacific continental shelf most abundantly at depths from 2 to 11 m but ranging from the intertidal down to at least 150 m. Found on rocky bottoms including reefs, kelp beds, sandy draws between rocks, and on sand flats. On rocks it often occurs in deep crevices and small caves, and ventures far into large underwater caverns. Juveniles shelter on sandy bottom, often near algae, rocks, detritus, or in feeding holes excavated by bat rays (***Myliobatis californica***).

Biology: The horn shark is sluggish, nocturnal, and mostly solitary, though small aggregations have been seen by divers. It is seldom seen moving during the daytime but commonly has its head in a crevice. Shortly after dusk this shark becomes active and apparently feeds mostly at night, but ceases activity after dawn. Adults tend to return to the same resting place every day, but range at night over a small home range of roughly 0.1 hectare. According to Michael (1993) these sharks migrate into deeper water in winter, but it is uncertain if this occurs in the tropical part of their range. Experimentation with captive horn sharks indicates that their diel activity pattern is controlled by light intensity. The broad, muscular paired fins of the horn shark are used as limbs for clambering on the bottom, and are highly mobile and flexible. Swimming is slow and sporadic.

Courtship and copulation have been observed in captivity. The male horn shark chases the female until the latter is ready, then both drop to the bottom. The male grabs the female's pectoral fin with his teeth and inserts a single clasper in her cloaca; copulation lasts 30 to 40 min. One to two weeks later eggs are laid by captive females, one of which laid two eggs per day at 11 to 14 day intervals for four months. In nature these sharks mate in December or January and females drop eggs in February to April. Females normally deposit eggs under rocks or in crevices between them, but in captivity they drop eggs on the bottom where the contents of egg cases may be subsequently sucked out and eaten by these sharks. Eggs can be readily hatched in aquaria and take 7 to 9 months to hatch; the young begin to feed a month after hatching.

The horn shark feeds on benthic invertebrates,including sea urchins (echinoids), crabs, shrimp, isopods, sipunculid worms, anemones, bivalves, gastropods (possibly abalone), cephalopods (octopuses), but less commonly on small fish including pipefish (Syngnathidae) and blacksmith (***Chromis punctipinnis***, Pomacentridae). According to Michael (1993), the active diurnal blacksmith is eaten at night by the horn shark while it is resting on the bottom. Predators are little known: a Pacific angelshark (***Squatina californica***) has been filmed as swallowing small horn sharks and spitting them out alive, possibly because of their strong spines.

Size: Maximum 122 cm but most adults are below 97 cm. Egg cases 10 to 12 cm long and 3 to 4 cm wide at broad end (not over flanges); length at hatching 15 to 16 cm; males maturing at about 58 to 59 cm and adult at 59 to 84 cm; females mature above 58 cm.

Interest to Fisheries and Human Impact: Interest to fisheries minimal, probably utilized or formerly utilized for fishmeal as a bycatch of the shrimp fishery and other bottom-trawling operations in Pacific Mexican waters. It has been captured by divers for sport and for its large fin spines, which are made into jewellery; decreases in numbers of horn sharks have been noted in areas with intense diver activity in southern California. Horn sharks are often harassed and grabbed by divers, but when provoked may swim after their assailants and bite them. These sharks are kept in many public aquaria in the United States. They are hardy, attractive, readily maintained, will breed in captivity, and have been displayed for many years.

Local Names: California bull-head shark, Bullhead shark, Horned shark.

Remarks: Michael (1993) had a photobraph and brief account of what may be an undescribed bullhead shark in the southern Gulf of California, which he termed the Cortez bullhead shark (***Heterodontus* sp.**). According to Michael it is similar to ***H. francisci*** and ***H. mexicanus*** but differs from both species in having higher, more falcate dorsal fins, no dark spots, a lighter abdomen, and no light line on the interorbital space. It has low supraorbital ridges as in ***H. mexicanus***. The species has not, to the writer's knowledge, been collected, so its status is treated as uncertain here pending detailed comparison of material with the sympatric ***H. mexicanus*** and ***H. francisci***.

Literature: Daniel (1928); Beebe and Tee-Van (1941); Smith (1942); Roedel and Ripley (1950); Limbaugh (1963); Nelson and Johnson (1970); Miller and Lea (1972); Taylor (1972); Feder, Turner and Limbaugh (1974); Applegate et al. (1979); Chirichigno (1980); Compagno (1983, 1984); Michael (1993); Compagno, Krupp and Schneider (1995); Segura-Zarzosa, Abitia-Cárdenas and Galván-Magaña (1997).

Heterodontus galeatus (Günther, 1870) Fig. 34

Cestracion galeatus Günther, 1870, *Cat. Fish. British Mus.*, 8: 416. Holotype: British Museum (Natural History), BMNH 1862.7.2.2, about 64 cm long, catalogue number according to Eschmeyer (1998, *Cat. Fish.: CD-ROM*), Australia.

Synonyms: None.

Other Combinations: ***Gyropleurodus galeatus*** (Günther, 1870), ***Molochophrys galeatus*** (Günther, 1870).

FAO Names: En - Crested bullhead shark; **Fr** - Requin dormeur à crête; **Sp** - Dormilón carenado.

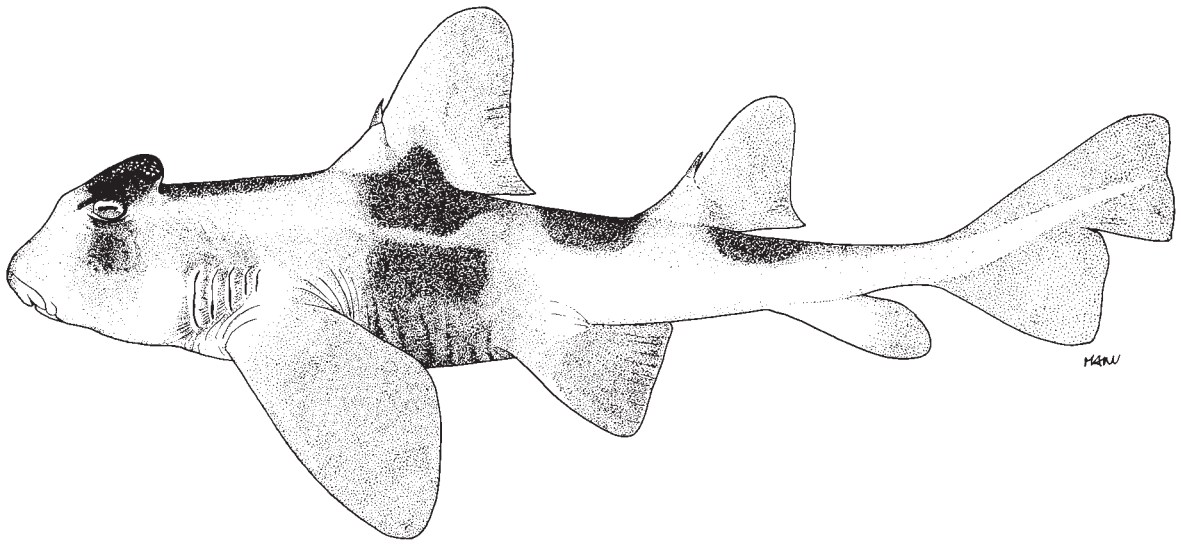
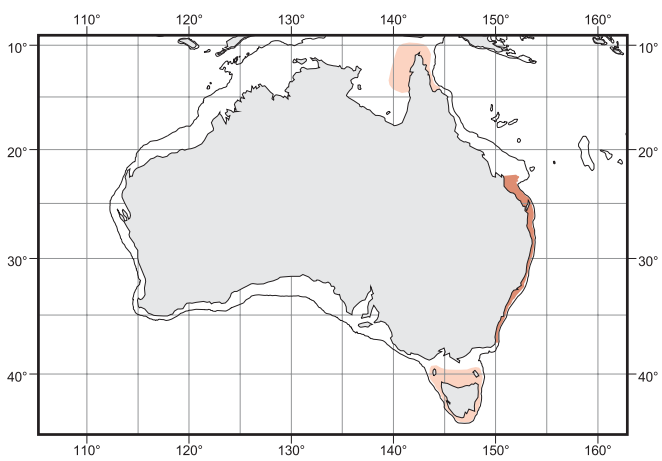


Fig. 34 ***Heterodontus galeatus***

Field Marks: Dorsal fins with spines, anal fin present, supraorbital ridges greatly enlarged, colour pattern of dark broad bands on head, back and tail.

