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Validity of *Psammoperca datnioides* Richardson 1848 and redescriptions of *P. waigiensis* Cuvier in Cuvier & Valenciennes 1828 and *Hypopterus macropterus* (Günther 1859) in the family Latidae (Perciformes) from the Indo-West Pacific

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Abstract

Psammoperca datnioides Richardson 1848, long considered a synonym of *P. waigiensis* (Cuvier in Cuvier & Valenciennes 1828), is redescribed as a valid species of *Psammoperca* Richardson 1848. The species is likely to be endemic to Australia, where it was formerly considered to be *P. waigiensis*, but differs from *P. waigiensis* in having the following characters: more slender body (mean depth 28.9% of SL vs. mean depth 36.7% of SL in *P. waigiensis*), pored lateral-line scales 49–54 (vs. 46–48 in *P. waigiensis*), scale rows above and below lateral line 6½ / 10½–11½ (vs 4½ / 9½–10½ in *P. waigiensis*), and vertical at hind margin of maxilla posterior/behind center of eye (vs. vertical at hind margin of maxilla anterior to/in front of hind margin of eye in *P. waigiensis*). Live specimens of *Psammoperca datnioides* have a uniformly dense black or brownish body, with this dark colour on body scales and pored lateral-line scales persisting even in preserved specimens. Live specimens of *Psammoperca waigiensis* have a brownish body, often golden in colour, and pored lateral-line scales that are yellow-edged. The COI sequence (cytochrome c oxidase subunit I, 612 bp) of *P. datnioides* also is distinct from *P. waigiensis,* and the related and poorly known *Hypopterus macropterus* (Günther 1859). The latter species is redescribed and diagnosed with eight indistinct dark bands on the head and body, and dorsal-fin rays VII-I, 14–15 (vs. no dark bands and dorsal-fin rays VII-I, 12–13 in *Psammoperca*). Nominal species in the genus *Psammoperca* are discussed and *Cnidon chinensis* Müller & Troschel 1849 (type locality: Manila, Philippines) is included as a junior synonym of *P. waigiensis. Psammoperca vaigiensis* Boulenger 1895 is an unneeded emendation and thus an invalid name. *Psammoperca macroptera* Günther 1859 is retained in the monotypic genus *Hypopterus* Gill 1861 in the family Latidae, although the species has been overlooked in most studies on the Latidae and/or Centropomidae. A key to the Latidae is provided.

Key words: *Psammoperca datnioides*, *Hypopterus macropterus,* sea perch, Latidae, cryptic species, genetic phylogeny, COI, Australia

Introduction

The genera *Psammoperca, Lates* and *Centropomus* were previously included in the family Centropomidae by Greenwood (1976), who they recognised the subfamilies Latinae (*Psammoperca, Lates*) and Centropominae (*Centropomus*). However, based on the observed distribution of dorsal epaxial musculature patterns among percoid fishes, Mooi & Gill (1995) questioned the relationship of recent Latinae with the Centropominae, and proposed they be recognised as separate families: Latidae and Centropomidae. An osteological study of Otero (2004) supported separating the families Latidae and Centropomidae. Otero (2004) also presented a phylogenetic hypothesis based on a cladistic analysis using 29 characters (28 osteological, and one myological) for four genera: *Lates* (recent and fossil), *Psammoperca* (recent) and *Eolates* (fossil), comprising the monophyletic family Latidae and Centropomidae with a monophyletic genus, *Centropomus.*

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A genetic study by Li *et al*. (2011) reported that the phylogeny for the extant Centropomidae is '((*Lates*, *Psammoperca*), *Centropomus*)', based on DNA sequence data (12 888 bp aligned) from thirteen genes (one mitochondrial and twelve nuclear markers). These authors recognised a single family, Centropomidae, which included the subfamily Latinae (two genera, *Lates* and *Psammoperca*) and the subfamily Centropominae (single genus *Centropomus*). However, the bootstrap (63) and posterior probability (0.74) values in support of such a relationship are weak, and their topology tests failed to reject a sister-group relationship between latines and centropomines (Li *et al*. 2011: 469). Thus, we do not consider re-establishing the family Centropomidae is sufficiently justified. Gan *et al*. (2017) also studied mitochondrial genomes (13 mitochondrial protein-coding genes and two ribosomal RNA genes) and phylogenetic relationships of three species of the Latidae, but did not examine *Centropomus,* and their analysis, while supporting monophyly of the genus *Lates*, does not clarify the phylogenetic position of the Latidae.

The genus *Lates* contains 11 species. The economically important barramundi or giant sea perch, *L. calcarifer* Bloch 1790, was long considered to be a single species from the Indo-West Pacific, but Katayama & Taki (1984) described a threatened endemic Japanese giant perch, *Lates japonicus*, with a limited distribution in southern Japan (Iwatsuki *et al*. 1992; Iwatsuki 2010; Takahashi *et al*. 2015).

Two new species, *Lates lakdiva* and *L. uwisara*, were recently described by Pethiyagoda & Gill (2012) from Sri Lanka and Myanmar respectively. However, while mitochondrial analysis supports the recognition of *L. japonicus* as distinct from *L. calcarifer*, genetic data for the other species are lacking, and the *Lates* species complex from the Indo-West Pacific is in need of further taxonomic review. *Lates* species in marine waters, including estuaries, have never been reported from the east coast of Africa (Katayama & Taki 1984). However, seven freshwater congeners of the genus *Lates*, including the economically important Nile perch, *L. niloticus,* inhabit the Nile basin and connected African freshwaters, and were probably derived from the Mediterranean which was connected to the Indian Ocean until the mid-Miocene (Matthew 2009; Harzhauser & Piller 2007).

A poorly known species, *Hypopterus macropterus* (Günther 1859) was included in the synonymy of *Psammoperca waigiensis* Cuvier in Cuvier & Valenciennes 1828 by Greenwood (1976, p. 77). The species has been overlooked in most studies involving the Latidae and/or Centropomidae. Pethyagoda and Gill (2013) recently noted that Gill & Mooi (1995) examined a specimen and verified that the species had the same epaxial muscle pattern as *Lates* and *Psammoperca.* Several authors (Allen & Swainston 1988; Paxton *et al*. 1989; Hutchins 2001) considered *H. macropterus* to be a valid genus and species, although no detailed examination was undertaken.

Psammoperca waigiensis, the Waigieu sea perch or Waigeo barramundi, on the other hand, is a well-known species, reported in tropical coastal waters from the Bay of Bengal, south through Indonesia to Australia, north through the Philippines, and through the South China Sea to the Ryukyu Islands, Japan (Fowler & Bean 1930; Larson *et al*. 2013). Although *P. waigiensis* is less common than *L. calcarifer*, the species is widely considered as a commercial fish in southeastern Asian countries.

During faunal research on fishes of Western and Northern Australia, another discernible species in the genus *Psammoperca,* erroneously identified as *P. waigiensis* (Paxton *et al*. 1989; Larson 1999; Allen *et al*. 2006), was noticed as an unfamiliar *Psammoperca* species by the first author. The other species is easily differentiated from *P. waigiensis* in having a more slender body, a more densely black head and body, different counts of the pored-lateral line, and other morphological characters. The nominal species are discussed, and the name *Psammoperca datnioides* Richardson 1848 is available for this species from Australia.

Herein we redescribe *Psammoperca datnioides* Richardson 1848 as a valid species of *Psammoperca,* and designate a neotype for the species. Another poorly known latid species (called Spikey bass in Australia), *Hypopterus macropterus* (Günther 1859), also is recognized as a valid monotypic genus. The phylogenetic position of the COI sequence (612 bp) in *H. macropterus* strongly suggests it belongs to the latid group (*Lates* (*Psammoperca* + *Hypopterus*)) and not *Centropomus*, and it is redescribed. All nominal species in *Psammoperca* are discussed. A key to the family Latidae is provided.

Material and methods

Counts and measurements generally follow the methods described by Iwatsuki *et al*. (2007) and Iwatsuki & Heemstra (2011). Additional counts of circumpeduncular scales follows Pethiyagoda & Gill (2012). The vertebral

formula gives the number of abdominal and the number of post-abdominal vertebrae as 'vertebrae 11 + 15 = 25'. The predorsal formula follows Ahlstrom *et al*. (1976) and Otero (2004). Institutional codes follow Sabaj Perez (2014), with the addition of Okinawa Churashima Foundation (OCF). Standard length is abbreviated as SL, total length as TL. Specimens X-rayed are indicated by '(X)' after the size in the list of specimens. *Psammoperca* specimens in the QM and AMS from the eastern coast of Australia were examined only for counts of pored lateral-line scales and soft dorsal-fin rays and for photographic confirmation of their identity.

