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Author(s)	Nagano, Yuki; Imamura, Hisashi; Yabe, Mamoru
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1 **A new ghost flathead (Scorpaeniformes: Hoplichthyidae) from southwestern Australia**

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4 **Yuki Nagano · Hisashi Imamura · Mamoru Yabe**

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16 Y. Nagano (✉) · H. Imamura · M. Yabe

17 Laboratory of Marine Biology and Biodiversity (Systematic Ichthyology), Faculty of

18 Fisheries Sciences, Hokkaido University, 3-1-1 Minato-cho, Hakodate, Hokkaido 041-8611,

19 Japan

20 E-mail: yuki.ghost_flatheads@fish.hokudai.ac.jp

21 Phone: +81 138 40 5540

22

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28

29 **Abstract** A new hoplichthyid species, *Hoplichthys mcgrouteri*, is described on the basis of
30 six specimens (188–244 mm standard length) collected off southwestern Australia. It is
31 clearly distinguished from its congeners by the following combination of characters:
32 dorsal-fin rays V-14; anal-fin rays 16–17, usually 16; pectoral-fin rays 13–14 + 4–5 = 17–18,
33 usually 14 + 4 = 18; infraorbitals mostly spineless; scales present on dorsal surface of body;
34 vomerine tooth patch constricted medially, mostly separating teeth into bilaterally
35 symmetrical patches; interorbit narrow [interorbital width 5.8–6.8 % of head length (HL)];
36 and orbit relatively large (orbital diameter 41.8–44.9 % HL). The form of the vomerine
37 tooth patch is unique to *H. mcgrouteri* in this genus.

38

39 **Keywords** *Hoplichthys mcgrouteri* · Hoplichthyidae · New species · Australia

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43 **Introduction**

44

45 Ghost flatheads of the family Hoplichthyidae, which consist of only one genus *Hoplichthys*
46 Cuvier in Cuvier and Valenciennes 1829 and 12 valid species, inhabit the continental shelves
47 and their slopes at depths of ca. 50–1,500 m in the central and western Pacific and Indian
48 oceans (Matsubara and Ochiai 1950a; McGrouther 1999; Nagano et al. 2012, 2013a, b).

49 *Hoplichthys* is characterized by an extremely depressed head, the dorsal surfaces of the head
50 and body covered with many spines and serrated ridges, an elongated and mostly scaleless
51 body, one or two rows of spines on the lateral scutes along the body, and the ventralmost three
52 to five pectoral-fin rays free.

53 During our ongoing study of ghost flatheads, we found specimens of an undescribed
54 species of *Hoplichthys* (Fig. 1) collected from southwestern Australia and deposited in the
55 ichthyological collections of the Australian National Fish Collection, Commonwealth
56 Scientific and Industrial Research Organization, Division of Marine and Atmospheric
57 Research, Hobart (CSIRO), Museum Victoria, Melbourne (NMV) and the National Museum
58 of Nature and Science, Tsukuba (NSMT). These specimens resemble *Hoplichthys haswelli*
59 McCulloch 1907, which is known from southern Australia and New Zealand, in having
60 mostly spineless infraorbitals, scales present on the dorsal surface of the body, V-14 dorsal-fin
61 rays, usually 16 anal-fin rays and usually 18 total pectoral-fin rays, but differ from it in other
62 morphological characters (e.g., form of vomerine tooth patch, interorbital width and orbital
63 diameter). We herein describe them as a new species.

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65

66 **Materials and methods**

67

68 Counts and proportional measurements follow Nagano et al. (2013b), except for head width 1

69 measured at the anterior margin of the eye, head width 2 at the inner base of the posteriormost
70 preopercular spine, and head width 3 at the outer base of the posteriormost preopercular spine.
71 Data for holotype are presented first, followed by those of paratypes in parentheses if different.
72 Gill rakers were counted on the outer row of the first gill arch of the right side. Vertebrae
73 were counted from radiographs. Sex was determined from the shape of gonads by
74 microscope examination. Measurements were made with calipers to the nearest 0.1 mm.
75 Standard and head lengths are abbreviated as SL and HL, respectively. Counts of spines on
76 the head are given as “left side/right side”. The pectoral-fin ray count is shown as “joined
77 pectoral-fin rays + free pectoral-fin rays = total pectoral-fin rays”. The terminology for
78 spines and ridges on the dorsal surface of the head is given in Fig. 2, following Nagano et al.
79 (2013b). Institutional abbreviations follow Fricke and Eschmeyer (2014).