Diagnostic Features: Supraorbital ridges very high, more prominent than in any other ***Heterodontus***, abruptly truncated posteriorly; interorbital space deeply concave, depth between ridges about equal to eye length. Anterior holding teeth with a cusp and a pair of cusplets in adults, posterior molariform teeth strongly carinate and not greatly expanded and rounded. Pre-first dorsal-fin length 22 to 28%, and anal-caudal space 5 to 8%, of total length. Lateral trunk denticles fairly large and rough. Propterygium separate, not fused to mesopterygium. First dorsal-fin spine directed obliquely posterodorsally in adults; first dorsal-fin origin anterior to pectoral-fin insertions, slightly behind pectoral-fin midbases and well posterior to fifth gill openings; first dorsal-fin insertion well anterior to pelvic-fin origins and well behind pectoral-fin insertions; first dorsal-fin free rear tip about opposite to or slightly behind pelvic-fin origins; first dorsal fin moderately high and semifalcate or angular in adults, height 10.8 to 15.2% of total length, slightly larger than pelvic fins. Second dorsal-fin origin well in front of pelvic-fin rear tips, second dorsal fin somewhat falcate or angular and nearly as large as first dorsal fin. Anal fin subangular or rounded to weakly falcate, apex reaching lower caudal-fin origin when laid back; anal-caudal space between 1 and 2 times anal-fin base. Total vertebral count 106 to 108, precaudal count 71 or 72, monospondylous precaudal count 34 or 35, diplospondylous precaudal count 36 to 38, pre-first dorsal-fin spine count 16 to 18, and count from diplospondylous transition to second dorsal-fin spine 8 to 11. Egg cases with flat thin spiral flanges that are diagonal to case axis and a pair of long, slender tendrils on case apex, flanges with 6 or 7 turns. A large species, mature between 60 and 152 cm. **Colour**: background colour of dorsal surface light brown or yellowish brown with five broad diffuse-edged brown or blackish saddles, but without light or dark spots; saddles not arranged in a harness pattern; head with a dark bar on interorbital surface and a single broad dark blotch under eye; fins without abrupt dark tips and white dorsal-fin apices; hatchlings without whorls on fins and body, colour pattern as in adults.



Distribution: Western South Pacific: East coast of Australia, from southern Queensland and New South Wales, with a doubtful record from Tasmania, and a possible record from the top of the Cape York Peninsula.

Habitat: A moderately common benthic and epibenthic shark of the southern Australian continental shelf at moderate depths, ranging from close inshore in the intertidal zone to 93 m. Found on reefs, in kelp and in beds of seagrass.

Biology: This shark often wedges its way between rocks in search of prey. The egg cases are dropped by females in seaweeds or sponges from 20 to 30 m depth on the bottom, during July and August, and hatch after about eight months. Eggs are commonest on the bottom in August and September but are found throughout the year. In captivity a newly hatched female matured and began to lay eggs at an age of 11.8 years and a length of about 70 cm. The crested bullhead shark feeds primarily on sea urchins (echinoids), but also crustaceans, molluscs and small fishes.

Size: Maximum said to be 152 cm long and attaining at least 130 cm, but most individuals are below 122 cm. Young hatch at about 17 cm. Males mature at about 60 cm and females at about 70 cm.

Interest to Fisheries and Human Impact: Interest to fisheries minimal, taken by bottom trawlers but not utilized commercially. Conservation status uncertain, distribution restricted to the warm east coast of Australia. Utilization by aquarium trade uncertain, but an obvious candidate because of its unusual appearance and striking colour pattern. Observed and photographed by divers, but not a special focus of ecotourism.

Local Names: Crested Port Jackson shark, Crested shark, Crested horn shark.

Literature: Whitley (1940); Fowler (1941); Smith (1942); McLaughlin and O'Gower (1971); Taylor (1972); Compagno (1984); Michael (1993); Last and Stevens (1994); Compagno and Niem (1998).

Heterodontus japonicus (Maclay and Macleay, 1884) Fig. 35

Cestracion japonicus Maclay and Macleay, 1884, *Proc. Linnean Soc. New South Wales*, 1884, 8(4): 428, pl. 20. Holotype: Australian Museum, Sydney, AMS B.68, female from Tokyo, Japan.

Synonyms: ?***Cestracion philippi*** var. ***japonicus*** Dumeril, 1865: 426. Dumeril proposed this as a colour variant of ***Squalus philippi*** Bloch and Schneider, 1801 (= ***S. portusjacksoni*** Meyer, 1793) for Japanese specimens with transverse bands, but considered it equivalent to ***Centracion zebra*** Gray, 1831. Thus Dumeril may have confused two species, both of which occur in Japan. Taylor (1971: 107-108) requested the International Commission on Zoological Nomenclature to suppress Dumeril's name to remove the clearly defined ***Cestracion japonicus*** Maclay and Macleay, 1884, from possible junior homonymy if ***C. philippi*** var. ***japonicus*** is considered a synonym of ***C. zebra***. Dumeril's account could also be interpreted as providing a separate name for a Japanese variety of ***C. philippi*** with transverse bands apart from ***C. zebra*** (which Dumeril also synonymized with ***C. philippi***), and recognized as defined by subsequent workers.

Other Combinations: ***Gyropleurodus japonicus*** (Macleay and Macleay, 1884).

FAO Names: En - Japanese bullhead shark; **Fr** - Requin dormeur nekozame; **Sp** - Dormilón japonés.

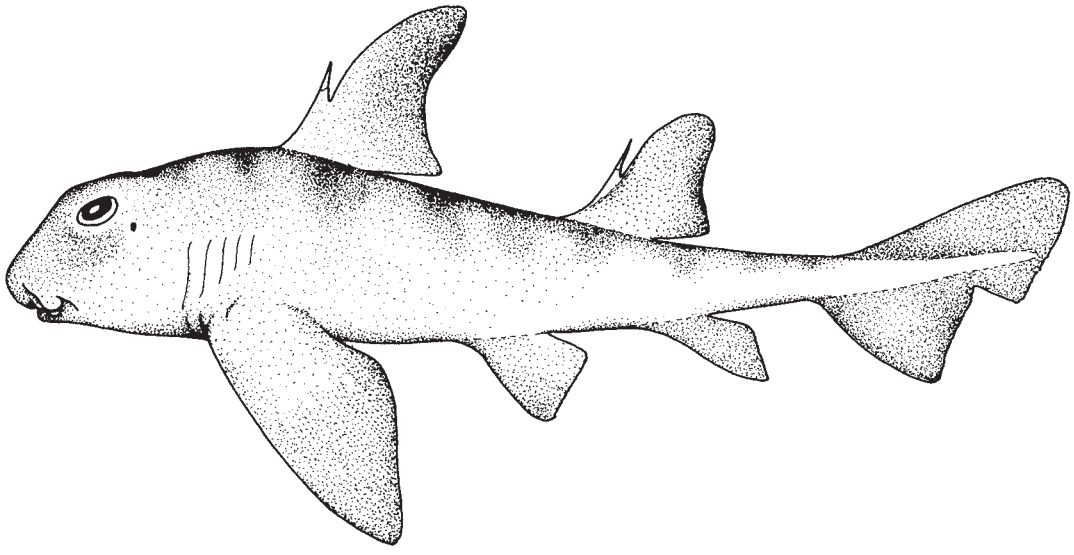
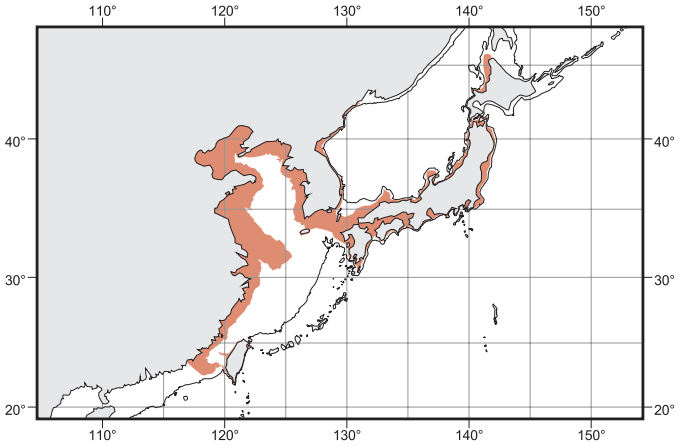


Fig. 35 ***Heterodontus japonicus***

Field Marks: Dorsal fins with spines, anal fin present, first dorsal-fin origin over pectoral-fin bases, colour pattern of 11 to 14 broad, irregular-edged, dark saddles and vertical stripes on a light background.

Diagnostic Features: Supraorbital ridges moderately low, gradually ending posteriorly; interorbital space shallowly concave, depth between ridges about half eye length. Anterior holding teeth with a cusp and a pair of cusplets in adults, posterior molariform teeth not carinate and greatly expanded and rounded. Pre-first dorsal-fin length 21 to 25% and anal-caudal space 8 to 10% of total length. Lateral trunk denticles large and rough. Propterygium separate, not fused to mesopterygium. First dorsal-fin spine directed obliquely posterodorsally in hatchlings, juveniles and adults; first dorsal-fin origin anterior to pectoral-fin insertions and slightly behind pectoral-fin midbases, well posterior to fifth gill openings; first dorsal-fin insertion well anterior to pelvic-fin origins, well behind pectoral-fin insertions; first dorsal-fin free rear tip about opposite to or slightly ahead or behind pelvic-fin origins; first dorsal fin very high and broadly semifalcate in young but moderately high and semifalcate in adults, height 11 to 21% of total length, first dorsal fin much larger than pelvic fins. Second dorsal-fin origin over or slightly in front of pelvic-fin rear tips, broadly falcate and much smaller than first dorsal fin. Anal fin subangular and rounded to weakly falcate, apex well anterior to lower caudal-fin origin when laid back; anal-caudal space nearly or quite twice anal-fin base. Total vertebral count 109 to 116, precaudal count 72 to 78, monospondylous precaudal count 33 to 39, diplospondylous precaudal count 37 to 42, pre-first dorsal-fin spine count 15 to 17, and count from diplospondylous transition to second dorsal-fin spine 9 to 15. Egg cases with flat thin spiral flanges diagonal to case axis and having a pair of very short, slender tendrils on case apex, flanges with three turns. A large species, mature between 69 and 120 cm. **Colour**: background colour of dorsal surface tan to brown with 11 to 14 brown diffuse-edged markings from snout tip to origin of caudal fin, including broad saddles and narrower vertical bands usually between them, body without light or dark spots, bands and saddles not arranged in a harness pattern; head with a light-coloured bar on interorbital surface, and with a single broad dark blotch under eye that is indistinct in large adults; fins without abrupt dark tips and white dorsal-fin apices; hatchlings without whorls on fins and body, pattern as in adults although brighter.

