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***Gymnocranius superciliosus* and *Gymnocranius satoi*, two new large-eye breams (Sparoidea: Lethrinidae) from the Coral Sea and adjacent regions**

Gymnocranius superciliosus et *Gymnocranius satoi*, deux nouveaux bossus blancs (Sparoidea : Lethrinidae) de la mer de Corail et des régions adjacentes

Philippe Borsa ^{a,*}, Philippe Béarez ^b, Sobar Paijo ^c, Wei-Jen Chen ^d

^a *Institut de recherche pour le développement (IRD), Nouméa, New Caledonia*

^b *Museum national d'histoire naturelle, Paris, France*

^c *Proyek BarKor, Jl Pelabuhan Boswesen, Sorong, West Papua*

^d *Institute of Oceanography, National Taiwan University, Taipei, Taiwan*

* Author for correspondence: IRD-UR 227, Centre de Montpellier, 911 avenue Agropolis, 34394 Montpellier cx, France; e-mail addresses: philippe.borsa@ird.fr; philippeborsa@gmail.com (P. Borsa)

ABSTRACT

Two related perciform fish species of the subfamily Monotaxinae (Sparioidea: Lethrinidae) *Gymnocranius superciliosus* sp. nov. and *Gymnocranius satoi* sp. nov. are described from specimens and tissue samples from the Coral Sea and adjacent regions. *Gymnocranius superciliosus* sp. nov. is distinct from all other known *Gymnocranius* spp. by the following combination of characters: body elongated (depth 2.7-3.1 in standard length), caudal fin moderately forked with a subtle middle notch, its lobes slightly convex inside, distinctive blackish eyebrow, snout and cheek with blue speckles, and dorsal, pectoral, anal and caudal fins reddish. *Gymnocranius satoi* sp. nov. is the red-finned '*Gymnocranius* sp.' depicted in previous taxonomic revisions. While colour patterns are similar between the two species, *Gymnocranius satoi* sp. nov. is distinct from *Gymnocranius superciliosus* sp. nov. by the ratio of standard length to body depth (2.4-2.5 vs. 2.7-3.1) and by the shape of the caudal fin, which is more shallowly forked, its lobes convex inside and their extremities rounded. The two species are genetically distinct from each other and they are genetically distinct from *G. elongatus*, *G. euanus*, *G. grandoculis*, and *G. oblongus* sampled from the Coral Sea and adjacent regions.

Keywords

Gymnocranius sp.; Torao Sato; New Caledonia; cytochrome *b*

R É S U M É

Deux espèces proches de poissons perciformes de la sous-famille des Monotaxinae (Sparioidea : Lethrinidae) *Gymnocranius superciliosus* sp. nov. et *Gymnocranius satoi* sp. nov. sont ici décrites à partir de spécimens et d'échantillons de tissus provenant de la mer de Corail et des régions adjacentes. *Gymnocranius superciliosus* sp. nov. se distingue de toutes les autres espèces connues du genre par la combinaison de caractères suivante : corps allongé (rapport de la longueur standard à la hauteur du corps : 2.7-3.1), nageoire caudale modérément fourchue présentant une légère encoche en son milieu, ses deux lobes légèrement convexes vers l'intérieur, un sourcil noirâtre distinct, des taches bleues sur le museau et les joues, et les nageoires dorsale, pectorale, anale et caudale rougeâtres. *Gymnocranius satoi* sp. nov. est le '*Gymnocranius* sp.' à nageoires rouges décrit lors de révisions taxonomiques antérieures. Alors que les patterns de coloration entre les deux espèces sont semblables, *Gymnocranius satoi* sp. nov. se différencie de *Gymnocranius superciliosus* sp. nov. par le rapport de la hauteur sur la longueur standard (2.4-2.5 vs. 2.7-3.1) et par la forme de la nageoire caudale, qui est moins fourchue, aux lobes convexes vers l'intérieur et aux extrémités arrondies. Les deux espèces sont génétiquement distinctes l'une de l'autre, ainsi que des espèces suivantes du genre *Gymnocranius*, échantillonnées en mer de Corail et dans les régions adjacentes : *G. elongatus*, *G. euanus*, *G. grandoculis* et *G. oblongus*.

Mots clés

Gymnocranius sp. ; Torao Sato ; Nouvelle-Calédonie ; cytochrome *b*

1. Introduction

The taxonomy of large-eye breams (Lethrinidae: Monotaxinae), which comprise large, carnivorous species of the Indo-West Pacific coral reef lagoons and reef slopes, still awaits completion [1,2]. In his revision of the Monotaxinae, Sato [1] noted that specimens labelled "*Gymnocranius griseus*" (non Temminck and Schlegel 1844 [3]) by Coleman [4] and "*Gymnocranius lethrinoides*" (non Bleeker 1850 [5]) by Masuda et al. [6] were actually misidentified and he referred to them as an undetermined species, "*Gymnocranius* sp.". Sato's *Gymnocranius* sp. is a distinctive, bright-coloured, large-sized (up to 50 cm) fish of the reef-associated sandy habitats throughout the Coral Triangle and the western Pacific [1,2]. This fish is occasionally encountered on the stalls of fish markets in southern Japan, western West Papua and the tropical south-western Pacific islands ([2,6]; P. Borsa and S.P., pers. obs.). It is surprising that Sato's *Gymnocranius* sp. has remained undescribed, nearly three decades after it was first mentioned in the ichthyological literature.