Sex was examined by incision of the right side for the neotype and non-type specimens of *Psammoperca datnioides*. URM specimens are now at OCF. Cyanine blue solution in 70% ethanol was used for counting scales and examining squamation. The nomenclature for genetic sequences for type specimens follows Chakrabarty (2010) and Harrison *et al.* (2011). Muscle tissue samples were taken from fresh specimens and stored frozen in 99.9% ethanol. DNA was extracted from muscle tissue by protenase K digestion, followed by a standard phenol chloroform method (Sambrook & Russell 2001). Primers used for the amplification of the cytochrome c oxidase subunit I (COI, 612 bp) gene were Fish F1–5'-TCAACCAACCACAAAGACATTGGCAC-3' and Fish R1–5'-TAGACTTCTGGGTGGCCAAAGAATCA-3' (Ward *et al.*, 2005). The thermal regime consisted of an initial step of 2 min at 95˚C followed by 35 cycles of 40 s at 94˚C, 40 s at 54˚C and 1 min 10 s at 72˚C, followed by final extension for 10 min at 72˚C. The PCR products were visualized on 1.2% agarose gels. Sequencing of the samples was performed by the Dragon Genomics Center, TAKARA BIO INC (Otsu, Shiga, Japan). Sequences were aligned using CLUSTAL X (Larkin *et al*. 2007). The COI gene of the six species (*Lates calcarifer*, *L. japonicus, Psammoperca datnioides*, *P. waigiensis*, and *Hypopterus macroptera*) were aligned to yield a partial sequence with *Centropomus unidecimalis* of the family Centropomidae, which was used as an outgroup. The Kimura's parameters K2P from the COI gene were calculated by Mega 6 (version 6.05: www.megasoftware.net; Tamura *et al*. 2013). A neighbour-joining (NJ) tree of K2P distances was created to provide a graphic representation of the pattern of divergence between species (Saitou & Nei 1987), by bootstrapping sequence data of the above latid species using Mega 6 software with 1000 replications. Samples from *Psammoperca datnioides* and *P. waigiensis*, and the data provided are given as follows: (number of specimens examined), catalogued number, GenBank accession numbers for nucleotide sequences associated with vouchers: *Psammoperca datnioides* (*n* = 3), NTM S.16708-010, neotype (neogenotype), 138 mm SL (1 of 7 specimens, tissue [NTM #623] removed from right side), Darwin Harbour, Northern Territory (NT), Australia, and one tissue sample (NTM #209 = MUFS 47404) without voucher, Middle Arm, Darwin Harbour, 10 Feb. 2003; uncatalogued specimen without voucher (Fig.1B), 204 mm SL, tissue (MUFS 42669), Perth, WA, Australia (WAM P.344852-001 [024+06, X]), Accession Nos. LC269829, LC269830, and LC269831, respectively; *Psammoperca waigiensis* (*n* = 1), MUFS 36075, 250 mm SL, Okinawa, Japan, Accession No. LC269828; *Hypopterus macropterus* (*n* = 2), WAM P.34451-001 and WAM P.34512-001, Shark Bay in both specimens, Western Australia, Australia, Accession Nos. LC269833 and LC269834, respectively; *Lates japonicus* MUFS 33124, Miyazaki, Japan, Accession No. LC269832; other Accession Nos. JF919741, EF609379, and JX983354 for *Lates calcarifer*, AP017445 and AF240737 for *L. japonicus*, and JQ365276 for *Centropomus undecimalis* (the outgroup) were obtained from NCBI (http://www.ncbi.nlm.nih.gov/).

Taxonomy

Genus *Psammoperca* Richardson 1844

Psammoperca Richardson 1844

Type species: *Labrax waigiensis* Cuvier & Valenciennes 1828

Diagnosis. Distinguished from other latid genera by the following combination of characters: a smooth horizontal limb of the preopercle; nostrils widely separated on each side of the head, anterior nostril with a tube-like flap or skin flap posteriorly, and posterior nostril oval and larger; tiny scales (not seen with naked eye but visible through binocular scope) on posterior uppermost part of the maxilla; one row of lateral-line scales on caudal fin; several supralamellar tooth patches only on outer face of first four gill arches and a tooth patch on the basihyal; ventral border of first and second infraorbital bones smooth (no denticulations); no parapophysis on the first 5 or 6

abdominal vertebrae; epineurals on the first 7 or 8 abdominal vertebrae; three sharp, strong spines on inferior margin of preopercle; supraneural spine formula 0/0/0 + II/I + I/; dorsal-fin rays VII–I, 12 or 13; anal-fin rays III, 8; caudal fin with posterior border rounded; procurrent spur present; vertebrae 11 + 14 = 25.

Distribution. Two species from southern Indian coast, Bay of Bengal and Andaman Sea, to western Pacific, north Okinawa Island, Japan, and south to Australia.

Psammoperca datnioides Richardson 1848

Proposed New English name: Black Sand Bass
Fig. 1A, Table 1

Psammoperca datnioides Richardson 1848:116, pl. 57, figs. 1–2 (type locality: 'Australia'=probably Western Australia, type in BMNH lost)

Psammoperca waigiensis (*non* Cuvier); Günther 1859:69 (Victoria [= Port Essington], NT, Australia); Günther 1872:426 (Victoria [= Port Essington], NT, Torres Strait, NSW, Australia); Allen & Swainston 1988:62 (northwestern Australia); Paxton *et al*. 1989:483 (Australia); Randall *et al*. 1990:88 (Great Barrier Reef, Australia); Allen 1997:98 (tropical Australia); Larson & Williams 1997:354 (Darwin Harbour, NT, Australia); Kuiter 1997:124 (Australia); Randall *et al*. 1997:88 (Great Barrier Reef, Australia); Larson 1999:2430 (as *vaigiensis*; Indo-Australian Archipelago, but Australia, shown as distributional map, presumably considered this species); Johnson 1999:729 (Moreton Bay, Queensland, Australia); Hutchins 2001:29 (Western Australia); Allen *et al*. 2006:968 (Australia).

Neotype. NTM S.16708-077, 138 mm SL, tissue removed (right side), Bullocky Point Reef, Darwin Harbour (Vestey's Beach boat ramp, Fannie Bay, Darwin, NT, Australia.

Non-type specimens (118–214 mm SL, n = 26): WAM P.34451-001 204–214 mm SL (X), Carnarvon Boat Harbour, mouth of Shark Bay, Western Australia; WAM P.34452-001, 6 specimens, 137–197 mm SL (X), Shark Bay, Western Australia; NTM S.10136-001, 201 mm SL, West Woody Reef, Melville, Bay, NT, Australia; NTM S.11238-001, 207 mm SL, Roche Reef, off Dum In Mirrie Island, NT, Australia; NTM S.11253-006, 186 mm SL, Table Head, Cobourg Peninsula, NT, Australia; NTM S.12444-021, 7 specimens, 126–149 mm SL, Pools south of Settlement, Elcho Island, NT, Australia; NTM S.12449-003, 206 mm SL, East of 5th Shell Island, Darwin Harbour, NT, Australia; NTM S.16131-017, 183 mm SL, Raft Point, Bynoe Harbour, NT, Australia; NTM S.16148-007, 206 mm SL, Point Jenny, Fog Bay, NT, Australia; NTM S.16708-010, 6 specimens, 117–143 mm SL, Bullocky Point Reef, Darwin Harbour, NT, Australia.

Photographic confirmation. QM I.35512, 77 mm SL, Double Point, Queensland (17° 38'S, 146° 09'E); QM I.32402, 184 mm SL, Elliot Heads (24°59'S, 152°33'E): QM I.23774, 3 specimens, 196–208, Cullen Island (21° 25'S, 149° 30'E), Queensland; AMS I.20776-007, 3 of 8 specimens, ca. 100–125 mm SL, False Orfordness, Cape York (11°23' S, 142°52' E), Torres Strait, Queensland, Australia.

Diagnosis. Distinguished from *P. waigiensis* by the following combination of characters: dense black or brownish colour on whole of head and body, pored lateral-line scales same colour of other scales of body (Fig. 1B), not yellow-edged like *P. waigiensis* (Fig. 1C), same dark colour persisting even in preserved specimens; higher counts of pored lateral-line scales, 49–54; hind margin of maxilla reaching vertically beyond center of eye when mouth closed; pelvic-fin spine slightly longer than 4th dorsal spine; 25 or 26 circumpeduncular scales; shallower body depth, 23–30% (mean 28%) of SL; greater number of scale rows above and below lateral line 6½ / 11½–12½; gill rakers 7 [including 6 rudiments] + 1 + (12–14 [3–4 rudiments]) = 20–24 [9–10 rudiments]; last dorsal-fin spine / penultimate dorsal-fin spine 0.9–1.1.

Description. Counts and proportional measurements (as percent of SL) of the neotype and other non-type specimens of *Psammoperca datnioides* are shown in Table 1.