Distribution: Western North Pacific: Japan, Korean peninsula, northern China, and Taiwan (Province of China). An East African record is apparently erroneous.



Habitat: A common, temperate-water bullhead shark of the western North Pacific continental shelf, occurring at moderate depths of 6 to 37 m, on or near the bottom. It prefers rocky areas (including reefs) and kelp-covered bottom.

Biology: This is a sluggish, slow-swimming shark, easily caught by divers. It slowly explores the bottom, swimming and 'walking' with its mobile paired fins.

Oviparous, laying its large spiral-cased eggs among rocks or in kelp, at depths of about 8 or 9 m; several females may lay their eggs in a single site, termed 'nests', although they apparently do not guard these sites after laying. In Japanese waters, eggs are laid from March through September, most abundantly in March through April; each female usually lays two eggs at a time, for 6 to 12 spawnings. Eggs hatch in about a year.

The Japanese bullhead shark feeds on crustaceans, molluscs (including top shells [Trochidae; Gastropoda]), small fishes and sea urchins. It can protrude its jaws a considerable distance while grabbing prey.

Size: Maximum total length about 120 cm. Size at hatching about 18 cm; males adult at 69 cm.

Interest to Fisheries and Human Impact: Interest to fisheries probably minimal, caught and eaten in Japan and presumably elsewhere in its range. Kept in public aquaria in Japan.

Local Names: Bull head, Japanese bull-head shark, Cat shark, Japanese horn shark, Cestracion shark, Sazaewari, Sazaiwari, Nekozame (Japan); Japanse bulkophaai (South Africa).

Literature: Fowler (1941); Smith (1942); Lindberg and Legeza (1959); Chen (1963); McLaughlin and O'Gower (1971); Taylor (1972); Nakaya and Shirai (1984); Compagno (1984); Michael (1993); Shen et al. (1993).

Heterodontus mexicanus Taylor and Castro-Aguirre, 1972 Fig. 36

Heterodontus mexicanus Taylor and Castro-Aguirre, 1972, *An. Esc. Nac. Cienc. Biol. México*, 19: 125, figs 1-5, 8-9. Holotype: Scripps Institution of Oceanography, SIO-70-90, 610 mm adult female, Cerro Colorado, Sonora, Gulf of California, Mexico.

Synonyms: None.

Other Combinations: None.

FAO Names: En - Mexican hornshark; **Fr** - Requin dormeur buffle; **Sp** - Dormilón búfalo.

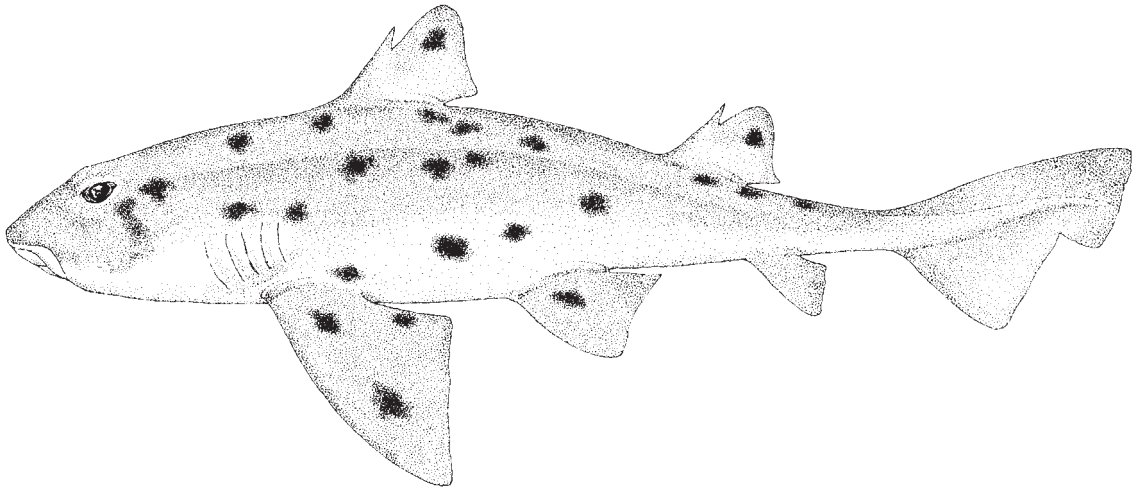
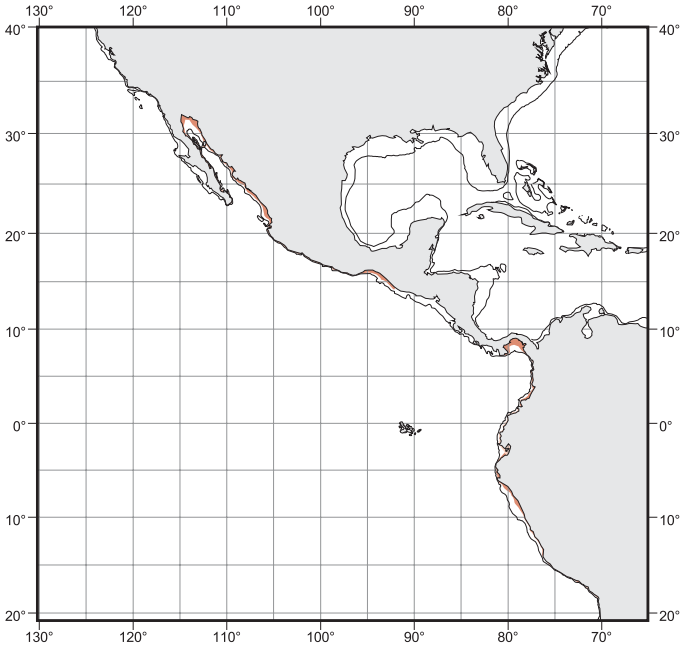


Fig. 36 ***Heterodontus mexicanus***

Field Marks: Dorsal fins with spines, anal fin present, colour pattern of large dark spots of one-half eye diameter or more on light background, a light bar present on space between supraorbital ridges, first dorsal-fin origin over pectoral-fin bases.

Diagnostic Features: Supraorbital ridges low, gradually ending posteriorly; interorbital space shallowly concave, depth between ridges less than one-fourth eye length. Anterior holding teeth with a cusp and a pair of cusplets in adults, posterior molariform teeth strongly carinate and not greatly expanded and rounded. Pre-first dorsal-fin length 24 to 29% and anal-caudal space 6 to 9% of total length. Lateral trunk denticles large and rough, area behind first dorsal fin with about 70 to 130 denticles per cm^2 in adults. Propterygium fused to mesopterygium. First dorsal-fin spine directed obliquely posterodorsally in juveniles and adults; first dorsal-fin origin slightly anterior to pectoral-fin insertions, behind pectoral-fin midbases, and well posterior to fifth gill openings; first dorsal-fin insertion well anterior to pelvic-fin origins and well behind pectoral-fin insertions; first dorsal-fin free rear tip about opposite to or slightly ahead of pelvic-fin origins; first dorsal fin low and weakly falcate in adults, height 8 to 18% of total length, first dorsal fin about as large as pelvic fins; second dorsal-fin origin over or slightly in front of pelvic-fin rear tips, weakly falcate and nearly as large as first dorsal fin. Anal fin subangular and rounded to weakly falcate, with apex reaching lower caudal-fin origin or falling somewhat behind it when laid back; anal-caudal space between 1 and 2 times anal-fin base. Total vertebral count unknown, precaudal count 60 to 70, monospondylous precaudal count 30 to 34, diplospondylous precaudal count 30 to 38, pre-first dorsal-fin spine count 14 to 16, and count from diplospondylous transition to second dorsal-fin spine 9 to 14. Egg cases with thick, T-shaped paired spiral flanges, transverse to case axis, and a pair of long, slender tendrils on case apex; flanges with five turns. A small species, mature between 50 and 70 cm. **Colour**: background colour of dorsal surface light grey-brown with large black spots on body and fins, these one-half eye diameter or more in size; body without a dark harness pattern; head with a light-coloured bar on interorbital surface of head and 1 or 2 dusky indistinct blotches under eye; fins without abrupt dark tips and white dorsal-fin apices; hatchlings without whorls on fins and body.

Distribution: Eastern Pacific: Mexico (southern Baja California, the Gulf of California, and southern Pacific coast) south to Guatemala, Panama (Gulf of Panama), Colombia, probably Ecuador and Peru.



Habitat: A warm-temperate and tropical bullhead shark of littoral continental waters, found on rocky bottom including reefs and seamounts, on coral reefs, and on sandy areas from close inshore down to 20 to 50 m depth.

Biology: Common in the upper Gulf of California. Oviparous. The long tendrils and rigid, T-shaped spiral flanges on the egg cases of this shark suggest that wedging of the eggs in crevices through the action of flexible flanges has been replaced by anchoring of the cases to the substrate by the tendrils, unlike other bullhead sharks with flexible-flanged eggs. The heavy T-flanges may serve instead to protect the egg from impacts and egg-predators. Feeds on crabs and demersal fishes including midshipman (***Porichthys***, Batrachoididae).

Size: Maximum size about 70 cm. Egg cases about 8 to 9 cm long, young hatch at about 14 cm; males maturing between 40 and 50 cm and reaching at least 55 cm.

