

Squalus rancureli Fourmanoir, 1979, a new junior synonym of the blacktailed spurdog *S. melanurus* Fourmanoir, 1979, and updated diagnosis of *S. bucephalus* Last, Séret & Pogonoski, 2007 from New Caledonia (Squaliformes, Squalidae)

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ABSTRACT

Squalus rancureli Fourmanoir, 1979 and *S. melanurus* Fourmanoir, 1979 are deep-sea sharks described from off New Caledonia and Vanuatu. Morphological separation between them is limited to caudal fin coloration and a few morphometric characters. These two nominal species were described as new in more than one taxonomic account, thus requiring nomenclatural elucidation. Taxonomic complexity behind *S. rancureli* and *S. melanurus* has been disregarded and underestimated in previous studies, and indicated to rely on propagation of erroneous authorship and negligence of requirements from the International Code on Zoological Nomenclature for describing new taxa. Analysis of type material and topotypic specimens revealed congruency of external morphology, external measurements and meristic data, suggesting conspecificity. *Squalus rancureli* is herein considered a junior synonym of *S. melanurus*, and authorship of these nominal species is clarified. Differential diagnosis and redescription of *S. melanurus* and an updated diagnosis of *S. bucephalus* Last, Séret & Pogonoski, 2007 are also provided based on new material. Comparative examinations with other regional congeners support their validity and recognition of a third species provisionally identified as *Squalus* cf. *montalbani*. *Squalus melanurus* is easily distinguished from *S. bucephalus* Last, Séret & Pogonoski, 2007 by bearing a black caudal-fin lower lobe, snout conspicuously elongate, dermal denticles tricuspidate, and smaller number of vertebrae (vs whitish caudal-fin lower lobe, snout conspicuously short, dermal denticles unicuspidate, higher number of vertebrae).

KEY WORDS

Chondrichthyes,
redescription,
morphology,
New Caledonia,
Vanuatu,
new synonym.

RÉSUMÉ

Squalus rancureli Fourmanoir, 1979, un nouveau synonyme junior de l'aiguillat à queue noire *S. melanurus* Fourmanoir, 1979, et mise à jour de la diagnose actualisée de *S. bucephalus* Last, Séret & Pogonoski, 2007 de Nouvelle-Calédonie (*Squaliformes: Squalidae*).

Squalus rancureli Fourmanoir, 1979 et *S. melanurus* Fourmanoir, 1979 sont des requins de profondeur décrits du large de la Nouvelle-Calédonie et du Vanuatu. Les différences morphologiques entre ces deux espèces se limitent à la coloration de la nageoire caudale et à quelques caractères morphométriques. Ces deux espèces nominales ayant été décrites comme nouvelles dans plusieurs publications, un éclaircissement de leur nomenclature était nécessaire. Le problème taxonomique sous-jacent à *S. rancureli* et *S. melanurus* a été soit ignoré, soit sous-estimé, dans les études antérieures, ce qui explique la propagation de l'erreur des auteurs qui n'ont pas respecté les exigences du *Code international de Nomenclature zoologique* relatives à la description de nouveaux taxons. L'analyse des types et de spécimens topotypes a mis en évidence la similitude des caractères morphologiques, des données biométriques et des caractères méristiques, suggérant une conspécificité. *Squalus rancureli* est donc considérée comme synonyme junior de *S. melanurus*, et la paternité de ces espèces nominales est clarifiée. Une diagnose différentielle et une redescription de *S. melanurus*, ainsi qu'une diagnose actualisée de *S. bucephalus* Last, Séret & Pogonoski, 2007 sont également fournis sur la base de matériel nouveau. Les comparaisons avec les autres espèces régionales supportent leur validité et la reconnaissance d'une troisième espèce provisoirement identifiée *Squalus* cf. *montalbani*. *Squalus melanurus* se distingue facilement de *S. bucephalus* Last, Séret & Pogonoski, 2007 par son lobe inférieur de la caudale qui est noir, son museau nettement allongé, ses denticules cutanés tricuspides, et un plus petit nombre de vertèbres (vs lobe inférieur de la caudale blanchâtre, museau nettement court, denticules cutanés unicuspidés, et un nombre plus élevé de vertèbres).

MOTS CLÉS

Chondrichthyes,
redescription,
morphologie,
Nouvelle-Calédonie,
Vanuatu,
synonyme nouveau.

INTRODUCTION

Squalus Linnaeus, 1758 currently comprises 31 valid species with distribution in all oceans. Five species are often recognized in New Caledonia in the Southwestern Pacific Ocean (Fourmanoir & Laboute 1976; Fourmanoir & Rivaton 1979; Rivaton *et al.* 1990; Séret 1994; Séret *et al.* 1997; Trilles & Justine 2004; Last *et al.* 2007b; Fricke *et al.* 2011; Bernot & Boxshall 2017): *S. megalops* (Macleay, 1881), *S. blainvillei* (Risso, 1827), *S. rancureli* Fourmanoir, 1979, *S. melanurus* Fourmanoir, 1979, and *S. bucephalus* Last, Séret & Pogonoski, 2007. *Squalus rancureli* was originally described from Vanuatu based on the examination of 37 specimens measuring 630-770 mm from which a holotype and two paratypes (a male and a female, 690-700 mm) were designated in Fourmanoir & Rivaton (1979). *Squalus melanurus* is originally from Uatiao and Boulari Passes in New Caledonia, and its description was based on 18 specimens measuring 620-750 mm from which only the holotype was designated in the same work. According to Séret (1994), the authorship of *S. melanurus* and *S. rancureli* has been inadvertently widespread as belonging to Fourmanoir & Rivaton (1979) as it is shown in Eschmeyer *et al.* (2017). Earlier accounts of Anonymous (1978) and Fourmanoir (1979) described *S. rancureli* and *S. melanurus* repeatedly as new species for Vanuatu and New Caledonia, calling up for nomenclatural clarification.

Characters provided in Fourmanoir & Rivaton (1979) to separate these two nominal species include colour of the caudal-fin lower lobe (uniformly grey for *S. rancureli* vs

conspicuously black for *S. melanurus*), intermediate tooth (absent in *S. rancureli* vs present on upper and lower jaws in *S. melanurus*), shape of pelvic-fin free rear tips (more obtuse in *S. melanurus* than in *S. rancureli*). Morphometrics also separate them, according to these authors, including height of second dorsal fin, length of caudal fin, mouth width, and length of second dorsal fin inner margin whose values are all smaller in *S. rancureli* than in *S. melanurus*. Preoral length, head width, and length of first dorsal-fin inner margin are larger in *S. rancureli* than in *S. melanurus* (Fourmanoir & Rivaton, 1979). Mouth width related to preoral length and internarial space, and length of dorsal-fin spines are distinct between *S. melanurus* and *S. rancureli*, according to Compagno (1984), and Compagno & Niem (1998). Despite their differences, Fourmanoir (1979) and Fourmanoir & Rivaton (1979) pointed out that these two species are very similar morphologically regarding shape of first dorsal fin, dermal denticles and snout. Overlapping of characters between *S. melanurus* and *S. rancureli* were noticed in subsequent descriptions of Compagno (1984), Compagno & Niem (1998), Compagno *et al.* (2005), and Ebert *et al.* (2013). New diagnostic features for distinguishing these two species are rarely available in the recent literature, and still rely on caudal fin coloration and few proportional measurements.

Analyses of material recently collected from New Caledonia and Vanuatu together with reexamination of type material of *S. rancureli* and *S. melanurus* show that all specimens, with exception of two specimens from Vanuatu, bear black lower caudal lobe and dorsal fins with blackish apex, characteristics

that are diagnostic for *S. melanurus*. Intermediate tooth is exclusively noticed in a single specimen from New Caledonia and in the upper jaw of the holotype of *S. rancureli*, indicating that this character is unreliable. These observations suggest possible conspecificity between *S. rancureli* and *S. melanurus*. The present study aimed to clarify the taxonomic status and authorship of *S. melanurus* and *S. rancureli*, to redescribe and to provide differential diagnosis of the valid species herein recognized. An updated diagnosis of their sympatric *S. bucephalus* is also provided based on new material.

MATERIAL AND METHODS

Examination of external morphology was based on preserved specimens in 70% ethanol. Nomenclature for external morphology and colour pattern follows Last *et al.* (2007d), and claspers is according to Jüngersen (1899). Coloration is described from preserved specimens except otherwise noted. Vertebral counts were taken from digital radiographs and are according to Springer & Garrick (1964), except for *S. nasutus* Last, Marshall & White, 2007, *S. chloroculus* Last, White & Motomura, 2007, *S. griffini* Phillipps, 1931 and *S. mitsukurii* Jordan & Snyder, 1903 in which data were obtained from Last *et al.* (2007a, c), Duffy & Last (2007), and Viana *et al.* (2017b) for comparisons. Tooth row counts were obtained from preserved material and follow Herman *et al.* (1989). Teeth samples from upper and lower jaws (three lateral teeth toward the first series) were removed and examined using a stereoscopic microscope. Nomenclature for dentition is according to Cappetta (1987). Descriptions of dermal denticles are based on observations of skin samples measuring 1 cm² taken from below the first dorsal fin (right side) through Scanning Electron Microscopy undertaken at the Instituto de Biociências, Universidade de São Paulo and at the Electron Microscope Unity, Rhodes University. Terminology for dermal denticles follows Deynat & Séret (1996).

Measurements were obtained using digital callipers with a 0.1 mm accuracy and/or a metric tape for measurements greater than 150 mm, and follow Last *et al.* (2007d) as provided in Viana *et al.* (2016). Morphometrics are expressed as percentages of total length (%TL). Photographs of specimens in different views and specific body structures (e.g. fins) were obtained using digital camera. Photographs of teeth and dermal denticles were taken using a high-resolution digital camera attached to stereoscope microscope Leica DFC295. Map of distribution was generated through QGIS 2.18 Las Palmas de G.C. (QGIS Development Team 2018) and Google Earth 7.1.5.1557, using Etopo 1 Ice Surface Global Relief Model (Amante & Eakins 2009). Synonyms for species include authorship, date, pages and figures when possible. Single values for morphometric and meristic data in the descriptions are for holotype, while ranges represent values for other material in which data were taken. In tables, mean and standard deviation are given to include all specimens in which data were obtained. Institutional abbreviations are according to Sabaj (2016).

ABBREVIATIONS

General

ICZN International Code on Zoological Nomenclature.

Morphological

ap apople;
cg clasper groove;
hp hypople;
P2 pelvic fin;
rh rhipidion.

RESULTS

External morphology of specimens previously identified as *S. melanurus* and *S. rancureli* collected in New Caledonia and Vanuatu is intrinsically similar, including general coloration of body, shape of body and fins, and length and shape of snout and mouth. All specimens examined here have a conspicuously slender body from head to tail, dorsal fins upright and slender at apex, caudal fin with markedly slender upper and lower lobes, and pelvic-fin free rear tips rounded. Snout is obtuse and markedly elongate, mouth is narrow, and dermal denticles are tricuspidate. These specimens also have a greyish brown body dorsally and whitish grey ventrally, pectoral and pelvic fins dark grey, and dorsal fins grey with apex narrowly dark grey. Caudal fin is grey with a small black upper caudal fringe, upper postventral caudal margin broadly white, lower postventral caudal margin black, and lower caudal lobe conspicuously black in most specimens herein analyzed, with few exceptions. The holotype and paratype of *S. rancureli* from Vanuatu are the only specimens that lack black lower caudal lobe or caudal markings out of 18 specimens examined here. Ventral caudal lobe for these two specimens is mostly grey with ventral caudal tip broadly white. Absence of black lower caudal lobe in the types is probably due to abnormality in melanin pigmentation.

External measurements are coincident between the examined specimens from New Caledonia and Vanuatu. Differences on morphometrics reported in Fourmanoir & Rivaton (1979) for *S. melanurus* and *S. rancureli*, including second dorsal fin height and base length, length of inner margin of second dorsal fin, length of dorsal caudal margin, and preoral length are not supported in the current results. External measurements provided in Fourmanoir & Rivaton (1979) to separate *S. melanurus* and *S. rancureli* were based on raw data that do not allow comparative accuracy, interfering possibly in their results for recognizing them as distinct species. Discrepancies were observed for mouth width, head width, head width at mouth, and length of second dorsal-fin spine in Fourmanoir & Rivaton (1979) and Compagno & Niem (1998). However, range values are clearly continuous when comparing the holotype of *S. rancureli* and specimens of *S. melanurus*, indicating that it comprises morphological variations within a single species rather than diagnostic characters. Other morphometric variations may be due to preservation when comparing the holotypes of *S. rancureli* and *S. melanurus*, and range of other material, for instance: pectoral-pelvic space 13.7% TL for *S. rancureli*

vs 14.8-22.0% TL, and pelvic-caudal space 28.2% TL for *S. rancureli* vs 24.3-26.9% TL; precaudal length 77.6% TL for *S. melanurus* vs 78.6-80.1% TL, and pre-spiracular length 14.7% for *S. melanurus* vs 15.3-16.8% TL.