80

81

82 ***Hoplichthys mcgrouteri* sp. nov.**

83 (New English name: McGrouter's ghost flathead) (Figs. 1–2, 3a, 4; Table 1)

84

85 **Holotype.** CSIRO H.6395-03, 218 mm SL, female, 35°14.02'S, 118°39.84'E–35°13.67'S,
86 118°40.50'E, off Albany, Western Australia, 728–710 m depth, beam trawl, FR/V *Southern*
87 *Surveyor*, 23 Nov. 2005.

88 **Paratypes.** Five specimens. CSIRO H.1704-06, 188 mm SL, sex undetermined,
89 29°14.2'S, 113°52.2'E, off Geraldton, Western Australia, 556 m depth, demersal trawl, 28 Jan.
90 1989; CSIRO H.2005-02, 208 mm SL, sex undetermined, 33°03.2'S, 114°25.2'E, off Bunbury,
91 Western Australia, 701 m depth, bottom trawl, 10 Feb. 1989; CSIRO H.2601-01, 223 mm SL,
92 female, 30°39.1'S, 114°27.7'E–30°39.0'S, 114°27.6'E, off Wedge Island, Western Australia,
93 1,058–1,080 m depth, demersal trawl, FR/V *Southern Surveyor*, 9 Feb. 1991; NMV A.9617,
94 240 mm SL, female, 32°03'S, 115°14'E–32°00'S, 115°15'E, 35 km west of Rottneest Island,

95 Western Australia, 510 m depth, FR/V *Southern Surveyor*, collected by M. F. Gomon, 12 Feb.
96 1991; NSMT-P 112996, 244 mm SL, female, 31°32.9'S, 114°48.2'E, Western Australia, 603 m
97 depth, R/V *Kaiyo-maru*, 15 Nov. 1975.

98 **Diagnosis.** A species of *Hoplichthys* with the following combination of characters:
99 dorsal-fin rays V-14; anal-fin rays 16–17, usually 16; pectoral-fin rays 13–14 + 4–5 = 17–18,
100 usually 14 + 4 = 18; infraorbitals mostly spineless; scales present on dorsal surface of body;
101 vomerine tooth patch constricted medially mostly separating teeth into bilaterally symmetrical
102 patches; interorbit narrow (interorbital width 5.8–6.8 % HL) and orbit relatively large (orbital
103 diameter 41.8–44.9 % HL).

104 **Description.** Counts and proportional measurements are provided in Table 1.

105 Head extremely depressed, depth 3.4 (3.4–3.9) in head width 3. Body elongate, slightly
106 depressed, depth 1.3 (1.1–1.7) in body width. Snout paddle-like; preoptic snout length
107 longer than vertical eye diameter, 1.2 (1.1–1.3) in postorbital length. Anterior nostril located
108 mesial to anterior part of lachrymal, possessing short tube and long cirrus on posterior margin;
109 posterior nostril slit-like, located mesial to central part of lachrymal, of same size as anterior
110 nostril. Single cephalic sensory pore located anterior to anterior nostril. Upper jaw slightly
111 longer than lower jaw, but shorter than preoptic snout; posterior edge of maxilla not reaching
112 below anterior margin of eye, but extending to base of posteriormost spine in inner ridge on
113 first infraorbital. Teeth large and conical, forming tooth bands on jaws and palatines, and
114 tooth patch on vomer; vomerine tooth patch constricted medially mostly separating teeth into
115 bilaterally symmetrical patches, a few small teeth in single row across midline (Fig. 3a).
116 Anterior margin of tongue concave. Orbit relatively large, its diameter almost equal to
117 postorbital length. Eye relatively large; vertical eye diameter 1.9 (1.5–1.9) in preoptic snout
118 length. Interorbit concave and relatively narrow; interorbital width 3.2 (3.0–4.0) in vertical
119 eye diameter. Posterior margin of opercle relatively rounded. Lower margin of
120 branchiostegal membrane fused with isthmus. Gill rakers extremely short and knob-like;