Interest to Fisheries and Human Impact: Interest to fisheries minimal. Small numbers are or were taken as a bycatch of the shrimp fishery in Mexico and processed into fishmeal along with other sharks. It is also caught in gill nets set for small sharks. Observed by divers in the Gulf of California, but not a special focus for ecotouristic diving.

Local Names: Buffalo hornshark, Mexican horn shark; Gata (Mexico).

Remarks: This shark had been collected in the Gulf of California many years ago by ichthyologists at the Scripps Institution of Oceanography and referred to under the unpublished manuscript names “H. seftoni” and “H. oligostictus”. It was eventually published as ***H. mexicanus***.

Literature: Taylor (1972); Taylor and Castro-Aguirre (1972); Applegate et al. (1979); Chirichigno (1980); Compagno (1984); Franke and Acero (1991); Michael (1993); Compagno, Krupp and Schneider (1995).

Heterodontus portusjacksoni **(Meyer, 1793)** **Fig. 37**

Squalus portus jacksoni Meyer, 1793, *Syst. Summar. Zool. Entdeck. Neuholland, Afrika*: 71. No type material, Botany Bay, New South Wales, Australia, based on the Port Jackson Shark of Phillip, 1789, *Voyage Botany Bay*: 283, fig.

Synonyms: ***Squalus jacksoni*** Suckow, 1799: 102. No type material, Botany Bay, Port Jackson, Australia, based on the Port Jackson Shark of Phillip, 1789: 283, fig. Reference from Fowler (1941). ***Squalus philippi*** Bloch and Schneider, 1801: 134. No type material, Botany Bay, Port Jackson, Australia, based on the Port Jackson Shark of Phillip, 1789: 283, fig. ***Squalus philippinus*** Shaw, 1804: 341. No type material?, southern Pacific Ocean, Botany Bay (Port Jackson, Australia), apparently based on the Port Jackson Shark of Phillip (1789: 283, fig.), and termed the “Phillipian shark” by Shaw. ***Squalus jacksonii*** Turton, 1806: 922. Variant spelling of ***Squalus jacksoni*** Suckow, 1799 or independently proposed? ***Cestracion philippi*** Lesson, 1830, 2: 97; 3, pl. 2. No type material, Botany Bay, Port Jackson, Australia, based on the Port Jackson Shark of Phillip, 1789: 283, fig. Proposed as a new name; specimen illustrated may not be this species. ***Cestracion heterodontus*** Sherrard, 1896: 42, 88, figs. Hobson’s Bay, Victoria. Reference from Fowler (1941), uncertain if new name or error. ***Heterodontus bonae-spei*** Ogilby, 1908: 2. Holotype: Queensland Museum, No. QM I.1587, jaws only, “Table Bay, South Africa”, possibly a specimen of ***H. portusjacksoni*** with a mistaken locality label according to Reif (1973: 165-167).

Other Combinations: None.

FAO Names: En - Port Jackson shark; **Fr** - Requin dormeur taureau; **Sp** - Dormilón toro.

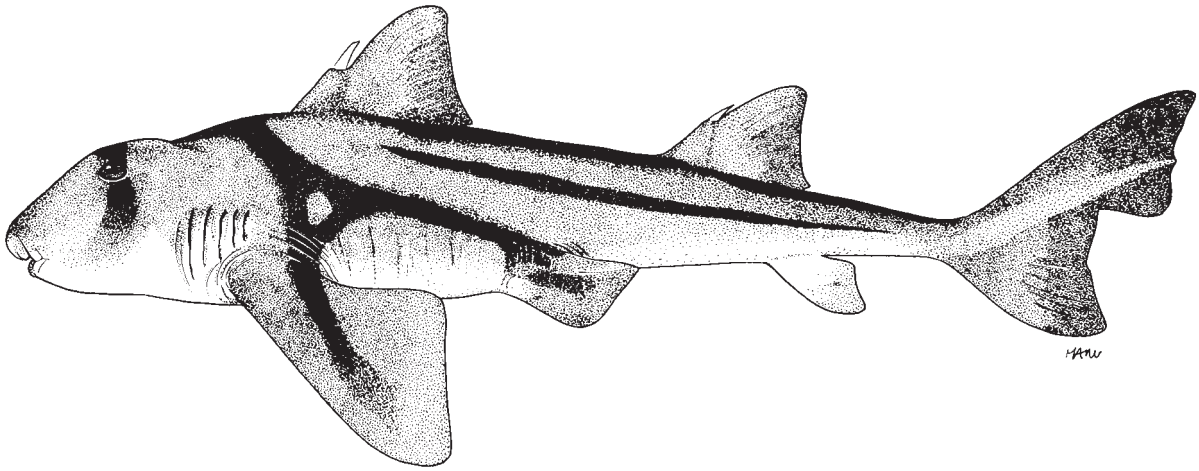
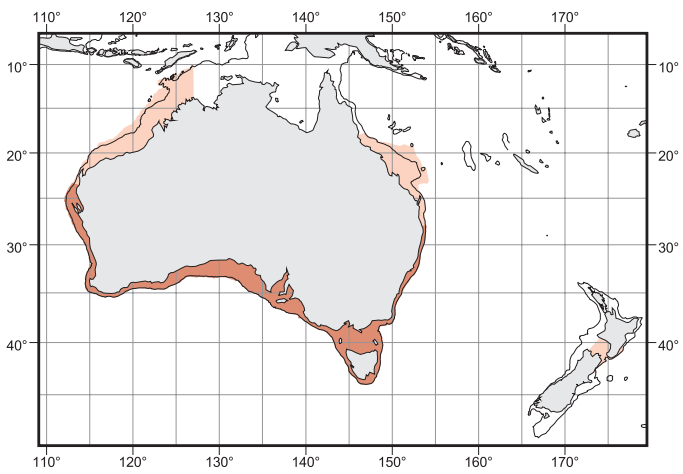


Fig. 37 ***Heterodontus portusjacksoni***

Field Marks: Dorsal fins with spines, anal fin present, colour pattern with a conspicuous set of harness-like narrow dark stripes on the back, unique to the species.

Diagnostic Features: Supraorbital ridges moderately low, gradually ending posteriorly; interorbital space moderately concave, depth between ridges less than half eye length. Anterior holding teeth with a cusp and no cusplets in adults, posterior molariform teeth not carinate and greatly expanded and rounded. Pre-first dorsal-fin length 21 to 24% and anal-caudal space 10 to 13% of total length. Lateral trunk denticles fairly large and rough. Propterygium fused to mesopterygium. First dorsal-fin spine directed obliquely posterodorsally in juveniles and adults; first dorsal-fin origin well anterior to pectoral-fin insertions, about over or slightly behind pectoral-fin midbases, and somewhat posterior to fifth gill openings; first dorsal-fin insertion well anterior to pelvic-fin origins and well behind pectoral-fin insertions; first dorsal-fin free rear tip about opposite to pelvic-fin origins; first dorsal fin moderately high and rounded angular or falcate, height 12 to 16% of total length, first dorsal fin larger than pelvic fins; second dorsal-fin origin over or slightly behind pelvic-fin rear tips, second dorsal fin rounded to angular or falcate and nearly as large as first dorsal fin. Anal fin subangular and rounded or weakly falcate, apex well anterior to lower caudal-fin origin when laid back; anal-caudal space about three times anal-fin base. Total vertebral count 114, precaudal count 76 to 81, monospondylous precaudal count 37 to 39, diplospondylous precaudal count 37 to 43, pre-first dorsal-fin spine count 15 to 17, and count from diplospondylous transition to second dorsal-fin spine 9 to 14. Egg cases with flat thin spiral flanges diagonal to case axis and a pair of very short, slender tendrils on case apex; flanges with four or five turns. A large species, mature between 70 and 165 cm. **Colour**: background colour of dorsal surface grey to light brown or whitish with distinctive black striped harness marking; body and fins without light or dark spots; head with a narrow dark bar on interorbital surface and a single narrow dark to blackish band under eye; fins without abrupt dark tips and white dorsal-fin apices; hatchlings without whorls on fins and body, colour pattern as in adults.

Distribution: Western South Pacific: Temperate and subtropical southern Australia, from off New South Wales, Victoria, Tasmania, South and Western Australia (west coast), with questionable records from southern Queensland and the tropical north coast of Western Australia; also New Zealand (a single record, possibly as a straggler or waif from Australia).



Habitat: A common littoral, nocturnal bottom shark of the temperate Australian continental shelves and uppermost slopes, ranging from close inshore in the intertidal to at least 275 m.

Biology: Underwater observation and tagging of this nocturnal species has elucidated its life-history to a degree attained with few other species of sharks. While inshore, the Port Jackson shark favours caves with sandy floors and open trenches of shallow rocky reefs as daytime resting places, and almost all individuals in a given area will be found resting in relatively few of such sites. Strong selection is shown for favoured sites, and superficially identical sites nearby may have few or no sharks.

Port Jackson sharks can be solitary but often occur in small to large groups. Althose these sharks are evidently social and apparently are amenable to study underwater, relatively little is known of their sociobiology and behaviour patterns. This could be elucidated in the future by electronic tagging and night-observation with low-light video devices, as well as observations of captive colonies in semi-naturalistic habitats.

Pronounced fluctuations in abundance have been noted on shallow reefs off New South Wales, directly correlated with seasonal influxes of adults for breeding and inversely correlated by seasonal variations in temperature. These sharks are apparently social while resting, and favoured resting sites may have up to 16 sharks occupying them. Data from tagging suggests that seasonal reef populations are in a state of continuous flux, with individuals moving in and out of their favoured reefs throughout the breeding season. Apparently individuals are capable of homing to favoured resting sites after ranging considerable distances away from them during the breeding season. When sharks were experimentally removed from resting sites in Sydney Harbour to different localities up to 3 km away, they returned to their original resting sites. It has been suggested that these sharks have a highly-developed spatial memory, and apparently the means to locate favoured resting and breeding sites long distances apart along migration routes.