A large-eye bream with reddish fins that resembles Sato's *Gymnocranius* sp. was first noticed (under "*Gymnocranius* sp.") at the Nouméa fish market in August 2002 by P. Béarez [7] (Fig. 1A). This fish was slender than *Gymnocranius* sp. pictured in Masuda et al. [6] (as "*G. lethrinoides*") and Carpenter and Allen [2], although its body proportions fitted Coleman's [4] "*G. griseus*" from the Great Barrier Reef. The same species was subsequently sampled from the northern and southern lagoons of New Caledonia's Grande Terre, the Chesterfield islands and Fiji, and proved genetically distinct from Sato's *Gymnocranius* sp. [8,9]. Inferred genotypes at four size-polymorphic intron loci indicated reproductive isolation between the two species in New Caledonia [9,10]. The two species were provisionally named *Gymnocranius* sp. B and *Gymnocranius* sp. C, respectively [9-12]. *Gymnocranius* sp. B and *Gymnocranius* sp. C were found to be genetically distinct from other *Gymnocranius* species from the Coral Sea and adjacent regions, including *Gymnocranius elongatus* Senta 1973 [13], *Gymnocranius euanus* (Günther 1879 [14]), *Gymnocranius grandoculis* (Valenciennes 1830 [15]) and the recently described *Gymnocranius oblongus* Borsa, Béarez and Chen 2010 [10] [8,9], and reproductively isolated from the three latter [9].

In the present article, we describe *Gymnocranius* sp. B and *Gymnocranius* sp. C as, respectively, *Gymnocranius superciliosus* sp. nov. and *Gymnocranius satoi* sp. nov. on the basis of morphology, colour patterns, and cytochrome-*b* nucleotide sequences.

2. Materials and methods

The following specimens of *Gymnocranius* sp. B and *Gymnocranius* sp. C were collected and examined: Institut de recherche pour le développement, Nouméa (IRDN) no. IRDN-z179 (sp. B, from the northern lagoon of New Caledonia, collected 21 December 2004 at the Nouméa fish market); Museum national d'histoire naturelle, Paris (MNHN) no. MNHN 2009-0010 (sp. B, captured using a demersal

gillnet, New Caledonia, 21 January 2005); MNHN 2009-0011 (sp. B, demersal gillnet, southern lagoon of New Caledonia, 02 March 2005); MNHN 2009-0012 (sp. B, demersal gillnet, New Caledonia, 07 June 2008); MNHN 2009-0013 (sp. B, demersal gillnet, Viti Levu, Fiji, 19 September 2008); and MNHN 2011-0103 (sp. C, reportedly from the Lesser Sunda islands, November 2009). Measurements on these specimens were made to the nearest mm using a Vernier calliper. Eight other specimens were examined by either P. Borsa, P. Béarez, S.P., F. Giancarlo (BioKor, Indonesia and West Papua), or J.-L. Justine (IRD, Nouméa) at the time of collection and subsequently re-examined and measured from photographs: IRDN-20071124-G3 (sp. C, from Raja Ampat, West Papua, 24 November 2007); IRDN-20080131-A (sp. C, reportedly from the Lesser Sunda islands, collected at the Kedongan fish market, 31 January 2008); IRDN-20080426 (sp. B, spearfished off Pindaï, northwestern lagoon of New Caledonia, 21°21'S 164°57'E, depth 7 m, coral sandy bottom, 26 April 2008); IRDN-20081022 (sp. B, spearfished off Loop islet, Chesterfield Islands, 19°58'S 158°28'E, depth 5 m, coral sandy bottom, 22 October 2008); J.-L. Justine's (pers. comm.) catalogue no. JNC-583 (sp. C, baited handline, Sournois reef, New Caledonia; JNC-2912 (sp. B, baited handline, Tomboo Pass, New Caledonia, 21 April 2009); JNC-3055 (sp. C, baited handline, pass south of Tomboo reef, New Caledonia, 16 September 2009); MNHN ICOS-00715 (sp. B, New Caledonia, 24 August 2002).

Photographs of the specimens examined are presented in Figs. 1-3 and in Supplementary material, Fig. S1. Specimens MNHN 2009-0010, MNHN 2009-0011, MNHN 2009-0012, MNHN 2009-0013, and MNHN 2011-0103 have been preserved whole. Specimen MNHN ICOS-00715 has been preserved as skeleton. For specimens IRDN-z179, IRDN-20080426, and JNC-2912, only the neurocranium has been preserved. Muscle-tissue or fin-clip samples of the foregoing except MNHN ICOS-00715 have been preserved in 95% ethanol.

Whole genomic DNA was extracted from fin clips of individuals nos. MNHN 2009-0010 (*Gymnocranius* sp. B) and IRDN-20071124-G3 (*Gymnocranius* sp. C) using the Qiagen DNeasy extraction kit (Qiagen, Valencia CA, U.S.A.) according to the manufacturer's instructions. These tissue samples and DNA extracts are nos. Let 20 and Let 19, respectively, in the collections of the Marine Phylogenomics Laboratory at the Institute of Oceanography, National Taiwan University, Taipei. Oligonucleotides *Mono14695F* (5'- A A G C C A C C G T T G T T A T T C A A C T A -3') and *Mono15971R* (5'- G A A T G T T A G C T T T G G G A G C T T T T -3') were designed by W.-J.C. to specifically amplify the complete cytochrome *b* gene in Monotaxinae. Conditions for polymerase-chain amplification reaction (PCR) were as follows: 0.5 units GoTaq® Flexi DNA polymerase (Promega, Madison WI, U.S.A.), 1x reaction buffer, 2 mM of MgCl₂, 200 μM of each dNTP, 0.2 μM of each primer, and 20–50 ng of genomic DNA in a 25 μl of final reaction volume. Thermocycling conditions for PCR were: initial denaturing step at 95°C for 4 min followed by 35 cycles of 95°C (for 40 s), annealing T_m of 55 °C (for 40 s), and 72°C (for 1-1.5 min. depending on size of fragments), and then a final extension step of 72°C (for 7 min) before a 4°C soak. Finally, the PCR products were cleaned up following the AMPure magnetic bead cleanup protocol (Agencourt Bioscience Corp.,

Beverly MA, U.S.A.) and resuspended in 30 µL sterile water. Sequences were then determined by MacroGen Inc. (Seoul, South Korea) using an ABI 3730xl analyzer (Applied Biosystems, Foster City CA, U.S.A.).

The sequences of these two individuals were aligned with the 315-bp fragments of the cytochrome *b* gene of *G. elongatus*, *G. euanus*, *G. grandoculis*, *G. oblongus*, *Gymnocranius* sp. B, and *Gymnocranius* sp. C that have been produced previously [8,16], using BioEdit [17].

