

A review of giant roughies of the genus *Hoplostethus* (Beryciformes, Trachichthyidae), with descriptions of two new Australasian species.

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Abstract

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Hoplostethus gigas McCulloch, 1914 and two previously unnamed species of the genus that reach a similarly ‘giant’ size are described. The redescription of *H. gigas*, which is confined in distribution to the southern coast of Australia, is based on specimens identified as comprising at least part of McCulloch’s type series (one herein designated lectotype), together with subsequently collected material. The very similar *H. melanopeza* sp. nov., occurring in northern New Zealand and southeastern Australian waters, as well as seamounts in the intervening Tasman Sea, is distinguished by the distinctly black outer margins of fins in large adults and count of predorsal scales. The New Caledonian *H. grandperrini* sp. nov., known only from the two types, differs from previously described species in having the combination of 17 or 18 pectoral–fin rays, 13 or 14 abdominal scutes, 19 or 20 total gill rakers and a buccal cavity that is mostly pale, the only black pigmentation occurring posterior to the gill arches.

Keywords

Giant roughy, Trachichthyidae, *Hoplostethus*, *H. gigas*, lectotype, species nov., Australasia

Introduction

In synthetic treatments of the Trachichthyidae and the Beryciformes, Kotlyar (1986, 1996) listed 23 species in the roughly genus *Hoplostethus* Cuvier (in Cuvier & Valenciennes, 1829). Thirteen of these he referred to the subgenus *Hoplostethus* (*Hoplostethus*), which he diagnosed as having pale colouration, scales on the ventral midline of the abdomen modified into enlarged, thickened scutes, 25–27 total vertebrae, dorsal fin with 4–8 (usually 6) spines and 14–18 (usually 15 or 16) soft rays, 14–19 (usually 15 or 16) pectoral–fin rays, 14–25 (usually 16–21) predorsal scales and 15–50 simple pyloric caeca. The resurrection of *H. latus* McCulloch, 1914 by Gomon (in Gomon et al., 1994) and descriptions of *H. vniro* by Kotlyar (1995), *H. ravurictus* by Gomon (2008) and *H. robustispinus* by Moore and Dodd (2010) brought the number referable to the subgenus, according to Kotlyar’s criteria, to 17. Moore and Dodd (2010) listed *H. intermedius* (Hector, 1875) as another species that would be referable to this assemblage, but genetic evidence supports its synonymy with *H. mediterraneus* Cuvier (in Cuvier & Valenciennes, 1829) (Smith and Roberts, 2004). Although the validity of Kotlyar’s four subgenera remains to be tested, the greatest diversity of species in this large complex is clearly in the Indo–Pacific. However, the conservative nature of the morphology of species in the group has caused great confusion

about their numbers and identities (e.g. Kotlyar, 2011), especially in the geographical areas of greatest diversity.

Of the 17 described species of *Hoplostethus* (*Hoplostethus*), only four have been reliably recorded in the literature as reaching what might be regarded as a truly large size, well in excess of 250 mm SL, although we question one of these. The southern Australian *H. gigas* McCulloch is certainly the largest of the subgenus with one of the type specimens measuring 525 mm SL (McCulloch, 1914). *Hoplostethus robustispinus* Moore and Dodd, 2010, follows based on the sole type from the Philippines reported to be 340 mm SL and a 354 mm SL specimen from southern Japan (HUMZ 148072). Kotlyar (1996) recorded *H. mediterraneus* as reaching 30 cm, but only provided specimen information for specimens to 240 mm SL, the collection locality of these specimens reported as the North Atlantic. No reliable, published account of the species exceeding 200 mm SL is known from the Australasian region. The fourth species reaching a size in the 250 mm SL range is *H. crassispinus* from the Emperor Seamounts, which Kotlyar (2011) stated was confined to that seamount group and the Hawaiian Island chain. Although only reported by Kotlyar (1996) to a size of 123 mm SL, specimens identified by Kawai (in Inada and Wudianto, 2006) as *H. crassispinus* Kotlyar, 1980 (HUMZ 193945: 253 mm SL) and *H. sp.* (HUMZ 191163: 289 mm SL) are specimens of *H. confinis* Kotlyar, 1980 that are considerably larger than any of Kotlyar’s specimens.

In 1989, Paulin et al. reported *Hoplostethus gigas* in New Zealand waters, based on captures of surprisingly large roughies from knolls and ridges in the Bay of Plenty on the northeastern coast of New Zealand's North Island. Subsequent work on these specimens motivated Roberts (1995, 1996, 2012) to implore New Zealand fishers to bring in additional examples of what he determined not to be *H. gigas*, but instead a yet undescribed species. The largest of the specimens now in hand exceeds a standard length of 500 mm, putting the species on par with *H. gigas* with respect to size. The species is very similar in appearance to *H. gigas* but is separable by colour pattern and minor though consistent morphological differences. In addition, a recent comparison of mitochondrial DNA sequences clearly separate the two (Te Papa/ NIWA/ CSIRO/NMV unpublished data).

At about the same time as the discovery of the New Zealand species, French surveys in New Caledonian waters turned up examples of a roughy that attains a size of similar magnitude, and which is clearly separable from *H. gigas* and the New Zealand species on the basis of meristic features.

The purpose of this publication is to provide a detailed redescription of *H. gigas*, together with descriptions and names for these two new large congeners. The three are clearly separable from each other and from other nominal species of the genus on the basis of a variety of features.

Methods and Materials

Terminology and methodology is that of Kotlyar (1996). The number and size range in standard length (SL) for each lot of specimens examined is presented as a parenthetical expression after the respective registration number; if a lot comprises a single specimen only the standard length is presented. Institutional abbreviations are listed in Leviton et al. (1985). The descriptions are based on the lectotype or holotypes with variations observed in paratypes following in parentheses. Pectoral fins of the two new species were counted on both sides. Gill rakers reported are those on the lateral face of the first gill arch of the right side. Scale terminology is that of Roberts (1993). The considerable variation in transverse scale counts is attributable to the apparent irregular distribution of scales on the sides of *Hoplostethus* species with lateral line scales considerably larger than those elsewhere; although most fishes have scales arranged in discrete oblique rows, a homologous arrangement is not apparent in species of this genus; in addition, the profusion of spines on scales of some species makes the distinction between individual scales extremely difficult. Modified scales on the ventral midline of the abdomen are regarded as scutes when they have acquired a laterally compressed keel-like form with a pointed apex or apices; numbers of scutes in species having them appear to increase slightly with growth.

Comparative material examined:

Hoplostethus confinis **HUMZ 191395** (282), Indian Ocean, off Sumatra, Indonesia, 03°29.03' N, 94°57.59' E – 03°29.23' N, 94°57.22' E, 760–790 m, 7 October 2004, coll. by K. Odani; **HUMZ 194238** (270) Indian Ocean, off Java, Indonesia,

08°19.07' S, 109°53.09' E – 08°19.00' S, 109°52.08' E, 864–950 m, 7 May 2005, coll. by T. Kawai; *H. robustispinus*: **HUMZ 148071** (195) and **HUMZ 148072** (354) southern Japan, 27°53.20' N, 128°28.72' E – 27°51.70' N, 128°29.05' E, 603–586 m, 18 July 1994.

Hoplostethus gigas McCulloch, 1914

Giant sawbelly

Figures 1 & 2; Tables 1 & 2

Hoplostethus gigas McCulloch, 1914: 101, plate xix, original description, Great Australian Bight.

Hoplostethus gigas. McCulloch, 1929: 132, listed ("holotype on deposit in Austr. Mus."), Great Australian Bight. –Munro, 1958: 79, fig. 548, description ex McCulloch, Great Australian Bight. –Whitley, 1964: 40, listed, Australia. –Scott, 1962: 108, fig., description ex McCulloch, Great Australian Bight. –Woods and Sonoda, 1973: 306, listed, Australia ("possibly a very large *japonicus*"). –Kotlyar, 1980: 197, fig. 10, family revision, description ex McCulloch, Australia. –Maxwell, 1980: 66, plate 155, description ex McCulloch, temperate Australia. –Kotlyar, 1986: 126, generic revision, key, description ex McCulloch, Australia. –Paxton and Hanley, 1989: 366, synonymy and Australian distribution. –Gomon, in Gomon et al., 1994 (in part): 403, Fig. 361, description, Great Australian Bight. –Paxton et al., 2006: 769, taxonomy, central south coast of Australia. –Gomon, in Gomon et al., 2008: 424, fig., description, central south coast of Australia. –Moore and Dodd, 2010: 138–141, morphological characters.