121 many minute spines on each raker. Several spines and ridges on dorsal surface of head (Fig.
122 2). Single paired ridges on dorsal midline anteriorly on head, without spines on snout, but
123 with some spines on inner margin of orbit. Single strongly developed spine on posterior
124 margin of orbit. Lachrymal without spines, but anterolateral margin minutely serrated.
125 Two ridges on first infraorbital, inner ridge on dorsal surface and outer ridge on lateral side;
126 inner ridge smooth and without spines, except for single well developed spine directed
127 posterodorsally on posterior edge; outer ridge devoid of spines. Two ridges on second
128 infraorbital, inner ridge on dorsal surface and outer ridge on lateral side; inner ridge smooth
129 and without spines, except for single well-developed spine directed posterodorsally on
130 posterior edge; anterior part of outer ridge slightly serrated, and with minute laterally directed
131 spines posteriorly. Ventral surface of lachrymal, and first and second infraorbitals smooth,
132 without spines. Dorsal surface of third infraorbital mostly smooth, with single small spine
133 directed dorsally on central portion. Fourth infraorbital smooth, without spines and ridges.
134 Single row of preopercular spines present laterally; those anteriorly minute and directed
135 laterally; penultimate spine better developed, directed posterodorsally; posteriormost spine
136 largest, directed posteriorly, not reaching posterior margin of opercle. Dorsal surface of
137 preopercle smooth, without spines and ridges. Single opercular spine directed posteriorly,
138 not reaching posterior edge of opercle. Two ridges on dorsal surface of opercle directed
139 posteriorly, radiating from anteromesial corner of opercle; outer ridge slightly serrated
140 anteriorly, smooth (with a few spines) posteriorly, with terminal opercular spine; inner ridge
141 with several small spines, directed toward posteromesial corner of opercle; no spines on
142 lateral, mesial and middle parts of these two ridges. Single parietal spine large, directed
143 posterodorsally; no spines around parietal spine. Single small spine present lateral to
144 parietal spine. No spines in area between posterior margin of orbit and parietal spine.
145 Single well-developed posttemporal spine present anterior to more strongly developed spine
146 on first lateral scute; two ridges directed anteriorly from posttemporal spine; small spines on

147 inner ridge of posttemporal spine; no spines on outer ridge of posttemporal spine. No spines
148 on ventral surface of lower jaw posterior to maxilla. Single ridge without humeral spine
149 (with single humeral spine on its posterior edge on right side in one paratype) posterior to
150 opercle. Single row of lateral scutes dorsolaterally along body; well-developed single spine
151 directed posterodorsally on central portion of each scute, with small ridge on its inner base;
152 spines becoming progressively larger posteriorly, posterior three spines becoming smaller
153 posteriorly; no other spines on lateral scutes; terminal scute extending to caudal-fin base.
154 Scales embedded in skin on dorsal surface of body, between lateral scutes on both sides from
155 posterior area of parietal spines to base of caudal fin; scales absent ventrally. First dorsal fin
156 low, originating above third lateral scute (third or junction between third and fourth lateral
157 scutes) and ending above sixth lateral scute; length of first dorsal-fin base 7.4 (6.3–7.9) in HL;
158 tip of adpressed dorsal fin not reaching origin of second dorsal fin; first to second dorsal-fin
159 spines longest, and third to fifth dorsal-fin spines progressively shorter posteriorly. Second
160 dorsal fin originating above junction between ninth and 10th lateral scutes and ending above
161 22nd lateral scute (junction between 22nd and 23rd lateral scutes); length of second dorsal-fin
162 base 1.1 in length of anal-fin base; second dorsal-fin soft ray longest and second to 14th
163 dorsal-fin soft rays becoming progressively shorter posteriorly; last (14th) dorsal-fin soft ray
164 shortest. All dorsal-fin spines and soft rays neither elongate nor filament-like. Pectoral fin
165 originating just behind posterior edge of opercle, reaching 14th (13th) lateral scute; fourth and
166 fifth (fourth, or fourth and fifth) rays longest, length 1.8 (1.8–2.0) in HL. Lower four (four
167 or five) rays of pectoral fin thick and free, shorter than remaining joined pectoral-fin rays, not
168 reaching anus; its length 2.9 (2.7–3.1) in HL. Pelvic-fin base anterior to pectoral-fin base;
169 distal tip of pelvic fin reaching below fourth lateral scute (third or junction between third and
170 fourth lateral scutes); pelvic-fin length 4.2 (4.4–4.7) in HL. Anal fin lower than second
171 dorsal fin, originating below 10th lateral scute (junction between 10th and 11th lateral scutes),
172 ending below junction between 24th and 25th lateral scutes; first anal-fin ray short, its length

173 1.3 (1.0–1.4) in length of last anal-fin ray. Caudal fin almost truncate with upper lobe
174 slightly longer than lower lobe; depth of caudal peduncle 8.3 (6.7–7.8) in caudal-fin length.
175 Anus slightly anterior to origin of anal fin.