Body compressed, its depth 3.2–3.7 times in SL, deepest at dorsal-fin origin; dorsal profile concave in interorbital region, rising steeply (convex) thereafter to dorsal-fin origin; head moderately acute, its length 2.8–3.1 times in SL; eye oval, height less than width, orbit diameter 3.4–4.4 times in head length; snout 2.9–3.9 times in head length; interorbital space 61–71% of eye diameter; mouth oblique, lower jaw projecting beyond upper one when mouth closed; maxilla progressively deeper posteriorly, extending to vertical through anterior margin of black iris; villiform teeth present on jaws, palatines, pterygoids and vomer; tongue smooth anteriorly and present posteriorly, respectively; three sharp, strong spines on inferior margin of preopercle, a retrorse spine at angle of preopercle, the posterior margin of which bears 17–23 denticulations; a sharp spine at angle of operculum; nares

level with anterior one third of eye, separated from eye by distance subequal to diameter of black iris; first dorsal fin commencing slightly behind pelvic-fin, third spine longest (III>IV>V>VI>II>VII>I); base of first dorsal fin less than that of second dorsal fin; second anal-fin spine longest (II>III>I) in specimens less than 20 cm SL but subequal to third in specimens over 20 cm SL; pectoral fin 91–105% of length of pelvic fin; distal profiles of pectoral, pelvic, anal and second-dorsal fins rounded; caudal fin rounded, with 9 + 8 in principal rays of upper lobe + lower lobe, respectively; dorsal and ventral procurrent rays (9 or 10) + 7, respectively; caudal peduncle depth 53–62% of its length; scales ctenoid; body and head scaled, except for snout, throat, preorbital and interorbital regions; dorsal and anal fins with a scaly sheath at base; second-dorsal, caudal, anal and lateral area of pelvic fin densely covered with minute scales; one or two rows of a few pored scales on caudal fin sometimes present, one above and one below median pored lateral line; vertebrae 11 + 14 = 25.

*Colouration***.** In fresh specimens (Fig. 1A, thawed holotype and all paratypes), head and body dense black or brownish colour, darker above lateral line and on dorsal region of head, subtly paler below; fins black, interradial membrane of dorsal fin black hyaline, yellowish or olive towards distal margin. Second dorsal fin, caudal and anal fins black, pectoral and pelvic fins subtly paler, pelvic-fin spine somewhat blackish hyaline; weak yellow longitudinal stripe present from upper part of maxilla to posteroventral part with one spine as well as weak yellow posterior hind edge and hind margin of upper opercula yellow; pored lateral line black, not yellow like *P. waigiensis* (Fig. 1B). In preserved (70% ethanol) specimens, head and body uniformly black hyaline, no yellowish or olive colour on body or fins.

New English name. We propose the Australian common and local name 'Black sand bass' for this species, although it is also known by the local name 'Sand bass', but this name is more widely applied to *Psammoperca waigiensis*.

Remarks. *Psammoperca datnioides* Richardson 1848 is recognized here as a second species in *Psammoperca*.

Distribution. This species in Australia has been mistakenly reported from Queensland, New South Wales, Northern Territory, and Western Australia as *Psammoperca waigiensis* (see the synonymy of *P. datnioides* above and *P. waigiensis* below). *Psammoperca* specimens from Australia have long been reported as *P. waigiensis* (Günther 1859, 1872, Paxton *et al*. 1989, and Larson *et al.* 2013) but eight specimens, collected from Queensland, not examined by us but subsequently confirmed from photographs of QM and AMS specimens (counted by J. Johnson and photographs sent to us by M. McGrouther), are clearly *Psammoperca datnioides* with a generally dense black or brown colour and slender body, 49–53 pored lateral-line scales (49 in only 3 of 8 specimens in QM and AMS, see **Photographic confirmation**), and 12 soft dorsal-fin rays (vs. 46–48 pored lateral-line scales and 13 soft dorsal-fin rays in *P. waigiensis*: see **Diagnosis** of *P. waigiensis* below). Pored lateral-line scales seem to be less (49–53) when compared with specimens of *P. datnioides* from the Northern Territory and Western Australia (52–54). While these ranges overlap, we consider the lateral-line scale variation with location of samples to be a specific geographical variation in *P. datnioides*.

***Psammoperca waigiensis* (Cuvier in Cuvier & Valenciennes 1828)**

English name: Waigieu sea perch

Figs. 1C, 2A–B, Table 1

Labrax waigiensis Cuvier in Cuvier & Valenciennes 1828:83 (type locality: Waigeo, Indonesia); Bauchot & Desoutter 1987:72 (Waigeo, Indonesia).

Cnidon chinensis Müller & Troschel 1849:21 (Manila, Philippines).

Psammoperca waigiensis; Günther 1859:69 (Victoria [= Port Essington], NT, Australia and China; but Australian records questionable, probably *P. datnioides*); Günther 1872:426 (Victoria [= Port Essington], NT, Australia, Torres Strait, NSW, Australia, questionable as noted above, Manila, and China); Bleeker 1871–1876:108, pl. (28) 306, fig. 2 (Singapore, Bintang, Banka, Java, Madura, Borneo Celebes Waigiu, Manila): Fowler & Bean 1930:181 (Philippines); Greenwood 1976:77 (Ceylon [Sri Lanka], Madras [Chennai], Singapore, Hong Kong, Borneo, Cebu, Culion, Philippines); Fisher & Bianchi 1984:CENTRP Psamm 1 (Arabian Sea?, noted as perhaps extending to Arabian Sea, but questionable); Katayama in Masuda *et al*. 1984:123 (Ryukyu Islands, Japan); Mohsin & Ambak 1996:219 (Malaysia and neighboring countries); Rainboth 1996:183 (Cambodian Mekong); Allen 1997:98 (tropical Australia [?] and south-east Asia); Chen *et al.* 1997:39 (Nansha Islands to South China Coastal Waters); Larson 1999:2430 (as *vaigiensis*; tropical east Indo-West Pacific, from Bay of Bengal, Indo-Australian Archipelago and northern Australia [?], Philippines, Japan, and the China Sea. western Pacific); Nakabo 2000:679 (Ryukyu Islands, Japan); Lim in Randall & Lim 2000:608 (South China Sea); Sadovy &

Cornish 2000:72 (Hong Kong); Allen 2000:97 (Calamianes Islands, Philippines); Iwatsuki *et al*. 2000:98 (Makassar [= Ujung Pandang], South Sulawesi, Indonesia); Hutchins 2001:29 (Western Australia); Nakabo 2002:679 (Ryukyu Islands, Japan), Allen & Adrim 2003:30 (Indonesia); Kimura *et al*. in Kimura & Matsuura 2003:43 (Bitung, northern tip of Sulawesi, Indonesia); Otero 2004:85 (coastal Indo-Pacific marine waters); Allen & Erdmann 2012:259 (the East Indies); Kottelat 2013:323 (Inland waters of southeast Asia); Nakae in Kimura *et al*. 2015:36 (northwestern Johor Strait, Peninsular Malaysia).

Psammoperca vaigiensis; Boulenger 1895:365 (unjustified emendation of Cuvier's *Labrax waigiensis*).

Holotype. MNHN 0000-0564, 195 mm SL, Waigeo, Indonesia.

Non-type specimens (*n* = 14). MUFS 9882, 179 mm SL, Singapore; MUFS 36075, 250 mm SL, Okinawa, Japan; MUFS 43427, 241 mm SL, Okinawa Island, Japan; URM P. 979 at OCN, 299 mm SL, Okinawa Island, Japan; URM P. 13418, Chantaburi fish Market, Thailand; URM P. 26804, 247 mm SL, Naha fish market (Nahachiku-gyoren), Okinawa Island, Japan; URM P. 31787 at OCF, 250 mm SL, Chinen, Okinawa Island, Japan; URM P. 36597 at OCF, 197 mm SL, Itoman, Okinawa , Japan; URM P. 41585, 208 mm SL, Naha, Okinawa, Japan; URM P. 43585 at OCF, 272 mm SL, Okinawa Island, Japan; URM P. 44173, Bintan Island, Indonesia; ZMB 35 (holotype of Müller & Troschel's *Cnidon chinensis*), 375 mm TL, Manila, Philippines.

Diagnosis. Distinguished from *Psammoperca datnioides* by the following combination of characters: brownish dark head and body, often golden in colour in live specimens, pored lateral-line scales yellow-edged, Fig. 1C) and similar yellowish brown colour in preserved specimens; lower counts of pored lateral line scales 46–48; hind margin of maxilla reaching slightly short of hind margin of eye when mouth closed; tiny scales (not seen with naked eye] but visible through binocular scope) on posterior uppermost part of maxilla (Fig. 3C–D); pelvic-fin spine subequal to 4th dorsal spine; 21 or 22 circumpeduncular scales; moderately lesser body depth (32–36% [mean 36%] of SL); lower counts, 5½ / 7½–9½ scale rows above and below lateral line; gill rakers (7 [including 6 rudiments] + 1 + 11 [including 3 rudiments] = 19 [9 rudiments]); last dorsal-fin spine / penultimate dorsal-fin spine 1.5–1.7.

Description. Counts and proportional measurements as percent of SL of the type and other specimens of *Psammoperca waigiensis* (Cuvier in Cuvier & Valenciennes 1828) are shown in Table 1.

Body compressed, its depth 2.8–3.1 times in SL, deepest at dorsal-fin origin; dorsal profile concave in interorbital region, rising steeply (convex) thereafter to dorsal-fin origin; head moderately acute, its length 2.6–3.0 times in SL; eye oval, height less than width, orbit diameter 3.8–4.1 times in head length; snout 3.3–3.9 times in head length; interorbital space 54–63% of eye diameter; mouth oblique, lower jaw projecting beyond upper one when mouth closed; maxilla progressively deeper posteriorly, extending to a vertical beyond posterior of black iris; villiform teeth present on jaws, palatines, pterygoids and vomer; tongue smooth anteriorly and present posteriorly, respectively; three sharp, strong spines on inferior margin of preopercle, the first antrorse; a retrorse spine at angle of preopercle, the posterior margin of which bears 26–31 denticulations; a sharp spine at angle of operculum; nares level with middle of eye, separated from eye by distance subequal to horizontal orbit diameter of black iris; posteriormost part of cleithrum with one or two dull spines-like as often on exposed part without skin, just above base uppermost pectoral-fin ray (Figs. 2A–C).