Dentition is congruent among the examined specimens as well, although the presence of an intermediate tooth varies. Most specimens do not exhibit intermediate teeth, except in a single specimen from New Caledonia and the holotype of *S. rancureli*, which reveals that this characteristic is not diagnostic for *S. melanurus* as proposed in Fourmanoir & Rivaton (1979). Tooth counts are overlapped between specimens of *S. melanurus* and *S. rancureli* in contrast to Fourmanoir & Rivaton (1979). These observations are consistent with the descriptions of both *S. melanurus* and *S. rancureli* from Compagno (1984), Compagno & Niem (1998), Compagno *et al.* (2005), and Ebert *et al.* (2013), denoting that their morphological features do not allow the separation between these two nominal species. Thus, the results support conspecificity between the specimens from New Caledonia and Vanuatu.

Morphological characteristics and ecological notes of *S. melanurus* and *S. rancureli* were interchangeably provided in Anonymous (1978), Fourmanoir (1979) and later in Fourmanoir & Rivaton (1979), contributing to the taxonomic confusion behind these two nominal species. *Squalus rancureli* was first mentioned as a new species in a local newspaper, *Les Nouvelles Calédoniennes* (Anonymous 1978). This article provides pictures and a short description of *S. rancureli* and states that its main diagnostic characteristic is the presence of a black lower caudal lobe. *Squalus melanurus* was described later in Fourmanoir (1979) as a new species very similar to *S. rancureli* but distinct from it by bearing black lower caudal lobe and other features that include height of dorsal fin, and length of snout and caudal fin. These differences were later reproduced in Fourmanoir & Rivaton (1979) when designating the types for *S. melanurus* and *S. rancureli*. Still in Fourmanoir (1979), the range of total length of *S. melanurus* (62-77 cm) is equivalent to that provided in the article of Anonymous (1978) for *S. rancureli*. This range was later slightly modified in Fourmanoir & Rivaton (1979), although the ranges are still congruent for these two species. Collecting data and depth range are also confusing and also reciprocal between them in Anonymous (1978), Fourmanoir (1979) and Fourmanoir & Rivaton (1979), indicating that these authors employed the same data to denote different species.

Application of the correct nomenclature to denote the species herein recognized reveals to be more complex than reported above and previously in Séret (1994) because nomenclatural acts were published successively in Anonymous (1978), Fourmanoir (1979), and Fourmanoir & Rivaton (1979) without attending crucial requirements of ICZN. The current evidences support that the authorship of *S. melanurus* is Fourmanoir (1979) rather than Fourmanoir & Rivaton (1979), although the authorship of *S. rancureli* is questionable. An unknown journalist based on an interview with Dr P. Fourmanoir (MNHN) wrote the article of 1978 describing *S. rancureli*. According to Articles 8 and 9 from ICZN, Anonymous (1978) is not in conformity with the criteria of publication of new scientific

zoological names that requires available works to be issued for the purpose of public and permanent scientific record. Thus, *S. rancureli* is an invalid and unavailable name and should be considered a *nomen nudum*. However, the reproduction of the article of 1978 together with the description of *S. melanurus* in Fourmanoir (1979) consist an available work and *S. rancureli* is an available name. Thus, the current study act as First Reviser (Article 24.2 from ICZN) on precedence of subjective simultaneous synonyms by choosing *S. melanurus* over *S. rancureli*.

Family SQUALIDAE Blainville, 1816

Genus *Squalus* Linnaeus, 1758

Squalus melanurus Fourmanoir, 1979

Blacktailed spurdog; Aiguillat à queue noire

(Figs 1-8, 15; Tables 1-2)

Squalus melanurus Fourmanoir, 1979: 11-12 (original description, illustrated. Type by subsequent designation in Fourmanoir & Rivaton (1979). Type locality: Uatio and Boulari, New Caledonia). — Fourmanoir & Rivaton 1979: 438-439, fig. 27 (description, illustrated, designation of type; Uatio and Boulari, New Caledonia). — Compagno 1984: 120 (description; Uatio and Boulari, New Caledonia); 2005: 504 (listed). — Rivaton *et al.* 1990: 72, 134 (listed, New Caledonia). — Séret 1994: 6-8 (cited, listed; New Caledonia). — Séret *et al.* 1997: 104 (cited; New Caledonia). — Compagno & Niem 1998: 1215, 1222, 1230 (cited, listed; New Caledonia). — Baranes 2003: 45, 49 (cited; New Caledonia). — Trilles & Justine 2004: 1-21 (cited; New Caledonia). — Compagno *et al.* 2005: 77 (description; Noumea). — Justine 2009: 1-2 (cited; New Caledonia). — Fricke *et al.* 2011: 346 (cited; Southwestern Grande Terre, New Caledonia). — Weigmann 2016: 904 (listed; Southwestern Pacific Ocean). — Bernot & Boxshall 2017: 275-276, 286, 288 (cited, listed; New Caledonia).

Squalus rancureli Fourmanoir, 1979: 11-12, 14, **n. syn.** (original description, illustrated. Type by subsequent designation in Fourmanoir & Rivaton (1979). Type locality: Vate, Vanuatu, formerly New Hebrides, and western New Caledonia). — Fourmanoir & Rivaton 1979: 437-438, figs. 25-26 (description, illustrated, type designation; Vate and Espiritu Santo, Vanuatu). — Compagno 1984: 122-123 (description; Vate, Vanuatu); 2005: 505 (listed). — Rivaton *et al.* 1990: 72, 134 (listed, New Caledonia). — Kulbicki *et al.* 1990: 17 (listed; Chesterfield Islands, New Caledonia). — Séret 1994: 6-7 (cited, listed; New Caledonia). — Compagno & Niem 1998: 1215, 1222, 1231 (cited; Vanuatu). — Baranes 2003: 45, 49 (cited; Vanuatu). — Compagno *et al.* 2005: 78 (description; Vanuatu). — Fricke *et al.* 2011: 346 (cited; New Caledonia). — Weigmann 2016: 904 (listed; Southwestern Pacific Ocean).

TYPE MATERIAL. — [MNHN-IC-1980-0460](#) (holotype of *S. melanurus*), adult ♂, 670 mm TL, New Caledonia, 320-340 meters depth, collected by P. Fourmanoir (IRD, formerly ORSTOM) on 10.IV.1978.

MATERIAL EXAMINED. — [MNHN-IC-1978-0693](#) (holotype of *S. rancureli*), adult ♂, 680 mm TL, Vate, Vanuatu, 17°30'0"S, 167°30'0"E, collected by P. Rancurel, date unknown; [MNHN-IC-1987-1203](#) (paratype of *S. rancureli*), adult ♀, 640 mm TL, Vate, Vanuatu, 17°30'S, 167°30'E; [MNHN-IC-1987-1204](#), adult ♀, 675 mm TL, Vate, Vanuatu, 17°55'1.2"S, 167°19'58.8"E; [MNHN-IC-1997-3606](#), adult ♀, 730 mm TL, unknown locality; [MNHN-IC-1997-3607](#), adult ♀, 750 mm TL, unknown local-

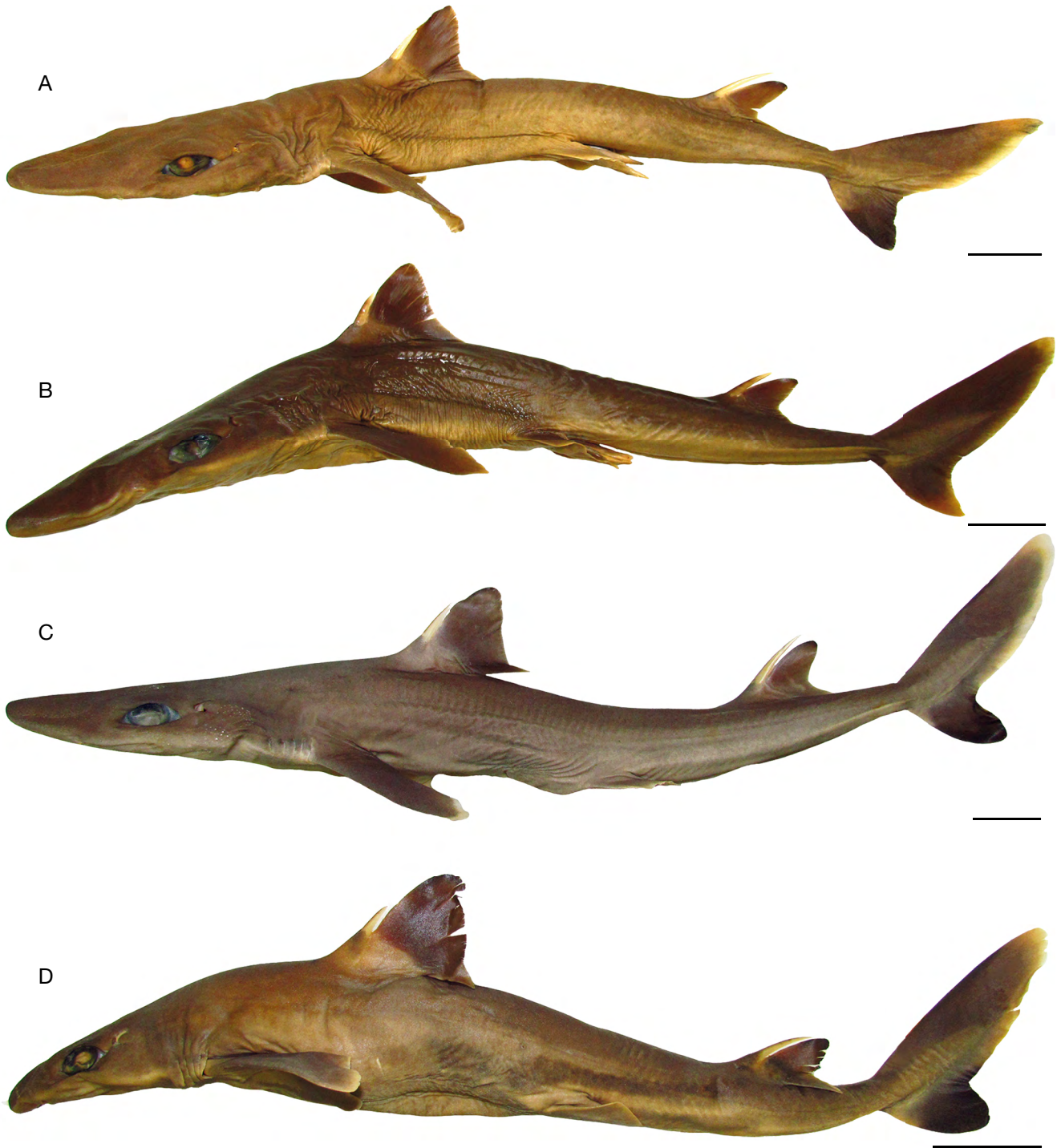


FIG. 1. — *Squalus melanurus* Fourmanoir, 1979 in lateral view: **A**, MNHN-IC-1980-0460 (holotype of *S. melanurus*), adult male, 670 mm TL; **B**, MNHN-IC-1978-0693 (holotype of *S. rancureli* Fourmanoir, 1979), adult male, 680 mm TL; **C**, MNHN-IC-2002-1392, adult female, 665 mm TL; **D**, MNHN-IC-1997-3619, juvenile female, 527 mm TL. Scale bars: 50 mm.

ity; MNHN-IC-1997-3617, adult ♂, 680 mm TL, New Caledonia, 23°43'1"S, 168°15'0"E; MNHN-IC-1997-3619, juvenile ♀, 527 mm TL, New Caledonia, 23°43'1"S, 168°15'0"E; MNHN-IC-1997-3621, adult ♂, 647 mm TL, Norfolk Island, Australia; MNHN-IC-1997-3622, adult ♂, 662 mm TL, Norfolk Island, Australia; MNHN-IC-1997-3624, adult ♂, 650 mm TL, Norfolk Island, Australia; MNHN-IC-1997-3625, adult ♂, 645 mm TL,

Norfolk Island, Australia; MNHN-IC-1997-3626, adult ♀, 650 mm TL, Norfolk Island, Australia; MNHN-IC-1997-3627, adult ♀, 690 mm TL, Norfolk Island, Australia; MNHN-IC-1997-3628, adult ♀, 695 mm TL, Norfolk Island, Australia; MNHN-IC-2002-1196, adult ♂, 655 mm TL, New Caledonia; MNHN-IC-2002-1197, adult ♂, 680 mm TL, New Caledonia; MNHN-IC-2002-1392, adult ♀, 665 mm TL, New Caledonia, 23°1'1"S, 166°55'1"E.