176 *Color of fresh specimen* (based on photograph of holotype, Fig. 1a, b). Dorsal surface
177 of head and body rusty brown to pale rusty brown; ventral side white. Dorsal fins light gray.
178 Pectoral fin rusty on anterodorsal area and paler on posteroventral area; free pectoral-fin rays
179 white. Pelvic fin white. Upper, posterior and lower margins of caudal fin gray; small
180 brown spot on ventral portion of caudal-fin base.

181 *Color of preserved specimen.* Color mostly faded, light yellowish-white on head and
182 body. Light gray on upper edges of opercles, dorsal fins, lower margin of anal fin and bases
183 of spines on each lateral scute. Margins of caudal fin gray. Peritoneum black.

184 **Distribution.** Off the southwestern corner of Australia, at depths of 510–1,080 m.

185 **Etymology.** The specific name “*mcgrouteri*” recognizes Mr. Mark A. McGrouther,
186 the collection manager of Ichthyology of Australian Museum (AMS), for his valuable
187 contributions to the taxonomy of the Hoplichthyidae.

188 **Remarks.** *Hoplichthys mcgrouteri* is most similar to *H. haswelli* and differs from its
189 other congeners [*Hoplichthys langsdorfii* Cuvier in Cuvier and Valenciennes 1829,
190 *Hoplichthys citrinus* Gilbert 1905, *Hoplichthys platophrys* Gilbert 1905, *Hoplichthys gilberti*
191 Jordan and Richardson 1908, *Hoplichthys regani* Jordan 1908, *Hoplichthys acanthopleurus*
192 Regan 1908, *Hoplichthys ogilbyi* McCulloch 1914, *Hoplichthys fasciatus* Matsubara 1937,
193 *Hoplichthys gregoryi* (Fowler 1938), *Hoplichthys prosemion* (Fowler 1938), *Hoplichthys*
194 *smithi* (Fowler 1938), *Hoplichthys pectoralis* (Fowler 1943), *Hoplichthys filamentosus*
195 Matsubara and Ochiai 1950b, *Hoplichthys mimaseanus* Nagano, Endo and Yabe 2013 and
196 *Hoplichthys imamurai* Nagano, McGrouther and Yabe 2013] in having five dorsal-fin spines,
197 14 dorsal-fin soft rays, usually 16 anal-fin rays, usually 18 total pectoral-fin rays, mostly
198 spineless infraorbitals, scales on the dorsal surface of the body and a black peritoneum (vs. six

199 dorsal-fin spines, 15 dorsal-fin soft rays, usually 17 anal-fin rays, usually 16 pectoral-fin rays,
200 many spines on infraorbitals, body naked except for lateral scutes and colorless peritoneum in
201 other congeners). *Hoplichthys mcgrouteri* can be clearly distinguished from *H. haswelli* in
202 having the vomerine tooth patch constricted medially, mostly separating teeth into bilaterally
203 symmetrical patches (vs. vomerine tooth patch deeply notched posteromedially, but broadly
204 continuous anteriorly in *H. haswelli*) (Fig. 3), a narrower interorbit (interorbital width 5.8–
205 6.8 % HL in *H. mcgrouteri* vs. 9.2–14.8 % HL in *H. haswelli*; Fig. 4a) and a relatively larger
206 orbit (orbital diameter 41.8–44.9 % HL vs. 37.3–41.0 % HL; Fig. 4b). In addition, *H.*
207 *mcgrouteri* usually has larger eyes (19.7–22.8 % HL) and shorter pelvic fins (8.7–9.4 % SL)
208 than *H. haswelli* (eye diameter 13.9–20.3 % HL and pelvic-fin length 8.5–10.9 % SL),
209 although some overlap exists in proportional values (Fig. 4c, d). The form of the vomerine
210 tooth patch is unique to *H. mcgrouteri* within the genus.

