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Manuscript title: **THE SYSTEMATICS OF THE OPHIDIID GENUS  
*SPECTRUNCULUS* (TELEOSTEI, OPHIDIIFORMES) REVISITED WITH  
DESCRIPTION OF A NEW SPECIES AND RESURRECTION OF *S. RADCLIFFEI***

Authors: Franz Uiblein<sup>1,2</sup>, Peter R. Møller<sup>3,4</sup> and Jørgen G. Nielsen<sup>3</sup>

Running head: Systematics of *Spectrunculus* revisited

Author addresses:

<sup>1</sup> Institute of Marine Research, P.O. Box 1870 Nordnes, N-5817 Bergen, Norway; E-mail: [franz@hi.no](mailto:franz@hi.no); ORCHID ID: <https://orcid.org/0000-0002-5642-0384>

<sup>2</sup> National Research Foundation – South African Institute for Aquatic Biodiversity (NRF-SAIAB), Makhanda, South Africa

<sup>3</sup> Natural History Museum of Denmark, University of Copenhagen, Universitetsparken 15, DK-2100 Copenhagen Ø, Denmark; E-mail: [pdrmoller@snm.ku.dk](mailto:pdrmoller@snm.ku.dk); [jgnielsen@snm.ku.dk](mailto:jgnielsen@snm.ku.dk)

<sup>4</sup> Norwegian College of Fishery Science, UiT – The Arctic University of Norway, Tromsø, Norway; E-mail: [pdrmoller@snm.ku.dk](mailto:pdrmoller@snm.ku.dk); ORCHID ID: [orcid.org/0000-0002-0177-0977](https://orcid.org/0000-0002-0177-0977)

1           **The Systematics of the ophidiid genus *Spectrunculus* (Teleostei, Ophidiiformes)**  
2           **revisited with description of a new species and resurrection of *S. radcliffei***

3  
4   **ABSTRACT**

5   After a preceding revision based on 87 specimens, the systematics of the abyssal Giant  
6   Cuskeel genus *Spectrunculus* has been revisited, based on the examination of additional 34  
7   specimens and new otolith shape data of the holotype of *S. grandis*. From the latter a clear  
8   distinction in otolith ostium width could be found in specimens from the Atlantic, Southern  
9   Indian Ocean and Southwest Pacific which were formerly identified as *S. grandis*.  
10   Consequently, the new species *S. stenostio* is described which has a narrower ostium when  
11   related to its length or to sulcus length and differs also in the combination of three body shape  
12   characters, three meristic characters and maximum size from the three other congeners, *S.*  
13   *crassus* (Atlantic, East Pacific), *S. grandis* (Pacific) and the previously synonymized *S.*  
14   *radcliffei* (Pacific, Southern Indian Ocean, Southeast Atlantic). The latter species is here  
15   resurrected based on a rather short pre-anal length and additional morphometric as well as  
16   meristic and maximum size differences. An identification key for the four *Spectrunculus*  
17   species is provided.

18  
19  
20   Key words: Ophidiidae, Neobythitinae, Giant Cuskeel, deep-sea fishes, distribution,  
21   morphology, color, otoliths

22

23 **INTRODUCTION**

24 The ophidiid deep-sea fish genus *Spectrunculus* belongs to the subfamily Neobythitinae,  
25 a rather diverse group of cuskeels found in a large variety of habitats mostly close to the  
26 bottom from the shelf to more than 4000 meters depth (Cohen & Nielsen 1978; Nielsen et al.  
27 1999). This group is still subject of intense taxonomic studies with new taxa being described  
28 and systematic information updated (e.g. Nielsen et al. 2015; Ohashi 2018; Uiblein & Nielsen  
29 2018, 2019, 2021; Schwarzhans & Møller 2021; Nielsen & Uiblein 2022; Schwarzhans et al.  
30 2022).

31 The Giant Cuskeel genus *Spectrunculus* – with a maximum size of 130 cm SL (ca. 140  
32 cm TL) – is among the largest deep-sea fishes known. Uiblein et al. (2008) revised the genus  
33 based on 87 specimens from the Atlantic and Pacific Oceans, resurrecting the species *S.*  
34 *crassus* (Vaillant, 1888) that had been synonymized by Nielsen & Hureau (1980).