Port Jackson sharks are seasonal oviparous breeders, with juveniles segregating by size after hatching and adults segregating by sex. Mature females accompanied by some males move onto inshore reefs in late July and August in the Sydney area (New South Wales), and probably mating occurs at this time. Most mature males remain in deeper water offshore. During August and September (rarely in July and October) females lay 10 to 16 (commonly 10 to 12) eggs in rock crevices on shallow, sheltered reefs at depths from 1 to 5 m but occasionally down to 20 to 30 m. In captivity females lay a pair of cased eggs a day every 8 to 17 days. The broad spiral flanges of the egg cases serve as anchors to keep them wedged in the rocks. Females apparently favour traditional 'nest' sites, which several apparently use collectively for many years. Apart from rock crevices, females may occasionally lay egg cases on open sand, and egg cases have been found wedged under an underwater oil pipeline and in tin cans. Egg cases are oriented with their pointed ends into crevices, and females have been seen carrying egg cases, suggesting that females lay their eggs, pick them up at the broad end, and insert them into appropriate crevices. According to Michael (1993), adults have been observed eating their own egg-cases (as in ***H. francisci***).

Young hatch after about 9 to 12 months and move into nursery areas in bays and estuaries. Some may retreat into deeper water during summer, but most juveniles remain in mixed groups with a 1:1 sex ratio on the nursery grounds for several years. At the beginning of sexual maturity adolescents move into deeper water and segregate into male and female groups. After several years of adolescence, apparently spent at the outer edges of the continental shelves, these groups join the adult populations.

Adult males apparently move into deeper water near the end of the breeding season, followed by the adult females in late September or October. Some adults move offshore into deeper water, but others migrate. Small numbers of adults may return to the inshore breeding reefs as early as March or April of the next year, but most do not stay inshore and few sharks are present until the onset of the next breeding season. Observed ratios of adult males and females are not significantly at variance with a 1:1 ratio.

On the east coast of Australia the Port Jackson shark shows a pattern of migration southwards after breeding, with females migrating at least for 5 to 6 months and moving up to 850 km south of breeding reefs before returning to the same sites the next year. Some may range as far south as Tasmania from the Sydney area in New South Wales in the annual migration cycle. It is thought that migrating adult sharks move southwards along inshore coastal waters but return to their breeding reefs along deeper offshore waters.

Studies on blood proteins between Port Jackson sharks of different regions suggest that they form at least two populations, a southwestern one from Western Australia to northeastern Victoria and a northeastern one from New South Wales and possibly southern Queensland. There is blood protein evidence to suggest that sharks using favoured breeding sites in three localities in New South Wales represent genetically distinct subpopulations, and indicates that the high site specificity shown by tagging and recapturing of sharks in this area is probably of relatively long duration.

Data from captive sharks suggests that juveniles grow at about 5 to 6 cm per year and adults between 2 and 4 cm per year. Approximate estimates of age at maturity from captive growth data are 8 to 10 years for males and 11 to 14 years for females. So far, data is unavailable on growth rates in the wild from tagging and remeasuring of tagged individuals or from calibration and examination of fin spine or vertebral rings.

The Port Jackson shark feeds primarily on benthic invertebrates, mainly echinoderms. Prey items include sea urchins, starfish, polychaetes, large gastropods, prawns, crabs, barnacles, and small fishes. Occasionally garbage such as bits of mammalian fur, potato and orange peels are taken in by these sharks. Juveniles with their smaller, more pointed teeth apparently take more soft-bodied prey than adults. Food items in stomachs are usually broken into small pieces, indicating that the sharks actively grind their food with their powerful jaws and heavy molariform teeth. Food is apparently taken at night on the bottom, and by searching close to the substrate. Olfactory cues are thought to be important, but electrosense and lateral line sense may play a role in this also. Food is eaten after final contact with the mouth region. Juveniles at least are capable of digging food out of the sand by sucking in water and sand and blowing it out of the gill covers. Respiration can occur by pumping water into the first, enlarged gill slits and out the last four, which is thought to allow the shark to crush and grind its prey at leisure without having to take in water through its mouth and risk passage of food out the gill slits.

Predators of this shark are poorly known, but it is suspected that adults are highly protected by their sedentary habits, cryptic, nocturnal behaviour, fin spines, and disruptive colour patterns. Possible predators are large macropredatory sharks such as bluntnose sevengill and white sharks as well as large otariid seals. Juveniles in nursery grounds are thought to be more vulnerable to predation by other sharks and larger benthic teleosts. Adults are sometimes attacked by small predatory

isopods, and eggs may be attacked by male Port Jackson sharks and possibly a gastropod drilling predator. As with other sharks, this has a sizeable parasite fauna, including cestodes (tapeworms), trematodes (flatworms), nematodes (roundworms), isopod larvae, copepods, fish lice, and leeches.

Size: Maximum total length reported as 165 cm, but apparently rare above 137 cm. Egg cases are 13 to 17 cm long and 5 to 7 cm wide at the broad end. Size at hatching 23 to 24 cm. Males are adolescent between 50 and 80 cm, mature between 70 and 80 cm, and reach at least 105 cm; females are adolescent between 65 and about 84 cm, mature between 80 and 95 cm, and reach at least 123 cm; adult females average about 25 cm longer than adult males.

Interest to Fisheries and Human Impact: Apparently of minimal interest to fisheries. Taken in commercial fisheries as bycatch in bottom trawls, shrimp nets, beach seines, anti-shark nets, bottom longlines and in shark gill nets on the south coast of Australia; also caught by sports anglers on rod-and-reel. Apparently not utilized as food. This shark is considered harmless to people. It is kept in public aquaria for display in Europe, the United States, and probably Australia, and is an obvious candidate for display because of its hardiness and attractive colour pattern. Divers observe this shark but it is not a special focus of ecotouristic diving. Conservation status uncertain.

Local Names: Bullhead shark, Bullhead, Pigfish, Oyster-crusher or Oyster crusher, Tabbigaw.

Remarks: Reif (1973) noted that the holotype of ***Heterodontus bonae-spei***, supposedly from South Africa, is most probably a specimen of ***H. portusjacksoni*** with an erroneous locality label. Eschmeyer (1998) noted that the name was unavailable because Ogilby (1908) did not distinguish it by characters but only by locality.

Literature: Ogilby (1908); Whitley (1940); Fowler (1941); Smith (1942); McLaughlin and O'Gower (1970, 1971); Taylor (1972); Reif (1973); O'Gower and Nash (1978); Michael (1993); Last and Stevens (1994); O'Gower (1995); Compagno and Niem (1998).

Heterodontus quoyi (Fréminville, 1840) Fig. 38

Cestracion quoyi Fréminville, 1840, *Mag. Zool. Guerir.*, ser. 2(5): 1-3, pl. 3. Holotype: Museum National d'Histoire Naturelle, Paris, MNHN-3445, adult male about 475 mm, type locality Galapagos Islands.

Synonyms: ***Cestracion pantherinus*** Valenciennes, 1846, pl. 10, fig. 2. Ibid., 1855, text: 350. Holotype the same specimen (MNHN-3445) as that of ***Cestracion quoyi***, Galapagos Islands. ***Gyropleurodus peruanus*** Evermann and Radcliffe, 1917: 2, pl. 1, fig. 1. Holotype: U.S. National Museum of Natural History, USNM-77691, 565 mm TL adult (gravid) female, Lobos de Tierra Island, Peru, confirmed by Howe and Springer (1993: 11).

Other Combinations: None.

FAO Names: En - Galapagos bullhead shark; **Fr** - Requin dormeur bouledogue; **Sp** - Dormilón de Galápagos.

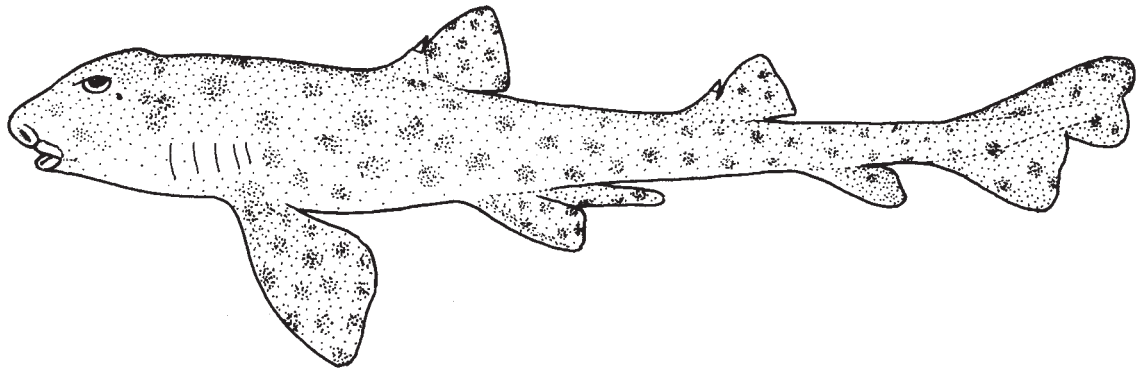
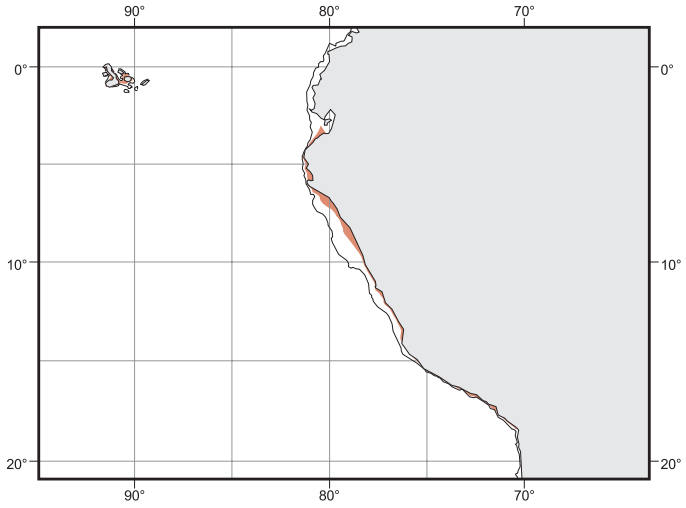


Fig. 38 ***Heterodontus quoyi***

Field Marks: Dorsal fins with spines, anal fin present, first dorsal-fin origin over pectoral-fin inner margins, colour pattern of large dark spots.