First dorsal fin commencing slightly behind pelvic-fin, third spine longest (III>IV>II>V>VI>VII>I); base of first dorsal fin less than that of second dorsal fin; third anal-fin spine longest (III>II>I) in specimens of 20 cm SL but subequal to third in specimens over 20 cm SL (III = II>I); pectoral fin 89–100% of length of pelvic fin, which has one spine and five rays; distal profiles of pectoral, pelvic, anal and second-dorsal fins rounded; caudal fin rounded, with 9+8 in principal rays of upper lobe + lower lobe, respectively; dorsal and ventral procurrent rays (8–10) + (6–8), respectively; caudal peduncle depth 54–58% of its length; scales ctenoid; body and head scaled, except for snout, throat, preorbital, and interorbital regions; dorsal and anal fins with a scaly sheath at base; second-dorsal, caudal, anal and lateral area of pelvic fin densely covered with minute scales; one row of pored lateral line scales on the caudal fin but one or two rows of a few pored scales on caudal fin sometimes present one above and one below median pored lateral line; vertebrae 11 + 14 = 25.

Colouration. In fresh specimens (Fig. 1B, MUFS 43427, 241 mm SL and MUFS 9882, 179 mm SL), head and body yellowish brown, darker above lateral line and on dorsal region of head, lighter below, ventrally creamy white; fins yellowish brown, inter-radial membrane of dorsal fin yellowish hyaline, spinous portion dark brown; second dorsal fin, caudal and anal fins yellowish brown or hyaline, pectoral and pelvic fins somewhat paler yellowish brown, pelvic-fin spine whitish; vivid yellow longitudinal stripe present from upper part of maxilla to

posteroventral part, with one spine as well as yellow posterior hind edge and hind margin of upper opercular yellow; pored lateral line outstandingly yellow. In preserved (70% ethanol) specimens, head and body yellowish tan; yellow longitudinal stripe and yellow on head, body and all fins absent.

Remarks. *Psammoperca waigiensis* (Cuvier in Cuvier & Valenciennes 1828), well known as the Waigiou sea perch, is a widely distributed coastal species in the tropical eastern Indian Ocean and western Pacific Ocean (Katayama & Taki 1984; Larson 1999). Fisher & Bianchi (1984) listed *P. waigiensis* from the Western Indian Ocean, but Manilo & Bogorodsky (2003) considered this to be a questionable record.

Richardson (1848) established the genus *Psammoperca* (Type species *Psammoperca datnioides* Richardson 1848; type locality: 'Australia') in a publication on the fishes collected by the *Erebus* and *Terror* Expedition under Sir James Ross. This expedition, however, visited only Van Diemen's Land (Tasmania) in Australia and, as *P. datnioides* is a tropical species, it is unlikely that it was collected during the expedition itself. This is confirmed in a footnote by Richardson (1848:1) who remarks: 'To make the list of Australian species as complete as possible, a few undescribed fish from the western coasts of that country, discovered by the officers of the Beagle surveying ship, have been added to Sir James Ross's collections'. The *Beagle* surveyed the coast of Northwestern Australia between the Gulf of Carpentaria and the Swan River (Perth, Western Australia) between 1838–1841 (Stokes 1846), and it is likely that *P. datnioides* was collected during these voyages. Unfortunately the holotype of the species in the BMNH is lost (J. Maclaine and C. Fisher pers. comm.) but the original description includes a fine figure (pl. 57, fig. 1 for a whole specimen and fig. 2 for scale; Fig. 2B). The figure clearly is *Psammoperca datnioides*, not *P. waigiensis,* because two clear diagnostic characters are shown: 12 soft dorsal-fin rays and the lower value (ca. 0.9) in last dorsal-fin spine / penultimate dorsal-fin spine (vs. 13 soft dorsal-fin rays and higher value [1.5–1.7] of last dorsal-fin spine / penultimate dorsal-fin spine in *P. waigiensis*), as redescribed above.

Paxton *et al*. (1989) and Allen *et al*. (2006) had synonymized *P. datnioides* under *P. waigiensis*, but we conclude that *Psammoperca datnioides* is a valid species of *Psammoperca*. Boulenger (1895) use of the name *Psammoperca vaigiensis* is an erroneous emendation of Cuvier's *Labrus waigiensis*, and as such is invalid (Article 58A., ICZN 1999).

Müller & Troschel (1849) described *Cnidon chinensis* from Manila, Philippines, based on a specimen ZMB 35 (Fig. 2C; holotype of *Cnidon chinensis* Müller & Troschel 1849) collected around 1831 by Franz Julius Ferdinand Meyen (1804–1840), Professor of Botany at the University of Berlin, who accompanied a circumnavigation of the world between 1830 and 1832 (P. Bartsch pers. comm.). Although Eschmeyer *et al*. (2016) regarded ZMB 35 as a non-typical specimen of 375 mm TL (J. Kapp & P. Bartsch [ZMB] pers. comm.), it fits the original description. The described holotype of Müller & Troschel (1849) is '14½ Zoll' TL. Because, in Prussia at that time (after 1816) a Prussian Zoll was a 12th part of a Prussian foot (313.85 mm) – and accordingly was 26.15 mm, and the TL of the specimen should be approximately 379 mm. Thus, allowing for some shrinkage in alcohol, the specimen (ZMB 35, 375 mm TL) is consistent with Müller & Troschel's (1849) holotype (J. Kapp & P. Bartsch pers. comm.). This value was also reconfirmed from another of Müller & Troschel's (1849) length measurements. For example, *Pimelodus lateristrigus* Müller & Troschel 1849 (= synonym of *Pimelodella lateristriga* [Lichtenstein 1823] ZMB 3038) is 4½ Zoll, meaning ca. 118 mm TL, and actual size is equal to 115 mm TL.

The descriptions of Cuvier and of Müller & Troschel conform rather well. The holotype of *Cnidon chinensis* has the following diagnostic characters of *Psammoperca waigiensis* (see **Diagnosis** below): 47 pored lateral-line scales (46–48 in *P. waigiensis* vs. 49–54 in *Psammoperca datnioides*), 13 soft dorsal-fin rays (vs. 12 in *P. datnioides*) and hind margin of maxilla slightly less than hind margin of eye when mouth closed (vs. hind margin of maxilla vertically behind center of eye when mouth closed in *P. datnioides*). These three characters are not found in *P. datnioides.* Accordingly, we conclude that *Cnidon chinensis* Müller & Troschel 1849 is a junior synonym of *Psammoperca waigiensis* (Cuvier 1828).

As explained in the **Introduction,** the poorly known species *Hypopterus macropterus* (Günther 1859) was placed in synonymy with *Psammoperca waigiensis* Cuvier in Cuvier & Valenciennes 1828 by Greenwood (1976, p. 77) who briefly mentioned this species as a member of the family Latidae. However, it was not discussed in subsequent work by Otero (2004) and its taxonomic identity has remained obscure. This species is redescribed below.