Hoplostethus latus (not McCulloch, 1914: 97, fig. 5). May and Maxwell, 1986: 219, fig., description ex McCulloch, Great Australian Bight.

Material examined. Lectotype. **AMS I.12766** (307) (herein designated), Great Australian Bight, FIS *Endeavour*, one of six registered, 27 March 1913.

Paralectotypes (5, 292–426 mm SL). **AMS I.15710-001** (ca. 375; skeleton, S.1285) same data as AMS I.12766; **NMV A.20541** (385; formerly E.4298) same data as AMS I.12766; **QMB I.1423** (426; formerly E.3238) Great Australian Bight, 33°18' S, 126°47' E, 238–311 m (130–170 fms), February 1913, FIS *Endeavour*.

Non-types (7, 293–378 mm SL). **CSIRO H.4874-01** (366), **CSIRO H.4874-02** (368), **CSIRO H.4874-03** (349), **CSIRO H.4874-04** (356), **CSIRO H.4874-05** (373), **CSIRO H.4874-06** (378) Great Australian Bight, 33°19' S, 128°25' E, 180–350 m, collected at end of tow over rough ground near a drop-off to canyon, FV *Noble Pearl*, demersal trawl, 21 September 1998; **NMV A.21541** (293) Victoria, south-west of Portland, 38°48' S, 141°44' E, 432–522 m, 19 June 2000, FV *Zeehaan*, demersal trawl, coll. by K. Graham.

Diagnosis. Pectoral–fin rays 15, rarely 14; total gill rakers on outer side of first arch 18; predorsal scales 9–15; abdominal scutes 9 or 10, few scutes in large individuals with multiple apical points; isthmus lacking scales; body scales adherent; lateral–line scales with tuberculate medial ridge, but no spine; scales on predorsal midline forming low raised ridge; body ovoid and deep, depth 2.0–2.2 in SL; nape distinctly curved, forehead almost straight to above upper lip; dorsal– and anal–fin spines of moderate thickness; body of adults grey, superimposed with orange–red to red in life, outer margin of soft portions of dorsal, anal and caudal fins greyish to almost blackish; buccal cavity and opercular recess black, vomer, underside of tongue and upper surface of lower jaw stark white. Reaches 525 mm SL.

Table 1. Selected meristic, standard length and morphometric values for types and other specimens examined of three species of *Hoplostethus*. Morphometric values are expressed as percent SL.

	<i>H. gigas</i>		<i>H. melanopeza</i> sp.nov.		<i>H. grandperrini</i> sp.nov.	
	lectotype	all specimens (n=9)	holotype	paratypes (n=27)	holotype	paratype
Dorsal fin	VI, 13	VI, 13-14	VI, 13	VI-VII, 12-13	VI, 13	VI, 13
Anal fin	III, 9	III, 9	III, 9	III, 9-10	III, 9	III, 9
Caudal fin	6+2+17+2+6	6-7+2+17+2+6-7	6+2+17+2+6	6-7+2+17+2+6	6+2+17+2+6	6+2+17+2+6
Pectoral fin	15	14-15	15	14-16	17-18	17
Pelvic fin	I, 6	I, 6	I, 6	I, 6	I, 6	I, 6
Lateral line scales	26+2	26-28+1-2	27+1	26-29+1-2	28+1	28+1
Transverse scales	13/1/23	9-13/1/22-24	12/1/25	9-15/1/20-28	12/1/26	11/1/35
Predorsal scales	9	9-15	18	16-22	21	24
Abdominal scutes	10	9-10	10	9-12	14	13
Gill rakers	5+13=18	5+13=18	6+14=20	5-6+12-15=18-21	6+14=20	6+13=19
Pseudobranch	~46*	19	16-21	15		
Vertebrae	11+15	11+15	11+15	11+15	11+15	11+15
Standard length	307	292-378	286	72.6-515	455	131
Body depth	47.6	46.2-50.7	52.0	47.9-56.4	55.6	53.2
Head length	37.1	34.7-39.1	40.6	32.6-42.6	41.4	42.9
Forehead height		39.8-40.1 ¹	41.2	34.1-46.4	41.0	44.2
Eye diameter	10.9	9.1-10.9	10.9	9.4-14.7	9.6	12.5
Postorbital length		19.1-20.0 ¹	20.3	17.8-21.8	22.4	22.0
Interorbital width	11.5	11.5-12.9	10.9	10.2-12.8	14.1	13.4
Maxillary length	26.0	24.4-27.5	26.5	23.3-29.2	26.3	30.4
Lower jaw length		24.7-28.4 ¹	28.2	23.6-29.6	28.6	31.1
Snout length	9.9	6.5-10.4	9.8	7.09-11.3	10.5	9.5
Caudal peduncle depth	11.3	9.9-12.5	12.0	10.4-15.3	12.5	13.0
Caudal peduncle length	25.2	21.9-27.1	23.0	20.2-26.1	22.6	22.9
Predorsal length	45.3	40.4-47.9	47.6	45.0-52.2	38.8	49.1
Preanal length		71.9-72.9 ¹	70.6	64.4-73.5	76.7	73.2
Prepectoral length		37.7-38.2 ¹	40.7	36.5-41.2	40.8	40.4
Prepelvic length		42.8-44.9 ¹	44.3	39.1-45.3	42.6	43.8
Pectoral Pelvic length		11.6-12.3 ¹	15.8	12.0-16.6	18.3	15.8
Pelvic Anal length		34.0-38.2 ¹	32.1	25.3-36.8	42.4	35.5
Dorsal base length		38.4-39.3 ¹	38.9	36.0-41.3	38.3	36.0
Anal base length		17.1-18.7 ¹	19.0	15.3-21.8	17.2	17.0
Pectoral fin length	23.8	23.8-27.3	23.8	21.1-34.9	25.2	34.0
Pelvic fin length	19.5	19.1-21.0	19.5	17.0-26.4	18.4	23.5
1st dorsal spine length		2.5-3.7 ³	3.9	1.8-7.5	2.9	4.7
2nd dorsal spine length		4.3-6.8 ⁴	8.1	3.1-12.1	4.1	8.9
Last dorsal spine length	14.9	13.7-15.0 ²	14.6	12.0-23.2	12.1	17.6
1st anal spine length		1.4-2.1 ²	2.1	1.2-2.8	1.6	2.1
Last anal spine length	11.0	10.8-12.3 ⁴	11.1	8.8-16.4	7.7	13.3

* 1 specimen only, ¹ 2 of 9 specimens, ² 6 of 9 specimens, ³ 7 of 9 specimens, ⁴ 8 of 9 specimens

Table 2. Frequency of abdominal scute numbers in specimens examined of *Hoplostethus gigas*, *H. melanopeza* sp. nov. and *H. grandperrini* sp. nov. Holotypes or lectotype indicated by *.

No. of scutes	9	10	11	12	13	14
<i>H. gigas</i>	7	2*				
<i>H. melanopeza</i> sp.nov.	10	7*	9	2		
<i>H. grandperrini</i> sp.nov.					1	1*