35 Since our last revision comparative data of 34 additional *Spectrunculus* specimens has  
36 been collected and analyzed together with earlier published as well as previously not  
37 considered or newly generated data. This allows for a more refined and detailed distinction  
38 among different forms occurring in various areas of the three major oceans. For instance, new  
39 otolith shape data of the holotype of *Spectrunculus grandis* (Günther, 1877) (type locality  
40 Japan, NW Pacific) became available suggesting a clear distinction from specimens of the  
41 Atlantic, previously considered conspecific in our former revision (Uiblein et al. 2008).  
42 Furthermore, detailed morphological studies of *Spectrunculus* specimens from the South  
43 Atlantic, Southern Indian Ocean and Pacific (including three recently obtained specimens  
44 from Japan) indicated the need to reconsider the formerly synonymized *S. radcliffei* Jordan &  
45 Thompson, 1914 as a valid species.

46 Thus, in the present study, we describe *S. stenostio* new species and resurrect *S.*  
47 *radcliffei*, considering also intraspecific regional and/ sex or size-related morphological and

48 color variation in the now four valid species. In addition to diagnostic, descriptive and  
49 distribution information for each species, an identification key is provided.

50

## 51 **MATERIAL AND METHODS**

52 Morphometric, meristic and color data of 121 specimens of *Spectrunculus* available from  
53 Uiblein et al. (2008) or collected during the present study were compiled and analyzed  
54 following the methods described by Cohen & Nielsen (1978), Nielsen et al, (1999) and  
55 Uiblein et al. (2008). For the descriptions the following additional morphometric characters,  
56 that had not been considered previously were collected from a few selected specimens:  
57 pectoral-fin width, i.e. the distance between dorsal and ventral pectoral-fin origins; pectoral-  
58 fin depth, i.e. the distance between dorsal pectoral-fin and dorsal-fin origins; head depth  
59 through eye; and tail length, i.e. the distance between anal-fin origin and posterior end of the  
60 vertebrae column.

61 In addition to radiographs used for obtaining unpaired fin-ray and vertebrae counts, CT  
62 scans were used of a few selected, recently collected specimens as well as for obtaining  
63 otolith measurements of the *S. grandis* HT. Because otoliths are rather difficult to extract,  
64 requiring considerable experience and may deteriorate with long-term preservation, the  
65 identification key is primarily based on non-otolith characters.

66 One large *Spectrunculus* specimen (127 cm SL; CAS-ICH 25724), of which only the  
67 right otolith and the posteriormost part of the tail had been retained, had been studied in detail  
68 by Hubbs and Follett (1978) when still intact and hence the published meristic and  
69 morphometric data were used, while the otolith could be investigated by us. Of another large  
70 specimen (128 cm SL; CAS-ICH 90121) a hand-written sheet with unpublished  
71 morphometric and meristic data from D.J. Long, taken shortly after collection of the  
72 specimen, was used.



73 To consider allometric change, the morphometric data including otolith shape and  
74 measurements were separated into two size groups: larger-sized fish ( $\geq 200$  cm SL; i.e.  
75 subadults or adults) and small-sized fish ( $< 200$  cm SL; i.e. juveniles).

76 Following Uiblein et al. (2008) four categories of body and head color patterns were  
77 identified: pale – body and head white-creamy, grey-whitish or nearly white, only unpaired  
78 fins sometimes brown or dark brown; dark – body, head and fins brown to dark brown; light  
79 brown – intermediate between the two former categories; speckled – body more or less  
80 covered by dark irregular spots of varying size on pale background. In the interpretation of  
81 color differences we tried to consider the possible effects of fixation and preservation on  
82 color loss (“bleaching”).

83 Morphometric data were rounded to two decimal digits in numbers  $< 4$ , to one decimal  
84 digit in numbers  $< 10$  and to whole numbers in higher values except for one decimal digit in  
85 averages provided in tables.

86 Institutional abbreviations follow Sabaj (2020). Other abbreviations are: HT = holotype;  
87 PT = paratype; SL = standard length; TL = total length; HL = head length; Min = Minimum;  
88 Max = Maximum;  $n$  = number (count); N = North; S = South; E = East; W = West.

89

## 90 **RESULTS**

91 *Spectrunculus* Jordan and Thompson, 1914

92 Giant Cuskeel

93 *Spectrunculus* Jordan and Thompson, 1914:301 (type species by monotypy *S. radcliffei*

94 Jordan and Thompson, 1914).

95 *Parabassogigas* Nybelin, 1957:298 (type species by original designation *Sirembo grandis*