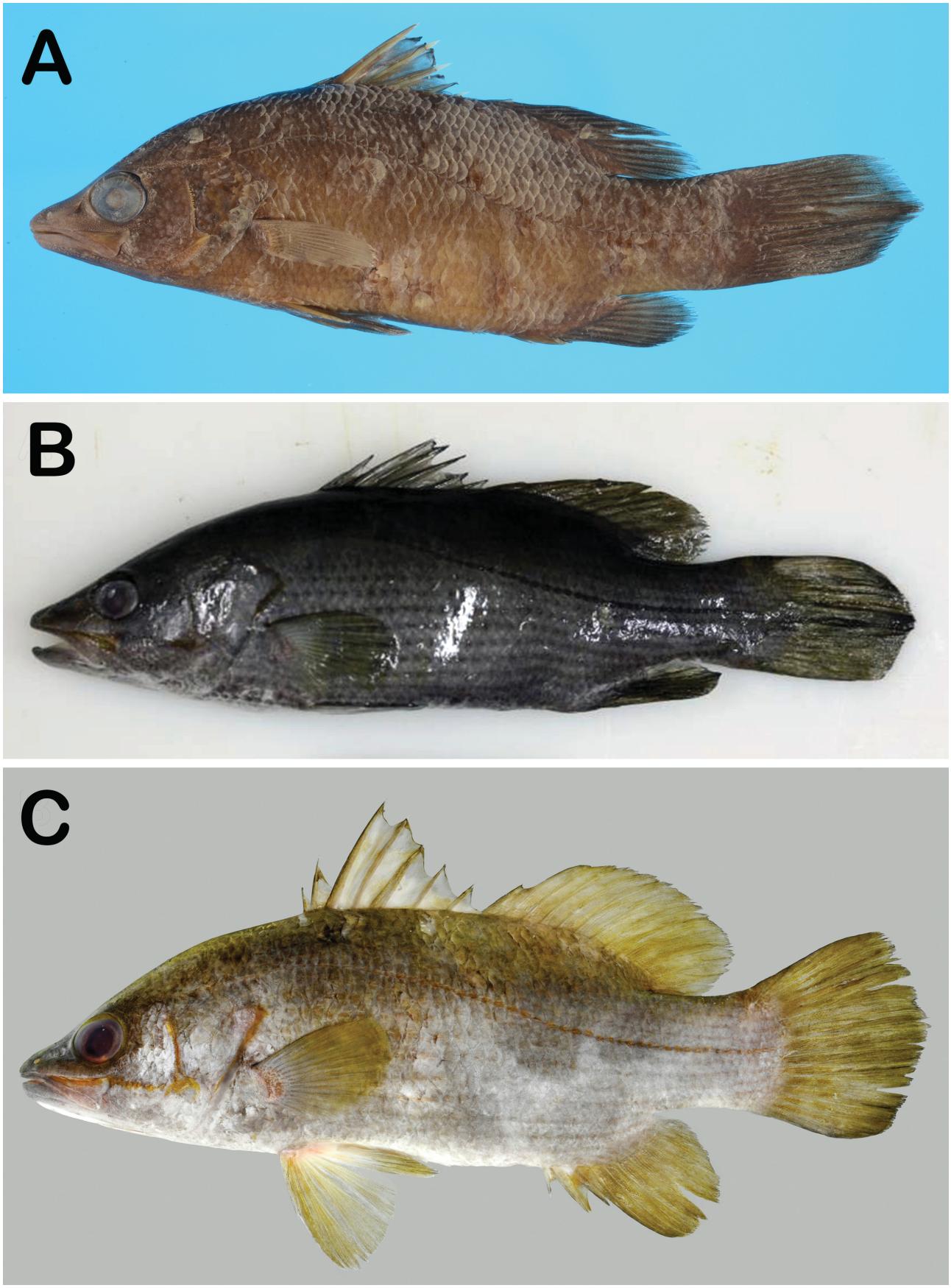

FIGURE 1. *Psammoperca datnioides* Richardson 1848 (A–B) and *Psammoperca waigiensis* (C). **A**, NTM S.16708-077, Neotype, 138 mm SL, Bullocky Point Reef, Darwin, Northern Territory; **B**, WAM P. 344852-001, 204 mm SL, Carnarvon Harbour, Western Australia; **C**, MUFS 43427, 241 mm SL, Okinawa Island, Ryukyu Is., Japan.

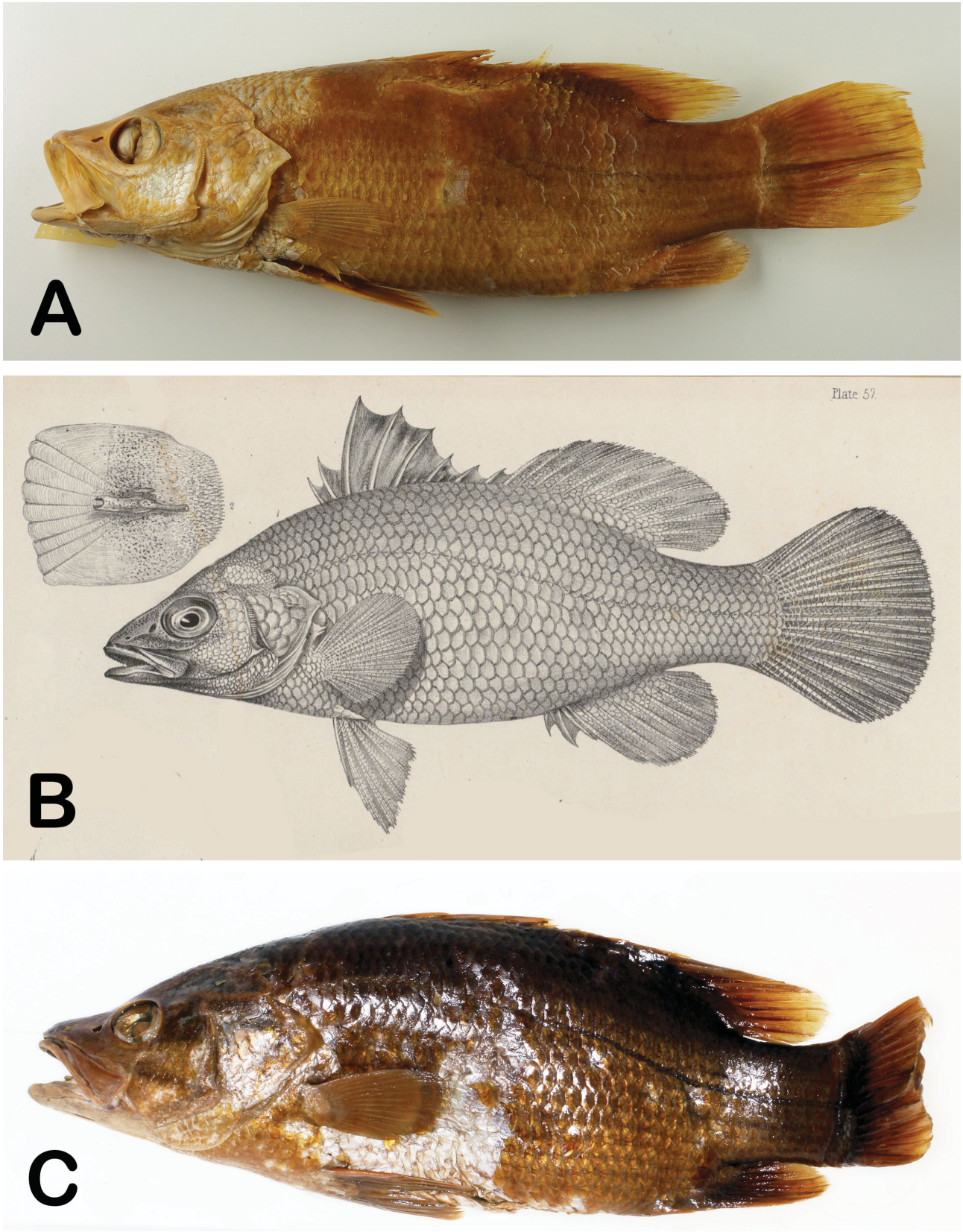

FIGURE 2. Holotype (**A**) of *Labrax waigiensis* Cuvier in Cuvier & Valenciennes 1828, a plate 57 (**B**) of Richardson (1848) for *Psammoperca datnioides,* and a holotype (**C**) of *Cnidon chinensis* Müller & Troschel 1849.

Biology. Shimose & Tachihara (2006) studied age, growth and reproductive biology of 291 specimens of *Psammoperca waigiensis* from around Okinawa Island, Japan. Opaque otolith zones formed every year (annual rings), correlated with spawning activity. Growth of this species was rapid during the first 2 years, reaching 186.2–

270.3 mm in SL. Females (196.6–334.0 mm SL) were larger than males (186.2–288.6 mm SL), a result of differential growth between sexes, which started before 2 years of age. Such biological information suggests that *P. waigiensis* does not grow to more than 50 cm TL.

Distribution. Currently known from Sri Lanka, Bay of Bengal, coasts of the Malay Peninsula, Indonesia, Malaysia, Vietnam, Philippines, China, Taiwan, and the Ryukyu Islands of Japan, but not Australia (Fowler & Bean 1930; Larson *et al*. 2013). Günther (1859, 1872) reported this species from Victoria (= Port Essington), NT, New South Wales and Torres Strait, but the species is probably *P. datnioides* (See **Distribution** of *P. datnioides* above). Our study indicates *P. waigiensis* is unlikely to be distributed in Australia, but further work is needed to confirm its distribution in the region adjacent to northern Australia.

Hypopterus Gill 1861

Type species: *Psammoperca macroptera* Günther 1859

Genus Hypopterus Gill 1861

Diagnosis. Distinguished from other latid genera by the following combination of characters: scales on smooth horizontal limb of the preopercle; nostrils widely separated on each side of the head, anterior nostril a tube-shaped flap and posterior nostril oval and greatly enlarged; large observable scales on posterior part of maxilla (Fig. 3B); pored lateral line scales extending onto median membrane of caudal-fin rays; no tooth patches on supralamellar tooth patch on the outer face of the first four gill arches and no tooth patch on the basihyal; denticulations on ventral border of first and second infraorbital bones; no parapophysis on the first 5 abdominal vertebrae; epineurals on the first 7–8 abdominal vertebrae; supraneural bones formula 0/0/0 + II/I + I/; dorsal-fin rays VII– I, 15; anal-fin rays III, 14; caudal fin with posterior border rounded; procurrent spur present; caudal spur absent; vertebrae 11 + 14 = 25.

Occurrence. A single species known only from the coastal waters of northwestern Australia.