3. *Gymnocranius superciliosus* sp. nov.

Gymnocranius superciliosus sp. nov. (Table 1; Fig. 1; Fig. 2). Previously referred to as *G. griseus* (non Temminck and Schlegel 1844 [3]) [4]; *Gymnocranius* sp. [7,18,19]; and *Gymnocranius* sp. B [8-12].

3.1. Vouchers and type material

Material examined (Table 1; Fig. 1 Fig. 2; Supplementary material, Fig. S1): IRDN-z179 (neurocranium preserved); IRDN-20080426 (neurocranium preserved); IRDN-20081022 (fin clip preserved); JNC-2912 (photo voucher); MNHN 2009-0010 (holotype); MNHN 2009-0011 (paratype); MNHN 2009-0012 (paratype); MNHN 2009-0013 (paratype); MNHN ICOS-00715 (skeleton; paratype).

3.2. Diagnostic description

The following diagnosis of *Gymnocranius superciliosus* sp. nov. is based on the nine specimens whose measurements are given in Table 1. Morphology: a slender *Gymnocranius*, with ratio of standard length to body depth between 2.65 and 3.06; forehead bumpy; lower edge of eye well above axis of body; caudal fin moderately forked, its lobes slightly rounded. Number of scales rows above lateral line: 6. Pored scales on lateral line: 48 (for 6/9 specimens examined) or 49 (3/9). Colour: flanks silvery; scales above lateral line with a dark-grey basal patch forming longitudinal rows; scales with similar dark-grey basal patch on a more or less extended portion of flank below lateral line; up to two dozens or more pale-blue speckles against bronze background on snout and cheeks, distinctive on fresh, larger individuals, faint on smaller individuals; pale-blue band joining the nostrils on forehead and reaching the eyes, bright in freshly captured, larger individuals; area immediately above eye (supraorbital shelf) forming a distinctive blackish eyebrow; more or less conspicuous vertical dark bar crossing the eye; upper lip reddish to red, lower lip white; dorsal, pectoral, anal and caudal fins reddish to red.

Gymnocranius superciliosus sp. nov. is here described by the nucleotide sequence of its cytochrome *b* gene (from holotype, MNHN 2009-0010): 5'- A T G G C C A G T C T C C G A A A A C C C A C C C C T C C T A A A A T T G C A A T G A T G C A C T A G T C G A C C T A C C G G C C C A A C A A C A T T T C T G C C

TGATGAAATTTTGGCTCTCTACTAGGTCTCTGCTTAATCGCCCAAATCCTTACTG
GCCTATTTCTCGCCATACATTACACCTCTGATATCGCCACAGCATTCTCCTCCGT
GGCCACATTTGCCGAGACGTAAACTTCGGATGACTCATTTCGTAACCTCCATGCC
AATGGGGCCTCATTTTTCTTCATCTGTATTTATCTCCATATTGGCCGAGGATTAT
ACTACGGCTCCTACCTGTACAAAGAGACCTGAAATATCGGAGTAGTCCTGCTTCT
CCTAGTAATAATAACAGCTTTTCGTAGGCTATGTTCTCCCCTGGGGACAAATATCT
TTTTGAGGTGCCACCGTCATCACTAACCTCCTCTCCGCAGTGCCATATGTAGGAA
ACACTCTTGTCCAATGAATTTGAGGCGGCTTTTCAGTCGACAATGCTACACTCAC
CCGATTTTTTCGCTTTTCCACTTTCTCTTCCCCTTCGTCATTGCAGCTGCAACTATC
CTCCACCTTCTATTCTACACGAAACCGGATCTAACAACCCTCTAGGCCTAAATT
CAGACTCAGACAAAATTTTCATTTACCCCTACTTCTCCTATAAAGACCTGCTAGG
TTTCGCAGCTGTCCTGATCACCTCACCTGTCTAGCACTTTTCTCCCCAACCTTC
TTGGAGACCCGGACAACCTTCACACCTGCGAACCCCTCGTGACCCCTCCCATAT
TAAACCAGAGTGATACTTTCTATTTCGCGTACGCCATTCTACGTTCAATTCCAAT
AACTTTGGTGGCGTACTCGCACTCTTGGCTTCCATCCTGGTTCTTATGGTGGTGC
CCATCCTCCACACATCTAAACAACGGAGTTTAACATTCCGTCCCCTAACACAATT
TCTCTTTTGAGTTCTTATTGCCAATGTTGCCATTCTTACCTGAATTGGAGGAATG
CCTGTAGAACACCCGTTTATTATCATTGGCCAAATCGCATCTCTTCTCTACTTTT
CGCTCTTCTCATTGCTATACCACTAGCAAGTTGATGGGAGAACAAAACCTTTAGG
TTGAGCT -3'.

3.3. Etymology

The epithet *superciliosus*, meaning 'eyebrowed', was chosen by reference to the conspicuous dark patch above eye, which evokes an eyebrow. This feature is particularly noticeable when the fish is seen underwater ([4,19]; Supplementary material, Fig. S1F). We propose as vernacular name: *Eyebrowed large-eye bream*.

3.4. Notes on distribution, habitat and ecology

Gymnocranius superciliosus sp. nov. was collected by spearfishing at 5-7 m depth on coral-sand bottom in the northwestern lagoon of New Caledonia's Grande Terre and in the Chesterfield Islands (central Coral Sea) in April 2008 and October 2008, respectively. Samples of this species were also collected using handlines in the southern lagoon of New Caledonia's Grande Terre in March 2006, April 2009 and September 2009 (J.-L. Justine, pers. comm.). It was also sampled from the lagoons of Viti Levu

and Gau islands in Fiji in September 2008, and from the northern lagoon of New Caledonia in December 2004. See also [19] for the underwater photograph of an individual from Fiji. A specimen was caught on a bottom line by C.A.J. Duffy (pers. comm.) in the south-western lagoon of Nukufetau atoll, Tuvalu in April 2007, “in 15-20 m depth, on a small patch of reef surrounded by sand”. *Gymnocranius superciliosus* sp. nov. has also been reported from Queensland (as “*G. griseus*”) by Coleman [4]. It was also sighted off Pulau Fam in Raja Ampat (West Papua) in December 2007 (P. Borsa, pers. obs.). This species is not mentioned from the Japanese archipelago [6]. It was not found by us among *Gymnocranius* spp. samples from the Lesser Sunda islands or from southern Sulawesi, where seven other *Gymnocranius* species including *G. elongatus*, *G. frenatus*, *G. grandoculis*, *G. microdon*, *Gymnocranius satoi* sp. nov. and two yet undescribed species (*Gymnocranius* sp. D and *Gymnocranius* sp. E) have been observed (P. Borsa and W.-J.C., pers. obs.). Therefore, the distribution of *Gymnocranius superciliosus* sp. nov. may be restricted to the tropical south-western Pacific, but more observations will be necessary to accurately delineate it.