96 Günther, 1877).

97

98 **Diagnosis**

99       The genus *Spectrunculus* differs from all other ophidiid genera in the combination of the  
100 following characters: dorsal-fin rays 121–148; anal-fin rays 91–112; total vertebrae 72–88;  
101 pectoral-fin rays 24–31; head short, 4.2 to 5.9 times in SL and 1.75 to 2.89 times in preanal  
102 distance; head robust with rounded snout and with several pores above and below eyes,  
103 mouth subterminal, upper jaw extending well behind eye. Teeth minute, blunt and robust,  
104 vomer roughly triangular or rhombic shaped. Anterior nostril with a thick, fleshy raised rim,  
105 posterior nostril larger, a mere hole or slit close to eye. Opercular spine strong. Head and  
106 body completely covered by small oval scales. Eyes shorter than snout, 5.5 or more times in  
107 head length; long rakers on anterior gill arch 7–10; two median basibranchial tooth patches;  
108 pelvic fins placed below preopercle; otolith ostium and sulcus well developed; color of head  
109 and body uniformly pale creamy or whitish, light or dark brown (rarely pale with dark  
110 speckles or rings); unpaired fins often dark when fresh or recently collected; dark  
111 pigmentation may not be retained with longer-term preservation.

112

113 **Remarks**

114       Four valid species with maximum sizes of 60 to 130 cm SL (= ca. 65 to 140 cm TL)  
115 distributed in various parts of the major oceans (for details see species accounts below).  
116 Larger juveniles, subadults and adults occur at or close to deep bathyal and abyssal bottoms  
117 (depth range ca. 1000 to at least 4255 m) mostly caught by bottom longlining or trawling or  
118 photographed in baited landers; larvae and small juveniles are pelagic (Ambrose 1996).  
119 Considering their large size and relatively common occurrence in distinct areas,  
120 *Spectrunculus* species may play an important ecological role in deep-sea ecosystems (Uiblein  
121 et al. 2008). No reported commercial value.

122

123

***Spectrunculus stenostio* new species**

124

Figures 1–4; Tables 1–3

125

*Spectrunculus grandis* (Günther, 1877); Duhamel et al. 2005; in part: Nielsen & Hureau

126

1980; Uiblein et al. 2008.

127

128

**Material studied (*n*=32)**

129

Holotype: ZMUB 18493 (ZMUB-MAR-ECO 20149), female, 825 mm SL (pale), N

130

Atlantic, 42°25.49'N, 29°48.14'W to 42°25.49'N, 29°46.13'W, M/S LORAN, sta. 13, bottom

131

longline, 2018–2429 m depth, 8 July 2004.

132

Paratypes, all North Atlantic (*n*=22): ZMUB 18477 (ZMUB-MAR-ECO 12291), male,

133

650 mm SL (pale), 42°48.6'N, 29°38.36'W to 42°46.64'N, 29°38.59'W, R/V G.O. SARS, sta.

134

42-368, bottom trawl, 2063–2107 m depth, 8 July 2004; ZMUB 18478 (ZMUB-MAR-ECO

135

13347), female, 825 mm SL (pale), 42°46.2'N, 29°16.2'W, R/V G.O. SARS, sta. 46-372,

136

bottom trawl, 3005–3050 m depth, 11 July 2004; ZMUB 18479 (ZMUB-MAR-ECO 2617),

137

male, 830 mm SL (pale), 43°2.07'N, 28°33.11'W to 43°0.88'N, 28°34'W, R/V G.O. SARS,

138

sta. 50-373, bottom trawl, 2593–2607 m depth, 12 July 2004; ZMUB 18480 (ZMUB-MAR-

139

ECO 13977), male, 670 mm SL and female, 840 mm SL (both pale), 42°55.32'N, 28°8.35'W

140

to 42°53.05'N, 28°8.33'W, R/V G.O. SARS, sta. 52-374, bottom trawl, 2973–2979 m depth,

141

13 July 2004; ZMUB 18481 (ZMUB-MAR-ECO 13821), male, 680 mm SL (pale), 53°7.8'N,

142

34°45.6'W, R/V G.O. SARS, sta. 68-384, bottom trawl, 2306–2374 m depth, 25 July 2004.

143

ZMUB 18482 (ZMUB-MAR-ECO 16013), male, 725 mm SL, ZMUB 18483 (ZMUB-MAR-

144

ECO 16027), male, 975 mm SL, ZMUB 18484 (ZMUB-MAR-ECO 16041), female, 858 mm

145

SL and ZMUB 18485 (ZMUB-MAR-ECO 16055), female, 765 mm SL (all pale),

146

42°34.91'N, 28°2.64'W to 42°33.91'N, 28°5.84'W, M/S LORAN, sta. 1, bottom longline,