Diagnostic Features: Supraorbital ridges low, gradually ending posteriorly; interorbital space very shallowly concave, depth between ridges less than one-fourth eye length. Anterior holding teeth with a cusp and a pair of cusplets in adults, posterior molariform teeth strongly carinate and not greatly expanded and rounded. Pre-first dorsal-fin length 32 to 36% and

anal-caudal space 4 to 7% of total length. Lateral trunk denticles fairly large and rough. Propterygium separate, not fused to mesopterygium. First dorsal-fin spine directed obliquely posterodorsally in hatchlings to adults; first dorsal-fin origin behind pectoral-fin insertions, over pectoral-fin inner margins and far behind gill openings; first dorsal-fin insertion about opposite pelvic-fin origins and far behind pectoral-fin insertions; first dorsal-fin free rear tip over or behind midbases of pelvic fins and sometimes about opposite pelvic-fin insertions; first dorsal fin rounded and brush-shaped in young and low and rounded-subangular in adults, height 8 to 9% of total length, first dorsal fin subequal to pelvic fins; second dorsal-fin origin slightly to well behind pelvic-fin free rear tips, second dorsal fin rounded-angular and nearly as large as first dorsal fin. Anal fin rounded-angular, apex well anterior or reaching lower caudal-fin origin when laid back; anal-caudal space less than twice anal-fin base. Total vertebral count 103 to 109, precaudal count 67 to 72, monospondylous precaudal count 24 to 36, diplospondylous precaudal count 33 to 41, pre-first dorsal-fin spine count 19 to 20, and count from diplospondylous transition to second dorsal-fin spine 11 to 19. Identification of egg cases uncertain, but possibly like those of ***H. francisci***, with flat thin spiral flanges diagonal to case axis, without tendrils on case apices, and flanges with five turns. A small species, mature between 48 and 61 cm. **Colour**: background colour of dorsal surface light grey or brown with large black spots greater than half eye diameter, no dark harness pattern; head without a light-coloured bar on interorbital surface and with mottled dark spots or blotches under eye; fins without abrupt dark tips and white dorsal-fin apices; hatchlings without whorls on fins and body and similar in coloration to adults.



Distribution: Eastern Pacific from the coasts and offshore islands of Peru and the Galapagos Islands.

Habitat: A little-known but apparently common tropical and warm-temperate bullhead shark of inshore continental and insular waters, at moderate depths on the bottom. Lives on rocky and coral reefs, often seen resting on ledges of vertical rock surfaces at 16 to 30 m depth.

Biology: A poorly known, primarily nocturnal shark. Oviparous. Feeds on crabs; sometimes with marine algae in its stomach. One taken from the stomach of a tiger shark.

Size: Maximum total length 61 cm; an egg case possibly from this species was about 11 cm long; an apparently newly hatched male was 17 cm and an adult male was 48 cm long.

Interest to Fisheries and Human Impact: Not a commercial species (N. Chirichigno, pers. comm.), though presumably caught as discarded bycatch. Commonly seen by divers off the Galapagos Islands.

Local Names: Galapagos bull-head shark, Peruvian horn shark, Galapagos horn shark (English); Gato, Suño, Tiburón tamborín (Peru).

Remarks: N. Chirichigno (1980, pers. comm. to Compagno, 1984) suggested that there may be more than one species included under ***H. quoyi***. The ***quoyi***-like ***Heterodontus*** from Peru, with the first dorsal-fin origin slightly behind the pectoral-fin bases, includes two forms: one of these has concave posterior dorsal-fin margins, a long space about twice the anal-fin base length between the anal-fin base and lower caudal-fin origin, and an anal fin that falls well ahead of the lower caudal-fin origin when laid back; and a second form with convex posterior dorsal-fin margins, a short space much less than twice the anal-fin base length between the anal-fin base and lower caudal-fin origin, and an anal fin that reaches the lower caudal-fin origin when laid back. If distinct species, the first type is apparently the true ***H. quoyi***, while the second could be distinguished as ***H. peruanus***. I continue to hesitate to separate these two forms with the small amount of material I have examined, and follow Taylor (1972), who examined material from Peru and included them in one species.

Literature: Beebe and Tee-Van (1941); Smith (1942); McLaughlin and O'Gower (1971); Taylor (1972); Chirichigno (1980); Compagno (1984); Michael (1993); Compagno, Krupp, and Schneider (1995).

Heterodontus ramalheira (Smith, 1949) Fig. 39

Gyropleurodus ramalheira Smith, 1949a, *Ann. Mag. Nat. Hist.* (ser. 12), 2(17): 367, fig. 1. Holotype in Natural History Museum, Maputo, Mozambique, 585 mm female, moderately deep water off Inhambane, Mozambique.

Synonyms: None.

Other Combinations: None.

FAO Names: En - Whitespotted bullhead shark; **Fr** - Requin dormeur chabot; **Sp** - Dormilón boquigrande.

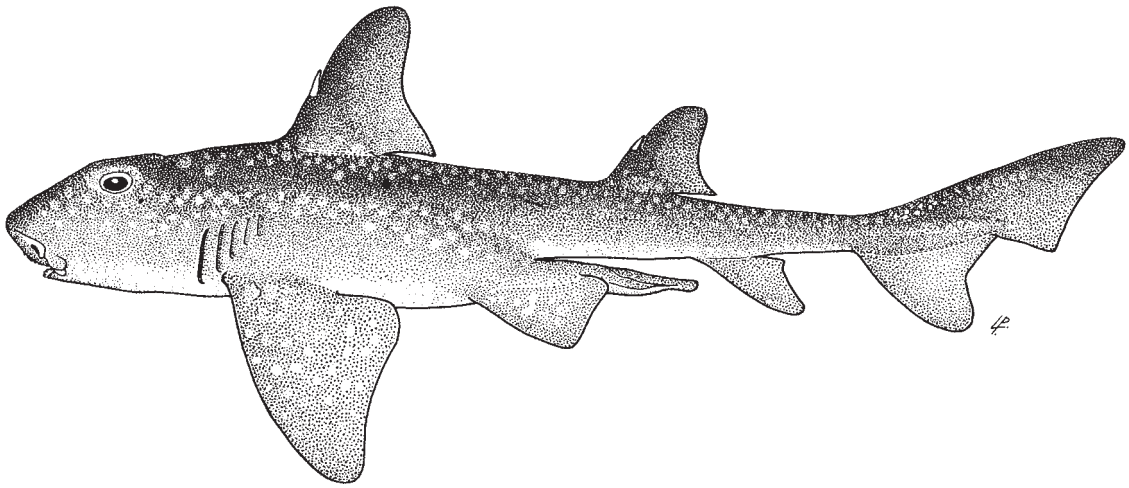
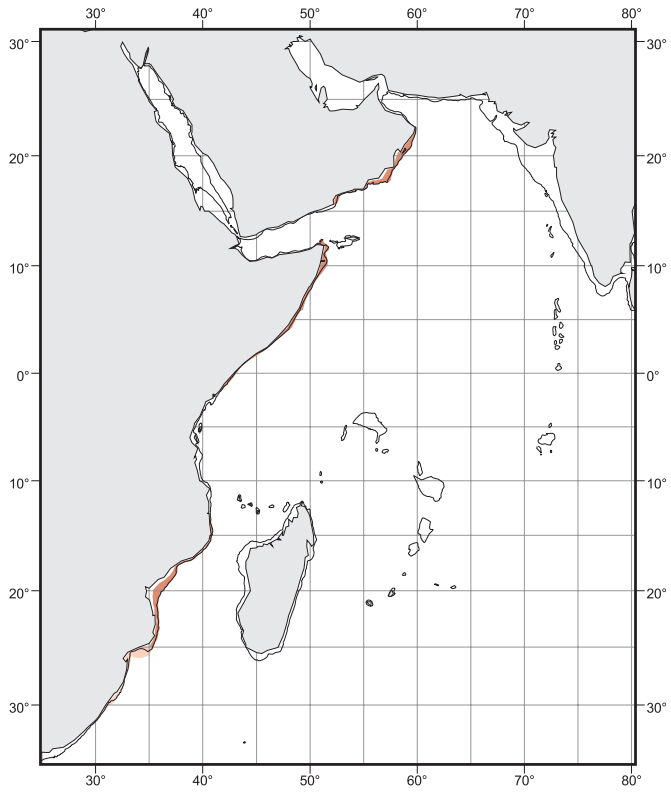


Fig. 39 ***Heterodontus ramalheira***

Field Marks: Dorsal fins with spines, anal fin present, colour pattern of white spots on variegated darker background including dark saddles in adults, hatchling young with whorls of dark lines on a light background.