Hypopterus macropterus (Günther 1859)

English name: Spikey bass

Figure 3A–B, Table 1

Psammoperca macroptera Günther 1859:69 ('Victoria, Australia' = Shark Bay, Western Australia); McCulloch 1929:200 ('Victoria' [= Port Essington, Northern Territory] (H.M.S. 'Herald') – but probably Shark Bay, Western Australia, see Remarks below.

Psammoperca waigiensis (*non* Cuvier & Valenciennes); Greenwood 1976:77 (Australia).

Hypopterus macropterus; Allen & Swainston 1988:62 (north-western Australia); Paxton *et al*. 1989:482 (Australia); Allen 1997:98 (tropical Australia); Hutchins 2001:29 (Western Australia); Otero 2004:85 (noted as 'Situation of *Hypopterus*' [see Remarks below], not examined); Allen *et al*. 2006:967 (Australia); Larson *et al*. 2013:93 (?NT, Australia).

Holotype. BMNH 1858.12.27.34, 104 mm SL, 'Victoria, Australia' = Shark Bay, Western Australia.

Non-type specimens. WAM P.30162-008, 89 mm SL, Shark Bay; WAM P.30681-004, 138 mm SL, Monte Bello Islands, around 60 km's north-northeastern offshore of Onslow between Shark Bay and Port Hedland, Western Australia; WAM P.32311-008, 132 mm SL, Shark Bay, Western Australia.

Diagnosis. Distinguished other latid species by the following combination of characters: deeper body depth (42–44% [mean 44%] of SL); lower counts, 6 ½/ 9 ½–10 ½ scale rows above and below lateral line; lower counts of pored lateral-line scales (43–44); gill rakers 7 [including 6 rudiments]+1+11 [including 3 rudiments]=19 [including 9 rudiments]; last dorsal-fin spine / penultimate dorsal-fin spine 1.7–2.1; head and body olive brown, darker above lateral line and on dorsal region of head, lighter below, ventrally lighter silvery reflection with eight indistinct bands of ovoid dark spots in center of each scale on head and body.

Description. Counts and proportional measurements as percent of SL of the holotype and other specimens of *Hypopterus macropterus* (Günther 1859) are shown in Table 1.

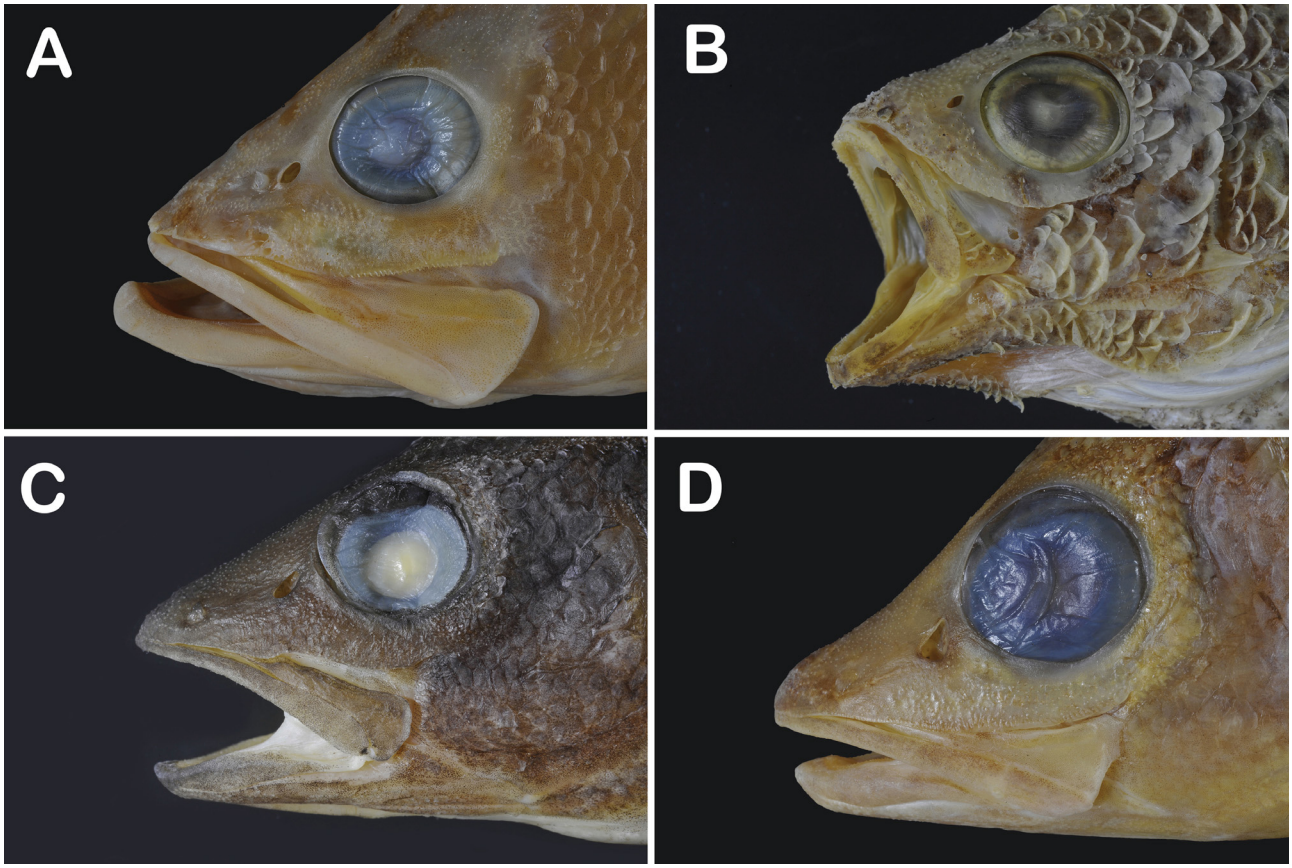

FIGURE 3. Snout region of four latid species: **A**, *Lates japonicus*, MUFS 11877, 253 mm SL, Miyazaki, Japan; **B**, *Hypopterus macropterus*, WAM P.30681-004, 138 mm SL, Shark Bay, Western Australia; **C**, *Psammoperca datnioides*, WAM P.34451-001 (024, X), 204 mm SL, Corronban Coast near Shark Bay, Western Australia; **D**, *Psammoperca waigiensis*, Chantaburi, Thailand.

Body compressed, its depth 2.3–2.4 times in SL, deepest at dorsal-fin origin; dorsal profile concave in interorbital region, rising steeply (convex) thereafter to dorsal-fin origin; head moderately short, its length 2.9–3.1 times in SL; eye oval, height less than width, eye diameter 3.0–3.2 times in head length; snout 1.9–2.5 times in head length; interorbital space 61–71% of eye diameter; mouth oblique, lower jaw projecting beyond upper one when closed; maxilla progressively deeper posteriorly, vertically extending to anterior level of black iris; villiform teeth present on jaws, palatines, pterygoids and vomer; tongue smooth; three sharp, strong spines on inferior margin of preopercle, a retrorse spine at angle of preopercle, the posterior margin of which bears 20–24 in denticulation; a sharp spine at angle of operculum; separated from eye by distance slightly less than half length of black iris diameter; cleithrum and supracleithrum each with one serrae of exposed part.

First dorsal fin commencing slightly behind pelvic-fin, with seven spines, third spine longest (III>IV>V>II> VI > I >VII); base of first dorsal fin 3/5 of second dorsal fin; anal fin commencing beneath base of second-dorsal fin ray; second anal-fin spine length subequal to third one (II=III>I); pectoral fin 83–108% of length of pelvic fin; pelvic-fin spine slightly less than 4th dorsal spine, subequal to 5th dorsal-fin spine; distal profiles of pectoral, pelvic, anal and second-dorsal fins rounded; caudal fin rounded, with 9 + 8 in principal rays of upper lobe + lower lobe, respectively; dorsal and ventral procurrent rays 8 + 7, respectively; caudal peduncle depth 63–66% of its length; scales ctenoid; body and head scaled, except for snout, throat, preorbital and interorbital regions; dorsal and anal fins with a scaly sheath at base; second-dorsal, caudal, anal and lateral area of pelvic fin densely covered with minute scales; pored lateral-line scales extending onto median caudal-fin rays; 23 or 24 circumpeduncular scales; vertebrae 11 + 14 = 25.

Colouration. Based on WAM P.30162-008, 89 mm SL, Shark Bay, photographed by J. B. Hutchins, WAM P.30681-004, 138 mm SL, Monte Bello Islands, photographed by G. R. Allen, and WAM P.32311-008, 132 mm SL, Shark Bay, photographed by S. M. Morrison: Head and body olive brown, darker above lateral line and on dorsal region of head, lighter below, ventrally lighter silvery reflection with eight indistinct bands of ovoid dark spots at

center of each scale on head and body, the first running from just above eye to just after posterior upper jaw, second running from nape to opercular process, third running from just before first dorsal-fin spine base to base of pectoral fin, fourth from posterior part of first dorsal fin spines to posterior part of pelvic fins when vented, fifth from anterior part of second dorsal-fin spines to third anal-fin spine base, sixth from posterior part of second dorsal fin to posterior part of anal fin rays, seventh on caudal peduncle from just after last dorsal-fin ray base vertically to lower caudal peduncle, eighth (last) on caudal fin base between dorsal and ventral procurrent rays (each band of upper part of dorsal head and body above lateral line Y-shaped-like). Fins greenish or olive brown, interradial membranes olive brownish hyaline. Dorsal fin, caudal and anal fins olive brown, pectoral and pelvic fins somewhat lighter greenish or olive brown. Horizontal scale rows with darker olive brown centres, forming horizontal and indistinct narrow stripes on body.