147

2925–2827 m depth, 5 July 2004; ZMUB 18486 (ZMUB-MAR-ECO 17105), female, 950

148 mm SL, ZMUB 18487 (ZMUB-MAR-ECO 20065), female, 742 mm SL, ZMUB 18488  
149 (ZMUB-MAR-ECO 20079), male, 625 mm SL, ZMUB 18489 (ZMUB-MAR-ECO 20093),  
150 female, 825 mm SL), ZMUB 18490 (ZMUB-MAR-ECO 20107), male, 685 mm SL, ZMUB  
151 18492 (ZMUB-MAR-ECO 20135), female, 925 mm SL, ZMUB 18494 (ZMUB-MAR-ECO  
152 20163), female, 885 mm SL (all pale) and ZMUB 18491 (ZMUB-MAR-ECO 20121),  
153 female, 895 mm SL (pale with several large brown rings on body), same station data as HT;  
154 ZMUC P77793, 960 mm SL, ZMUC P77794 800 mm SL, ZMUC P77795, male, 960 mm SL  
155 and ZMUC P77796, 730 mm SL (all pale), 43°39.3'N, 22°37.8'W, R/V WALTHER  
156 HERWIG, sta. 82-352, beam trawl, 1900–2080 m depth, 8 June 1982.

157 Non-types, S Indian Ocean E ( $n=4$ ): MNHN 2003-0598, 754 mm SL (dark) and MNHN  
158 2003-0599, 962 mm SL (light brown), Kerguelen, 50°50.3' S, 69°44.1' E, F/V Ile Bourbon,  
159 longline, 1768 m depth, 11 Oct 2002; SAIAB 118942, 2, 706 mm SL (dark) and 1001 mm SL  
160 (light brown), near Lena Tablemount, 53°30'S, 48°31.5'E, F/V Shinsei Maru nr. 3, longline,  
161 2112 m depth, 19 May 2010.

162 SW Pacific ( $n=5$ ): CSIRO H-5304.01, female, 1060 mm SL (light brown when fresh,  
163 pale after preservation), 38°34'S, 149°28'E to 38°36'S, 149°33'E, 1954–1979 m depth, 19  
164 April 2000; CSIRO H-6036.02, female, 510 mm SL (light brown when fresh, pale after  
165 preservation), 32°3'S, 159°52'E to 32°2'S, 159°51'E, NORFANZ cruise, R/V TANGAROA,  
166 station 0308/071, 1920–1934 m depth, 24 May 2003. NMNZ P.031193, female, 610 mm SL  
167 (pale), 42°55.59'S, 172°39.21'E, R/V TANGAROA, sta. TAN 9406/226, 1694–1707 m  
168 depth, 22 June 1994; NMNZ P.033111, female, 1030 mm SL (pale), ~37°30'S, ~176°30'E;  
169 USNM 215295, 248 mm SL (pale), 42°11'S, 175°11'E, 2602–2619 m depth, 20 Sep 1966.

170

171 **Diagnosis**

172 Number of dorsal-fin rays 137–148, anal-fin rays 102–112, total vertebrae 80–88, pre-  
173 anal length 47–55 % in SL, pelvic- to anal-fin origin 34–44 % in SL, orbit length 9.9–12 in %  
174 head length, otolith ostium width 15–21 in % sulcus length and 19–29 in % ostium length;  
175 maximum size to 110 cm SL.

176

### 177 **Description**

178 The most important meristic and morphometric characters as well as the otolith  
179 characters are shown in Tables 1–3. Body elongate, laterally compressed, tapering towards  
180 tail. Pectoral-fin depth 5.7–7.9 times in SL, tail length 1.76–1.90 times in SL and preanal  
181 length 1.01–1.15 times in tail length. Head length 4.7–5.6 in SL and 2.23–2.75 in preanal  
182 length; head depth through eye 7.8–9.5 times in SL. Orbit circular, shorter than snout, 2.09–  
183 2.80 in snout length. Anterior gill arch with 8–10 long and 10–13 rudimentary rakers.  
184 Pseudobranchial filaments 0–2.

185 Origin of dorsal fin above vertebra 9–11, well in front of distal tip of pectoral fin.

186 Pelvic fins with two rays each reaching about 1/3 from its base to anal-fin origin. Pectoral  
187 fins on lower half of body, rather short, 10–14 times in SL, and moderately wide at fin base,  
188 the width 19–21 time in SL.

189 Otolith (Fig. 3A) mostly elongate, length to height ratio 1.41–2.25, with pointed  
190 posterior tip. Anterior tip rounded. Dorsal surface concave. Sulcus long, 54–81 % of otolith  
191 length with separated colliculi and located at the centre of inner face. Ostium narrow, its  
192 width 15–21% of sulcus length and 19–29% of ostium length.