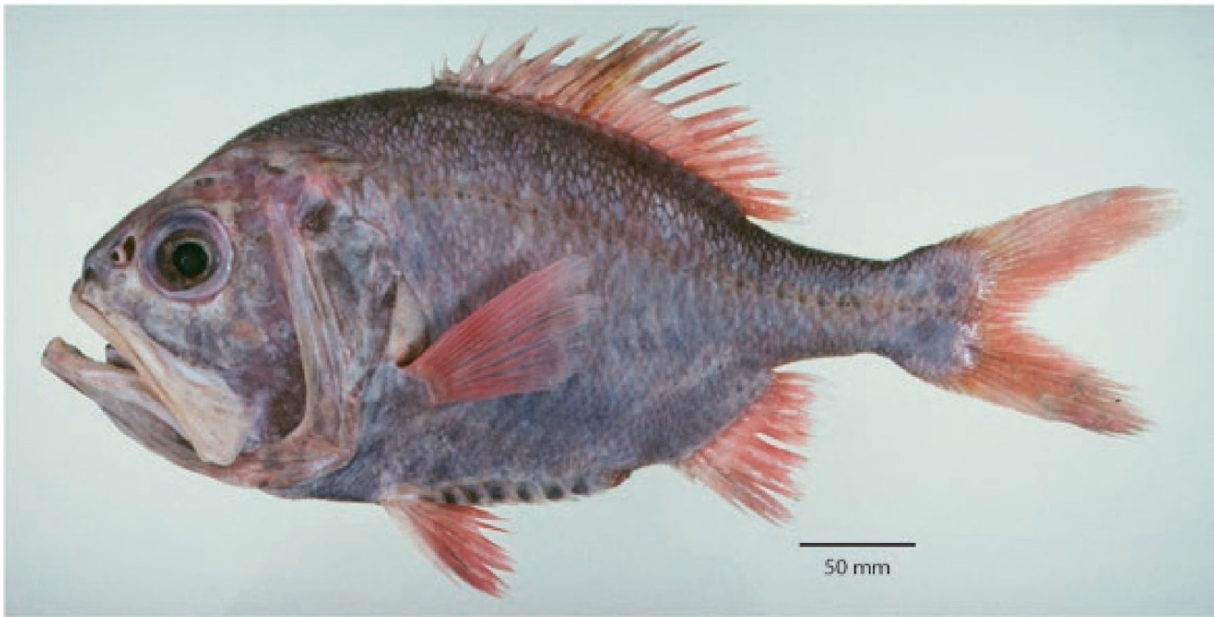


Figure 1. *Hoplostethus gigas* McCulloch, 1914. CSIRO H4874.02, 368 mm SL, photo by Thor Carter.

Description. (See Table 1 for frequencies of values for selected meristic characters.) Dorsal-fin rays VI, 13 (VI, 14 in 1 of 9); anal-fin rays III, 9; caudal-fin rays 6 + 2 + 9 + 8 + 2 + 6 (6 or 7 + 2 + 9 + 8 + 2 + 6 or 7); pectoral-fin rays 15 (14 in 1 of 9); pelvic-fin rays I, 6; gill rakers 5 + 1 + 12; lateral-line scales 26 + 2 (26 to 28 + 1 or 2 = 28 or 29); transverse scales 13/1/23 (9–13/1/22–24); predorsal scales 9 (9–15); scutes 10 (9 or 10; Table 2); vertebrae 11 + 15; pseudobranch about 46; branchiostegal rays 8.

(See Table 1 for comparative ranges of selected morphometric characters.) Body ovoid and deep, depth 1.98–2.16 in SL. Head large, its height slightly greater than its length, 110–115% HL; upper profile in front of dorsal fin distinctly curved to above rear of eye, then mostly straight to upper jaw, slightly concave above rear half of eye in some; anterodorsal profile well separated from upper orbital rim; space between eyes wide, interorbital width 28.8–35.2% HL; eye of moderate size, orbital diameter 24.0–32.8% HL; crests of head bones strong, fine spinules on apices at skin surface; depressions between crests moderately deep, hidden by thick skin in adults; infraorbital bones becoming progressively broader with growth; nostrils immediately preceding orbits, posterior nostril two to four times area of anterior nostril; mouth reaching just beyond vertical through hind margin of eye; large, fine denticulate teeth covering oral margins and exposed lateral surfaces of premaxilla and dentary, palatine

with posteriorly tapering band of similar teeth, vomer apparently lacking teeth, at least in adults; tip of dentary with ossified knob at symphysis. Preopercular spine short, reaching about 1/4 way from preopercular margin to pelvic-fin base, broad basally in large specimens. Humeral and preopercular spines of similar size. Longest gill raker about 2/3 eye diameter; gill filaments at angle of first gill arch very short, about 1/8 eye diameter and about 1/3 length of longest filaments of pseudobranch.

Body covered with adherent scales, with densely covered, finely spinoid scales above lateral line, posteriorly and low on side, scales above and covered laterally by pectoral fin cycloid (cycloid scales distributed more ventrally in smaller individuals); head naked except for patch of scales on cheek posterior to rear tip of maxilla in about four vertical rows, posteriormost row with about 17 scales; isthmus scale-less; each lateral-line scale with tuberculate ridge but lacking distinct spine; deep serrated abdominal keel formed from greatly enlarged scales (scutes) with slender spine-like apices, most without sculpturing or multiple tips, some striated; scales on dorsal midline in front of dorsal fin slightly but noticeably raised, their spinules complex but not greatly enlarged. First dorsal-fin spine short, subsequent spines distinctly longer but only increasing progressively in length slightly; spines of moderate thickness, those posteriorly progressively thicker with distinct lengthwise striations; first soft ray distinctly longer than last spine, third ray longest, subsequent

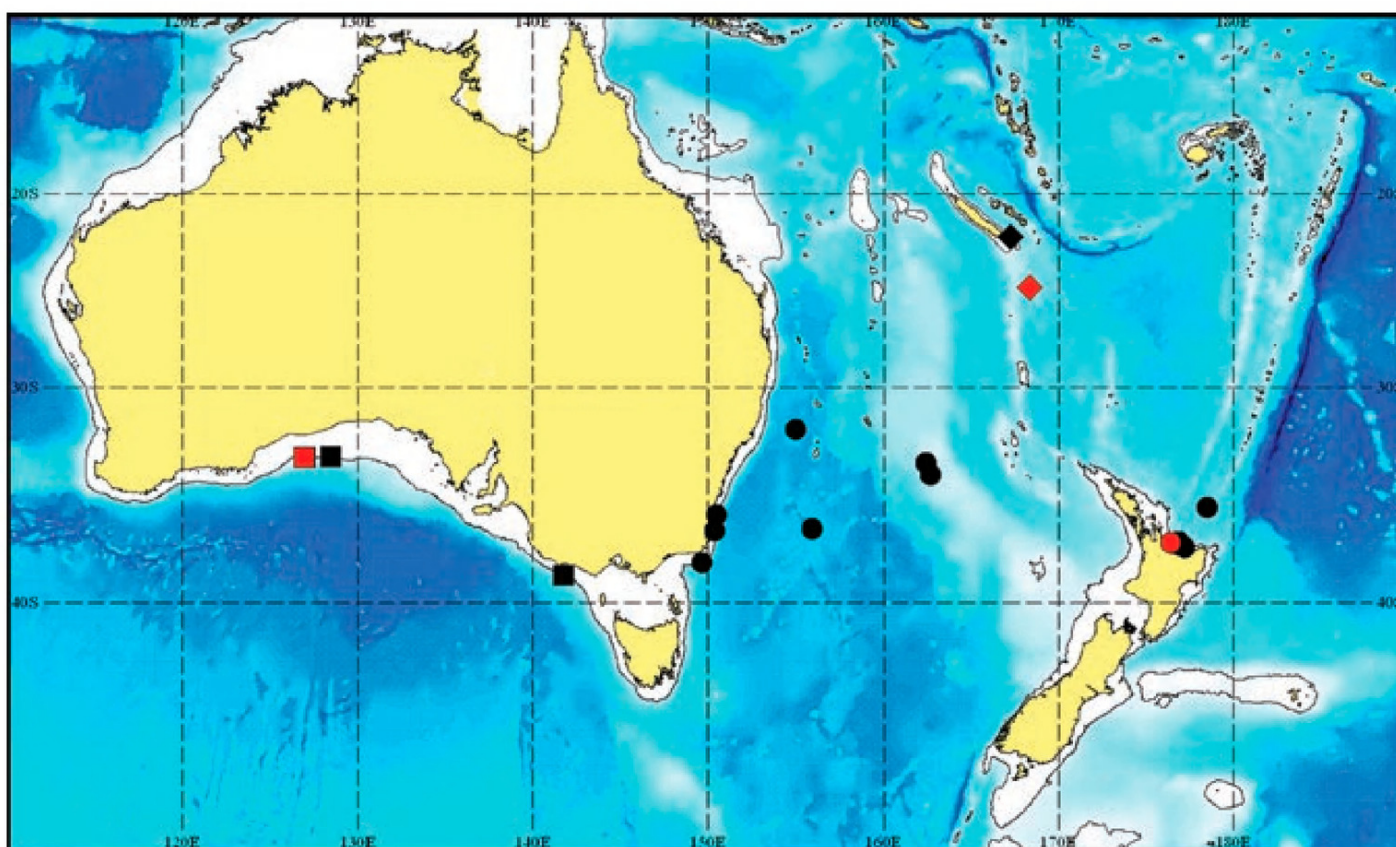


Figure 2. Collection localities for specimens examined of *Hoplostethus gigas* (squares), *H. melanopeza* sp. nov. (circles) and *H. grandperrini* sp. nov. (diamonds). Red symbols indicate holotypes or lectotype.

rays progressively decreasing in length, outer margin of soft dorsal fin curved anteriorly, straight posteriorly. First anal-fin spine short, second short or of intermediate length, and third long; spines of similar robustness to those in dorsal fin. Caudal fin distinctly forked, lobes of moderate breadth and rounded; middle rays about 40% length of longest rays. Pectoral fin moderately short, reaching to beyond anus in large specimens. Pelvic fin reaching to seventh or eighth scute in large specimens.