Little is known of the ecology of *Gymnocranius superciliosus* sp. nov., except that is “encountered around sandy lagoons along the outer Great Barrier Reef and cays of the Coral Sea” [4]. It has been captured by spearfishing on sandy bottom of back-reef lagoon and large pools at depths from 5 to 7 m in the northwestern lagoon of Grande Terre and in the Chesterfield lagoon. Nouméa fishermen capture *Gymnocranius superciliosus* sp. nov. together with other *Gymnocranius* spp. by setting gillnets on sandy bottom in the southern part of the southern lagoon of Grande Terre close to Kouaré pass, at depths between 15 m and 30 m. Individual no. JNC-2612 was captured by hand line baited with squid meat on the sandy bottom of Boulari Pass (depth 20 m). The stomach of specimen IRDN-20080426 contained broken bivalve shells; that of specimen JNC-2912 contained scraps of urchin shell. Its predatory behaviour has been briefly described by Coleman [4]: “[...] usually a solitary animal [which] swims a few meters from the bottom, making short forays to the sandy sea floor to investigate any movement which might indicate the presence of prey [...]”. An isolated individual was seen and photographed by P. Borsa, about 1 m above the sandy bottom at 22 m depth in the pass west of Pulau Fam, West Papua (Supplementary material, Fig. S1F).

4. *Gymnocranius satoi* sp. nov.

Gymnocranius satoi sp. nov. (Table 2; Fig. 3). Previously referred to as *G. lethrinoides* (non Bleeker 1850 [5]) [6]; *Gymnocranius* sp. [1,2,20,21]; *Gymnocranius* sp. C [8-10,12].

4.1. Vouchers and holotype

Material examined (Table 2; Fig. 3; Supplementary material, Fig. S1): IRDN-20071124-G3; IRDN-20080131-A; JNC-583; JNC-3055; MNHN 2011-0103 (see below).

We chose as holotype specimen MNHN 2011-0103. This specimen was purchased at the Kedonganan (Bali) fish market. Vendors at the market claimed the fish originated from Lombok or West Sumbawa (F. Giancarlo, pers. comm.). However, subsequent interviews with fish vendors in Bali and Lombok have yielded inconsistent and therefore unreliable indications on the origin of the catches in some instances (P. Borsa, pers. obs.; A. Sembiring, pers. comm.). One should therefore consider this specimen to originate from a region of several hundred kilometres radius centred in southern Bali, which is the range reported for the fishing boats that land their catch in Kedonganan [22]. Measurements on the holotype are reported in Table 2.

4.2. Diagnostic description

The following description of *Gymnocranius satoi* sp. nov. is based on the four specimens whose measurements are given in Table 2. Morphology: a high-bodied *Gymnocranius*, with ratio of standard length to body depth between 2.39 and 2.45 (Table 2); forehead bumpy; lower edge of eye well above axis of body; caudal fin shallowly forked, its lobes convex on inner side. Number of scale rows above lateral line: 6. Pored scales on lateral line: 47-50 (Table 2). Colour: flanks silvery; scales above the lateral line with a dark-grey basal patch forming longitudinal rows; scales in the 3 rows below lateral line in middle of flank similarly forming darker rows, but basal patch not as dark as above lateral line; blue speckles against bronze background on snout and cheeks, distinctive on fresh, larger individuals, faint on smaller individuals; blue band joining the nostrils on forehead; area immediately above eye (supraorbital shelf) forming a distinctive brownish to blackish eyebrow; more or less conspicuous vertical dark bar crossing the eye; dorsal, pectoral, anal and caudal fins reddish to bright vermilion red; upper lip reddish to red, lower lip white.

Gymnocranius satoi sp. nov. is here described by the nucleotide sequence of its cytochrome *b* gene (from specimen IRDN-20071124-G3): 5'- ATGGCCAGCCTTCGAAAACTCACCCCTCTTCTA
 AAAATTGCGAACGATGCACTAGTCGACCTACCAGCCCCAACAAACATTTCCGCTT
 GATGAAATTTTGGCTCCCTACTAGGTCTCTGCTTAATCGCACAAATCCTTACTGG
 CCTCTTCCTCGCTATACACTACACCTCTGATATCGCTACAGCATTCTCCTCCGTA
 GCACACATTTGCCGAGATGTAAACTTCGGATGGCTTATTCGTAACCTCCATGCCA
 ACGGAGCCTCATTTTTCTTCATCTGTATCTATCTCCATATTGGCCGAGGACTGT
 CTACGGCTCCTACCTATACAAAGAAACCTGAAATATCGGAGTAGTCCTGCTTCTC
 CTAGTAATGATAACAGCTTTCGTGGGCTATGTTCTCCCTGAGGACAAATATCCT
 TTTGAGGCGCCACTGTCATCACC AACCTCCTCTCTGCAGTACCATATGTAGGGAA
 CACCCTAGTCCAATGAATTTGAGGCGGCTTCTCAGTCGACAATGCCACACTCACC
 CGATTCTTCGCCTTCCACTTCCTCTTCCCCTTCGTCAATTGCAGCTGCAACCATCCT
 CCACCTTCTGTTCTACACGAAACCGGATCCAACAACCTCTAGGCCTAAATTCA