193 **Coloration.**– Freshly or recently caught specimens with pale creamy body and head,  
194 unpaired fins dark brown along distal margins or more entirely, as observed in the 19 type  
195 specimens collected by the MAR-ECO cruise, N Atlantic, in 2004. One of those specimens  
196 showed in addition several large brown rings on body. Of four specimens collected in the S

197 Indian Ocean the two smaller ones (706-754 mm SL) were dark brown and the two larger  
198 ones (962-1001 mm SL) light brown. In three of those specimens the unpaired fins were dark  
199 brown.

200

#### 201 **Etymology**

202 The new species name is composed of the Latin word for narrow or slender “tenuis” and  
203 the otolith structure “ostium”. The ablative of the combined term is “stenostio”, meaning  
204 “with a narrow ostium”.

205

#### 206 **Distribution**

207 N Atlantic and S Indian Ocean to SW Pacific, 1694 to 3050 m depth. No records from  
208 the S Atlantic.

209

#### 210 **Remarks**

211 Among the studied specimens that could be sexed were 9 males and 15 females. No  
212 sexual dimorphism could be found in any meristic and morphometric characters including  
213 otolith characters.

214 A clear negative allometry in otolith length, but not in ostium and sulcus shape, was  
215 detected (Fig. 4). Apart from a slight decrease in relative orbit length with size (Fig. 4), no  
216 other allometric changes in body shape were encountered in *Spectrunculus stenostio*.

217 A slight shift towards a lower number of total vertebrae was found in the Indo-Pacific  
218 population, while dorsal- and anal-fin ray number do not follow this trend (Table 2).

219 Small-sized specimens (< 200 mm SL) not known, the smallest specimen studied is 248  
220 mm SL.

221

222 *Spectrunculus crassus* (Vaillant, 1888)

223 Figures 1–4; Tables 2–5

224

225 *Bythites crassus* Vaillant, 1888:279 (type locality NE Atlantic, 44°20'N, 17°11'W).

226 *Bassogigas coheni* Mayer and Nalbant, 1972:163 (type locality SE Pacific, 8°23'S, 80°25'W).

227 *Spectrunculus grandis non* (Günther, 1877) in part: Nielsen & Hureau 1980

228 *Spectrunculus crassus* Uiblein et al. 2008; Hanke et al. 2015

229

230 **Material studied (n=58)**

231 *Holotype*. MNHN 1986-0552, 284 mm SL (light brown; described as dark brown in  
232 original description by Vaillant 1888), NE Atlantic, 44°20'N, 17°11'W, R/V TALISMAN sta.  
233 136, 4255 m depth; 26 August 1883.

234 Non-types, N Atlantic (n=49): MNHN 1979-0221, 329 mm SL (pale), 56°38'N, 11°6'W,  
235 R/V J. CHARCOT, sta. 2721, 2466 m depth, 17 July 1976; MNHN 1979-0222, 142 mm SL  
236 (light brown), 56°38'N, 11°6'W, R/V J. CHARCOT, sta. 2721, 2466 m depth, 17 July 1976;  
237 MNHN 1979-0223, 280 mm SL (light brown), 56°33'N, 11°11'W, J. CHARCOT, sta. 2721,  
238 2483–2513 m depth, 17 July 1976; MNHN 1979-0224, 400 mm SL (dark), 56°33' 0"N,  
239 11°10'58.8"O, Jean Charcot, sta. Cp04, 2483–2513 m, 17 July 1976; MNHN 1999-0708, 327  
240 mm SL (light brown), 56°15'N, 10°16'W, R/V N.O.THALASSA, 2020 m depth, 27 April  
241 1999; ZMUB 18351 (ZMUB-MAR-ECO 8081), female, 250 mm SL (dark) and ZMUB  
242 18352 (ZMUB-MAR-ECO 8067), male, 253 mm SL (light brown), 42°54.91'N, 30°20.37'W  
243 to 42°53.11'N, 30°20.92'W, R/V G.O. SARS, sta. 40-367, bottom trawl, 2660–2670 m depth,  
244 7 July 2004. ZMUB 18353 (ZMUB-MAR-ECO 13053), male, 216 mm SL (light brown),  
245 ZMUB 18354 (ZMUB-MAR-ECO 2679), 2 females, 240–282 mm SL and male, 260 mm SL  
246 (all dark) and ZMUB 18355 (ZMUB-MAR-ECO 12419), female, 187 mm SL (light brown),