211 Some species of *Hoplichthys* (*H. langsdorfii*, *H. citrinus*, *H. gilberti*, *H. ogilbyi* and *H.*
212 *filamentosus*) have sexual dimorphism in the forms of the first and second dorsal fins and
213 caudal fin (Nagano et al. 2013b). However sexual dimorphism, including the forms of the
214 dorsal and caudal fins, was not observed in *H. haswelli* (in seven males and 13 females),
215 which has most similar morphological characters to *H. mcgrouteri*. Although all examined
216 specimens of *H. mcgrouteri* are female or sex undetermined (in four and two specimens,
217 respectively), we consider the forms of the dorsal and caudal fins of this new species not to be
218 dimorphic sexually.

219 **Comparative material.** *Hoplichthys langsdorfii* (14 specimens including 12 males and
220 2 females, Tosa Bay, Japan): HUMZ 47450 (144 mm SL), HUMZ 75338 (151 mm SL),
221 HUMZ 79116 (153 mm SL), HUMZ 107569 (159 mm SL), HUMZ 110859–110860 (2
222 specimens, 158–167 mm SL), HUMZ 204809 (155 mm SL), HUMZ 205049–205054 (6
223 specimens, 137–159 mm SL), HUMZ 207784 (153 mm SL). *Hoplichthys citrinus* (8
224 specimens including 5 males and 3 females, Hawaii): USNM 51610 (holotype, 152 mm SL),

225 AMS I.12813 (paratype, 168 mm SL), USNM 51670 (paratype, 155 mm SL), USNM 51704
226 (5 paratypes, 135–185 mm SL). *Hoplichthys platophrys* (1 specimen, sex undetermined):
227 USNM 51620 (holotype, 60.9 mm SL, Hawaii). *Hoplichthys gilberti* (10 specimens
228 including 1 male, 4 females and 5 specimens sex undetermined, Suruga Bay, Japan): USNM
229 51271 (holotype, 127 mm SL), SU 20229 (2 paratypes, 110–162 mm SL), USNM 398507 (7
230 paratypes, 78.2–140 mm SL). *Hoplichthys regani* (1 specimen, male): SU 22390 (holotype,
231 145 mm SL, Kagoshima, Japan). *Hoplichthys acanthopleurus* (2 specimens including 1
232 male and 1 female): BMNH 1908.3.23.210–211 (syntypes, 150–157 mm SL, Saya de Malha
233 Bank). *Hoplichthys ogilbyi* (2 specimens including 1 male and 1 female, Queensland): AMS
234 E.2974 (holotype, 163 mm SL), AMS I.12812 (paratype, 132 mm SL). *Hoplichthys*
235 *fasciatus* (11 specimens, sex undetermined): BSKU 8896 (47.0 mm SL, Tosa Bay, Japan),
236 BSKU 9512–9513 (2 specimens, 45.6–48.5 mm SL, Tosa Bay, Japan), BSKU 11376 (43.4
237 mm SL, Tosa Bay, Japan), BSKU 45862 (52.2 mm SL, Tosa Bay, Japan), BSKU 64453 (44.6
238 mm SL, Tosa Bay, Japan), BSKU 80757 (48.2 mm SL, Tosa Bay, Japan), BSKU 94894 (51.5
239 mm SL, Tosa Bay, Japan), BSKU 95743 (41.3 mm SL, Tosa Bay, Japan), FAKU 1816 (43.7
240 mm SL, Mie, Japan), HUMZ 205016 (42.9 mm SL, Tosa Bay, Japan). *Hoplichthys gregoryi*
241 (5 specimens including 1 male and 4 females, Philippines): USNM 98862 (holotype, 168 mm
242 SL), USNM 150813 (4 paratypes, 119–180 mm SL). *Hoplichthys prosemion* (1 specimen,
243 male): USNM 98863 (holotype, 148 mm SL, Philippines). *Hoplichthys smithi* (1 specimen,
244 sex undetermined): USNM 59588 (85.9 mm SL, Kagoshima, Japan). *Hoplichthys pectoralis*
245 (1 specimen, sex undetermined): USNM 99503 (holotype, 61.1 mm SL, Philippines).
246 *Hoplichthys filamentosus* (1 specimen, female): FAKU 11918 (holotype, 110 mm SL, Suruga
247 Bay, Japan). *Hoplichthys mimaseanus* (2 specimens including 1 male and 1 female):
248 NSMT-P 109034 (holotype, 218 mm SL, Tosa Bay, Japan), ASIZP 63198 (paratype, 206 mm
249 SL, Senkaku Islands). *Hoplichthys imamurai* (3 specimens, male, Western Australia): AMS
250 I.22807-040 (holotype, 143 mm SL), AMS I.22807-066 (paratype, 144 mm SL), AMS