GACTCAGACAAAATTTCAATTCACCCCTACTTCTCGTACAAAGACCTTCTAGGCT
TTGCAGCCGTCCTGATCACCCCTCACCTGTCTCGCGCTTTTCTCCCCAACCTTCTT
GGGGACCCAGATAACTTCACACCCGCCAACCCCTCGTAACACCTCCCCATATTA
AACCCAGAATGATACTTTCTATTTCGCGTATGCAATCCTACGCTCAATTCCAAATAA
ACTTGGCGGAGTACTCGCACTCCTAGCTTCCATCCTGGTTCTCATGGTAGTGCCCT
ATCCTCCACACATCTAAACAACGAAGCTTGACATTCCGTCCCATAACACAATTTCT
TCTTTTGAGTTCTTATTGCCAATGTAGCCATTCTTACCTGAATTGGAGGAATGCC
TGTAGAACACCCGTTCAATTATCATTGGCCAGGTTGCATCTCTTCTCTACTTTTCA
CTCTTCTCGTTGCCATGCCGCTGGCAAGTTGATGGGAGAACAAAAATCTAGGTT
GAGCT-3'

4.3. Etymology

Named in the honour of Torao Sato, a Japanese ichthyologist who contributed to the taxonomy of Lethrinidae and who recognized the red-finned *Gymnocranius* presented in [6] (as "*G. lethrinoides*") as "distinct from the other *Gymnocranius* species" [1]. The vernacular name of this species should be *Sato's large-eye bream*, in replacement of, or in addition to *Blacknape large-eye bream*, the name previously coined by [2].

4.4. Notes on distribution and habitat

Gymnocranius satoi sp. nov. specimens were collected from the southern lagoon of New Caledonia and from Raja Ampat in western West Papua (present work). This species' distribution also includes southern Japan [6], and possibly Australia's Great Barrier Reef, the Solomon Sea, the Bismarck Sea and the whole Pacific-Ocean coast of New Guinea [2]. Additional specimens including the holotype of the species reportedly originate from the Lesser Sunda islands, Indonesia, but we were unable to independently confirm this. From the limited data available from New Caledonia (J.-L. Justine, pers. comm.), it seems that this species dwells on the coral sandy bottom at depths between 20 m and 40 m in the vicinity of coral reefs.

5. Discussion

The two species described here are reproductively isolated from each other [8,10] hence they fit the definition of biological species [23]. While colour patterns are similar between the two species, they mainly differ by the ratio of standard length to body depth and by the shape of the caudal fin.

In his brief description of *Gymnocranius* sp. [1], T. Sato mentioned a “caudal fin shallowly forked, its lobes rounded”: this feature points to *Gymnocranius satoi* sp. nov. and much less so to *Gymnocranius superciliosus* sp. nov., which has a moderately forked caudal fin and moderately curved and relatively elongated lobes. The specimen photographed by Masuda et al. [6] (as “*G. lethrinoides*”) and the description and drawing of *Gymnocranius* sp. by Carpenter and Allen [2] both correspond to *Gymnocranius satoi* sp. nov. Although Sato [1] included Coleman’s [4] “*G. griseus*” specimen in his definition of *Gymnocranius* sp., the latter is different from Masuda et al.’s [6] “*G. lethrinoides*” and instead matches the present description of *Gymnocranius superciliosus* sp. nov. by the relative elongation of its body and by the shape of its caudal fin, which are two characters diagnostic of the latter. An underwater picture of *Gymnocranius superciliosus* sp. nov. (from Fiji) has also been published by [19] under “*Gymnocranius* species”. The authors redirect the reader to Carpenter and Allen’s [2] identification sheet of “*Gymnocranius* sp.”, although the description and drawing provided in the latter designate another species (the one here described as *Gymnocranius satoi* sp. nov.). Thus, two distinct species (namely, *Gymnocranius superciliosus* sp. nov. and *Gymnocranius satoi* sp. nov.) have long been confused in the specialized literature under the single term “*Gymnocranius* sp.”. We hope that the present work offers the clarification needed to resolve the apparent mismatch between Coleman’s [4] and Allen and Erdmann’s [19] illustrations on the one side, and the descriptions of *Gymnocranius* sp. provided by Sato [1] and Carpenter and Allen [2] on the other side.

Gymnocranius superciliosus sp. nov. and *Gymnocranius satoi* sp. nov. can be distinguished from all other known *Gymnocranius* species (except *G. euanus*) by their reddish pectoral, dorsal, anal and caudal fins. They are distinct from *G. euanus* by their general body shape and by their pigmentation patterns: *G. euanus* has apparently randomly distributed blackish scales on flanks [2], a feature that is not present in either *Gymnocranius superciliosus* sp. nov. or *Gymnocranius satoi* sp. nov. The two latter can also be distinguished from *G. elongatus*, *G. euanus*, *G. grandoculis* and *G. oblongus* from the Coral Sea and adjacent regions by diagnostic nucleotides along the 315-bp fragment of the cytochrome-*b* gene sequenced by [8] (Fig. 4).

Monogenean parasites usually are specific to a fish species [12]. Assuming this, it is intriguing to observe that *Gymnocranius superciliosus* sp. nov. is parasitized by the same monogenean species (*Lamellodiscus magnicornis*, *L. parvicornis* and *L. tubulicornis*) as those encountered in up to three other sympatric *Gymnocranius* spp. [12]. This may indicate genetic divergence between the four *Gymnocranius* species too recent to have led to the ecological specialization and speciation of their *Lamellodiscus* spp. parasites. Nevertheless, one cannot discard the hypothesis that the *Lamellodiscus* spp. found on *Gymnocranius* spp. are actually host-specific, but include a number of morphologically cryptic species.