Remarks. The type specimen of *Psammoperca macroptera* Günther 1859 was collected by HMS *Herald* from 'Victoria, Australia'. McCulloch (1929:200) regarded the type locality as Victoria, Port Essington, Northern Territory. However, Randall & Hoese (1988), have suggested that species collected by the HMS *Herald* from 'Victoria', were collected from the Victoria District of Western Australia, this name appearing on maps in the 1800's for the area north of Perth and south of Carnarvon, which includes Shark Bay that was visited by HMS *Herald* in 1858.

A poorly known species, *Hypopterus macropterus* (Günther 1859) was put in synonymy with *Psammoperca* by Greenwood (1976, p. 77), who considered the type species of the genus *Hypopterus* (*Psammoperca macroptera* Günther 1859) as a synonym of *P. waigiensis.* Subsequently, however, several authors (Allen & Swainston 1988; Paxton *et al*. 1989) have considered this taxon to be a valid genus.

A combination of counts and morphometric characters for *Hypopterus* are quite different from those of *Psammoperca* and *Lates*: dorsal-fin rays VII-I, 14–15 and anal-fin rays III, 14 (vs. VII-I, 12–13 and anal-in rays III, 8 in two *Psammoperca* species; Table 1). Pored lateral-line scales in *H. macropterus* are lower, 43 or 44 (vs. 46–48 in *P. waigiensis* and 52–54 in *P. datnioides*). Body depth in *H. macropterus* also is much deeper (42–44% of SL vs. 29–36% of SL in *P. waigiensis* and *P. datnioides*; Table 1).

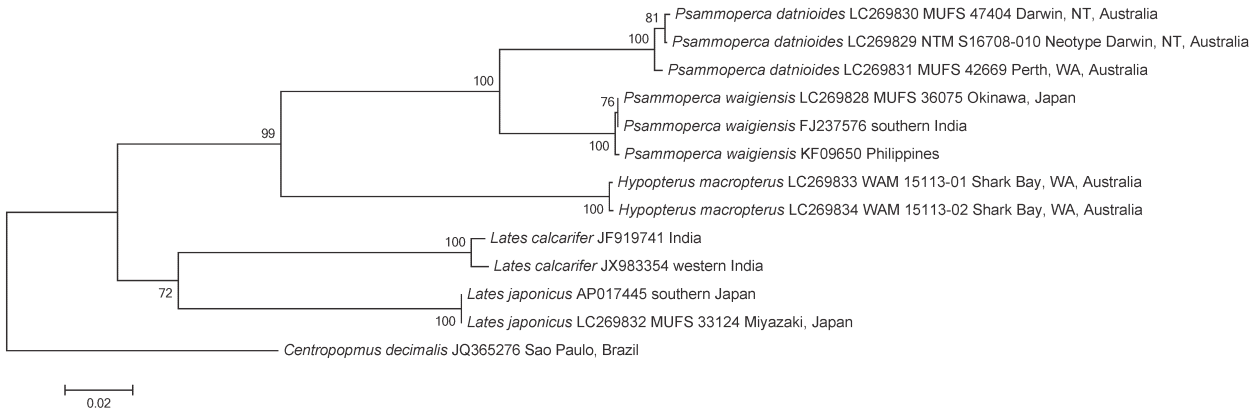

FIGURE 4. K2P distance neighboring-joining tree of the COI gene (612 bp) of latid species of *Hypopterus*, *Lates*, and *Psammoperca* in the family Latidae with *Centropomus undecimalis* as the outgroup.

Furthermore, *Lates* differs from both *Psammoperca* and an extinct genus †*Eolates* in having three rows of pored lateral-line scales on the caudal fin (Otero 2004) but *Psammoperca* usually has one row of pored lateral-line scales on the caudal fin (Otero 2004). *Lates* differs from *Psammoperca* in having the nostril of each side close together (vs. the nostrils widely separated in *Psammoperca*; Fig. 3). The nostrils are widely separate in *Hypopterus*, the anterior nostril is formed as a tube-shaped flap and posterior nostril is oval and also greater sized than that of the anterior one.

Accordingly, we conclude that the above meristic, external and internal characters of *Hypopterus macropterus* are sufficient to justify its placement in a separate genus. Further detailed examination of internal and external characters of *Hypopterus macropterusis* as well as genetic analysis could support a new phylogenetic relationship (*Lates*, *Psammoperca* and *Hypopterus*, plus the extinct genus †*Eolates*; see Otero 2004) under the family Latidae.

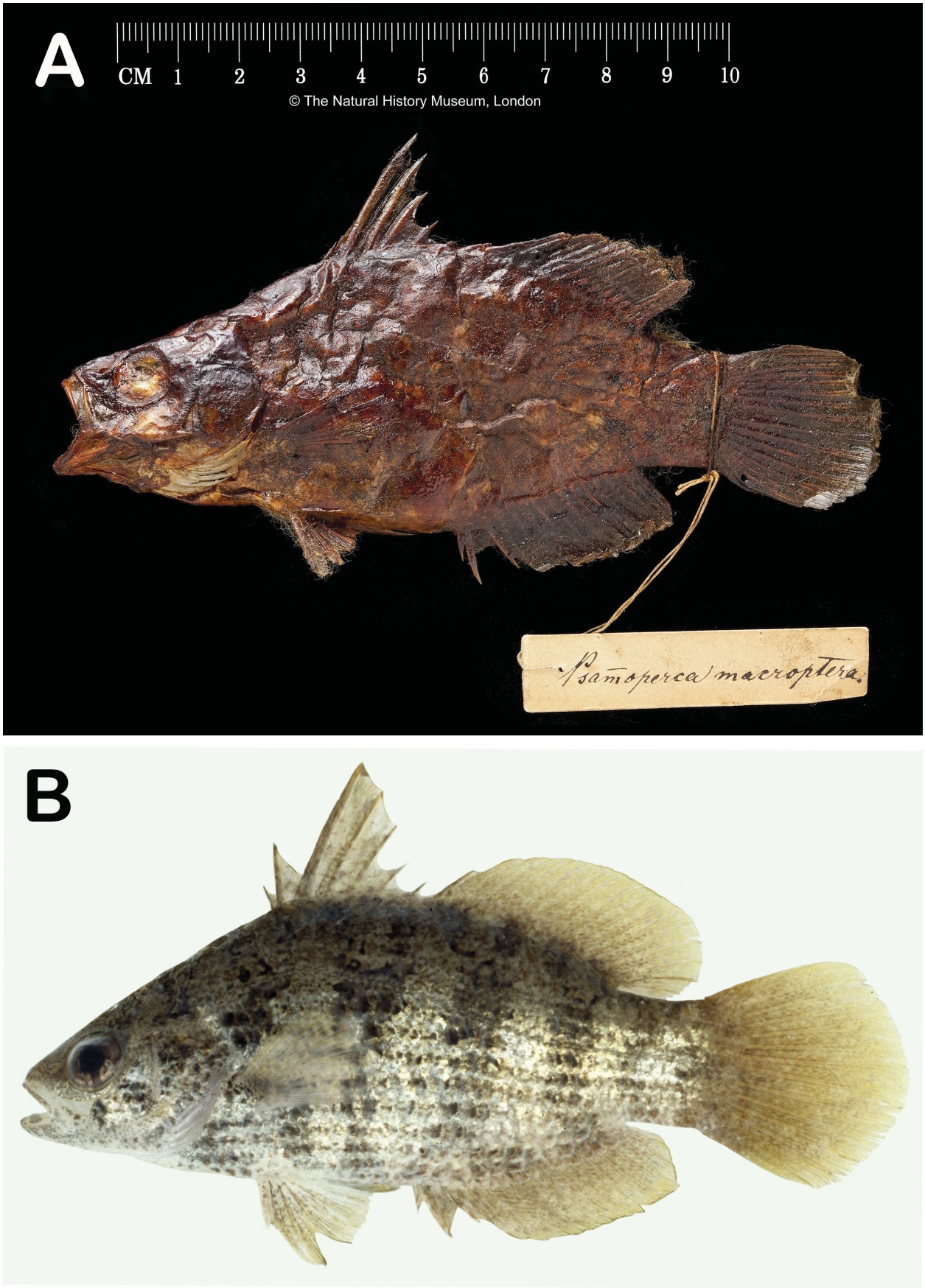

FIGURE 5. Holotype **(A)** and fresh specimen **(B)** of *Hypopterus macropterus*. **A**, BMNH 1858.12.27.34, 104 mm SL, Port Essington, Northern Territory, Australia; **B**, WAM P.30168-010, 129 mm SL, Shark Bay, Australia, collected by box of trawl, at a depth of 1–3 m, photographed by J. B. Huchins.