251 I.31156-016 (paratype, 129 mm SL). *Hoplichthys haswelli* (25 specimens including 7 males,
252 13 females and 5 specimens sex undetermined): New South Wales: AMS I.7892 (holotype,
253 369 mm SL), AMS I.15968-009 (2 specimens, 259–336 mm SL), AMS I.15970-013 (232 mm
254 SL), AMS I.15990-003 (247 mm SL), AMS I.18125-005 (384 mm SL), AMS I.18838-030
255 (376 mm SL), AMS I.18838-031 (299 mm SL), AMS I.18838-032 (345 mm SL), AMS
256 I.25318-006 (1 of 15 specimens, 357 mm SL), AMS I.31947-007 (1 of 3 specimens, 197 mm
257 SL), AMS I.33436-001 (325 mm SL), AMS I.43247-002 (1 of 2 specimens, 269 mm SL),
258 CSIRO CA.3208 (161 mm SL), USNM 399491 (182 mm SL); Victoria: CSIRO H.3522-03
259 (303 mm SL), NMV A.2988 (249 mm SL); Bass strait between Victoria and Tasmania: NMV
260 A.12322 (1 of 2 specimens, 222 mm SL); Western Australia: CSIRO H.1807-01 (377 mm SL),
261 CSIRO H.3012-01 (336 mm SL), CSIRO H.6414-15 (346 mm SL), CSIRO H.6414-16 (334
262 mm SL), CSIRO H.6414-17 (340 mm SL), CSIRO H.6414-18 (362 mm SL), NMV A.12324
263 (1 of 2 specimens, 159 mm SL).

264

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275

276

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326

327

328 **Table 1** Counts and proportional measurements of *Hoplichthys mcgrouteri* sp. nov. and *H.*
 329 *haswelli*
 330

	<i>H. mcgrouteri</i>		<i>H. haswelli</i>	
	Holotype	Paratypes	Holotype	Non-types
	CSIRO H.6395-03	(<i>n</i> = 5)	AMS I.7892	(<i>n</i> = 24)
Standard length (SL, mm)	218	188–244	369	159–384
Counts				
First dorsal-fin rays	V	V	Damaged	V–VI
Second dorsal-fin rays	14	14	14	14–15
Anal-fin rays	16	16–17	16	15–16
Pectoral-fin rays	14 + 4 = 18	13–14 + 4–5 = 17–18	15 + 4 = 19	13–15 + 4–5 = 17–19
Pelvic-fin rays	I, 5	I, 5	I, 5	I, 5
Gill rakers	3 + 14 = 17	3–4 + 13–15 = 16–19	3 + 14 = 17	3 + 12–15 = 15–18
Branchiostegals	7	7	7	7
Vertebrae	26	26	26	26
Lateral scutes	27	27	27	26–28
Head spines				
Spines on lachrymal	0/0	0/0	Uncounted	Uncounted
Inner ridge spines on first infraorbital	1/1	1/1	Uncounted	Uncounted
Outer ridge spines on first infraorbital	0/0	0/0	Uncounted	Uncounted
Inner ridge spines on second infraorbital	1/1	1/1	Uncounted	Uncounted
Outer ridge spines on second infraorbital	0/0	0/0	Uncounted	Uncounted
Preopercular spines	7/7	6–7/6–7	Uncounted	Uncounted
Spines on ventral surface of lower jaw	0/0	0/0	0/0	0/0
Proportional measurements (% SL)				
Head length (HL)	39.4	39.8–41.6	40.5	38.9–42.4
Body depth	7.9	6.6–8.2	9.7	5.8–8.7
Body width	10.3	8.6–11.0	9.7	8.4–12.9
Pre-first dorsal length	39.1	39.5–41.6	Damaged	37.6–41.8
Length of first dorsal-fin base	5.3	5.1–6.3	Damaged	5.5–7.2
Length of first dorsal-fin spine	5.9	8.3–9.5	Damaged	6.9–10.1
Length of second dorsal-fin spine	5.8	8.0–8.8	Damaged	7.8–9.9
Length of third dorsal-fin spine	5.9	7.0–8.8	Damaged	6.4–9.1
Length of fourth dorsal-fin spine	4.2	4.1–6.9	Damaged	4.3–7.6
Length of fifth dorsal-fin spine	2.6	2.8–4.6	Damaged	2.8–5.1
Pre-second dorsal length	51.9	53.1–55.0	55.6	51.1–55.7