The Nouméa fish market boasts coral-reef fishes captured in the southern, the north-western, and the northern reefs and lagoons of New Caledonia. Five *Gymnocranius* species (*G. euanus*, *G. grandoculis*, *G. oblongus*, *Gymnocranius satoi* sp. nov. and *Gymnocranius superciliosus* sp. nov.) are regularly seen on the

stalls there, with the first two species being the most frequently occurring (A. Collet and P. Borsa, pers. obs.). Nearly every month from 2002 to 2010, our IRD colleague J.-L. Justine has used handlines above the reef and coral-reef sandy bottom between 20 and 40 m in the passes of the southern lagoon of New Caledonia, to collect fishes. *Gymnocranius* spp. catches were distributed as following: 75% *G. euanus*, 15% *G. grandoculis*, 4% *G. oblongus*, 2% *Gymnocranius satoi* sp. nov., and 4% *Gymnocranius superciliosus* sp. nov. ($N=100$) (from the photograph files of J.-L. Justine, pers. comm.). During two expeditions to the Chesterfield islands in October 2008 and May 2012, handline fishing and spearfishing on sandy bottom at 5-25 m in the southern lagoon yielded 95% *G. euanus* and 5% *Gymnocranius superciliosus* sp. nov. ($N=42$) (P. Borsa, pers. obs.). From these observations it appears that the three *Gymnocranius* species that we recently described, namely *G. oblongus* [10], *Gymnocranius satoi* sp. nov. (this study) and *Gymnocranius superciliosus* sp. nov. (this study), are less abundant than *G. euanus* and *G. grandoculis* in the catches. Their inferred relative rarity may explain why they have long remained overlooked despite a number of underwater visual surveys of shore fishes in the Coral Sea and adjacent regions [24-29].

Disclosure of interest

The authors have no conflicts of interest concerning this article.

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Table 1

Measurements on specimens of *Gymnocranius superciliosus* sp. nov., listed by increasing size. *MNHN* Museum national d'histoire naturelle, Paris; *JNC* J.-L. Justine's catalogue, Nouméa; *IRDN* Institut de recherche pour le développement, centre de Nouméa; *SL* standard length; *Bdd* body depth at origin of dorsal fin; *Bda* body depth at origin of anal fin

Parameter	Specimen no.								
	MNHN ICOS- 00715 ^a	MNHN 2009-0011 ^a	MNHN 2009-0013 ^a	MNHN 2009-0012 ^a	MNHN 2009-0010 ^b	JNC- 2912	IRDN- 20081022	IRDN - z179	IRDN - 20080426
SL (mm)	214	220	260	311	323	344	387	419	430
Bdd (mm)	79	77	98	106	118	127	142	137	161
Ratio of SL to Bdd	2.71	2.86	2.65	2.93	2.74	2.71	2.73	3.06	2.67
Bda (mm)	75	77	92	99	110	114	122	129	148
Head length (mm)	63	70	86	96	105	101	132	120	135
Snout length (mm)	24	30	35	42	48	45	66	54	60
Eye diameter (mm)	21	22	27	27	29	30	37	33.5	30
Inter-orbital width (mm)	-	25	30	36	36	-	-	45	-
Predorsal length (mm)	76	79	90	113	118	120	148	136	153
Prepelvic length (mm)	72	76	91	107	114	129	157	155	153
Preanal length (mm)	128	137	166	196	202	219	255	248	279
Pored scales, lateral line	48	48	48	49	48	49	48	49	48

^a paratype

^b holotype

Table 2

Measurements on specimens of *Gymnocranius satoi* sp. nov., ranked by increasing size (except specimen JNC-583). *Abbreviations* as in legend to Table 1.

Parameter	Specimen				
	IRDN- 20080131-A	JNC-3055	MNHN 2011-0103 ^a	IRDN- 20071124-G3	JNC-583
SL (mm)	303	344	397	422	-
BDd (mm)	127	142	166	172	-
Ratio of SL to BDd	2.39	2.42	2.39	2.45	2.40
BDa (mm)	114	123	148	153	-
Head length (mm)	100	106	119	130	-
Snout length (mm)	37	49	48	57	-
Eye diameter (mm)	31	36	40	38	-
Inter-orbital width (mm)	-	-	46	-	-
Predorsal length (mm)	114	127	140	162	-
Prepelvic length (mm)	109	124	145	163	-
Preanal length (mm)	197	215	247	271	-
Pored scales on lateral line	47	49	48	49	49