Table 1. Counts and morphometric data for *Psammoperca datnioides* Richardson 1848, *Psammoperca waigiensis* (Cuvier in Cuvier & Valenciennes 1828) and *Hypopterus macroppterus* (Günther1859). Measurements expressed as percentages of standard length. The holotype data of *Cnidon chinenis* Müller & Troschel 1849 is included as parenthesis after the holotype data of *Labrus waigiensis*.

	Psammoperca datnioides		*Psammoperca waigiensis*		*Hypopterus macropterus*
	Neotype of *Psammoperca datnioides* Richardson 1848 NT S16708-077 *n*=1	Non-type specimens of *Psammoperca datnioides*. [8 data of AMS and QM photographic confirmation]** *n*= 26 [8]	Holotype of *Labrus waigiensis* MNHN 0000-8388 （Holotype of *Cnidon chinenis*, ZMB 35） *n*= 1 (*n*= 1)	Non-type specimens *n*= 12	Non-type specimens (holotype of *Psammoperca macroptera*, BMNH 1858.12.27.34, dried skin) *n*= 3
Counts:					
Dorsal-fin rays	VII-I, 12	VII-I, 12 [12]	VII-I, 13 (VII-I, 13)	VII-I, 13 (or VIII-I, 13)	VII-I, 15 (VII-I, ?14)
Anal-fin rays	III, 8	III, 8	III, 8 (III, 8)	III, 8	III, 14 (III, 14)
Pectoral-fin rays	16	16 or 17	16 (-)	16	16
Pelvic-fin rays	I, 5	I, 5	I, 5 (I, 5)	I, 5	I, 5
Pored lateral-line scales	52	52–54 [49–53]	48 (48)	46–48	44 (43)
Scales above/below lateral line	6 ½ / 11 ½	6 ½/ 11 ½–12 ½	5 ½/ 8 ½ (5 ½ / 9 ½)	5 ½/ 7 ½ –9 ½	6 ½/ 9 ½–10 ½ (5 ½/ 9 ½)
Gill rakers (upper [rudiments]+1+lower [rudiments])	7(4)+1+15(3)=21	7(6)+1+12–14 (3–4))=20–24 (9–10)	7(6)+1+11(3)=19 [not measured]	7(6)+1+11(3)=19	6(4)+1+14(4)=21 (4+4) [nothing in holotype]
Standard length (mm)	138	117–214 [ca. 100–208]	254 (309)	87–299	89–132 (104)
Proportions:					
Body depth	31	29–31 (29)	33 (-)	36 (36)	42 (44)
Body depth at first anal fin origin	32	26–29 (28)	30 (-)	32–37 (35)	39–43 (43)
Head length	40	30–38 (36)	36 (-)	33–39 (36)	32–34 (34)
Body width	14	10–15 (13)	15 (-)	14–16 (15)	13–17 (11)
Snout length	11	9–15 (12)	10 (-)	10 (10)	8 (9)
Orbit diameter	8	8–12 (10)	8 (-)	9–10 (9)	11 (10)
Dermal eye opening	7	7–9 (8)	8 (-)	8–9 (8)	10–11 (8)
Bony interorbital width	5	5 (5)	5 (-)	6 (6)	6 (7)
Upper jaw length	7	14–15 (15)	15 (-)	5–15 (10)	13–15 (12)
Caudal peduncle depth	14	13–15 (14)	15 (-)	15–16 (16)	18–19 (19)
Caudal peduncle length	19	15–18 (17)	15 (-)	17–18 (18)	17–18 (15)

...continued on the next page

Table 1. continued

	Psammoperca datnioides		*Psammoperca waigiensis*		*Hypopterus macropterus*
	Neotype of *Psammoperca datnioides* Richardson 1848 NT S16708-077 *n*=1	Non-type specimens of *Psammoperca datnioides*. [8 data of AMS and QM photographic confirmation]** *n*= 26 [8]	Holotype of *Labrus waigiensis* MNHN 0000-8388 （Holotype of *Cnidon chinenis*, ZMB 35） *n*= 1 (*n*= 1)	Non-type specimens *n*= 12	Non-type specimens (holotype of *Psammoperca macroptera*, BMNH 1858.12.27.34, dried skin) *n*= 3
Predorsal length	44	39–44 (42)	44 (-)	44–47 (45)	42–56 (45)
Preanal length	69	62–70 (66)	75 (-)	66–67 (67)	56–60 (63)
Prepelvic length		38-39 (38)	38 (-)	35–39 (37)	36–37 (40)
Dorsal-fin base	42	40–45 (43)	40 (-)	49 (49)	48–54 (51)
Anal-fin base	14	12–15 (13)	44 (-)	16 (16)	28–30(32)
Caudal-fin length	24	23–25 (24)	27 (-)	27–29 (28)	27–30 (27)
Pelvic-fin spine	9	11 (11)	11 (-)	12–15 (14)	10–12 (11)
First pelvic-fin ray	18	18–21 (19)	19 (-)	21 (21)	20–21 (22)
Pectoral-fin ray	20	17–19 (18)	17 (-)	19 (19)	20–23 (19)
First dorsal-fin spine	5	3–5 (5)	4 (-)	4–5 (4)	4 (5)
Second dorsal-fin spine	9	7–9 (8)	12(-)	7–18 (13)	10 (11)
Third dorsal-fin spine	16	16–18 (16)	17 (-)	17–20 (19)	21–22 (23)
Fourth dorsal-fin spine	13	14–15 (14)	14 (-)	12–16 (14)	18–20 (18)
Fifth dorsal-fin spine	15	12–14 (13)	11 (-)	9-12(11)	12–13(12)
Sixth dorsal-fin spine	13	8–10 (9)	6 (-)	5–6 (6)	3–4 (7)
Seventh dorsal-fin spine	6	-	7 (-)	9–11 (10)	-
First dorsal-fin spine of second dorsal fin	15	7–9 (7)	11 (-)	10–14 (12)	10–14 (12)
First dorsal fin ray		12-14(13)	16 (-)	15–17(16)	13–14(14)
First anal-fin spine	16	4–11 (6)	4 (-)	5 (5)	4–5 (5)
Second anal-fin spine	5	7–10 (8)	7 (-)	8–9 (9)	9–10 (10)
Third anal-fin spine	8	8–9 (8)	7 (-)	9–10 (9)	7–10 (10)
First anal-fin ray	8	15–19 (16)	14 (-)	18–19 (19)	14–15 (15)
Suborbital width	2	1–2 (2)	3 (-)	2–3 (2)	2–3 (4)
Last dorsal-fin spine / Penultimate dorsal-fin spine*	1.0	0.9–1.1	1.5 (-)	1.5–1.7	1.7–2.1 (1.7)

*Last dorsal-fin spine / Penultimate dorsal-fin spine: The proportion rate of the following character was calculated as “The first (last or eighth) dorsal-fin spine length of the second dorsal fin / the lst dorsal-fin spine length (the penultimate dorsal-fin spine) of the first dorsal fin. **see “**Photographic confirmation.**” of *P. datnioides* section.

In this study, K2P distance neighboring-joining tree of the COI gene (612 bp) of latid species of *Hypopterus*, *Lates*, and *Psammoperca* in the family Latidae (plus *Centropomus undecimalis* [Bloch] as the outgroup) showed two major clades: *Lates* species and other two genera, *Psammoperca* and *Hypopterus* (Fig. 4). Phylogenetic position of the COI sequence (612 bp) in *H. macropterus* strongly suggests it is closely related to *Psammoperca* and belongs to the family Latidae.

Distribution. Currently known only from Shark Bay, Western Australia.

Key of genera to the family Latidae

1a. Nostrils of each side close together (Fig. 3A); lower edge of preopercle with 3 or 4 large flat spines . . . . . *Lates* (11 valid species; see Eschmeyer 2016)

1b. Nostrils widely separated on each side of the head (Fig. 3B–D); lower edge of preopercle with only 1 spine present at angle 2

2a. Large observable scales on posterior part of maxilla (Fig. 3B); dorsal-fin rays VII-I, 14–15; 43–44 pored lateral-line scales; eight indistinct dark bands on head and body . . . . . *Hypopterus macropterus*

2b. Tiny scales (not visible to the naked eye, but visible through binocular microscope) on posterior uppermost part of maxilla (Fig. 3C–D); dorsal-fin rays VII-I, 12–13; 46–54 pored lateral-line scales; yellow longitudinal stripe from lower margin of infraorbital margin to posterior spine of preopercular flange in fresh 3

3a. Dense black or brownish colour on head and body; pored lateral-line scales same colour of other scales of body (Fig. 1B); pored lateral-line scales 49–54; dorsal soft rays 12; Last dorsal-fin spine / Penultimate dorsal-fin spine 0.9–1.1 . . . . . *Psammoperca datnioides*

3b. Brownish colour on head and body (often golden colour in live specimens); pored lateral-line scales yellow edged (Fig. 1C); pored lateral-line scales 46–48; dorsal soft rays 13; Last dorsal-fin spine / Penultimate dorsal-fin spine 1.5–1.7 . . . . . *Psammoperca waigiensis*

Comparative material examined

Lates japonicus (Katayama & Taki 1984): MUFS 11877, 253 mm SL, Miyazaki, Japan.

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