A large species, largest specimen examined 426 mm SL; reported to 525 mm SL (McCulloch, 1914).

Colour in life. Head and body grey, obscured by deep reddish orange to red; opercle black suffused with red; buccal cavity and opercular recess black, vomer, underside of tongue and upper surface of lower jaw stark white; fins deep red; membranes between dorsal fin spines grey, marginal strip on soft portions of dorsal, anal and caudal fins dark grey to almost blackish in large individuals (fig. 1).

Pigmentation in alcohol. Slightly dusky above, pale below; opercle dark; buccal and branchial chambers dark, including gill arches and rakers; vomer, palatines, underside of tongue and lower jaw uniformly pale; medial fins and pelvic fins dusky near outer edges.

Distribution. Confined to the southern coast of Australia, documented from the western part of the Great Australian Bight (126°47' E) to southwest of Portland, Victoria (141°44' E)

with collection depths recorded between about 188 and 522 m (fig. 2). It is reported to “hang-out at canyon edges” and in areas with “rough ground” (pers. comm. T. Parsons, skipper of ‘FV Noble Pearl’).

Comments. The type locality given by McCulloch (1914) in his original description of *Hoplostethus gigas* does not accurately match registration records for specimens collected by the FIS *Endeavour* we have been able to locate. In his account, McCulloch presented it as Great Australian Bight, 33°18' S, 126°42' E, 130–170 fms (= 238–311 m). The closest locality we have been able to find for specimens identifiable as this species is that of three specimens registered in the South Australian Museum (SAM F137, formerly AMS E.3236), Western Australian Museum (WAM P.63-001, formerly E.3237) and Queensland Museum (QMB I.1423, formerly E.3238). So far, the specimens at the South Australian Museum and Western Australian Museum have not been found, although specimens of *Hoplostethus* collected by the *Endeavour* were received and registered by the institutions as indicated, and in both cases, like the Australian Museum material, they were recorded as *H. intermedius*. As no further *Endeavour* material identifiable as *H. gigas* appears to be in the Australian Museum collection, we assume the other six specimens of the type series were distributed to museums elsewhere in Australia, along with an assortment of other “E series” specimens currently in their collections. For instance, in addition to the assumed type of *H.*

gigas in the Museum Victoria collection listed above among Material examined, a specimen of *H. latus* was received as part of the same gift. That specimen, NMV R5962 (formerly AMS E.2350) is most likely one of the nine specimens on which *Hoplostethus mediterraneus* var. *latus* was based in the same McCulloch publication and is consequently considered a syntype of what is now regarded as the valid species, *H. latus*.

The ledger of original *Endeavour* numbers, which is in the care of the Australian Museum, records E.3236, E.3237 and E.3238 as having been collected at 33°18' S, 126°47' E, 130–170 fms and having been exchanged to the Adelaide, Perth and Queensland Museums, respectively. Although identified in the ledger as *Hoplostethus intermedius* these are the specimens of *H. gigas* listed above. We suspect the discrepancy in minutes longitude is a misinterpretation of the handwritten record or a transcription error. Despite his lone locality for the species, McCulloch indicated the account is based on eleven specimens. We consider it unlikely that all were collected at the one station as specimens of this species are uncommonly rare in collections and the few that do exist were not taken in large numbers. As McCulloch was zoologist at the Australian Museum at the time of publication, we assume he retained at least one type and AMS I.12766 is one of two specimens currently registered in that collection as *H. gigas*, even though it was registered as *Hoplostethus intermedius* without locality information on 27 April 1913. No subsequent annotations were made to that ledger entry. The other specimen so identified in the AMS collection is a skeleton (AMS I.15710-001) prepared about the time of registration. AMS Skeleton Register records in the hand of McCulloch “S.1285, 28 Mar 1913, *Hoplostethus intermedius*” with *intermedius* crossed out and “*gigas*” inserted, in the same hand.

Based on our perceptions of human nature, we assume that McCulloch chose to retain the specimen he regarded as the most representative of the species (now regarded as a holotype). We adjudge AMS I.12766 to be that specimen and here designate it lectotype of *Hoplostethus gigas* McCulloch, 1914. Other specimens listed above as paralectotypes are considered to also be from the original series.

The redescription presented here is the first since the original description of the species nearly 100 years ago, and includes additional specimens and data ranges. This is the largest of currently described species and is easily separated from other nominal species by its maximum size attained and the combined morphological features comprising 9–15 predorsal scales, 9–10 enlarged abdominal scutes, 15 (rarely 14) pectoral-fin rays, and 18 total gill rakers. It is separable from the two species described below as discussed in the commentary following each treatment.

Hoplostethus melanopeza sp. nov.

New Zealand giant sawbelly

Figures 2–5; Tables 1 & 2

Hoplostethus gigas (not McCulloch, 1914). Paulin & Stewart, 1985: 31, listed, Bay of Plenty, 100–300 m, first record for New Zealand. –Paulin et al., 1989: 153, 257, colour plate (opposite page 163), key. –Gomon, in Gomon et al., 1994 (in part): 403, Fig. 361, description, off Sydney, NSW, and Bay of Plenty, New Zealand.

Hoplostethus ?gigas (not McCulloch, 1914). Roberts, 1995: 106, colour figs, description, Bay of Plenty. –Roberts, 1996: 40, colour fig., description, Bay of Plenty.

Hoplostethus cf. *gigas* (not McCulloch, 1914). Roberts et al., 2009: 532 (listed). –Roberts, 2012: 38, colour fig., description, off Mayor Island, Bay of Plenty.

Material examined. *Holotype.* NMNZ P.053205 (286) New Zealand, North Island, Bay of Plenty, Mayor Knolls, 12 km east of Mayor Island, 37°19.07' S, 176°25.35' E, 320 m, gill net, 3 hr soak, 5 March 2012, FV *Ruben Jack*, A. Oliver & C. Molloy.