247 42°55.32'N, 28°8.35'W to 42°53.05'N, 28°8.33'W, R/V G.O. SARS, sta. 52-374, bottom  
248 trawl, 2973–2979 m depth, 13 July 2004; ZMUB 18356 (ZMUB-MAR-ECO 11582), male,  
249 220 mm SL (light brown), 53°16.8'N, 35°31.8'W, R/V G.O. SARS, sta. 72-386, bottom trawl,  
250 2522–2567 m depth, 27 July 2004; ZMUB 18463 (ZMUB-MAR-ECO 12291), 3 males, 482–  
251 522 mm SL and 522 mm SL (all dark), 42°48.6'N, 29°38.36'W to 42°46.64'N, 29°38.59'W,  
252 R/V G.O. SARS, sta.42-368, bottom trawl, 2063–2107 m depth, 8 July 2004; ZMUB 18464  
253 (ZMUB-MAR-ECO 10891), 3 females, 435–575 mm SL (all dark), 51°55.08'N, 30°25.02'W  
254 to 51°56.14'N, 30°24.44'W, R/V G.O. SARS, sta. 62-380, bottom trawl, 1872–1959 m depth,  
255 20 July 2004; ZMUB 18465 (ZMUB-MAR-ECO 13807), female, 445 mm SL (light-brown  
256 speckled) and ZMUB 18466 (ZMUB-MAR-ECO 13821), male, 420 mm SL, 7 females, 375–  
257 480 mm SL and 405 mm SL (all dark), 53°7.8'N, 34°45.6'W, R/V G.O. SARS, sta. 68-384,  
258 bottom trawl, 2306–2374 m depth, 25 July 2004; ZMUB 18467 (ZMUB-MAR-ECO 20275),  
259 female, 490 mm SL, ZMUB 18468 (ZMUB-MAR-ECO 20261), female, 465 mm SL and  
260 ZMUB 18469 (ZMUB-MAR-ECO 20247), female, 480 mm SL (all dark), 42°25.49'N,  
261 29°48.14'W to 42°25.49'N, 29°46.13'W, M/S LORAN, sta.13, bottom longline, 2429–2018 m  
262 depth, 8 July 2004; ZMUB 18470 (ZMUB-MAR-ECO 17133), female, 510 mm SL (dark),  
263 42°23.26'N, 29°59.71'W to 42°24.88'N, 30°0'W, M/S LORAN, sta. 15, bottom longline,  
264 2650–2675 m depth, 9 July 2004; ZMUB 18471 (ZMUB-MAR-ECO 16433), 470 mm SL,  
265 ZMUB 18472 (ZMUB-MAR-ECO 16419), 510 mm SL and ZMUB 18473 (ZMUB-MAR-  
266 ECO 16405), female, 475 mm SL (dark), 42°37.77'N, 28°22.18'W to 42°37.58'N,  
267 28°19.16'W, M/S LORAN, sta. 5, bottom longline, 2125–2436 m depth, 6 July 2004; ZMUB  
268 18474 (ZMUB-MAR-ECO 17119), female, 480 mm SL (dark), 42°25.49'N, 29°48.14'W to  
269 42°25.49'N, 29°46.13'W, M/S LORAN, sta. 13, bottom longline, 2429–2018 m depth, 8 July  
270 2004; ZMUB 18475 (ZMUB-MAR-ECO 17189), female, 330 mm SL (dark), 42°36.14'N,  
271 29°20.05'W to 42°37.82'N, 29°19.51'W, M/S LORAN, sta. 16, bottom longline, 3366–3280



272 m depth, 9 July 2004; ZMUB 18476 (ZMUB-MAR-ECO 17393), female, 522 mm SL (dark),  
273 42°25.33'N, 29°38.2'W to 42°25.37'N, 29°40.42'W, M/S LORAN, sta. 12, bottom longline,  
274 1580–1964 m depth, 8 July 2004; ZMUB 19505 (ZMUB MAR-ECO 9757), 5 females, 455–  
275 540 mm SL and 2 specimens, 476–530 mm SL (all dark), 51°27.02'N, 29°19.73'W to  
276 51°28.02'N, 29°19.54'W, R/V G.O.SARS, st.56-378, bottom bottom trawl, 1872–1950 m  
277 depth, 17 July 2004; ZMUC P77797, 500 mm SL (dark), 43°39.3'N, 22°37.8', R/V  
278 WALTHER HERWIG, sta. 82-352, beam trawl, 1900–2080 m depth, 8 June 1982; ZMUC  
279 P77805, female, 490 mm SL (dark), 43°33.6'N, 22°33.4'W, WALTHER HERWIG, sta. 82-  
280 350, beam trawl, 1800–1970 m depth, 8 June 1982.

281 S Atlantic ( $n=2$ ): MNHN 1979-0227, 282 mm SL (light brown), 32°29'S, 13°26'E, R/V  
282 J. CHARCOT, sta. 4736, 3677 m depth, 13 January 1979; SAM MB-F042004, 128 mm SL  
283 (light brown), 33°49'S, 16°30'E, ca. 2743 m depth.