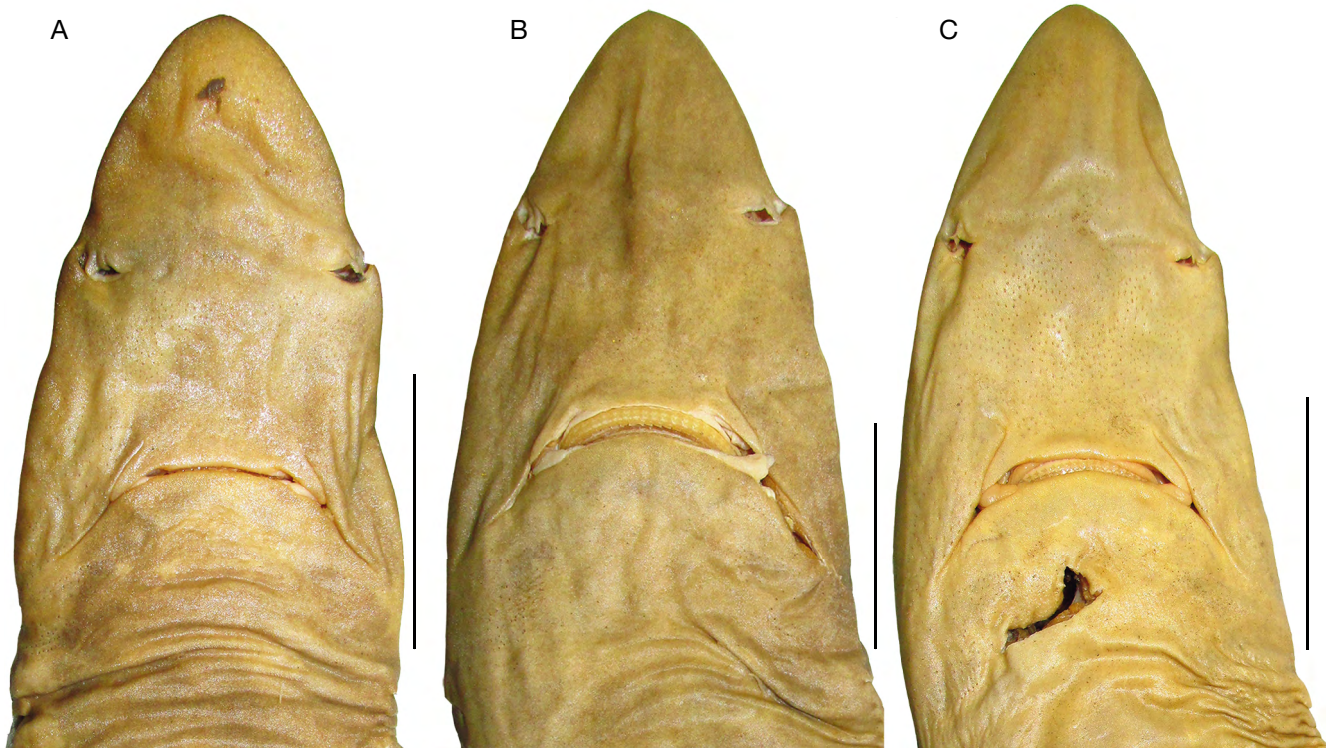


FIG. 2. — Head in ventral view of *Squalus melanurus* Fourmanoir, 1979. **A**, MNHN-IC-1997-3619, juvenile female, 527 mm TL; **B**, MNHN-IC-1980-0460 (holotype of *S. melanurus*), adult male, 670 mm TL; **C**, MNHN-IC-1978-0693 (holotype of *S. rancureli* Fourmanoir, 1979), adult male, 680 mm TL. Scale bars: 50 mm.

GEOGRAPHICAL DISTRIBUTION. — It occurs in the Southwestern Pacific Ocean, surrounding waters from New Caledonia, Vanuatu, and Norfolk Island (Australia) (Fig. 15).

DIAGNOSIS. — *Squalus melanurus* is distinguished from all its congeners by: body conspicuously slender; conspicuous black caudal-fin lower lobe; snout obtuse and markedly elongate, its preorbital length 9.6% (10.0-10.9%) TL; more elongate distance from nostrils to tip of snout, comprising 6.9% (7.2-8.4%) TL; larger preoral length, corresponding to 12.6% (12.7-14.3%) TL; more elongate distance from spiracle to tip of snout, its length 14.7% (15.3-16.8%) TL. It is further distinct from its congeners by having broader internarial space, its width 5.1% (5.1-6.1%) TL, and more elongate second dorsal-fin spine, its length 6.2% (4.9-6.5%) TL. *Squalus melanurus* also differs from congeners by monospondylous vertebrae 41-41 (vs 49 for *S. bucephalus* vs 45-46 for *S. mitsukurii* vs 43-46 for *S. chloroculus* vs 45-47 for *S. griffini* vs 36-39 for *S. nasutus*), precaudal 85-94 (vs 78-83 for *S. nasutus*), and total vertebrae 114-120 (vs 124 for *S. bucephalus* vs 103-109 for *S. nasutus*).

DESCRIPTION

General body, snout and eyes (Figs 1, 2)

Body fusiform and markedly thin throughout all its extension; body with its greatest width at head, its width 1.3 (1.0-1.3) times trunk width and 1.8 (1.1-1.4) times abdomen width. Head flattened dorsally and conspicuously tapered, its height 0.8 (0.8-1.0) times trunk and abdomen height; head elongate, its length 23.6% (22.4-26.8%) TL. Snout obtuse at the tip and conspicuously extended, its preorbital length 9.6% (10.0-10.9%) TL; anterior margin of nostrils bi-lobed with second lobe pointed, larger and thinner than first lobe; nostrils much closer to mouth than tip of snout,

its prenarial length 1.4 (1.4-1.7) times distance from nostril to upper labial furrow and 0.5 (0.6-0.6) times preoral length; internarial width 1.2 (1.1-1.3) times larger than length of eye. Eyes narrowly oval with anterior margin pointed; posterior margin of eye pointed to somewhat notched; eyes large, its length 2.7 (2.3-3.1) times greater than its height. Prespiracular length 0.6 (0.6-0.7) times prepectoral length and 1.5 (1.5-1.6) times preorbital length. Spiracles crescent and markedly constricted, its length 0.2 (0.2-0.3) times eye length, placed laterally behind the eyes. Prebranchial length 1.4 (1.3-1.4) times prespiracular length. Gill slits straight to slightly concave, very low with fifth gill slit 1.2 (1.0-1.6) times greater in height than first gill slit.

Mouth and dentition (Figs 2, 6)

Preoral length comprising 2.0 (1.9-2.3) times greater than mouth width. Mouth somewhat arched and very narrow, its width 0.9 (0.8-0.9) times prenarial length and 1.3 (1.1-1.3) times larger than internarial space; upper labial furrow short with slender fold, its length 2.1% (1.9-2.6%) TL; lower labial furrow also short, not reaching head laterally and lacking a fold. Teeth unicuspid and similar in both jaws; upper teeth smaller than lower teeth; mesial cutting edge convex; mesial heel notched on upper teeth and weakly notched on lower teeth; distal heel rounded; cusp short and thick, pointed obliquely; apron very short and heavy, placed at midline of the crown base. Three series of functional teeth on upper jaw and two series on lower jaw in holotype. Upper teeth rows 13-1-13; lower teeth rows 11-1-11.

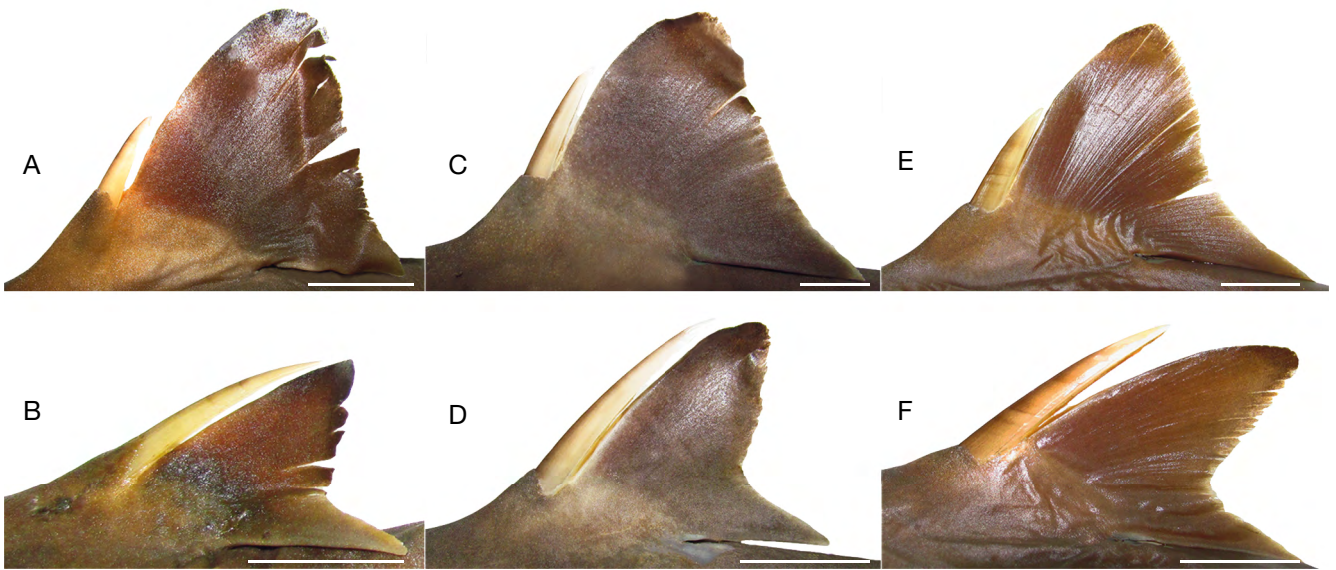


FIG. 3. — First and second dorsal fins of *Squalus melanurus* Fourmanoir, 1979: **A, B**, MNHN-IC-1997-3619, juvenile female, 527 mm TL; **C, D**, MNHN-IC-2002-1196, adult male, 655 mm TL; **E, F**, MNHN-IC-1978-0693 (holotype of *S. rancureli* Fourmanoir, 1979), adult male, 680 mm TL. Scale bars: 20 mm.

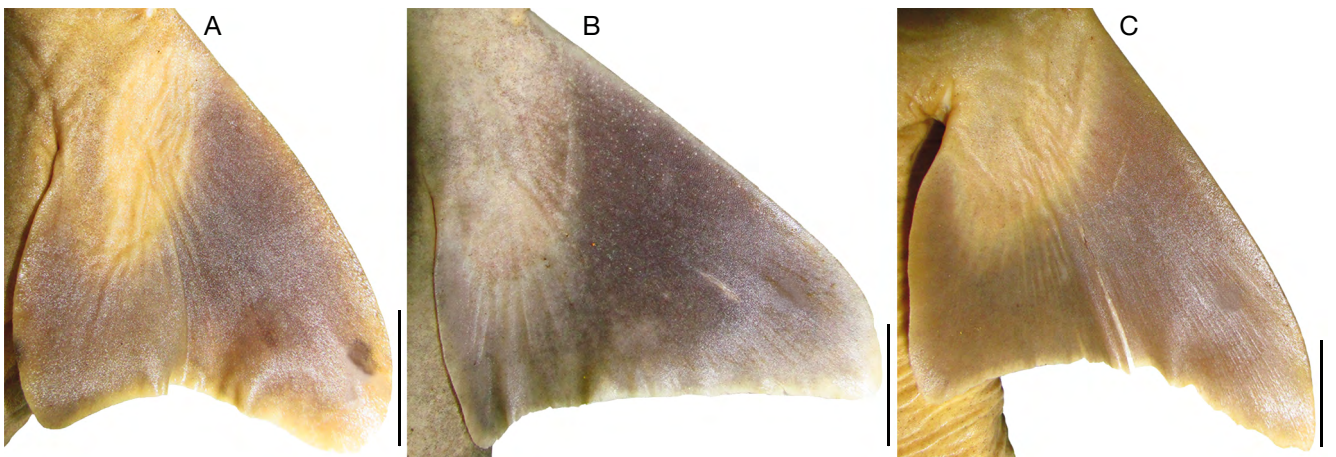


FIG. 4. — Pectoral fins of *Squalus melanurus* Fourmanoir, 1979 in ventral view: **A**, MNHN-IC-1997-3619, juvenile female, 527 mm TL; **B**, MNHN-IC-2002-1196, adult male, 655 mm TL; **C**, MNHN-IC-1978-0693 (holotype of *S. rancureli* Fourmanoir, 1979), adult male, 680 mm TL. Scale bars: 20 mm.



FIG. 5. — **A, B**, Caudal fin of *Squalus melanurus* Fourmanoir, 1979, showing black lower caudal lobe: **A**, MNHN-IC-1997-3619, juvenile female, 527 mm TL; **B**, MNHN-IC-2002-1197, adult male, 655 mm TL; **C**, caudal fin of holotype of *S. rancureli* Fourmanoir, 1979 (MNHN-IC-1978-0693). Scale bars: 20 mm.

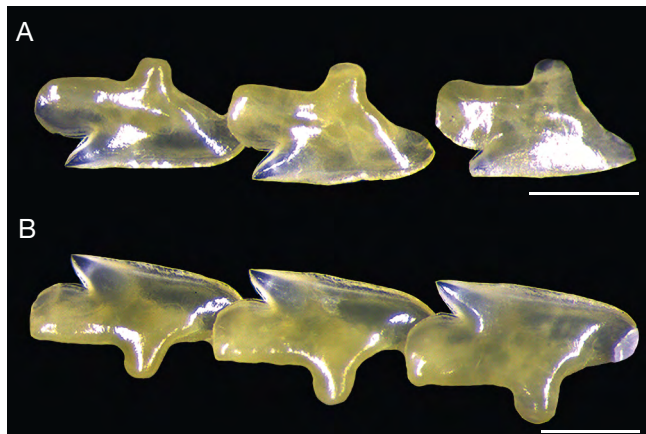


FIG. 6. — Upper (A) and lower (B) teeth of *Squalus melanurus* Fourmanoir, 1979 (MNHN-IC-1997-3626) in labial view. Scale bars: 1 mm.