Paratypes. (27, 72.6–515 mm SL). AMS I.27085–001 (515) Australia, New South Wales, Taupo Seamount, 32° S, 155° E, March 1982; AMS I.30415–001 (2, 72.6–123) Australia, New South Wales, Moruya, 36°03' S, 150°27' E, 383 m, 21 November 1979, K. Graham; AMS I.40390–004 (108) Australia, New South Wales, Bermagui, 36°47' S, 150°21' E, 585 m, 23 July 2000, K. Graham; CSIRO H5321–04 (107), Australia, Victoria, Cape Everard, 38°14' S, 149°36' E, 486–602 m, 23 July 2000, K. Graham; CSIRO H7387–01 (380) formerly NMNZ P.053725, New Zealand, Bay of Plenty, east of Mayor Island, west of Rangitira Knoll, 37°15.52' S, 176°44.41' E, 500 m, set net, April 2012, FV *Ruben Jack*, OPC Fish & Lobster Ltd, A. Oliver & C. Molloy; MNHN 2012–0268 (273) formerly NMNZ P.053206, same data as holotype; NMNZ P.014162 (465) New Zealand, North Island, Bay of Plenty, Rangitira Knoll, 37°15.5' S, 176°51' E, 140 m, June 1983, G. Schroeder; NMNZ P.015181 (2, 440–450) New Zealand, Tokokemoke Knoll, 12 miles west of White Island, 37°28' S, 176°54' E, 256 m, longline, FV *Arapawa I*, C. Walker; NMNZ P.015854 (3, 397–467) New Zealand, North Island, Bay of Plenty, Rangitira Knoll, 37°15' S, 176°51' E, 366 m, February 1984, gill net, G. Schroeder; NMNZ P.031100 (3, 449–482) New Zealand, North Island, Bay of Plenty, southeast of Rangitira Knoll, 37°17.2' S, 176°53.6' E, 240–500 m, April 1994, bottom trawl, FV *Margaret Philippa*, J. & J. McGrath; NMNZ P.038312 (99) New Zealand, southern Kermadec Ridge, outer Bay of Plenty, Rumble 3 submarine volcano, 35°44.51' S, 178°29.62' E, 270–426 m, epibenthic sled, 11:31–11:51 hrs, 19 May 2001, GRV *Tangaroa*; stn. TAN 0107/004; NMNZ P.038325 (395) Gascoyne Seamount, 36°42.00' S, 155°54.00' E, 925 m, 8 August 2001, dropline, D. Smith; NMNZ P.038548 (178) same data as NMNZ P.015854; NMNZ P.047799 (132) Tasman Sea, Lord Howe Rise, Central Plateau 34°11.95' S, 162°38.90' E, 712–760 m, 7 September 2010, trawl, FV *Voyager*, OBS 3177/058, J. Houston; NMNZ P.053308 (486) New Zealand, North Island, Bay of Plenty, east of Mayor Island, 37°19.75' S, 176°29.57' E, 540 m, set net, March 2012, OPC Fish & Lobster Ltd., coll. A. Oliver & C. Molloy; NMNZ P.053877 (468) New Zealand, Bay of Plenty, Mayor Knolls, east of Mayor Island, 37°18.6' S, 176°31.32' E, 347 m, set net, April 2012, FV *Ruben Jack*, A. Oliver & C. Molloy; NMV A22070 (128) Tasman Sea, Lord Howe Rise, 33°38' S to 33°40' S, 162°21' E to 162°28' E, demersal trawl, 300–750 m, 22 March–2 April 2001, coll. K. Smith; NMV A30942-001 (282) formerly NMNZ P.053307, New Zealand, Bay of Plenty, east of Mayor Island, 37°19.75' S, 176°29.57' E, set net, 540 m, March 2012, FV *Ruben Jack*, OPC Fish & Lobster Ltd., coll. A. Oliver & C. Molloy; NMV A30943–001 (393) formerly NMNZ P.053726, New Zealand, Bay of Plenty, E of Mayor Island, Rangitira Knoll, 37°15.522' S, 176°44.408' E, set net, 500 m, April 2012, FV *Ruben Jack*, OPC Fish & Lobster Ltd., coll. A. Oliver & C. Molloy; NMV A30944–001 (420) formerly NMNZ P.054048, New Zealand, Bay of Plenty, E of Mayor Island, Maungaiti Knoll, 37°17.25' S, 176°51.63' E, set net, 450 m, June 2012, FV *Ruben Jack*, OPC Fish & Lobster Ltd., coll. A. Oliver; USNM 406863 (262) formerly NMNZ P.053529, New Zealand, North Island, Bay of Plenty, Mayor Knolls, 12 km east of Mayor Island, 37°19.07' S, 176°25.35' E, 320 m, 5 March 2012, FV *Ruben Jack*, coll. A. Oliver & C. Molloy.

Diagnosis. Pectoral-fin rays 15, rarely 13, 14 or 16; total gill rakers on outer side of first arch 18–21; abdominal scutes 9–12,

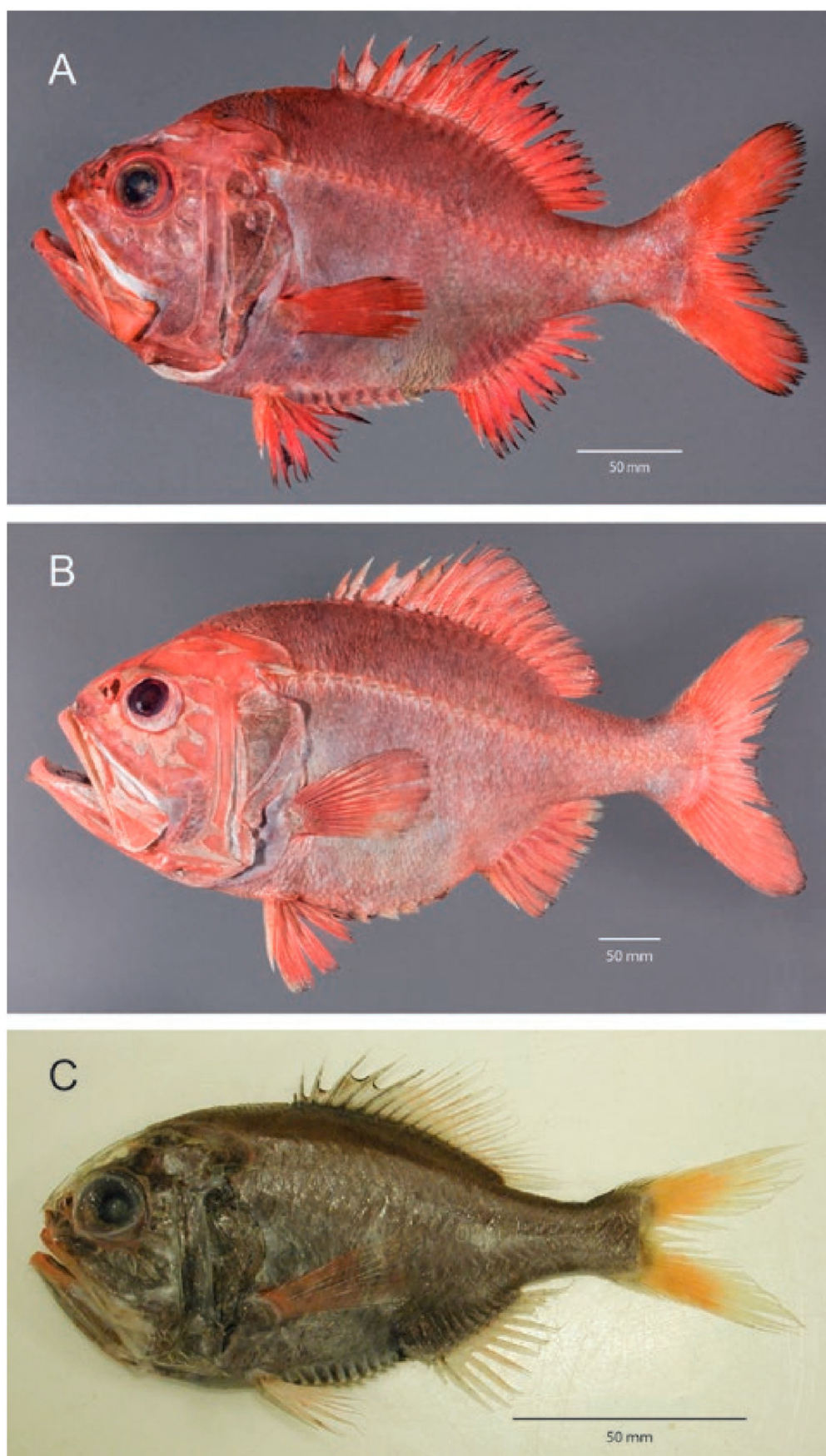


Figure 3. *Hoplostethus melanopeza* sp. nov. A, NMNZ P.053205, holotype, 286 mm SL, photo by C. Struthers; B, NMNZ P.053308, paratype, 486 mm SL, photo by C. Struthers; C, NMV A22070, paratype, 128 mm SL, photo by M. Gomon.



Figure 4. Buccal colouration of *Hoplostethus melanopeza* sp. nov. NMNZ P.053206, paratype, 273 mm SL, photo by C. Struthers.

some scutes in large individuals with multiple apical points; predorsal scales, 16–22; isthmus lacking scales; body scales adherent; lateral-line scales with strong medial ridge, but no spine in small and medium sized adults, with strong spine centrally on posterior margin in large adults; scales on predorsal midline forming low raised ridge; body ovoid and deep, depth 1.9–2.1 in SL; nape gently curved, forehead almost straight to above upper lip; dorsal- and anal-fin spines of moderate thickness; body of adults grey, superimposed with deep red in life, outer margin of all fins with narrow black edge in adults; buccal cavity and opercular recess black, vomer, margins of mouth roof lateral to palatines, underside of tongue and upper surface of lower jaw stark white. Reaches at least 515 mm SL.