Diagnostic Features: Supraorbital ridges moderately high, abruptly truncated posteriorly; interorbital space moderately concave, depth between ridges about half eye length. Anterior holding teeth with a cusp and a pair of cusplets in adults, posterior molariform teeth strongly carinate and not greatly expanded and rounded. Pre-first dorsal-fin length 20 to 26% and anal-caudal space 8 to 10% of total length. Lateral trunk denticles large and rough. Propterygium separate, not fused to mesopterygium. First dorsal-fin spine directed somewhat forward in hatchlings and juveniles and vertical in adults; first dorsal-fin origin far anterior to pectoral-fin insertions, just behind or even over pectoral-fin origins and over third to fifth gill openings; first dorsal-fin insertion far anterior to pelvic-fin origins, just behind pectoral-fin insertions; first dorsal-fin free rear tip anterior to or opposite of pelvic-fin origins; first dorsal fin falcate in young and high and semifalcate in adults, first dorsal-fin height 11 to 21% of total length, first dorsal fin much larger than pelvic fins; second dorsal-fin origin over pelvic-fin inner margins and well in front of pelvic-fin rear tips, second dorsal fin falcate and much smaller than first dorsal fin. Anal fin angular and falcate, apex slightly anterior to lower caudal-fin origin when laid back; anal-caudal space slightly less than twice anal-fin base. Total vertebral count 104 to 116, precaudal count 67 to 73, monospondylous precaudal count 32 to 34, diplospondylous precaudal count 34 to 40, pre-first dorsal-fin spine count 10 to 14, and count from diplospondylous transition to second dorsal-fin spine 7 to 10. Egg cases unknown. A moderately large species, mature between 60 and 83 cm. **Colour**: background colour of dorsal surface dark reddish brown with white spots, lighter in hatchlings, without a dark harness pattern but with darker indistinct saddles; head without light-coloured bar on interorbital surface of head in adults but young with transverse parallel dark lines there, and a series of narrow dark parallel stripes under eye in hatchlings, changing to a dusky patch in larger juveniles and lost in adults; fins without abrupt dark tips and white dorsal-fin apices; hatchlings with a unique and striking pattern of numerous thin curved parallel dark lines in whorls on fins and body, lost with growth and absent in adults.



Distribution: Western and northern Indian Ocean, South Africa (KwaZulu-Natal), south-central Mozambique, Somalia, eastern shore of the Arabian Peninsula and southern Oman.

Habitat: A rare and little-known benthic shark of the outer continental shelf and uppermost slope of southern and East Africa and the eastern Arabian Peninsula, unusual for the family in being a deepish water species found at 40 to 275 m, with most records below 100 m and from trawler hauls. At least one station that recorded this shark was on sandy bottom.

Biology: Presumably oviparous, but egg cases have not been reported to date. Young individuals including a hatchling have been found off southern Mozambique at 110 m. Crabs were found in the stomachs of two individuals.

Size: Maximum about 83 cm; hatchling 18 cm; males immature at 39 cm, adolescent at 56 cm, adults to at least 69 cm; adult females 75 to 83 cm.

Interest to Fisheries and Human Impact: Interest to fisheries none, occasionally caught as bycatch of commercial bottom trawlers including shrimp trawlers off southern Mozambique and South Africa. Conservation status unknown, apparently rare or uncommon, only one specimen caught recently in experimental trawling off Mozambique (Sea Fisheries Research Institute, *R.V. ALGOA* cruise 014, 1994) with 52 offshore bottom trawl stations at depths of 37 to 517 m.

Local Names: Mozambique bullhead shark, Mosambiekse bulkophaai (South Africa); Turbarão dorminhoco de Moçambique.

Literature: Smith (1949a); Pinchuk (1969); Taylor (1972); Bass, D'Aubrey and Kistnasamy (1975d); Compagno (1984); van der Elst and Vermeulen (1986); Compagno, Ebert and Smale (1989); Bass (1986); Randall (1995); S. Dudley and P. van Blerck (pers. comm.).

Heterodontus zebra (Gray, 1831) Fig. 40

Centracion zebra Gray, 1831, *Zool. Misc.*: 5. Holotype: British Museum (Natural History), BMNH 1953.5.10.4, dry specimen, female about 47 cm, from Swatow, China (confirmed by Eschmeyer, 1998, *Cat. Fish.*, CD-ROM, who gives the catalogue number). Also, ***Cestracion zebra*** Agassiz, 1853, *Proc. Am. Acad. Sci.*, 3: 65 (Eschmeyer, ibid.), possibly a correction of Gray's generic allocation rather than a new name.

Synonyms: ?***Cestracion philippi*** var. ***japonicus*** Dumeril, 1865: 426 (In part? See note above under ***H. japonicus***). ***Cestracion amboinensis*** Regan, 1906b: 436. Holotype: British Museum (Natural History), BMNH 1867.11.28.100 or 183, 580 mm specimen, Amboyna (confirmed by Eschmeyer, 1998: CD-ROM, who gives the catalogue number).

FAO Names: En - Zebra bullhead shark; **Fr** - Requin dormeur zebre; **Sp** - Dormilón acebrado.

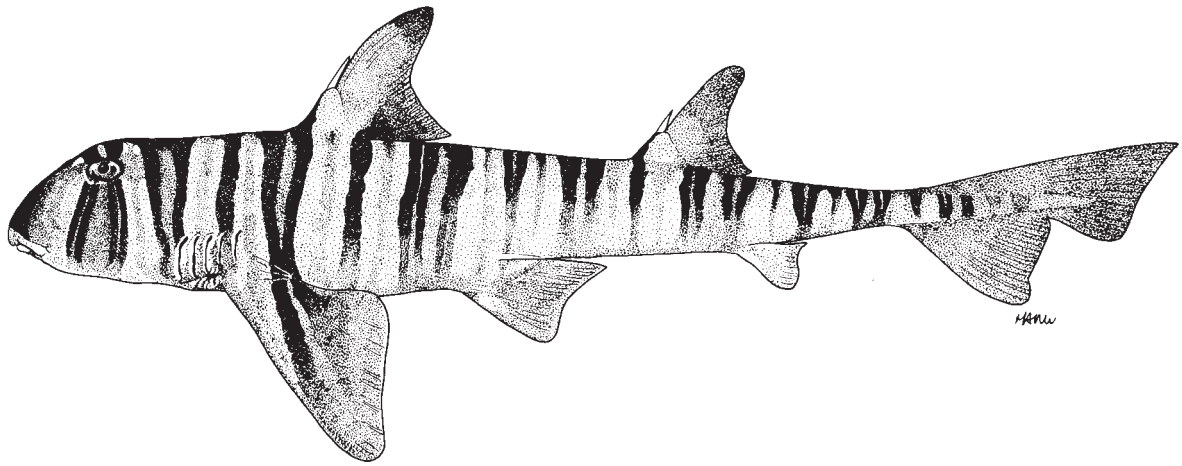


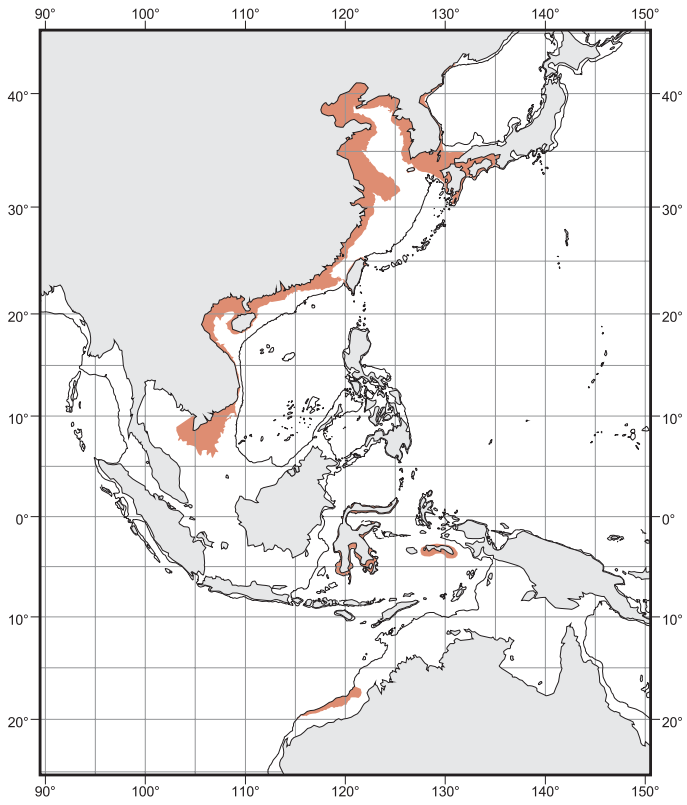
Fig. 40 ***Heterodontus zebra***

Field Marks: Dorsal fins with spines, anal fin present, striking zebra-striped colour pattern of numerous narrow dark vertical saddles and bands on light background.