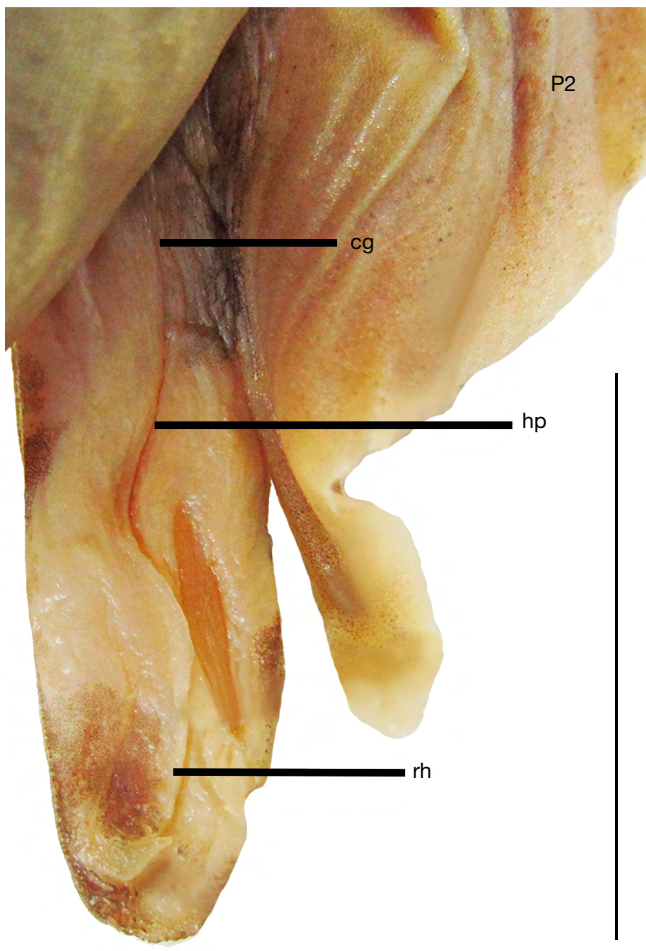


FIG. 7. — External dorsal view of right clasper of holotype of *Squalus melanurus* Fourmanoir, 1979 (MNHN-IC-1980-0460, adult male, 670 mm TL). Abbreviations: **cg**: clasper groove; **hp**: hypopyle; **P2**: pelvic fin; **rh**: rhipidion. Scale bar: 20 mm.

TABLE 1. — External measurements for *Squalus melanurus* Fourmanoir, 1979 expressed as percentage of total length (%TL). Total length is expressed in millimeters. Values for holotype of *S. rancureli* Fourmanoir, 1979 are provided separately. Abbreviations: **N**, number of specimens; **x**, mean; **SD**, standard deviation.

Measurements	<i>S. melanurus</i> MNHN-IC-1980-0460	<i>S. rancureli</i> MNHN-IC-1978-0693	N	Range	x	SD
TL (mm)	670.0	680.0	9	527.0-695.0	656.1	46.4
PCL	77.6	80.0	9	78.6-80.1	79.0	0.8
PD2	60.7	61.9	9	60.2-63.8	61.8	1.0
PD1	30.9	31.3	9	29.6-34.8	31.5	1.4
SVL	48.2	47.6	9	46.7-50.8	48.3	1.2
PP2	44.2	44.4	9	43.7-47.8	45.5	1.2
PP1	22.8	25.0	9	22.2-25.9	23.8	1.3
HDL	23.6	25.4	9	22.4-26.8	24.5	1.3
PG1	20.0	22.4	9	20.2-23.2	21.7	1.1
PSP	14.7	15.8	9	15.3-16.8	15.8	0.6
POB	9.6	10.3	9	10.0-10.9	10.4	0.4
PRN	6.9	7.7	9	7.2-8.4	7.7	0.5
POR	12.6	13.6	9	12.7-14.3	13.2	0.5
INLF	4.8	5.0	9	4.9-5.9	5.2	0.3
MOW	6.4	5.8	9	6.2-7.4	6.6	0.4
ULA	2.1	2.1	9	1.9-2.6	2.2	0.2
INW	5.1	5.3	9	5.1-6.1	5.6	0.3
INO	8.2	7.9	9	8.0-8.9	8.4	0.3
EYL	4.4	4.6	9	4.3-5.2	4.8	0.3
EYH	1.6	1.8	9	1.5-2.1	1.8	0.2
SPL	0.9	1.1	9	1.1-1.6	1.2	0.2
GS1	1.6	1.3	9	1.3-2.1	1.6	0.3
GS5	1.9	2.0	9	1.8-2.4	2.0	0.2
IDS	22.5	25.1	9	22.8-25.7	23.9	1.0
DCS	9.3	10.0	9	8.2-10.5	9.4	0.6
PPS	15.2	13.7	9	14.8-22.0	18.5	2.8
PCA	25.7	28.2	9	24.3-26.9	26.1	1.1
D1L	13.8	13.4	9	12.9-14.1	13.5	0.4
D1A	11.1	10.1	9	8.3-12.8	11.5	1.3
D1B	7.9	8.3	9	7.6-9.1	8.2	0.5
D1H	9.5	8.8	9	8.2-10.3	9.0	0.6
D1I	5.8	5.2	9	5.0-5.8	5.4	0.3
D1P	10.6	9.8	9	8.4-9.7	9.2	0.7
D1ES	3.9	3.7	9	2.9-5.1	4.2	0.6
D1BS	0.8	0.8	9	0.7-1.0	0.8	0.1
D2L	13.6	12.6	9	11.6-13.0	12.4	0.6
D2A	12.5	12.2	9	10.8-12.3	11.8	0.6
D2B	8.6	8.4	9	7.2-9.0	8.0	0.5
D2H	6.9	6.7	9	6.3-8.0	7.2	0.5
D2I	4.7	4.3	9	4.1-4.8	4.4	0.3
D2P	6.6	5.8	9	3.3-5.8	5.0	0.9
D2ES	6.2	4.9	9	5.7-6.5	5.8	0.4
D2BS	0.7	0.9	9	0.7-0.9	0.8	0.1
P1A	14.3	14.2	9	13.5-15.3	14.3	0.5
P1I	8.2	7.4	9	7.0-8.1	7.6	0.4
P1B	4.2	3.9	9	4.4-5.0	4.5	0.3
P1P	11.1	10.5	9	9.3-12.0	10.5	0.9
P2L	12.7	12.2	9	10.4-12.0	11.4	0.7
P2I	7.3	5.9	9	5.3-6.8	6.2	0.6
CDM	21.7	20.2	9	19.2-20.8	20.5	0.6
CPV	10.0	10.9	9	4.9-11.3	10.2	1.8
CFW	6.3	6.2	9	5.7-6.7	6.3	0.2
HANW	7.7	7.6	9	7.8-8.8	8.2	0.4
HAMW	11.2	10.5	9	10.8-12.7	11.7	0.7
HDW	11.9	11.1	9	11.7-13.3	12.3	0.6
TRW	9.3	9.4	9	9.3-12.3	10.7	1.2
ABW	6.8	8.6	9	8.3-11.8	9.8	1.6
HDH	7.6	9.4	9	8.8-11.2	9.8	1.1
TRH	9.3	11.1	9	9.2-13.3	11.2	1.4
ABH	9.2	10.9	9	8.8-13.7	11.0	1.3
CLO	3.8	4.2	3	3.6-4.3	3.9	0.3
CLI	7.9	6.8	3	7.1-8.6	7.6	0.7

Dorsal fins (Fig. 3)

Pre-first dorsal length 1.4 (1.2-1.4) times prepectoral length; origin of first dorsal fin prior to vertical traced at pectoral-fin free rear tips. First dorsal fin upright and slender at apex with anterior margin convex and posterior margin straight to weakly concave near free rear tips; first dorsal-fin apex very narrow and rounded; first dorsal-fin free rear tip pointed; first dorsal-fin inner margin short, its length 5.8% (5.0-5.8%) TL; first dorsal fin elongate, its length 13.8% (12.9-14.1%) TL, and tall with its height 1.6 (1.5-1.8) times greater than length of first dorsal-fin inner margin. First dorsal fin length 1.0 (1.0-1.2) times length of second dorsal fin. First dorsal-fin spine short, its length 0.4 (0.3-0.5) times height of first dorsal fin, and slender with base width 0.8% (0.7-1.0%) TL. Interdorsal space 1.0 (0.9-1.1) times prepectoral length, and 2.4 (2.3-3.0) times dorsal-caudal space. Pre-second dorsal length 2.7 (2.4-2.8) times prepectoral length. Second dorsal fin upright and conspicuously slender; second dorsal-fin apex rounded and lobe-like; second dorsal-fin anterior margin convex and posterior margin concave; second dorsal-fin free rear tip pointed; second dorsal-fin inner margin very short, its length 4.7% (4.1-4.8%) TL; second dorsal fin tall, its height 1.5 (1.3-1.9) times length of second dorsal-fin inner margin. Second dorsal spine very thin, its base width 0.7% (0.7-0.9%) TL, and elongate, its length 0.9 (0.7-0.9) times height of second dorsal fin, almost reaching second dorsal fin apex; second dorsal-fin spine length 1.6 (1.1-2.0) times more elongate than length of first dorsal-fin spine.

Paired fins and claspers (Figs 4, 7)

Pectoral fins somewhat narrow with pectoral-fin posterior margin length 11.1% (9.3-12.0%) TL; pectoral-fin anterior margin straight, although convex distally; pectoral-fin inner margin convex; pectoral-fin posterior margin straight to weakly concave; pectoral-fin apex rounded and lobe-like; pectoral-fin free rear tips rounded; pectoral-fin anterior margin elongate, its length 1.7 (1.7-2.0) times larger than length of pectoral-fin inner margin, and 1.3 (1.2-1.5) times greater in length than pectoral-fin posterior margin. Pectoral-pelvic space 0.6 (0.5-0.9) times pelvic-caudal distance. Pelvic fins small, its length 12.7% (10.4-12.2%) TL; pelvic-fin margins convex; pelvic-fin free rear tips rounded and lobe-like; origin of pelvic fins placed at midline between first and second dorsal fins, slightly nearest to first dorsal fin. Claspers rather thick and short, its inner length 1.1 (1.1-1.3) times more elongate than length of pelvic-fin inner margin; clasper groove longitudinal, dorsal and small; apophyle and hypophyle constricted, placed anterior and posteriorly in the clasper groove, respectively; rhipidion flap-like, short, and conspicuously thin, located medial-distally at the clasper.

Caudal fin (Fig. 5)

Caudal keel prominent, located laterally in the caudal peduncle from vertical traced at insertion of second dorsal fin to behind origin of caudal fin. Caudal fin small, its dorsal caudal margin length 0.9 (0.7-0.9) times head length, and 2.2 (1.8-4.2) times

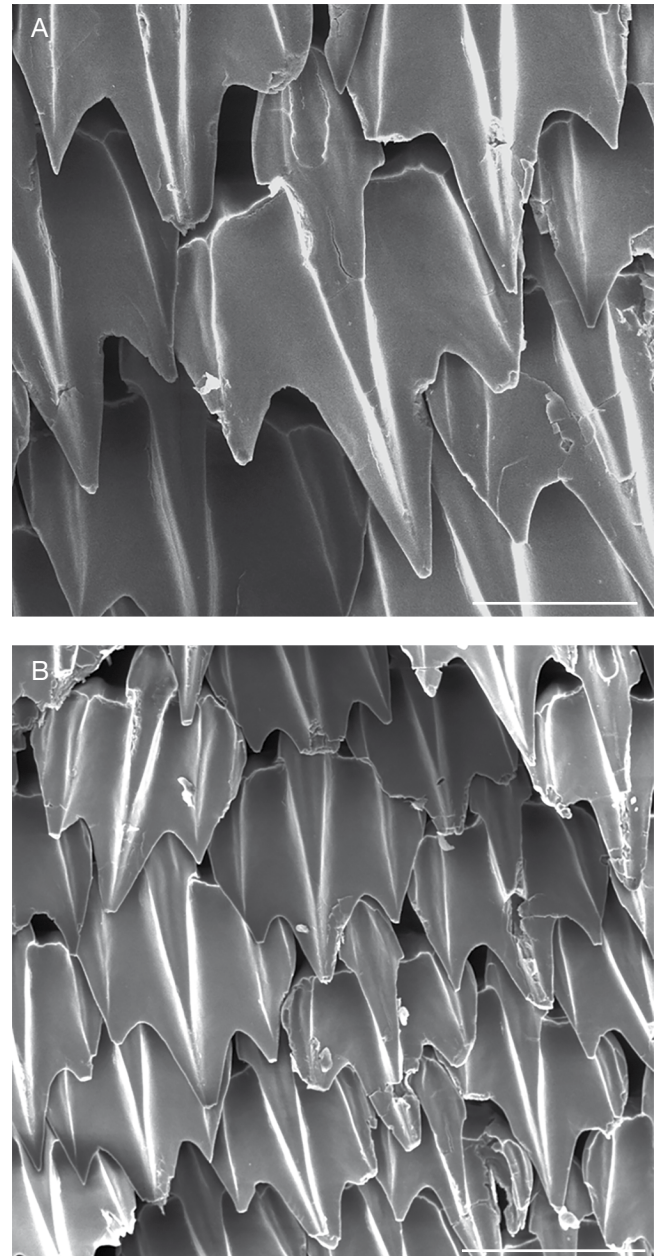


FIG. 8. — Scanning electron microscopy of dermal denticles of *Squalus melanurus* Fourmanoir, 1979, MNHN-IC-1997-3627, adult female, 690 mm TL. Scale bars: A, 100 µm; B, 200 µm.

larger than length of preventral caudal margin; dorsal caudal margin straight; upper postventral caudal margin somewhat convex to straight; lower postventral caudal margin straight; preventral caudal margin convex; dorsal caudal tip pointed; ventral caudal tip pointed to weakly rounded; caudal fin very thin on upper and lower lobes, its width at caudal fork 6.3% (5.7-6.7%) TL.