Description. (See Table 1 for frequencies of values for selected meristic characters.) Dorsal-fin rays VI, 13 (VI, 12 in 2 and VII, 12 in 1 of 27); anal-fin rays III, 9 (III, 10 in 1 of 27); caudal-fin rays 6 + 2 + 9 + 8 + 2 + 6 (7 + 2 + 9 + 8 + 2 + 6 in 2 of 21); pectoral-fin rays 15 (13 in 1, 14 in 2 and 16 in 4 of 54); pelvic-fin rays I, 6; gill rakers 6 + 1 + 13 (5 or 6 + 1 + 12–14 = 18–21, usually 6 + 1 + 13 = 20, mean total 19.7); lateral-line scales 27 + 1 (26–29 + 1, rarely 2, mean 27.7 + 1.1); transverse scales 12/1/25 (9–15/1/20–28; mean 11.1/1/23.4); predorsal scales 18 (16–22, mean 18.5); scutes 10 (9–12; Table 2); vertebrae 11 + 15; pseudobranch 19 (16–21); branchiostegal rays 8.

(See Table 1 for comparative ranges of selected morphometric characters.) Body ovoid and deep, depth 1.92–2.08 in SL. Head large, its height slightly greater than its length, 94.1–114% HL; upper profile in front of dorsal fin gently curved to above rear of eye, then mostly straight to upper jaw, slightly concave above rear half of eye in some; anterodorsal profile only slightly separated from upper orbital rim; space between eyes wide, interorbital width 28.8–35.2% HL; eye of moderate size, orbital diameter 24.0–32.8% HL; crests of head bones strong, fine spinules on apices at skin surface; depressions between crests moderately deep, hidden by thick skin in adults; infraorbital bones becoming progressively broader with growth; nostrils immediately preceding orbits, posterior nostril two to four times area of anterior nostril; mouth reaching just beyond vertical through hind margin of eye; large, fine denticulate teeth covering oral margins and exposed lateral surfaces of premaxilla and dentary, palatine with narrow band of similar teeth, vomer apparently lacking teeth (with about 3 tiny teeth in small specimens); tip of dentary with ossified knob at symphysis. Preopercular spine short, reaching about 1/4 to 1/2 way from preopercular margin to pelvic-fin base, broad basally in large specimens. Humeral and preopercular spines of similar size. Longest gill raker about 2/3 eye diameter; gill filaments at angle of first gill arch very short, about 1/8 eye diameter and about 1/3 length of longest filaments of pseudobranch.

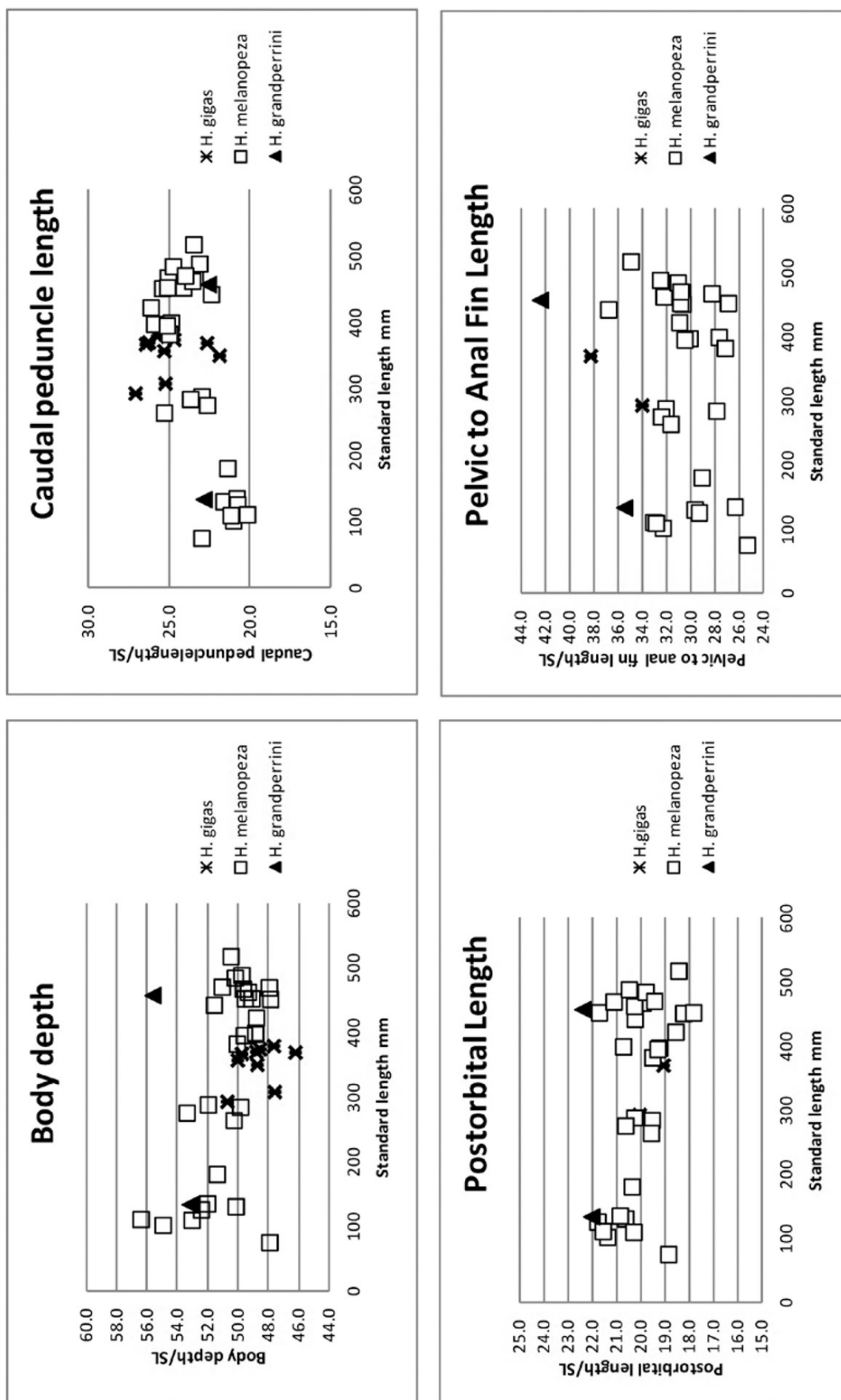


Figure 5. Selected proportional measurements relative to standard length for *Hoplostethus gigas*, *H. melanopeza* sp. nov. and *H. grandperrini* sp. nov.

Body covered with adherent scales, scales densely covered with low, knob-like spinules above lateral line, posteriorly and low on side, scales above and covered laterally by pectoral fin, cycloid (cycloid scales distributed more ventrally in small individuals); head naked except for patch of scales on cheek posterior to rear tip of maxilla in about four vertical rows, posteriormost row with 8–12 scales; isthmus scaleless; lateral line with fine spinulation at free margin, each lateral-line scale with strong ridge but lacking distinct spine (no spine in small and medium sized adults, with strong spine centrally on posterior margin in large adults), considerably larger than other body scales, although adjacent scales intermediate in size between lateral-line scales and others away from lateral line; deep serrated abdominal keel formed from greatly enlarged scales (scutes) with spine-like apices, most without sculpturing or multiple tips, though with striations in some especially posteriorly; scales on dorsal midline in front of dorsal fin slightly but noticeably raised, their spinules not greatly enlarged. First dorsal-fin spine short, subsequent spines distinctly longer but only increasing slightly progressively in length; spines of moderate thickness, those posteriorly progressively wider with distinct lengthwise striations; first soft ray longer than last spine, subsequent rays progressively decreasing in length, outer margin of soft dorsal fin slightly curved. First anal-fin spine short, second only slightly or considerably longer, third long; spines of similar robustness to those of dorsal fin. Caudal fin distinctly forked, lobes of moderate breadth and rounded. Pectoral fin of moderate length, reaching to or beyond last few scutes (relatively longer in small individuals, to base of the third anal-fin ray in 99.3 mm SL paratype). Pelvic fin reaching just beyond middle scutes (to anal-fin origin in smallest paratype).

A large species, largest specimen examined 515 mm SL.

Colour in life. Head and body dark grey, obscured by deep red; opercle black suffused with red; dark areas of buccal and branchial cavities black; fins deep red with narrow black distal edges (figs 3 & 4).

Pigmentation in alcohol. Freshly preserved individuals dark grey (juveniles pale below a line between humeral spine and dorsal side of caudal peduncle near termination of dorsal fin base, dusky above); opercle dark; buccal and branchial chambers dark, including gill arches and rakers; vomer, roof of mouth lateral to palatines, underside of tongue and lower jaw uniformly pale; fins pale with narrow dark margins (juveniles with pale fins, except for slightly dusky outer portion of membrane between dorsal-fin spines).