Diagnostic Features: Supraorbital ridges low, gradually ending posteriorly; interorbital space very shallowly concave with depth between ridges about one-fourth eye length. Anterior holding teeth with a cusp and probably a pair of cusplets in adults, posterior molariform teeth strongly carinate and not greatly expanded and rounded. Pre-first dorsal-fin length 21 to

27% and anal-caudal space 10 to 12% of total length. Lateral trunk denticles fairly small and smooth. Propterygium fused to mesopterygium. First dorsal-fin spine directed obliquely posterodorsally in young and adults; first dorsal-fin origin anterior to pectoral-fin insertions, slightly behind pectoral-fin midbases, and well posterior to fifth gill openings; first dorsal-fin insertion well anterior to pelvic-fin origins and well behind pectoral-fin insertions; first dorsal-fin free rear tip about opposite to or somewhat behind pelvic-fin origins; first dorsal fin very high and falcate in young and moderately high and falcate in adults, first dorsal-fin height 9 to 27% of total length, first dorsal fin much larger than pelvic fins; second dorsal-fin origin behind pelvic-fin rear tips, second dorsal fin falcate and much smaller than first dorsal fin. Anal fin subangular and rounded to falcate, apex slightly anterior to lower caudal-fin origin when laid back; anal-caudal space over twice anal-fin base. Total vertebral count 117, precaudal count 74 to 81, monospondylous precaudal count 34 to 38, diplospondylous precaudal count 39 to 45, pre-first dorsal-fin spine count 15 to 17, and count from diplospondylous transition to second dorsal-fin spine 10 to 16. Egg cases with flat thin spiral flanges nearly transverse to case axis, without tendrils on case apices but with short ones on opposite end, flanges with a single turn. A large species, mature between 64 and 122 cm. **Colour**: background colour of dorsal surface white or cream with a zebra-striped pattern of 22 to 36 brown or black, narrow vertical markings from snout tip to origin of caudal fin, with bold saddles and bands often separated by more diffused narrow bands, without light or dark spots, bands not arranged in a harness pattern; head with transverse dark and light bars on interorbital surface, and with a bilobate pair of dark bands separated by a light stripe under eye; fins without abrupt dark tips and white dorsal-fin apices; hatchlings without whorls on fins and body, colour pattern as in adults.

Distribution: Western Pacific: Japan, Korean peninsula, China, Taiwan (Province of China), Viet Nam, Indonesia (Sulawesi, Ambon), and tropical Australia (northern Western Australia).



Habitat: A common but little-known bottom shark, found on the continental and insular shelves of the western Pacific from inshore down to at least 50 m in the South China Sea, but deeper and in 150 to 200 m off Western Australia.

Biology: Oviparous, details of spawning not recorded. Biology poorly known. Probably eats bottom invertebrates as with other members of the family.

Size: Maximum total length about 122 cm, hatchlings at least 15 cm, males immature at 44 cm and mature at 64 to 84 cm, females to 122 cm.

Interest to Fisheries and Human Impact: Probably of minimal interest to commercial fisheries. Caught as bycatch by commercial trawlers and possibly other fisheries in its range. Conservation status unknown but of some concern. Utilization in aquarium trade not recorded, but an obvious candidate because of its attractive colour pattern.

Local Names: Zebra horn shark, Zebra Port Jackson shark, Striped bullhead shark, Barred bull-head shark, Barred shark, Striped cat shark, Shima-nekozame (Japan); Maou urh sha or Cat shark, Mau i sha or Little shark (China).

Literature: Fowler (1941); Smith (1942); Lindberg and Legeza (1959); Chen (1963); Bessednov (1969); Taylor (1972); Compagno (1984); Nakaya and Shirai (1984); Last and Stevens (1994); Compagno and Niem (1998).

Heterodontus sp. A

Fig. 41

***Heterodontus* sp. A** J. Mee, pers. comm. for a bullhead shark collected off Oman, apparently representing an undescribed species. Also Randall, 1995, Coastal Fishes of Oman: 19, fig. 2.

Synonyms: None.

Other Combinations: None.

FAO Names: En - Oman bullhead shark; **Fr** - Requin dormeur d'Oman; **Sp** - Dormilón de Omán.

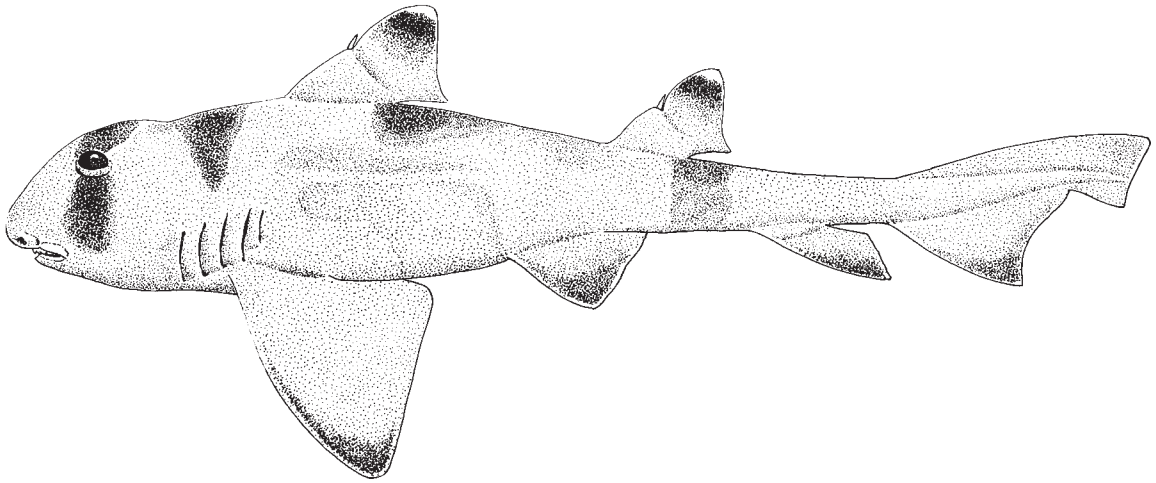
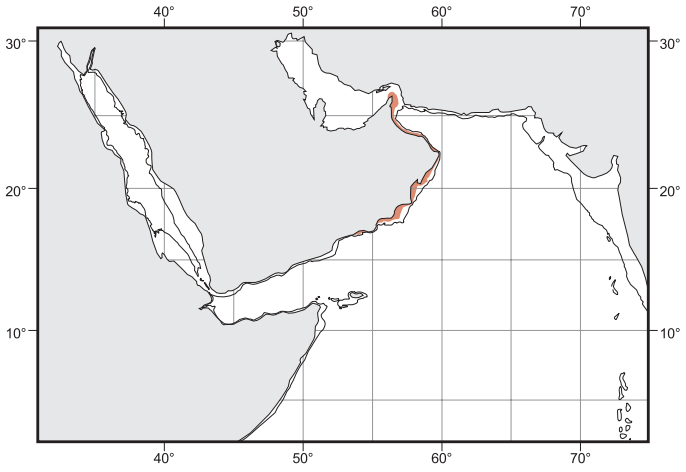


Fig. 41 ***Heterodontus*** **sp. A**

Field Marks: Dorsal fins with spines, anal fin present, first dorsal-fin origin over pectoral-fin inner margins, colour pattern of a few broad dark saddles on body, without narrow intermediate stripes or small dark spots, dorsal, caudal and pectoral fins with abruptly black tips, dorsal fins with white apical spots.

Diagnostic Features: Supraorbital ridges moderately low, gradually ending posteriorly. Interorbital space weakly concave, depth between ridges probably less than one-fourth eye length. Anterior holding teeth with a cusp and a pair of cusplets in adults, posterior molariform teeth unknown. Pre-first dorsal-fin length about 24% and anal-caudal space about 7% of total length. Lateral trunk denticles fairly rough. Propterygium condition unknown. First dorsal-fin spine directed obliquely posterodorsally in adults, first dorsal-fin origin in front of pectoral-fin insertions, somewhat behind pectoral-fin midbases, and well posterior to fifth gill openings; first dorsal-fin insertion well anterior to pelvic-fin origins and well behind pectoral-fin insertions; first dorsal-fin free rear tip slightly anterior to pelvic-fin origins; first dorsal fin low and rounded-angular in adults, height about 11% of total length, first dorsal fin about as large as pelvic fins; second dorsal-fin origin about opposite pelvic-fin insertions or rear tips, second dorsal fin weakly falcate and nearly as large as first dorsal fin. Anal fin subangular, with apex reaching lower caudal-fin origin when laid back; anal-caudal space less than twice anal-fin base. Total vertebral count 106, precaudal count 68, monospondylous precaudal count 35, diplospondylous precaudal count 33, prefirst dorsal-fin spine count 13, and count from diplospondylous transition to second dorsal-fin spine 8. Egg cases unknown. Possibly a small species, mature between 52 and 61 cm. **Colour**: background colour of dorsal surface tan to brown with 4 or 5 broad diffuse-edged brown saddles from snout tip to origin of caudal fin, without light or dark spots except dark fin tips, no harness pattern; head with a dark bar on interorbital surface and a single broad dark blotch under eye; fins tipped with dark brown or blackish, additionally a white spot on apices of dorsal fins; hatchling colour pattern unknown.

Distribution: Northern Indian Ocean: Oman.



Habitat: Caught off southern Oman, depth 80 m, presumably on soft bottom as specimens came from commercial trawlers.

Biology: Essentially unknown.

Size: Maximum size 61 cm. An adult male is 52 cm and an adult female 61.2 cm.

Interest to Fisheries and Human Impact: Caught in hauls by commercial trawlers off southern Oman.

Local Names: Oman bullhead shark.

Remarks: This is apparently an undescribed species of bullhead shark, superficially similar to ***H. japonicus*** but readily separable by its different colour pattern, very low dorsal fins, and possibly smaller size.

Literature: Randall (1995); J. Mee (pers. comm).