Dermal denticles

Tricuspid and imbricate dermal denticles, very broad at crown with its length slightly greater than its width; cusps pointed and posterior; lateral cusps smaller than median

TABLE 2. — Meristic data for holotypes of *Squalus melanurus* Fourmanoir, 1979, MNHN-IC-1980-0460, *S. rancureli* Fourmanoir, 1979, MNHN-IC-1978-0693, and *S. bucephalus* Last, Séret & Pogonoski, 2007, MNHN-IC-2006-1754. Range for other material is also provided. Abbreviation: N, number of specimens.

	<i>S. melanurus</i>				<i>S. bucephalus</i>		
Character	Holotype of <i>S. melanurus</i>	Holotype of <i>S. rancureli</i>	Range	N	Holotype	Range	N
upper teeth (right)	12	13	12-14	10	13	13-14	5
intermediate teeth (right)	—	1	—	10	—	—	5
upper teeth (left)	13	13	12-13	10	13	13-14	5
lower teeth (right)	11	11	11-12	10	11	11-12	5
intermediate teeth (left)	—	—	—	10	—	—	5
lower teeth (left)	11	11	11-12	10	11	11-12	5
upper teeth series	3	3	2-3	10	2	2-3	5
lower teeth series	2	2	1-3	10	2	2-2	5
monospondylous vertebrae	41	41	41	1	49	—	1
diplospondylous vertebrae	73	79	77	1	75	—	1
precaudal vertebrae	85	94	90	1	93	—	1
caudal vertebrae	29	26	28	1	31	—	1
total vertebrae	114	120	118	1	124	—	1

cusps, although almost reaching its tip; median ridge elongate and thick, turning thin distally; lateral ridges thin and as large as median ridge; anterior margin of the crown arrow-shaped with anterior furrow oval and shallow; small lateral ridges aside anterior furrow may be present in some denticles (Fig. 8).

Coloration

Body greyish brown dorsally and whitish grey ventrally (Fig. 1); both dorsal fins grey, light grey at fin base, and narrowly dark grey at the apex; dorsal-fin free rear tips slightly white. Dorsal-fin spines light brown, dark brown anteriorly and white at tips (Fig. 3). Pectoral fins dark grey with pectoral-fin posterior margin somewhat whitish, although not uniform; pectoral fins light grey ventrally and white at its base (Fig. 4). Pelvic fins dark grey dorsally and whitish grey ventrally; pelvic-fin posterior margins slightly white. Caudal fin mostly grey, light grey over vertebral column; dorsal caudal margin with black upper caudal fringe small, placed distally, although not reaching dorsal caudal tip; upper postventral caudal margin broadly white till caudal fork; lower postventral caudal margin black; lower caudal lobe conspicuously black with white basal marking at origin of preventral caudal margin; black caudal stripe absent (Fig. 5).

Vertebral counts

41 (41-41) monospondylous vertebrae; 85 (90-94) precaudal vertebrae; 29 (26-28) caudal vertebrae; 114 (118-120) total vertebrae.

REMARKS

Squalus melanurus is known to occur on upper insular slopes at depth range between 34-480 m (Fourmanoir 1979; Four-

manoir & Rivaton 1979; Kulbichi *et al.* 1990; Compagno *et al.* 2005; Fricke *et al.* 2011). It is also observed in shallow waters in Chesterfield Islands (at 34 m), and at medium to deeper waters (between 223-790 m) in New Caledonia and Vanuatu. Biology of this species is poorly known with little information about its reproduction and feeding habits available in the literature (e.g. Fourmanoir & Rivaton 1979; Fowler & Séret 2003). Studies on life-history traits such as maturation and offspring size associated to population dynamics on growth and density are of urgent concern for conservation purposes of *Squalus melanurus*. Paratypes of *S. melanurus* are apparently lost even though 17 specimens, measuring between 620-750 mm TL, were mentioned in Fourmanoir & Rivaton (1979).

Squalus bucephalus Last, Séret & Pogonoski, 2007 Bighead spurdog; Aiguillat à grosse tête (Figs 9-15; Tables 2-3)

Squalus bucephalus Last, Séret & Pogonoski, 2007: 23-29 (original description; illustrated. Type by original designation. Type locality Norfolk Ridge, south of New Caledonia, 405-411 m depth). — Ebert *et al.* 2013: 78, 86 (cited, description; Southwest Pacific Ocean). — Weigmann 2016: 903 (listed; Southwestern Pacific Ocean). — Bernot & Boxshall 2017: 275-276, 288 (cited, listed; New Caledonia).

Squalus sp. — Séret 1994: 7 (listed; New Caledonia).

MATERIAL EXAMINED. — MNHN-IC-1997-3634, juvenile ♂, 520 mm TL, Norfolk Ridge, New Caledonia, 24°43'1"S, 168°6'0"E, 500-600 m depth; MNHN-IC-1997-3635, juvenile ♀, 476 mm TL, Norfolk Ridge, New Caledonia, 24°43'1"S, 168°6'0"E, 500-600 m depth; MNHN-IC-1997-3636, juvenile ♀, 495 mm TL, Norfolk Ridge, New Caledonia, 24°43'1"S, 168°6'0"E, 500-600 m depth; MNHN-IC-1997-3641 (paratype of *S. bucephalus*), juvenile ♀, 430 mm TL, Norfolk Ridge, New Caledonia, 23°39'0"S, 167°43'59"E, 420-470 m depth; MNHN-IC-1997-3657, adult ♂, 705 mm TL, New Caledonia, 23°43'1"S, 168°15'0"E, 405-411 m depth; MNHN-IC-1997-3659, adult ♂, 805 mm TL, Stylaster Seamount, Norfolk Ridge, New Caledonia, 23°37'1"S, 167°39'0"E, 486-962 m depth; MNHN-IC-1997-3662, adult ♂, 795 mm TL, Stylaster Seamount, Norfolk Ridge, New Caledonia, 23°36'0"S, 167°40'59"E, 448-880 m depth; MNHN-IC-1998-1017, adult ♂, 810 mm TL, New Caledonia, 23°43'1"S, 168°15'0"E, 405-411 m depth; MNHN-IC-2006-1754 (holotype of *S. bucephalus*), juvenile ♂, 550 mm TL, Norfolk Ridge, south of New Caledonia, 23°43'S, 168°16'E, 405-411 m depth, collected on 28.XI.1993; NMNZ P 34030 (paratypes of *S. bucephalus*), two adult ♂, 787-802 mm TL, Stylaster Seamount, Norfolk Ridge, New Caledonia, 23°35'S, 167°42'E, 448-880 m depth.

GEOGRAPHICAL DISTRIBUTION. — *Squalus bucephalus* is endemic to New Caledonia in the Southwestern Pacific Ocean (Fig. 15).

DIAGNOSIS. — Short-snouted dogfish shark from New Caledonia that it is distinguished from its congeners by: head conspicuously humped dorsal-posteriorly and wide, its width at mouth 13.5% (12.1-13.9%) TL; anterior margin of nostrils conspicuously bilobate and broad; mouth straight and wide, its width 8.7% (7.6-8.8%) TL; caudal fin very slender on upper and lower lobes; caudal fin elongate, its dorsal caudal margin length 24.2% (21.7-23.9%); smaller pelvic-caudal space 24.9% (23.1-

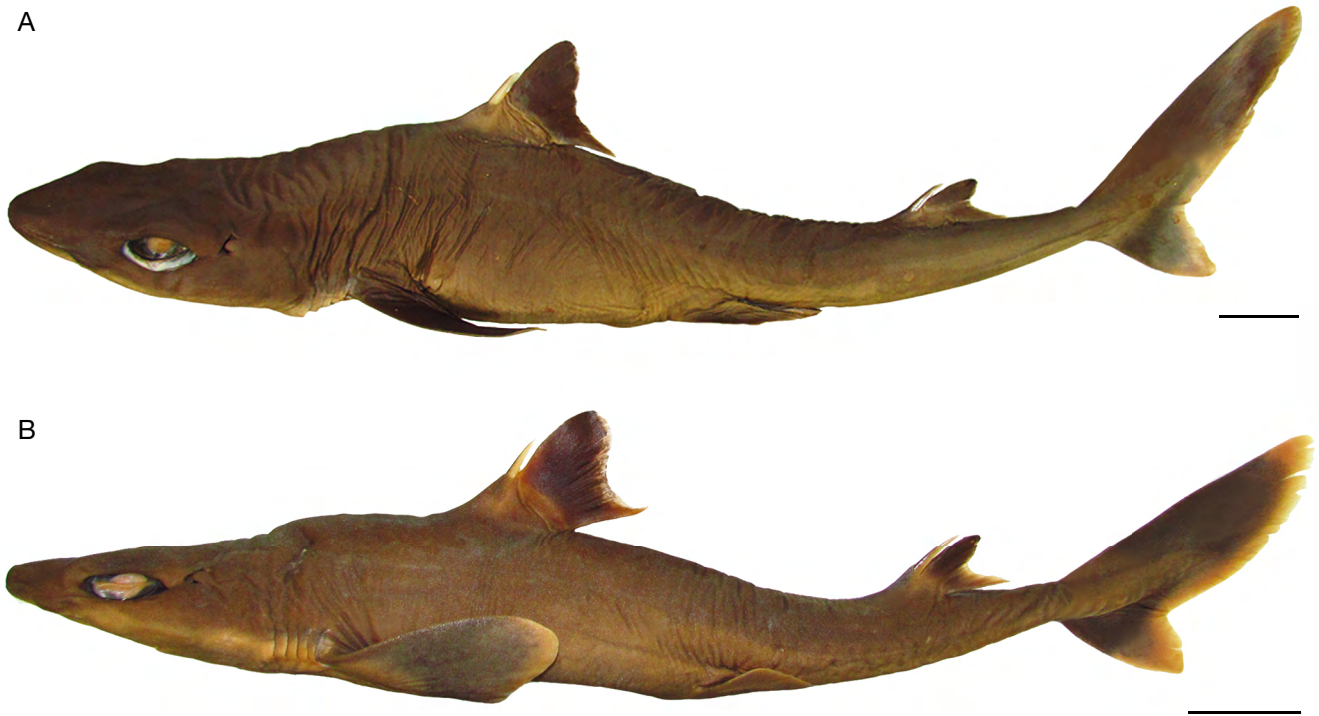


FIG. 9. — *Squalus bucephalus* Last, Séret & Pogonoski, 2007 in lateral view: **A**, MNHN-IC-1998-1017, adult male, 810 mm TL; **B**, MNHN-IC-1997-3636, juvenile female, 495 mm TL. Scale bars: 50 mm.

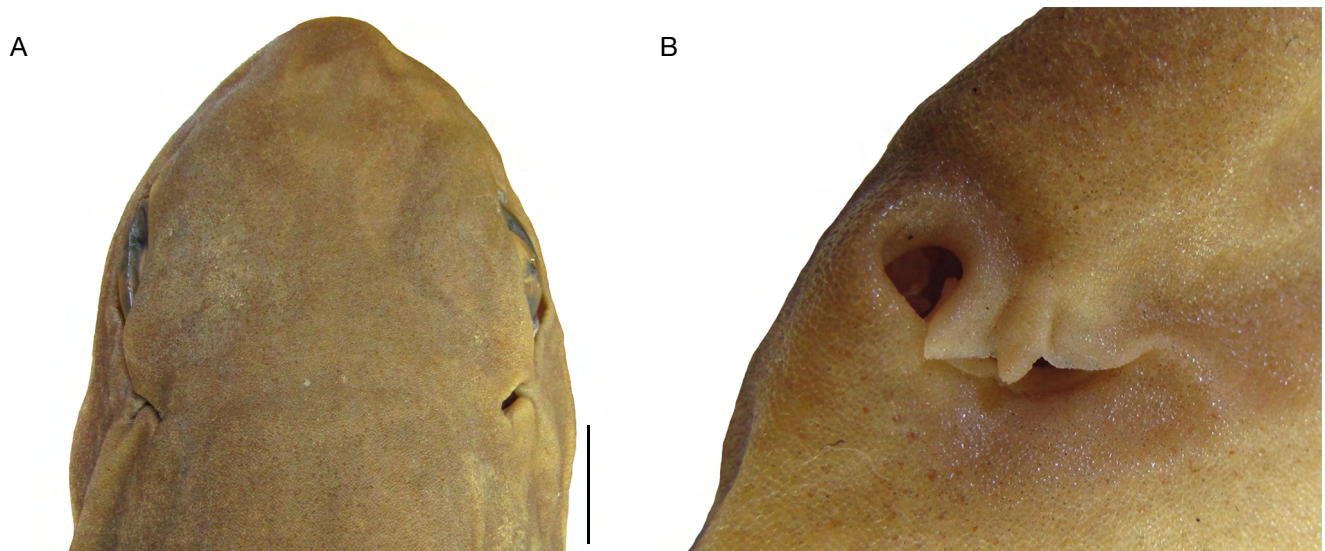


FIG. 10. — Detail of head in anterior dorsal view (**A**) and right nostrils (**B**) of holotype of *Squalus bucephalus* Last, Séret & Pogonoski, 2007 (MNHN-IC-2006-1754, juvenile male, 550 mm TL). Scale bar: A, 20 mm; B, not to scale.