Length of second dorsal-fin base	34.7	32.7–34.9	34.1	31.9–36.4
Length of first dorsal-fin soft ray	Damaged	10.6–12.4	11.5	10.6–13.0
Length of second dorsal-fin soft ray	13.4	11.6–12.9	12.2	11.8–13.3
Length of sixth dorsal-fin soft ray	10.6	9.7–10.4	10.2	9.6–11.3
Length of 13th dorsal-fin soft ray	5.7	5.0–6.3	5.7	5.0–7.0
Length of 14th dorsal-fin soft ray	3.9	3.1–4.0	4.4	3.4–5.4
Pre-anal length	53.8	54.8–57.8	58.3	53.2–59.2
Length of anal-fin base	39.4	36.0–39.2	36.2	33.8–39.6
Length of first anal-fin ray	3.4	3.1–4.2	2.1	2.6–4.6
Pectoral-fin length	22.0	20.7–21.9	23.3	22.0–29.2
Length of longest free pectoral-fin ray	13.4	13.3–14.6	11.2	10.5–14.7
Pelvic-fin length	9.3	8.7–9.4	9.8	8.5–10.9
Caudal peduncle depth	1.9	1.8–2.2	2.5	2.0–2.7
Length of upper caudal peduncle	14.0	12.1–13.3	10.3	10.3–14.4
Length of caudal peduncle	7.4	6.0–7.4	6.6	5.4–8.0
Caudal-fin length	16.1	14.5–16.6	13.9	12.8–16.9
Proportional measurements (% HL)				
Head depth	18.8	17.2–18.5	24.2	14.0–23.4
Head width 1	44.0	40.3–44.8	53.3	44.0–52.3
Head width 2	49.7	43.7–50.4	61.7	50.2–64.0
Head width 3	64.4	61.9–69.1	77.5	64.5–81.3
Preoptic snout length	37.0	34.3–38.0	36.3	34.8–38.9
Preorbital snout length	16.8	16.5–17.5	17.1	16.2–19.2
Orbital diameter	41.8	41.8–44.9	39.8	37.3–41.0
Vertical eye diameter	19.7	20.3–22.8	17.7	13.9–20.3
Horizontal eye diameter	14.3	14.3–17.6	13.3	9.2–14.9
Interorbital width	6.1	5.8–6.8	14.8	9.2–14.5
Postorbital length	43.7	41.6–44.6	46.7	43.9–47.7
Upper jaw length	33.9	33.4–36.8	37.6	33.2–37.9
Lower jaw length	32.0	31.0–34.3	38.4	32.9–36.5

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333 Figure legends:

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335 **Fig. 1** Lateral view in fresh condition (**a**), dorsal view in fresh condition (**b**) and drawing in
336 dorsal view (**c**) of *Hoplichthys mcgrouteri* sp. nov., CSIRO H.6395-03, holotype, female,
337 218 mm SL

338

339 **Fig. 2** Dorsal view of head of *Hoplichthys mcgrouteri* sp. nov., showing series of spines
340 and ridges. 1 inner ridge of spines on the first infraorbital, 2 outer ridge of spines on the first
341 infraorbital, 3 inner ridge of spines on the second infraorbital, 4 outer ridge of spines on the
342 second infraorbital, 5 preopercular spines, 6 opercular spine, 7 parietal spine, 8 posttemporal
343 spine and 9 spines on lateral scutes; *scale bar* 10 mm