Etymology. The name *melanopeza* is from the Greek *melano* for 'black' and *peza* 'edge', in reference to the characteristic black edge on all fins in large individuals of this species. As a noun in apposition, the spelling of *melanopeza* is not influenced by masculine gender of genus *Hoplostethus*.

Distribution. Confined to sub-tropical and temperate latitudes of the Tasman and South Fiji Basins in the south-western Pacific, documented from localities between about 33° and 37° S from south-eastern Australian slopes on the west to the outer Bay of Plenty and southern Kermadec Ridge at the north end of

the North Island in New Zealand in the east (fig. 2). Occurs on continental slopes, seamounts and submarine rises with collection depths recorded between about 140 and 760 m, but most often 250–400 m.

Comments. *Hoplostethus melanopeza* is very similar to *H. gigas*, a species with which it was confused in the early 1980's when initial specimens were collected. The absence of detailed descriptive information beyond McCulloch's initial description of *H. gigas* nearly 100 years ago no doubt contributed to this confusion. McCulloch evidently received the specimens on which his description is based well after they were preserved, saying about the species' original colouration only that "when first received all the fins had traces of deep rose pink." Although both species have a similar overall red or reddish-orange colouration, *H. melanopeza* has distinct black margins to all fins in large individuals, while the edges of only the medial fins appear to be no more than dark grey to blackish in large individuals of *H. gigas*. The recognition of the two species is supported by Cytochrome Oxidase subunit one sequences (Te Papa/ NIWA/CSIRO/NMV unpublished data).

Morphologically *H. gigas* and *H. melanopeza* have nearly identical ranges for meristic values, but the latter has a greater number of predorsal scales (16–22 versus 9–15) and a higher mean value for total gill rakers of 19.7 versus 18.0, based on material examined. Proportional measurements for the two are also extremely similar. The greater size range of specimens for the new species makes a full comparison of the two impossible, although an examination of the distribution of values in a number of other species shows morphometric ranges converging at smaller sizes and the greatest disparities evident as individuals approach their maximum size. At comparable sizes *H. melanopeza* seems to have a slightly deeper body and shorter pelvic to anal-fin length than *H. gigas* (fig. 5).

Morphological comparisons with other nominal species referred to the subgenus *H. (Hoplostethus)* are difficult because of the relatively small sample sizes that literature descriptions on which most are based and the considerably greater variation detected when greater numbers are examined. In comparison with *H. robustispinus*, which reaches a comparably large size, *H. melanopeza* has 15, rarely 16, versus 17, rarely 16 pectoral-fin rays, 9–12 versus 11–13 abdominal scutes, 26 versus 27 total vertebrae, and medial fin spines of a moderate breadth versus broad in large individuals. The Indian Ocean *H. confinis*, as mentioned in the Introduction, also reaches a reasonably large size and has meristic values that are more similar to those of *H. melanopeza* and *H. gigas*, apparently differing from the former in having the same lower mean value of total gill rakers as the latter. It is further separable from *H. melanopeza* in lacking the black margins to its fins at a large size. Two other species occurring in the Indo-Pacific region have pectoral-fin ray numbers that appear to be comparable with *H. melanopeza*, the Red Sea *H. marisrubri* Kotlyar, 1986 and western Indian Ocean *H. mikhailini* Kotlyar, 1986. Neither has been reported to have dark margins to their fins, but individuals of *H. melanopeza* do not appear to develop dark margins until they reach a standard length well in excess

of 150 mm SL, a size that is greater than the largest specimen reported for either of these two species. *Hoplostethus melanopeza* differs from *H. marisrubri* in having 26 versus 27 total vertebrae and from *H. mikhailini* in having 18–21 versus 23–27 total gill rakers.

Although *H. melanopeza*, together with most other species of the genus reaching a significant size (apart from the commercially important orange roughy *Hoplostethus atlanticus* Collett, 1889), have long been regarded as very rare in deepwater environments. The type series took over 30 years to collect despite periodic requests to networks and the commercial and recreational fishing sectors (e.g. Roberts, 1995, 1996, 2012). The use of fishing gear such as deep droplines and set nets that are effective in capturing species living in rough bottom environments, have shown them to occur locally in greater numbers than originally thought. Even though life history details are yet to be identified for this and other giant roughy species, it is reasonable to believe their age and growth rate approach species like the orange roughy for which information is reasonably well known. Consequently, we urge restraint in the development of targeted commercial exploitation of what is potentially another long-lived, late maturing species, for which we currently have inadequate information on its abundance and biology.

Hoplostethus grandperrini sp. nov.

Grandperrin's giant sawbelly

Figures 2, 5 & 6; Tables 1 & 2

Hoplostethus cf. *gigas*: Grandperrin & Lehodey, 1992: 7, 26 and 35, listed, seamount "B", Norfolk Ridge, New Caledonia.

Holotype. NMNZ P.027462 (455) New Caledonia, Norfolk Ridge, Seamount "B", 24°55.15'S, 168°20.95'E, 600–675 m, BERYX 2, stn 3, N.O. *Alis*, chalut à poissons (= fish bottom trawl), 24 October 1991, R. Grandperrin and C. Roberts. (Lodged in NMNZ collection at the request of MNHN).

Paratype. MNHN 2012–0269 (131) New Caledonia, SE slope of Grande Terre, 22°13.00' S, 167°14.00' E, 500–510 m, MUSORSTOM 4, stn 238, N.O. *Vauban*, chalut à perche (= beam trawl), 2 October 1985.

Diagnosis. Pectoral–fin rays 17 or 18; total gill rakers on outer side of first arch 19 or 20; abdominal scutes 13 or 14, scutes rectangular and rugose in large individuals; predorsal scales, 21–24; isthmus lacking scales; body scales adherent; lateral line scales with strong medial ridge and spine posteriorly and with numerous fine rather long spines in small individuals, scales rugose, lacking a posterior spine in large adults; scales on predorsal midline forming very low ridge in small individuals, no ridge apparent in very large individuals; body ovoid and deep, depth 1.8–1.9 in SL; dorsal profile of head gently curved; dorsal– and anal–fin spines of moderate thickness; pectoral fin of moderate length, reaching base of second anal–fin spine in small individuals, to tenth or eleventh abdominal scute in largest; adults orange–red; buccal cavity mostly white, black only on roof of mouth posteriorly, opercular recess black anteriorly, much paler near periphery. Reaches 455 mm SL.

Description. (See Table 1 for frequencies of values for selected meristic characters.) Dorsal–fin rays VI, 13; anal–fin rays III, 9; caudal–fin rays 6 + 2 + 9 + 8 + 2 + 6; pectoral–fin rays 17 (18 in 1 of 4); pelvic–fin rays I, 6; gill rakers 6 + 1 + 13 (6 + 1 + 12); lateral–line scales 28 + 1; transverse scales 12/1/26 (11/1/35); predorsal scales 21 (24); scutes 14 (13; Table 2); vertebrae 11 + 15; pseudobranch 15 (only holotype examined); branchiostegal rays 8.

(See Table 1 for comparative ranges of selected morphometric characters.) Body ovoid and deep, depth 1.8–1.9 in SL. Head large, its height equal to or slightly greater than its length, 99.1–103% HL; upper profile in front of dorsal fin gently curved to upper jaw; anterodorsal profile moderately separated from upper orbital rim; space between eyes wide, interorbital width 31.1–34.0% HL; eye of moderate size, orbital diameter 23.2–29.18% HL; crests of head bones strong, fine spinules on apices at skin surface; depressions between crests moderately deep, hidden by thick skin in adults; infraorbital bones becoming progressively broader with growth; nostrils immediately preceding orbits, posterior nostril two to four times area of anterior nostril; mouth reaching just beyond vertical through hind margin of eye; large, fine denticulate teeth covering oral margins and exposed lateral surfaces of premaxilla and dentary, palatine with narrow band of similar teeth, vomer apparently lacking teeth (with three small teeth in 131 mm paratype); tip of dentary with ossified knob at symphysis. Preopercular spine short and rounded (slender and pointed, reaching to pelvic–fin base in small individual). Humeral spines short and rounded (short and pointed in smallest individual). Longest gill raker about 2/3 eye diameter; gill filaments at angle of first gill arch very short, about 1/10 eye diameter and just less than 1/2 length of longest filaments of pseudobranch.