26.3%) TL. It is clearly separated from *S. melanurus* by snout conspicuously short, its prenarial length 1.0-1.1 times distance nostril-upper labial furrow (vs snout conspicuously elongate, its prenarial length 1.4-1.7 times distance nostril-upper labial furrow in *S. melanurus*), prespiracular length (12.2-14.0% TL for *S. bucephalus* vs 14.7-16.8% TL for *S. melanurus*), and preoral length (9.2-10.9% TL for *S. bucephalus* vs 12.6-14.3% TL for

S. melanurus). It is further distinct from this species by having lower caudal lobe conspicuously white (vs conspicuously black), and dermal denticles unicuspidate and lanceolate (vs tricuspidate and rhomboid). *Squalus bucephalus* is also separated from *S. melanurus* by number of monospondylous (49 vs 41 for *S. melanurus*), caudal (31 vs 26-29 for *S. melanurus*), and total vertebrae (124 vs 114-120 for *S. melanurus*).

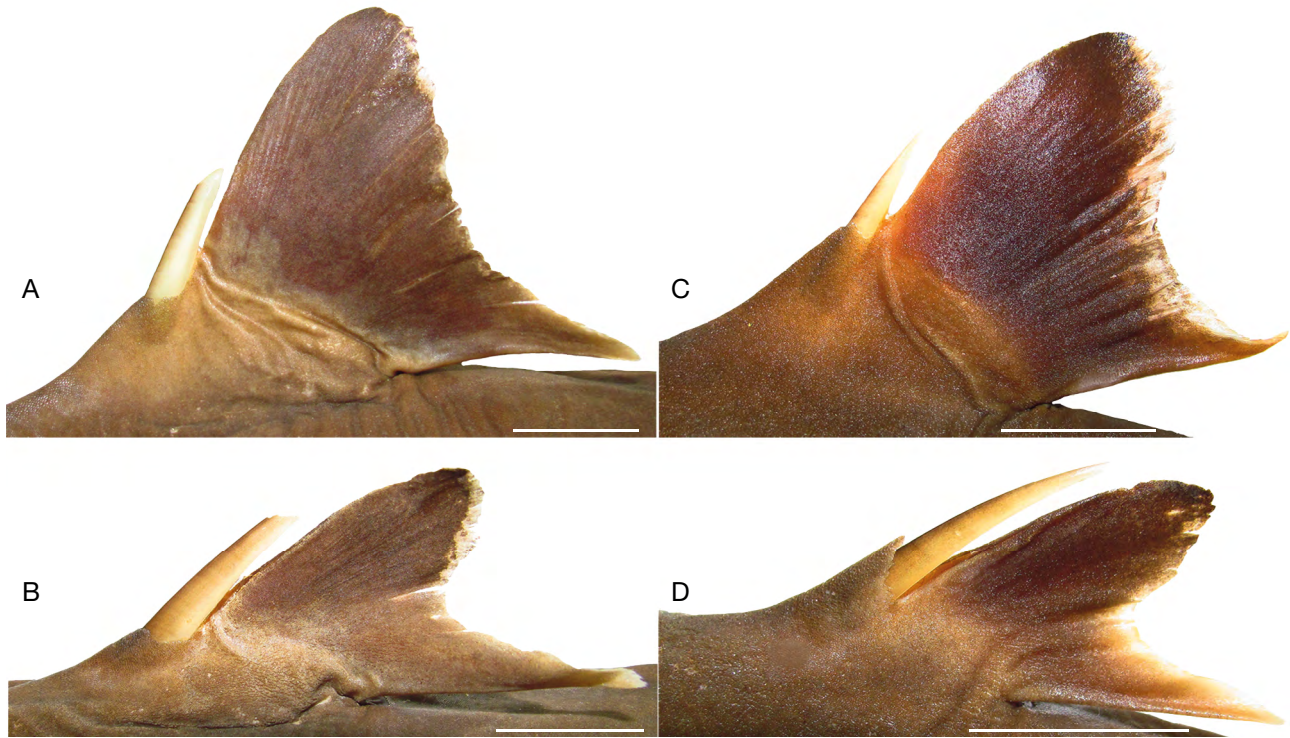


FIG. 11. — First (A, C) and second (B, D) dorsal fins of *Squalus bucephalus* Last, Séret & Pogonoski, 2007: A, B, MNHN-IC-1998-1017, adult male, 810 mm TL; C, D, MNHN-IC-1997-3636, juvenile female, 495 mm TL. Scale bars: 20 mm.

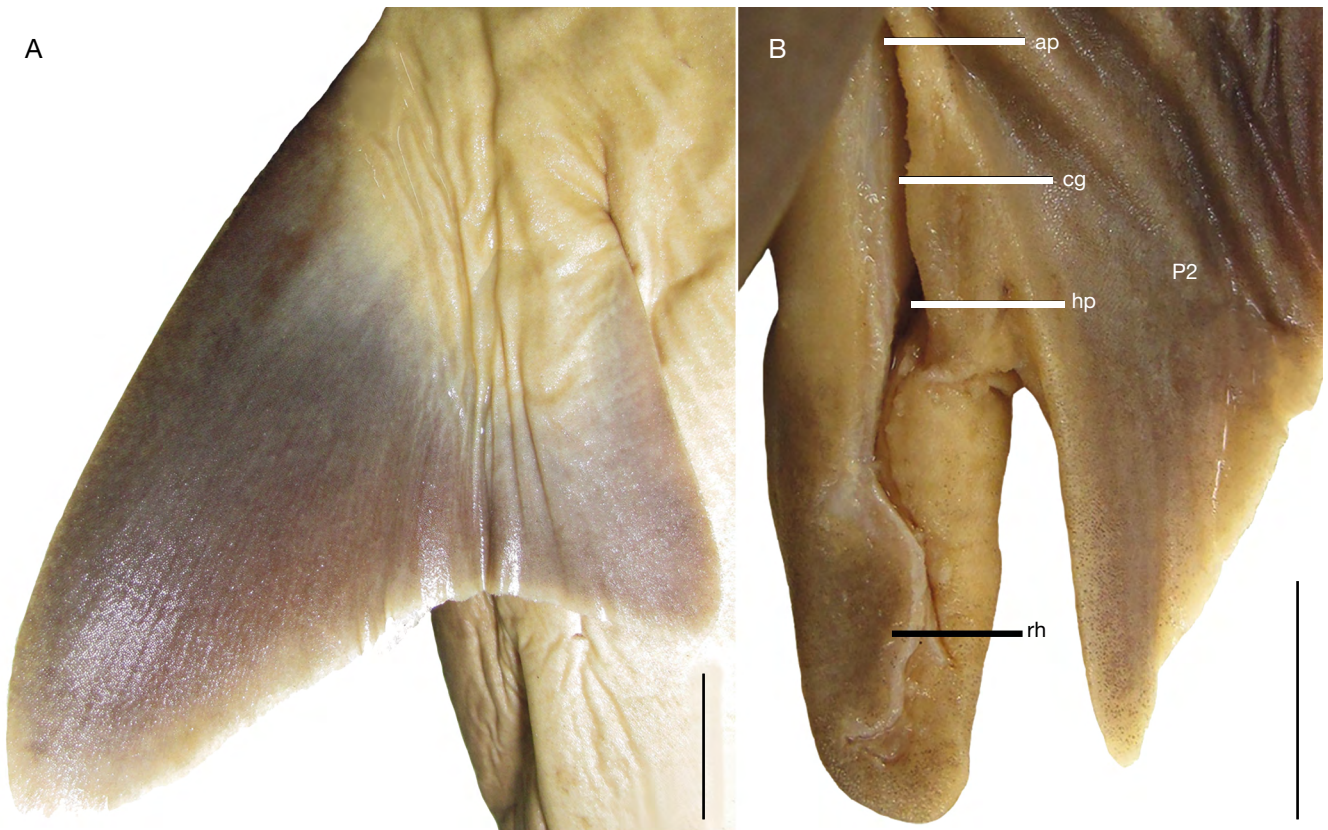


FIG. 12. — Pectoral fin in ventral view (A) and right clasper in dorsal view (B) of *Squalus bucephalus* Last, Séret & Pogonoski, 2007: A, MNHN-IC-1998-1017, adult male, 810 mm TL; B, NMNZ P 34030 (paratype), adult male, 787 mm TL. Abbreviations: ap, apophyle; cg, clasper groove; hp, hypophyle; P2, pelvic fin; rh, rhypidion. Scale bar: 20 mm.

TABLE 3. — External measurements for *Squalus bucephalus* Last, Séret & Pogonoski, 2007 expressed as percentage of total length (% TL). Total length is expressed in millimeters. Abbreviations: **N**, number of specimens; **x**, mean; **SD**, standard deviation.

<i>S. bucephalus</i>				
	Holotype	Range N=8	x	SD
TL (mm)	550.0	430.0-810.0	666.0	161.8
PCL	75.3	74.9-78.1	76.8	1.1
PD2	58.5	59.0-61.4	60.0	1.0
PD1	27.5	28.3-29.6	28.7	0.6
SVL	46.7	46.2-49.5	47.6	1.1
PP2	44.5	43.8-45.5	44.6	0.6
PP1	21.1	20.0-24.2	22.0	1.4
HDL	22.7	20.8-24.8	22.8	1.3
PG1	18.7	18.5-20.2	19.3	0.6
PSP	13.2	12.2-14.0	13.0	0.5
POB	8.1	6.8-7.9	7.5	0.4
PRN	5.0	4.5-5.4	5.0	0.3
POR	9.7	9.2-10.9	9.7	0.5
INLF	4.7	4.6-5.2	4.8	0.2
MOW	8.7	7.6-8.8	8.2	0.4
ULA	2.4	2.0-2.6	2.3	0.2
INW	4.4	4.3-5.0	4.7	0.3
INO	9.5	8.0-9.8	8.9	0.5
EYL	4.9	4.5-5.6	4.9	0.4
EYH	1.8	1.3-2.1	1.9	0.3
SPL	1.3	1.2-1.7	1.4	0.2
GS1	2.1	1.6-2.2	2.0	0.2
GS5	2.3	2.1-2.5	2.3	0.1
IDS	22.7	21.5-24.7	23.2	1.1
DCS	9.5	8.7-10.3	9.6	0.5
PPS	20.5	17.3-21.4	19.9	1.2
PCA	24.9	23.1-26.3	24.4	0.9
D1L	14.1	13.0-15.2	14.4	0.6
D1A	12.3	10.0-13.8	12.3	1.1
D1B	8.0	8.3-9.6	8.9	0.5
D1H	9.8	8.5-9.8	9.4	0.5
D1I	6.1	4.7-5.8	5.5	0.4
D1P	9.9	5.7-10.2	9.1	1.4
D1ES	3.5	2.7-3.8	3.4	0.4
D1BS	0.8	0.7-0.8	0.8	0.1
D2L	12.3	10.8-13.1	11.8	0.7
D2A	10.9	9.3-11.6	10.4	0.7
D2B	7.3	6.9-8.4	7.4	0.4
D2H	6.1	4.3-6.6	5.9	0.7
D2I	5.0	4.0-4.9	4.5	0.4
D2P	5.1	4.3-6.0	5.0	0.5
D2ES	4.5	3.4-4.6	4.2	0.5
D2BS	0.8	0.7-1.0	0.8	0.1
P1A	16.4	14.9-16.3	15.6	0.5
P1I	9.1	6.7-8.8	8.3	0.7
P1B	5.4	4.8-5.6	5.2	0.2
P1P	12.4	11.5-12.3	12.0	0.3
P2L	10.9	9.8-12.3	11.1	0.9
P2I	5.9	5.2-6.1	5.6	0.3
CDM	24.2	21.7-23.9	23.0	0.8
CPV	11.9	11.2-12.2	11.8	0.3
CFW	7.4	6.5-7.5	7.1	0.3
HANW	8.2	7.0-8.4	7.9	0.4
HAMW	13.5	12.1-13.9	13.0	0.6
HDW	13.8	12.7-14.0	13.4	0.5
TRW	11.9	8.9-13.0	11.3	1.3
ABW	9.1	8.4-11.0	9.6	1.1
HDH	10.8	9.5-11.6	10.7	0.7
TRH	11.0	10.0-14.9	11.8	1.5
ABH	10.6	8.3-13.3	10.5	1.7
CLO	—	1.1-3.4	2.8	0.9
CLI	—	3.2-6.8	5.9	1.3

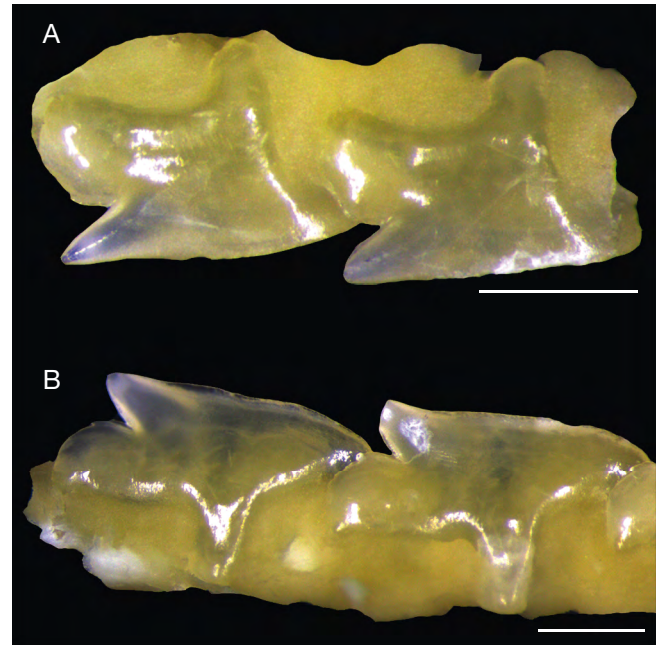


FIG. 13. — Upper (A) and lower (B) teeth of *Squalus bucephalus* Last, Séret & Pogonoski, 2007 (MNHN-IC-1997-3662, adult male, 795 mm TL) in labial view. Scale bars: 1 mm.