^aholotype

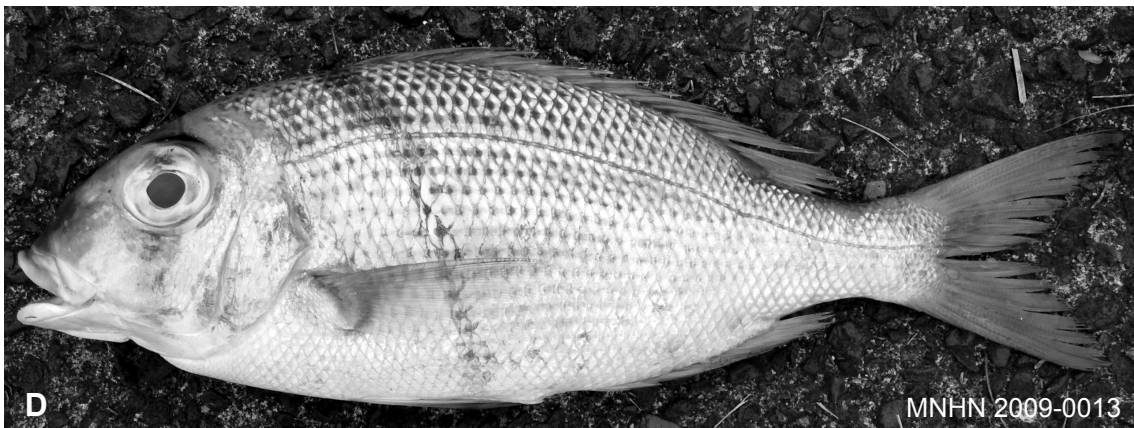
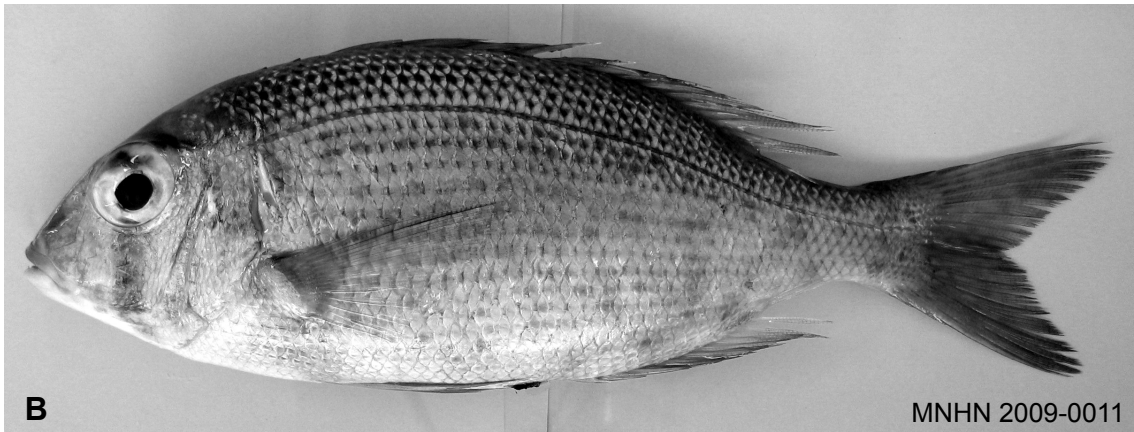
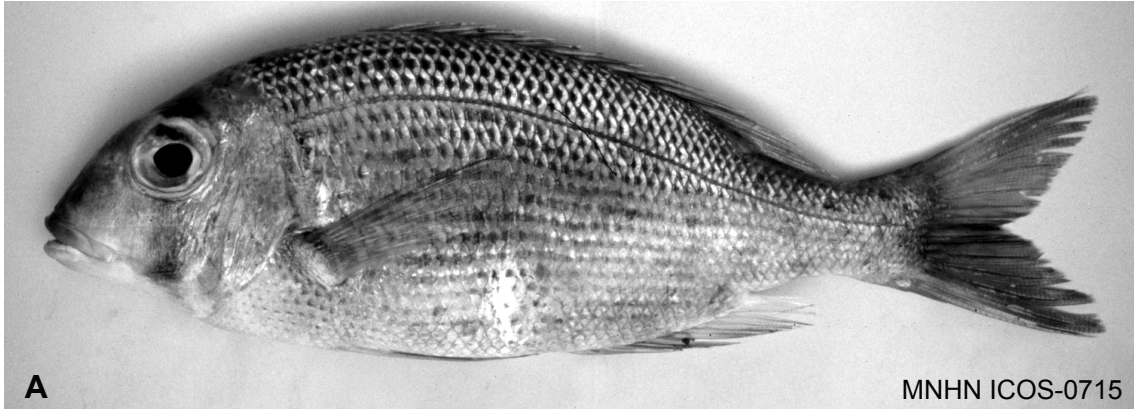
FIGURE CAPTIONS

FIG. 1. *Gymnocranius* sp. B specimens chosen as paratypes of *Gymnocranius superciliosus* sp. nov. A. Specimen from New Caledonia, standard length (SL) 265 mm; skeleton preserved in the ichthyological collections of the Museum national d'histoire naturelle, Paris as MNHN ICOS-00715. B. MNHN 2009-0011, southern lagoon of New Caledonia's Grande Terre, SL 220 mm. C. MNHN 2009-0012, New Caledonia, SL 311 mm. D. MNHN 2009-0013, Viti Levu, SL 260 mm

FIG. 2. Holotype of *Gymnocranius superciliosus* sp. nov., registered at Museum national d'histoire naturelle, Paris, no. MNHN 2009-0010; SL 323 mm. Scale bar: 5 cm

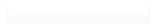
FIG. 3. Holotype of *Gymnocranius satoi* sp. nov., registered at Museum national d'histoire naturelle, Paris, under no. MNHN 2011-0103; SL 397 mm. Scale bar: 5 cm

FIG. 4. Polymorphic nucleotide sites at the cytochrome *b* locus in six *Gymnocranius* species (*G. elongatus*, *G. euanus*, *G. grandoculis*, *G. oblongus*, *Gymnocranius superciliosus* sp. nov., *Gymnocranius satoi* sp. nov.) from the Coral Sea and adjacent regions. Point mutations diagnostic of *Gymnocranius superciliosus* sp. nov. and *Gymnocranius satoi* sp. nov. relative to the other species are highlighted. The sequence used as reference is that of an uncatalogued specimen of *G. elongatus* lodged at the Australian Museum, Sydney (AMS), GenBank accession no. AF381260 [16]; numerotation of nucleotide sites starts from first nucleotide of the cytochrome *b* gene. *IRDN* Institut de recherche pour le développement, Nouméa; *MNHN* Museum national d'histoire naturelle, Paris. Sequence of individual IRDN-20071124-G3 from present survey; all other sequences from [8,16].





MNHN 2009-0010



MNHN 2009-0010



Supplementary material to: "Gymnocranius superciliosus and G. satoi, two new large-eye breams (Sparoidea: Lethrinidae) from the Coral Sea and adjacent regions"