284 NE Pacific, off Oregon ( $n=5$ ): CAS-ICH 36991, female (?), 458 mm SL (dark),  
285 44°37'24"N, 125°39'54"W to 44°37'18"N 125°41'6"W, 2816 m depth, beam trawl, 13 Apr  
286 1976; CAS-ICH 40222, male, 334 mm SL (dark), Cascadia Abyssal Plain, 45°9'18"N,  
287 125°38'18"W to 45°10'30"N, 125°38'0"W, 2669 m depth, 45°10'30"N, beam trawl; CAS-ICH  
288 62977, male, 362 mm SL (dark), Cascadia Abyssal Plain, 47°50'30"N, 127°2'36"W, 2519 m  
289 depth, beam trawl; OSUO 11743, 345 mm SL (light brown), 44°40'N, 126°0'W, 2800 m  
290 depth, 21 August 1965; OSUO 11775, 239 mm SL (light brown), 45°31.7'N, 127°28.4'W,  
291 2800 m depth, 4 February 1973.

292 SE Pacific: NHMB 191, HT of *Spectrunculus coheni*, 106 mm SL (dark), 8°23'S,  
293 80°25'W, R/V ANTON BRUUN, beam trawl, 2945–2966 m depth, 31 October 1965.

294

295 **Diagnosis**

296 Number of dorsal-fin rays 121–131, anal-fin rays 91–102, total vertebrae 72–79, pre-anal  
297 length 42–54 % in SL, pelvic- to anal-fin origin 29–41 % in SL, orbit length 12–17 in % head  
298 length, otolith ostium width 22–30 in % sulcus length and 31–40 in % ostium length; dark-  
299 brown body, head and fins in larger, fresh or recently collected fish; juveniles lighter colored  
300 with dark unpaired fins; longer preserved specimens mostly light brown, paler than when  
301 fresh; maximum size to 60 cm SL.

302

### 303 **Description**

304 The most important meristic and morphometric characters as well as the otolith  
305 characters are shown in Tables 2–5. Body elongate, laterally compressed, tapering towards  
306 tail. Pectoral-fin depth 6.9–8.3 times in SL, tail length 1.78–1.86 times in SL and preanal  
307 length 1.16–1.33 times in tail length. Head length 4.6–5.6 in SL and 2.00–2.72 in preanal  
308 length; head depth through eye 8.2–11 times in SL. Orbit circular, shorter than snout, 1.56–  
309 2.26 times in snout length. Anterior gill arch with 8–10 long and 8–12 rudimentary rakers.  
310 Pseudobranchial filaments 0–2.

311 Origin of dorsal fin above vertebra 7–9, well in front of distal tip of pectoral fin. Pelvic  
312 fins with two rays reaching about halfway from base to anal-fin origin. Pectoral fins on lower  
313 half of body, rather short, 9.6–11 times in SL, and rather wide at fin base, the width 23–27  
314 times in SL.

315 Otolith (Fig. 2) oval to elongate (length to height ratio 1.34–2.10), with pointed  
316 posterior tip. Anterior tip rounded. Sulcus moderately long, 43–72 % of otolith length, with  
317 separate colliculi and located at the center of inner face. Ostium vertically enlarged, its width  
318 22–30 % of sulcus length and 31–40 % of ostium length in fish of 187 mm SL and larger;  
319 ostium width 59 % of ostium length in the 110 mm juvenile.

320 **Coloration.**— Fresh or recently caught fish mostly entirely dark brown. Among the 42  
321 specimens collected during the MAR-ECO expedition in the N Atlantic in 2004, 37 showed  
322 uniformly dark-brown colored body, head and fins; one larger specimen (445 mm SL) had a  
323 speckled color pattern with dark dots or blotches on pale background on head, body and fins;  
324 four of the five smallest specimens (187–253 mm SL) had light brown body and head color  
325 with ventral parts of head and belly pale bluish grey. Long-time preserved specimens  
326 including HT are entirely light brown.

327

328 **Distribution**

329 Atlantic and E Pacific; 1580 to 4255 m depth.

330

331 **Remarks**

332 Among the specimens that could be sexed were ten males and 27 females. No sexual  
333 dimorphism could be found in any of the meristic and morphometric characters including  
334 otoliths (see also, Uiblein et al. 2008).