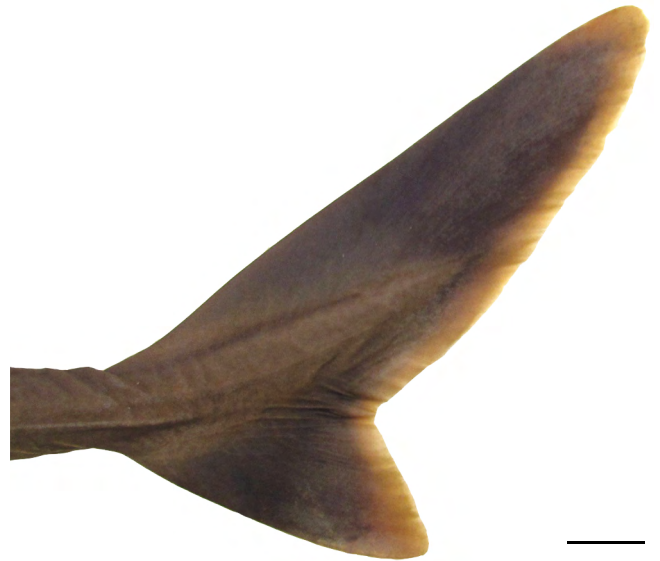


FIG. 14. — Caudal fin of paratype of *Squalus bucephalus* Last, Séret & Pogonoski, 2007 (NMNZ P 34030, adult male, 787 mm TL). Scale bar: 20 mm.

REMARKS

Squalus bucephalus is a deep-water dogfish shark that occurs in the continental slope between 405-962 m depth, although it is often caught at depths between 405-600 meters. It is a species with very restrict geographical distribution and whose biology is totally unknown. Females are rarely caught in New Caledonia, arousing attention for conservation and fisheries management. Studies on population size and trends, maturation, feeding and reproduction are imperative for threatened assessments of this species.

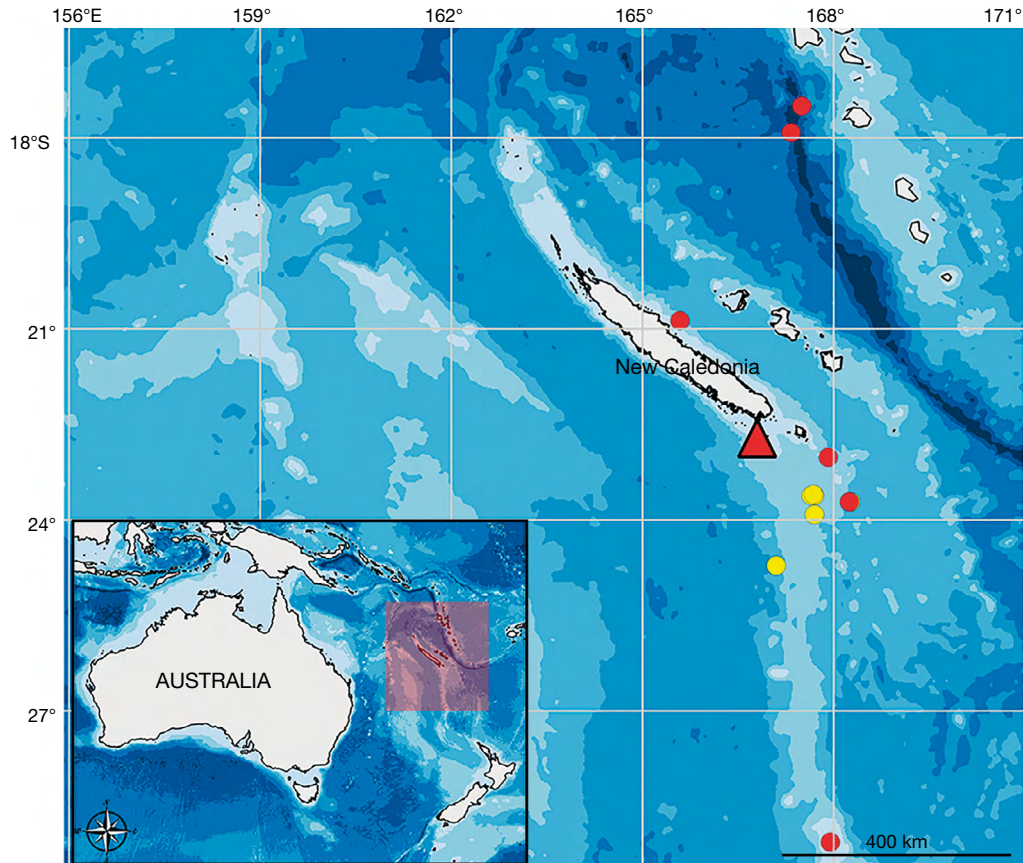


FIG. 15. — Map of distribution of *Squalus melanurus* Fourmanoir, 1979 (●) and *S. bucephalus* Last, Séret & Pogonoski, 2007 (●) in the Coral Sea. ▲: holotype of *S. melanurus*.

DISCUSSION

Squalus melanurus is endemic to waters from New Caledonia and Vanuatu, which it is in agreement with Fourmanoir (1979), Fourmanoir & Rivaton (1979), Compagno (1984), Séret (1994), Compagno *et al.* (2005), and Fricke *et al.* (2011). It is sympatric with *S. bucephalus* and *S. cf. montalbani*, corroborating results of Last *et al.* (2007b) for the former species. These findings are against Fourmanoir & Laboute (1976), Fourmanoir (1979), Fourmanoir & Rivaton (1979), Kulbicki *et al.* (1990), Rivaton *et al.* (1990), Séret (1994), Séret *et al.* (1997), Compagno *et al.* (2005), Last *et al.* (2007a), Fricke *et al.* (2011), and Ebert *et al.* (2013) in recognizing *S. rancureli*, *S. blainvillei* and *S. megalops* in these areas. *Squalus melanurus* and *S. bucephalus* reveal autapomorphic characteristics, which allow their easy separation from other *Squalus* congeners. Some of these characteristics are described exclusive in the current taxonomic evaluation, including greatest values of some proportional external measurements (e.g. internarial space, preorbital length, preoral length, and length of second dorsal-fin spine) for *S. melanurus*, and shape of nostrils and caudal fin, and higher number of vertebral counts for *S. bucephalus* (see diagnosis above).

Squalus melanurus together with *S. japonicus* Ishikawa, 1908 and *S. nasutus* Last, Marshall & White, 2007 comprise

a group of species, the *S. japonicus* group (Last *et al.* 2007a). These species exhibit snout conspicuously elongate and body markedly slender throughout all its extension, according to Last *et al.* (2007a) and to the present observations. *Squalus melanurus*, *S. japonicus* and *S. nasutus* also share snout obtuse, mouth markedly narrow, and pectoral fins tapered. *Squalus melanurus* is easily separated from these two species by having larger pectoral-fin posterior margin length, first dorsal fin higher and more elongate at base, and broader distance between nostrils. *Squalus melanurus* has larger snout than *S. japonicus* with prenarial length 6.9-8.4% TL (vs 5.9-6.8% TL for *S. japonicus*), and preorbital length 9.6-10.9% TL (vs 8.7-9.3% TL for *S. japonicus* see Appendix 1). The blacktailed spurdog also shows shorter prepiracular length and preoral length (14.7-16.8% TL, 12.6-14.3% TL for *S. melanurus* vs 12.8-14.3% TL, 10.7-11.9% TL for *S. japonicus*), and narrower head than *S. japonicus*, its width at nostrils 7.6-8.8% TL (vs 6.3-7.3% TL for *S. japonicus*). *Squalus melanurus* is distinguished from *S. nasutus* by having smaller precaudal length and dorsal-caudal space, and more elongate second dorsal-fin spine, higher second dorsal fin, and first dorsal-fin posterior margin greater in length. These current results support that the recognition of the *S. japonicus* group is unnecessary, following earlier findings of Viana *et al.* (2016, 2017) for other group of species in *Squalus*.

Other long-snouted congeners similar to *S. melanurus* that occur in the Southwestern Pacific Ocean are *S. mitsukurii*, *S. griffini*, *S. montalbani* Whitley, 1931, *S. chloroculus*, and *S. grahami* White, Last & Stevens, 2007. These species share dermal denticles tricuspidate and rhomboid, high number of vertebrae, pectoral-fin free rear tips rounded, body uniformly grey to dark grey, lacking white spots, and nostrils nearer mouth than snout tip. *Squalus melanurus* is easily separated from *S. mitsukurii*, *S. griffini*, *S. montalbani*, *S. chloroculus* and *S. grahami* by lacking black caudal bar and black upper caudal fringe (vs presence of black caudal bar and black upper caudal fringe), body markedly thin (vs body markedly robust), pectoral fins narrow (vs broad), and tall and upright dorsal fins (vs low and oblique).

Squalus species composition from New Caledonia and Vanuatu are here updated to include *S. melanurus* and *S. bucephalus* as well as a third species herein provisionally identified as *Squalus* cf. *montalbani* due to the lack of additional morphological evidence (e.g. vertebral and teeth counts). *Squalus* cf. *montalbani* resembles morphologically *S. montalbani*, *S. chloroculus* and *Squalus* sp. sensu Duffy & Last (2015) from New Zealand, and reveals overlapping of characteristics with other long-snouted species from the Southwestern Pacific Ocean provided earlier in this account. Comparative taxonomic approach between these species has been undertaking to clarify either one of these species exhibiting broader geographical range of distribution in the Southwestern Pacific Ocean or either *S. cf. montalbani* comprising a new undescribed species. *Squalus melanurus* differs from *S. cf. montalbani* on body shape (conspicuously slender in *S. melanurus* vs conspicuously heavy in *S. cf. montalbani*), caudal fin coloration (lower caudal lobe black and upper caudal lobe grey in *S. melanurus* vs lower caudal lobe greyish and upper caudal lobe with conspicuous black caudal bar in *S. cf. montalbani*), snout length (markedly elongate in *S. melanurus* vs moderate elongate in *S. cf. montalbani*), shape of pectoral fins (narrow in *S. melanurus* vs broad in *S. cf. montalbani*), height of dorsal fins (taller in *S. melanurus* than in *S. cf. montalbani*), and length of dorsal spines (elongate in *S. melanurus* vs small in *S. cf. montalbani*). *Squalus melanurus* is separated from *S. bucephalus* by characters of external morphology, including shape of dermal denticles and coloration, vertebral counts and some proportional measurements as provided in the diagnosis of the latter species.

Regional similar congeners to the bighead spurdog comprise *S. megalops*, *S. raoulensis*, *S. albifrons*, and *S. notocaudatus*, which is in congruence with Last *et al.* (2007e). *Squalus bucephalus* is separated from *S. megalops* on having head humped and broad (vs head straight and narrow), caudal fin not uniformly grey and lower caudal lobe whitish (vs caudal fin uniformly grey, including lower caudal lobe), and first dorsal fin slender at apex (vs wide at apex). *Squalus bucephalus* is distinct from *S. raoulensis* by having pectoral fin not transcending the trunk height when adressed on body (vs pectoral fin transcending trunk height when adressed on body), and from *S. raoulensis* and *S. notocaudatus* by body dark grey dorsally (vs body reddish brown in *S. raoulensis* vs body light grey to

white in *S. notocaudatus*). *Squalus bucephalus*, *S. albifrons*, and *S. notocaudatus* share dorsal fin upright and tall. However, the former species is separated from *S. albifrons* by lacking whitish eyebrow, and from *S. notocaudatus* by pectoral-fin posterior margin slightly concave and not falcate (vs conspicuously concave and falcate).