Philippe Borsa, Philippe Béarez, Sobar Paijo and Wei-Jen Chen

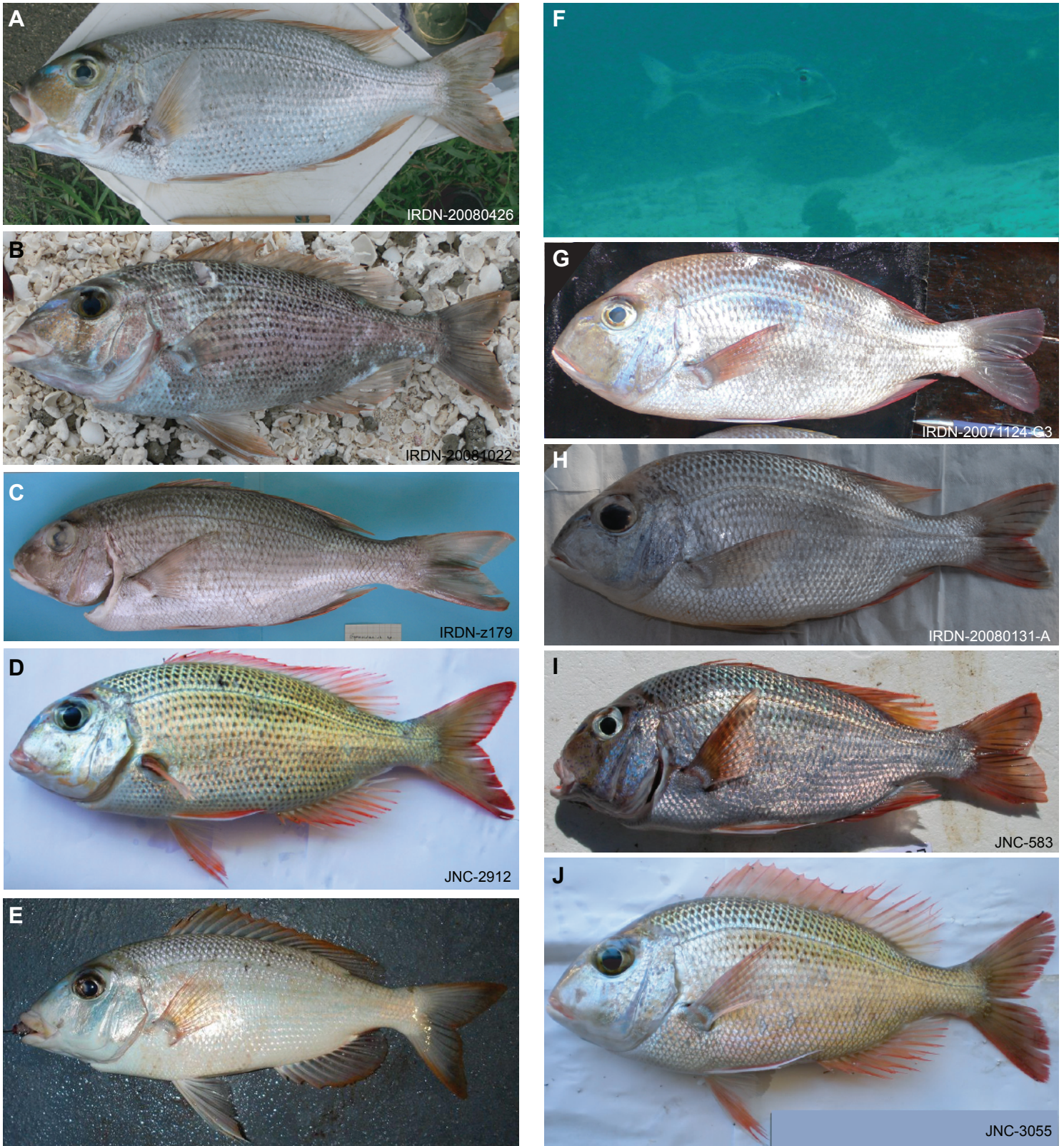


Fig. S1 Large-eye bream specimens examined for the present study, other than type material. **A** *Gymnocranius superciliosus* sp. nov., IRDN- 20080426, from coral sandy bottom (depth 7 m) off Pindai, northwestern lagoon, New Caledonia, 26 April 2008; caught by A. Cheype (IRD, Nouméa) using a speargun; neurocranium preserved (photograph: P. Borsa / IRD). **B** *Gymnocranius superciliosus* sp. nov., IRDN-20081022, from coral sandy bottom (depth 5 m) of Loop Islet in the southern lagoon of the Chesterfield islands, Coral Sea, 22 October 2008; caught by J. Palene (Marine nationale, Nouméa) using a speargun (photograph: P. Borsa / IRD). **C** *Gymnocranius superciliosus* sp. nov., IRDN-z179 from the northern lagoon of New Caledonia; purchased from the Noumea fish market by P. Borsa, 21 December 2004; neurocranium preserved (photograph: A. Collet / IRD). **D** *Gymnocranius superciliosus* sp. nov., JNC-2912, from the sandy bottom north of Tomboo Reef (depth 20-30 m), southwestern lagoon, New Caledonia, 21 April 2009; caught by handline by J.-L. Justine, N. Colombani and M. Briand (IRD, Noumea); neurocranium preserved (photograph: J.-L. Justine / IRD). **E** *Gymnocranius superciliosus* sp. nov., southwestern lagoon of Nukufetau Atoll, Tuvalu, 21 April 2007; caught by handline on a "small patch reef surrounded by sand at 15-20 m depth" (photograph: C.A.J. Duffy / Department of Conservation, Auckland). **F** *Gymnocranius superciliosus* sp. nov., specimen sighted underwater one meter above the coral sandy bottom (depth: 22 m) off Pulau Fam, West Papua, 02 December 2007 (photograph: P. Borsa / IRD / LIPI Ekspedisi Widya Nusantara). **G** *Gymnocranius satoi* sp. nov., specimen IRDN-20071124-G3 from Raja Ampat, West Papua; sampled at the Sorong fish market by S.P., 24 November 2007; fin clip preserved (photograph: S.P. / BioKor). **H** *Gymnocranius satoi* sp. nov., IRDN-20080131-A, Lesser Sunda islands; sampled at the Kedongan fish market by F. Giancarlo and C. Cristofoli, 31 January 2008; fin clip preserved (photograph: F. Giancarlo / BioKor). **I** *Gymnocranius satoi* sp. nov., JNC-583, from the sandy bottom of Le Sournois Reef (depth 20-40 m), southwestern lagoon, New Caledonia (22°31'S, 166°26'E), 01 July 2003; caught by handline by J.-L. Justine and students (photograph: J.-L. Justine / IRD). **J** *Gymnocranius satoi* sp. nov., JNC-3055, from the coral sandy bottom (depth 20-40 m) of the pass east of Tomboo Reef, southwestern lagoon, New Caledonia (22°34'S 166°29'E), 16 September 2009; caught by handline by J.-L. Justine, C. Schoelincq, É. Henry and S. Tereua; tissue preserved (photograph: J.-L. Justine / IRD).