Body covered with adherent scales, those above lateral line, posteriorly and low on side densely covered by rather long fine spines, scales above and covered laterally by pectoral fin, cycloid (cycloid scales distributed more ventrally in smaller individual); head naked except for patch of scales on cheek posterior to rear tip of maxilla in about three or four vertical rows, posteriormost row with 13 or 14 scales; isthmus scaleless; lateral–line scales rugose, without a strong spine (smaller individual having each lateral–line scale with slender ridge and small pointed spine posteriorly, peripheral row of spinules noticeably longer than others); low serrated abdominal keel formed from slightly rugose, enlarged scales (scutes) with pointed apices (smaller individual with smooth scutes more typical of other species), scales on midline preceding scutes somewhat enlarged but not counted as scutes above; scales on dorsal midline in front of dorsal fin not forming low ridge (smaller specimen with posterior scales slightly raised medially), their spinules not enlarged. First dorsal–fin spine short, second and third spines progressively longer, last three increasing in length only slightly; spines of moderate thickness, those posteriorly progressively thicker with distinct lengthwise striations; first soft ray longer than last spine, subsequent rays progressively decreasing in length, outer margin of soft dorsal fin slightly curved. First anal–fin spine short, second short or of intermediate length, and third long; spines of similar robustness to those in dorsal fin. Caudal fin distinctly forked,

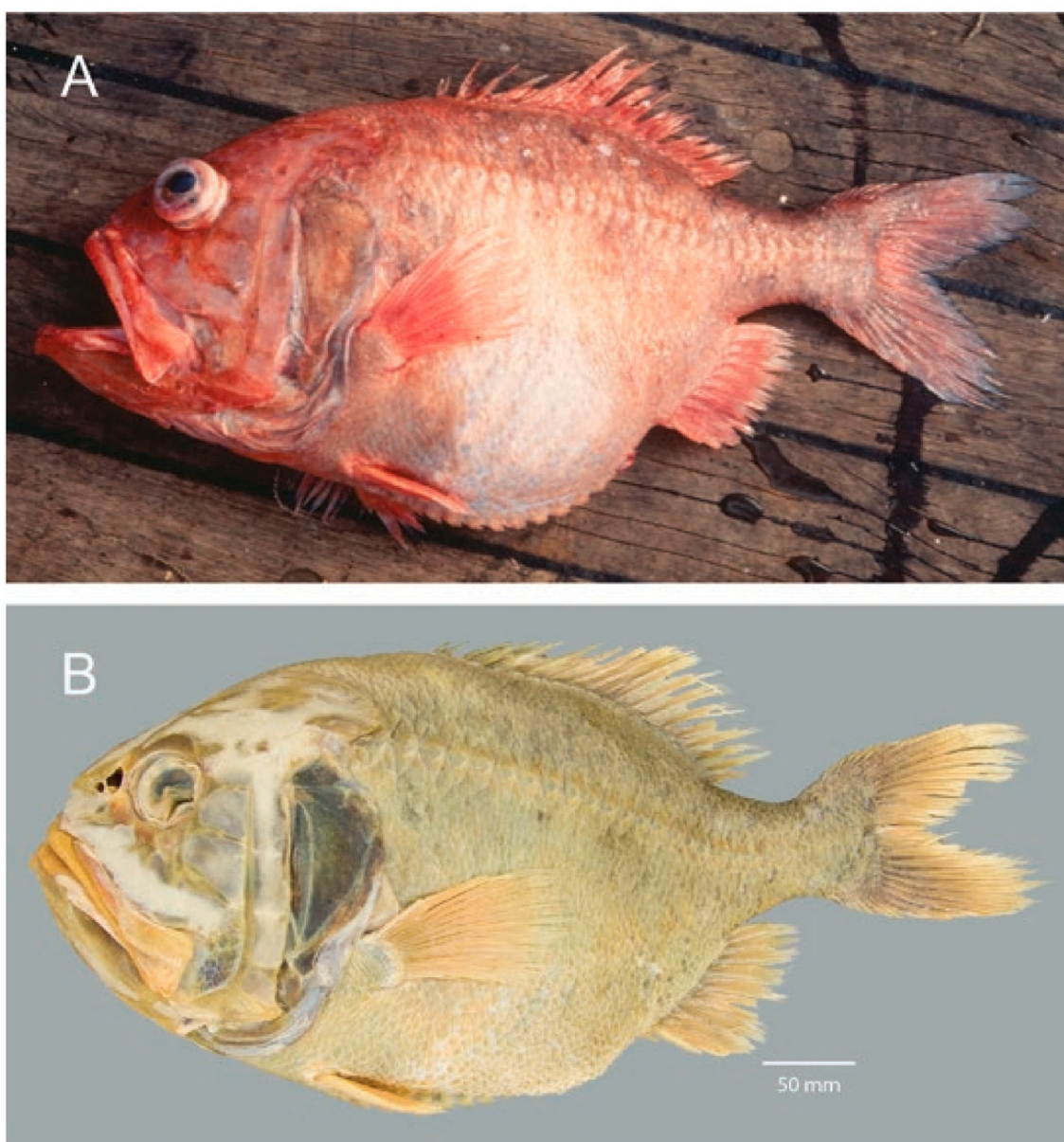


Figure 6. *Hoplostethus grandperrini* sp. nov., NMNZ P.027462, 455 mm SL, holotype. A, fresh, photo by C. Roberts. B, preserved, photo by C. Struthers.

lobes broad and rounded. Pectoral fin of moderate length reaching tenth or eleventh abdominal scute (reaching base of second anal-fin spine in smaller individual). Pelvic fin reaching to middle scutes (to eighth scute in smaller individual).

A large species, largest specimen examined 455 mm SL.

Colour in life. Head orange-red; body orange-tan dorsally, extending ventrally to pelvic-fin base anteriorly and to anal-fin base posteriorly; opercle black suffused with red; dark areas of buccal and branchial cavities black, pale areas stark white; fins orange to orange-tan, without darker margins (fig. 6).

Pigmentation in alcohol. Freshly preserved individuals grey-tan; opercle dark; buccal chamber pale, roof dark posteriorly; fins pale, outer edge of membranes between dorsal-fin spines dusky.

Etymology. The specific name *grandperrini* recognises Dr René Grandperrin, retired chief scientist of ORSTOM Nouméa, ardent fish researcher and leader of deepwater fish explorations off New Caledonia (Chef de Mission of research cruises BERYX 2 and HALIPRO2), in recognition of his strong support for collaborative fieldwork between French and New Zealand scientists.

Distribution. Known only from the types collected at Seamount “B” in the northern portion of the Norfolk Ridge, south of New Caledonia and on the south-eastern slope of New Caledonia’s Grande Terre (fig. 2), from depths of 500–675 m.

Comments. The great similarity of many *Hoplostethus* species to one another has led to confusion about the identity of this species with two other apparently undescribed species living on

seamounts in waters off southern New Caledonia. At least one of the latter reaches a considerable size, the largest known specimen measuring 355 mm SL, and has a distribution that includes Australian territorial waters. The three are consistently separable by a combination of characters, including numbers of pectoral-fin rays and abdominal scutes, and the pigmentation of the buccal cavity. The identities of the other two species will be the subject of a forthcoming publication by Gomon and Roberts (ms).

With regard to the three New Caledonian species we recognise, *G. grandperrini* has 17 or 18 pectoral-fin rays (versus 16 or 17, rarely 15 or 18, and 15, rarely 16 in the other two), 13 or 14 abdominal scutes (versus 10–15 and 11–13 scutes) and has a buccal cavity that is mostly pale, any black pigmentation confined to the rear of the mouth in the vicinity of the throat (versus buccal cavity entirely black behind the oral valves, including the underside of the tongue and top of the lower jaw, and buccal cavity black with vomer, underside of the tongue and the top of the lower jaw white). These same character combinations, plus high count of predorsal scales (21–24 versus 9–15, 16–22), separate *H. grandperrini* from the other two giant species treated above. Based on the limited series of types, *H. grandperrini* also appears to have a greater body depth, postorbital length, interorbital width, and pelvic fin to anal fin distance (fig. 5).

Of the remaining nominal species referred to the subgenus *H. (Hoplostethus)* apparently only two regularly have 17 or 18 pectoral-fin rays, *H. druzhinini* Kotlyar, 1986 in the Arabian Sea and *H. vniro* in the southeastern Atlantic. Both of these species differ from *H. grandperrini* in having on average more numerous gill rakers, 21–25, versus 19 or 20. In addition, *H. druzhinini* has only 8–12 abdominal scutes (versus 13–14) and a mostly black buccal cavity (versus mostly pale).

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