Ordinary publications of scientific zoological names in grey literature such as magazines, newspapers, and websites have been recently under discussion in Kullander (2011) for bony fishes and Schleip (2014) for snakes, and also rely on the nomenclatural status of *S. rancureli* noticed in the present study. This nominal species has been in long usage and fully accepted by specialists, despite of Séret (1994) earlier assumptions on its confused authorship. These findings awaken for strict usage of ICZN requirements and continuous verifications of nomenclatural acts and available works for the purpose of taxonomic stability in later investigations as suggested in Dubois *et al.* (2013). Systematic complexity behind *S. rancureli* and *S. melanurus* reveals to be beyond nomenclatural confusion because congruent descriptions of these species have been reproduced repetitively elsewhere (e.g. Compagno *et al.* 2005; Ebert *et al.* 2013) without an update comparative evaluation. The present study comprises a comprehensive attempt in revise taxonomically species of the genus *Squalus* in Vanuatu and New Caledonia using morphological data, following other recent regional studies of Last *et al.* (2007b), Maourani *et al.* (2012), Viana & Carvalho (2016), and Viana *et al.* (2016, 2017a, b). *Squalus* species delineation through molecular barcoding for Vanuatu and New Caledonian representatives is still of urgent concern in order to contribute to understanding the diversity of the genus as it has been under scrutiny in other areas such as Australia, Indonesia and New Zealand in Ward *et al.* (2007), global examination in Naylor *et al.* (2012), and more recently in the Eastern Atlantic Ocean in Veríssimo *et al.* (2017).

COMPARATIVE MATERIAL

S. japonicus (five specimens): CSIRO H 6294-31, juvenile ♀, 540 mm TL, Tashi fish market, near I-Lan (NE coast), Taiwan; HUMZ 189685, adult ♀, 512 mm TL, East China Sea; HUMZ 189737, adult ♂, 560 mm TL, East China Sea; NSMT-P 44380, adult ♂, 645 mm TL, Southern Japan, Japan; NSMT-P 67530, adult ♀, 560 mm TL, Southern Japan, Japan.

S. nasutus (four specimens): CSIRO H 2567-08 (paratype of *S. nasutus*), adult ♂, 467 mm TL, West of Dorre Island, Western Australia; CSIRO H 4132-03, juvenile ♀, 475 mm TL, Bolinao evening market, Philippines; CSIRO H 6125-04, adult ♂, 465 mm TL, Kedonganan, Jimbaran Bay (South coast of Bali), Indonesia; CSIRO H 6413-01, adult ♀, 580 mm TL, West of Shark Bay, Western Australia.

S. mitsukurii (four specimens): HUMZ 68767, adult ♂, 620 mm TL, Emperor Sea Mount, Kinmei; HUMZ 89858, adult ♀, 705 mm TL, off Hachijo-jima Island, Tokyo, Japan;

NMMB P 15560, juvenile ♂, 656 mm TL, Pingtung county, Taiwan; NMMB P 15619, adult ♀, 700 mm TL, Pingtung county, Taiwan.

S. griffini (five specimens): NMNZ P 41224, juvenile ♀, 540 mm TL, Chatham Islands, New Zealand; NMNZ P 41225, juvenile ♀, 572 mm TL, adult ♂, 693 mm TL, Chatham Islands, New Zealand; NMNZ P 42761, juvenile ♂, 533 mm TL, West off Kahurangi Point, Nelson, South Island, New Zealand; NMNZ P 52106, adult ♀, 692 mm TL, Kermadec Islands, New Zealand.

S. montalbani (four specimens): CSIRO H 1290-2, juvenile ♂, 590 mm TL, East of Flinders Reefs, Queensland, Australia; CSIRO H 2606-02, juvenile ♀, 550 mm TL, West of Rottnest Island, Western Australia; CSIRO H 2609-07, adult ♂, 620 mm TL, West of Rottnest Island, Western Australia; CSIRO H 7066-01, juvenile ♀, 457 mm TL, SE of Coffs Harbour, New South Wales, Australia.

S. chloroculus (four specimens): CSIRO CA 121 (paratype of *S. chloroculus*), adult ♀, 725 mm TL, East of Ulladulla, New South Wales, Australia; CSIRO H 1405-1 (paratype of *S. chloroculus*), adult ♂, 760 mm TL, South of King Island, Tasmania, Australia; CSIRO H 2867-04 (paratype of *S. chloroculus*), adult ♀, 786 mm TL, Great Australian Bight, Southern Australia; CSIRO H 5941-01 (paratype of *S. chloroculus*), adult ♂, 760 mm TL, West of Cape Sorell, Tasmania, Australia.

S. grahami (four specimens): AMS I 37735-001, adult ♀, 685 mm TL, off Terrigal, New South Wales, Australia; AMS I 37735-002, adult ♂, 730 mm TL, off Terrigal, New South Wales, Australia; CSIRO H 4476-03, adult ♂, 520 mm TL, Northeast of Batemans Bay, New South Wales, Australia; CSIRO H 7043-05, juvenile ♂, 433 mm TL, East of Ballina (Byron Banks site), New South Wales, Australia.

S. megalops (five specimens): CSIRO H 2225-01, adult ♂, 449 mm TL, Storms Bay, Tasmania, Australia; CSIRO H 2605-09, juvenile ♂, 460 mm TL, Northwest of Rottnest Island, Western Australia; CSIRO H 3969-14, adult ♀, 545 mm TL, Southwest of Fremantle, Western Australia; CSIRO T 1516, juvenile ♀, 438 mm TL, Maria Island, Tasmania, Australia; QMI 18629, juvenile ♀, 343 mm TL, East of Bunker Group, Queensland, Australia.

S. raoulensis (five specimens): AIM 655693, adult ♂, 696 mm TL, Northwest of Cheesman Island, Kermadec Islands, New Zealand; AIM 655697, adult ♀, 710 mm TL, Northwest of Cheesman Island, Kermadec Islands, New Zealand; NMNZ P 52109, juvenile ♂, 400 mm TL, Southwest off Denham Bay, Kermadec Islands, New Zealand; NMNZ P 52116, juvenile ♀, 538 mm TL, Southwest off Denham Bay, Kermadec Islands, New Zealand.

S. albifrons (three specimens): AMS I 37736-001, adult ♀, 720 mm TL, New South Wales, Australia; CSIRO H 644-04 (paratype of *S. albifrons*), adult ♂, 640 mm TL, South of Saumarez Reef, Queensland, Australia; CSIRO H 4705-01 (paratype of *S. albifrons*), adult ♀, 592 mm TL, East of Sydney, New South Wales, Australia.

S. notocaudatus (two specimens): CSIRO H 1321-01 (paratype of *S. notocaudatus*), juvenile ♀, 490 mm TL, Capricorn

Channel, Queensland, Australia; CSIRO H 1373-01, juvenile ♂, 635 mm TL, South of Saumarez Reef, Queensland, Australia.

Squalus cf. *montalbani* (five specimens): MNHN-IC-1997-3666, juvenile ♂, 675 mm TL, Norfolk Ridge, New Caledonia; MNHN-IC-1997-3667, adult ♂, 825 mm TL, Chesterfield Islands, New Caledonia; MNHN-IC-1997-3671, adult ♀, 745 mm TL, New Caledonia; MNHN-IC-1997-3675, adult ♂, 765 mm TL, New Caledonia; MNHN-IC-1997-3676, adult ♀, 930 mm TL, New Caledonia.

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Appendix 1. — Morphometrics of *Squalus japonicus* Ishikawa, 1908 and *Squalus nasutus* Last, Marshall & White, 2007 expressed as percentage of total length (% TL) for comparisons. Total length is expressed in millimeters. Abbreviations: **N**, number of specimens; **x**, mean; **SD**, standard deviation.

	<i>S. japonicus</i>			<i>S. nasutus</i>		
	Range N = 5	x	SD	Range N = 4	x	SD
TL (mm)	512.0-645.0	563.4	49.7	465.0-580.0	496.8	55.7
PCL	79.6-80.1	79.8	0.2	80.5-81.5	81.0	0.5
PD2	60.7-62.0	61.4	0.5	61.1-62.9	61.9	0.9
PD1	31.8-33.0	32.4	0.5	31.2-32.8	31.8	0.7
SVL	47.2-48.8	47.6	0.7	47.8-50.0	48.6	1.0
PP2	43.7-45.9	45.0	0.9	45.4-47.6	46.2	1.0
PP1	22.0-23.6	22.7	0.6	23.0-23.7	23.5	0.3
HDL	23.0-24.2	23.3	0.5	23.5-24.5	24.0	0.4
PG1	18.7-20.6	19.7	0.8	20.3-21.0	20.7	0.3
PSP	12.8-14.3	13.7	0.6	13.7-15.0	14.5	0.6
POB	8.7-9.3	9.1	0.2	9.2-10.4	9.7	0.5
PRN	5.9-6.8	6.4	0.3	6.6-7.5	7.0	0.4
POR	10.7-11.9	11.3	0.5	11.8-12.6	12.1	0.3
INLF	4.6-5.0	4.7	0.2	4.9-5.2	5.1	0.1
MOW	4.3-7.0	5.9	1.1	6.4-6.8	6.7	0.2
ULA	1.9-2.4	2.1	0.2	1.9-2.4	2.1	0.2
INW	4.1-4.7	4.4	0.2	4.5-4.8	4.7	0.1
INO	7.5-8.2	7.8	0.3	8.2-8.5	8.3	0.1
EYL	3.8-4.7	4.1	0.4	4.2-5.0	4.5	0.4
EYH	1.6-2.1	1.9	0.2	1.9-2.1	2.0	0.1
SPL	1.2-1.5	1.3	0.1	1.3-1.5	1.4	0.1
GS1	1.3-1.6	1.5	0.2	1.4-1.6	1.5	0.1
GS5	1.5-2.1	1.8	0.3	1.9-2.1	2.0	0.1
IDS	22.5-24.8	23.3	0.9	23.2-25.2	24.0	0.9
DCS	10.2-11.4	10.9	0.4	10.9-11.6	11.3	0.3
PPS	18.6-22.6	20.7	1.8	18.4-20.7	19.4	1.0
PCA	26.4-27.9	27.0	0.6	26.2-28.7	27.5	1.0
D1L	12.3-13.6	12.9	0.5	11.8-12.9	12.2	0.5
D1A	10.1-11.3	10.6	0.5	9.9-10.6	10.3	0.3
D1B	6.6-7.5	7.1	0.4	7.0-7.3	7.2	0.2
D1H	6.6-7.4	7.0	0.3	7.2-7.4	7.3	0.1
D1I	5.5-6.6	5.8	0.5	5.0-5.6	5.2	0.3
D1P	6.7-8.6	7.7	0.7	6.9-8.0	7.6	0.5
D1ES	3.2-3.8	3.5	0.2	3.3-3.8	3.5	0.3
D1BS	0.5-0.8	0.7	0.1	0.7-0.8	0.7	0.1
D2L	12.3-14.4	13.1	0.8	10.9-12.7	12.2	0.9
D2A	10.8-12.7	11.6	0.8	9.3-10.8	10.3	0.7
D2B	6.9-9.6	8.1	1.0	6.5-8.4	7.9	0.9
D2H	5.4-6.5	6.0	0.4	4.9-5.4	5.2	0.2
D2I	4.4-5.1	4.8	0.3	4.0-4.5	4.3	0.2
D2P	4.4-6.0	5.0	0.7	4.5-5.5	4.9	0.5
D2ES	4.7-5.6	5.4	0.4	4.0-4.5	4.2	0.3
D2BS	0.7-0.8	0.7	0.1	0.8-0.9	0.9	0.1
P1A	12.9-13.9	13.3	0.4	12.4-13.9	13.2	0.6
P1I	7.5-8.8	8.2	0.5	7.2-8.1	7.6	0.4
P1B	4.0-4.7	4.4	0.3	4.4-4.9	4.7	0.2
P1P	7.8-9.2	8.5	0.5	7.2-8.9	8.4	0.8
P2L	10.2-11.9	11.0	0.7	9.3-12.6	11.0	1.5
P2I	4.7-7.3	5.8	1.0	4.3-6.8	5.7	1.2
CDM	19.8-20.4	20.2	0.2	18.1-19.4	18.9	0.6
CPV	6.6-11.5	10.2	2.0	10.2-11.7	11.1	0.7
CFW	6.0-6.7	6.3	0.3	6.4-6.9	6.7	0.2
HANW	6.3-7.3	7.0	0.4	6.9-7.6	7.3	0.3
HAMW	9.7-10.6	10.2	0.4	10.2-10.7	10.5	0.2
HDW	11.5-12.3	11.9	0.4	11.2-12.1	11.7	0.5
TRW	9.1-10.8	10.2	0.7	9.2-10.0	9.8	0.4
ABW	6.9-9.6	8.3	1.2	6.3-9.1	8.1	1.3
HDH	8.5-10.5	9.6	0.8	8.9-9.6	9.1	0.4
TRH	8.3-11.6	10.3	1.2	8.9-10.3	9.8	0.6
ABH	8.7-12.2	10.4	1.3	8.3-11.3	9.8	1.3
CLO	4.3-4.8	4.6	0.4	5.2-5.6	5.4	0.3
CLI	7.2-7.5	7.4	0.2	9.0-9.1	9.1	0.1