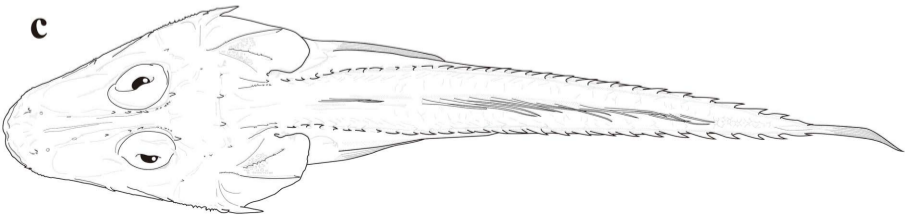
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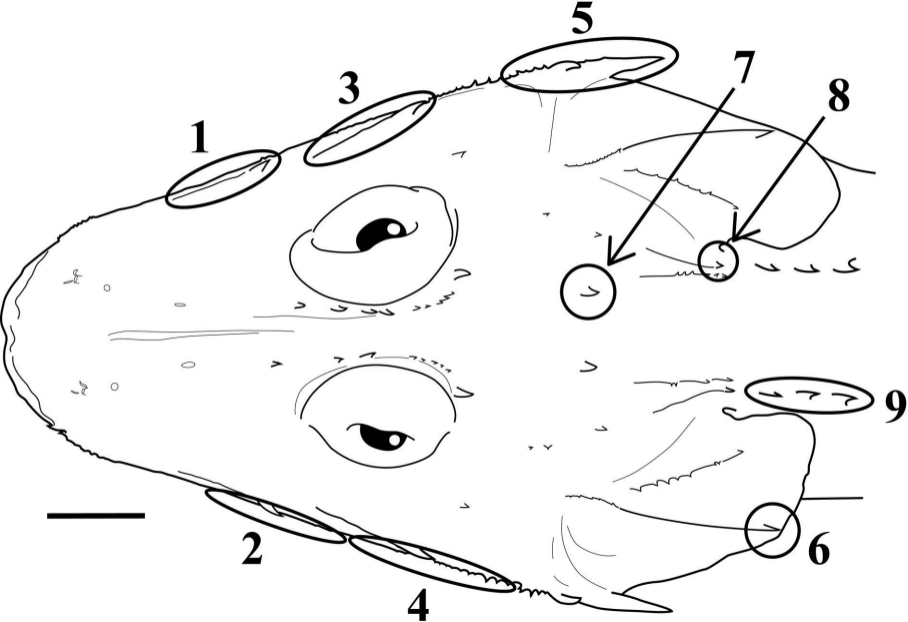
345 **Fig. 3** Ventral views of vomerine teeth showing form of tooth patch of **a** *Hoplichthys*
346 *mcgrouteri* sp. nov. (CSIRO H.2005-02, 208 mm SL, paratype) and **b** *H. haswelli* (CSIRO
347 CA.3208, 161 mm SL). *Scale bars* 4.0 mm

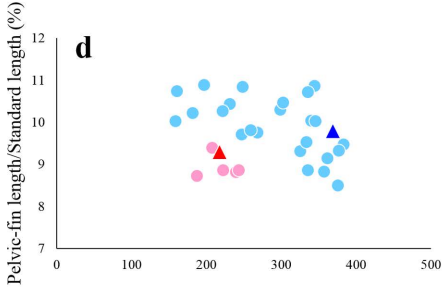
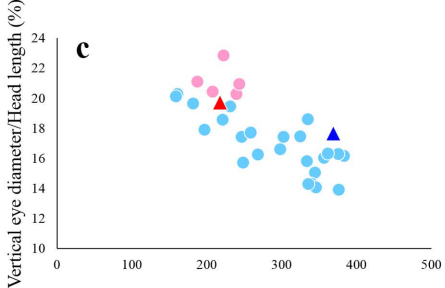
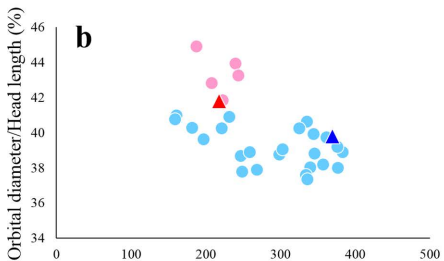
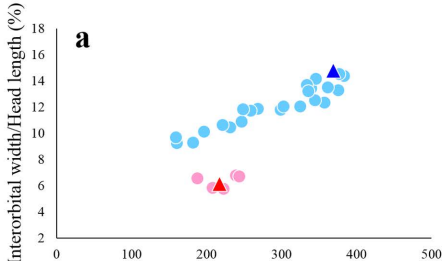
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349 **Fig. 4** Relationships of **a** interorbital width to head length, **b** orbital diameter to head length,
350 **c** vertical eye diameter to head length and **d** pelvic-fin length to standard length relative to
351 standard length. *Red* and *pink* *Hoplichthys mcgrouteri* sp. nov., *blue* and *light blue* *H.*
352 *haswelli*, *triangle* holotypes

353

a**b****c**





Standard length (mm)