335 Slight positive allometry in jaw length and negative allometry in orbit length was found  
336 (Fig. 4). Orbit in head length in the E Pacific population is slightly shorter than in the  
337 Atlantic. Otolith length showed negative allometry, while ostium and sulcus shape did not  
338 when the entire size range is considered (Fig. 4). However, the smallest specimen showed a  
339 slightly wider and shorter ostium which – when combined – indicate an early life-history shift  
340 in otolith form (i.e., from small-sized juveniles to larger-sized subadults and adults).

341 No regional variation in meristic characters could be detected.

342

343 *Spectrunculus grandis* (Günther, 1877)

344 (Figures 1–4; Tables 2,3,6)

345 *Sirembo grandis* Günther, 1877 (type locality: Northwest Pacific, E of Central Japan,  
346 34°37'N, 140°32'E)

347 *Spectrunculus grandis*: Hubbs & Follett 1978; in part: Nielsen & Hureau 1980; Uiblein et al.  
348 2008

349

### 350 **Material studied (*n*=7)**

351 *Holotype*, BMNH 1887, 675 mm SL (pale; described as brown in original description by  
352 Günther 1877), Northwest Pacific, E of Central Japan, 34°37'N, 140°32'E, R/V Challenger,  
353 sta. 237, 3431 m depth, 17 June 1875.

354 Non-types, SW Pacific (*n*=3): CSIRO H-6036.01, male, 450 mm SL (pale), 32°3'S,  
355 159°52'E to 32°2'S, 159°51'E; NORFANZ cruise, R/V TANGAROA, station # 0308/071,  
356 1920–1934 m depth, 24 May 2003; LACM 43564-1, 200 mm SL (light brown), 42°11'S,  
357 175°11'E, 2602–2619 m depth, 20 Sept 1966; NMNZ P.041204, female, 840 mm SL (dark),  
358 58°36'S, 161°23'E, 1496–1638 m depth, 19 August 2004.

359 NE Pacific (*n*=3): CAS-ICH 25724, male, 1270 mm SL (light brown), California, 40  
360 miles west southwest of the Farallon Islands, ~37°30'N, ~132°4'W, surface, above ca. 3000 m  
361 depth; CAS-ICH 90121, 1283 mm SL (dark), California, off Trinidad Head, 41°50'N,  
362 125°10'W, surface, above ca. 2500 m depth, 16 Sept 1996; OSUO 11789, 370 mm SL (light  
363 brown), Northeast Pacific, 44°41.8'N, 127°22.7'W, 3021 m depth, 12 June 1974.

364

### 365 **Diagnosis**

366 Number of dorsal-fin rays 135–137, anal-fin rays 101–105, total vertebrae 77–80, pre-  
367 anal length 47–55 % in SL, pelvic- to anal-fin origin 32–36 % in SL, orbit length 9.3–14 in %  
368 head length, otolith ostium width 24–29 in % sulcus length and 35–39 in % ostium length;  
369 maximum size to 130 cm SL

370

371 **Description**

372 The most important meristic and morphometric characters as well as the otolith  
373 characters are shown in Tables 2, 3 and 6. Body elongate, laterally compressed, tapering  
374 towards tail. Pectoral-fin depth in HT 7.2 times in SL, tail length 1.80–1.88 times in SL and  
375 preanal length 1.04–1.14 times in tail length in HT and two non-types. Head length 4.9–5.9 in  
376 SL and 2.22–2.89 in preanal length; head depth through eye 8.57 times in SL. Orbit circular,  
377 shorter than snout, 1.98–3.27 times in snout length. Anterior gill arch with 7–10 long and 11–  
378 19 rudimentary rakers. Pseudobranchial filaments 1–2.

379 Origin of dorsal fin above vertebrae 9–10, well in front of distal tip of pectoral fin.  
380 Pelvic fins with two rays in each reaching about 1/4 to 1/3 from its base to anal-fin origin.  
381 Pectoral fins on lower half of body, rather short, 10–12 times in SL, and moderately wide at  
382 fin base, the width 17–19 times in SL.

383 Otolith (Fig. 2) oval to slightly elongated (length to height ratio 1.20–1.67), posteriorly  
384 flattened or with only a weakly pointed tip. Variably formed anteriorly, no pointed tip. Sulcus  
385 long, 49–61 % of otolith length with separate colliculi and located at the center or slightly  
386 dorsally of inner face. Ostium width 24–29 % of sulcus length and 35–39 % of ostium length.

387 **Coloration.**– Two specimens collected in the SW Pacific in 2000 and 2003 (510–1060 mm  
388 SL) both showed light brown body and head color when fresh (the smaller specimen slightly  
389 paler and pale greyish from below eye to belly) and were found to be pale after preservation,  
390 the unpaired fins still being slightly darker. A large NE Pacific specimen (1270 mm SL) had  
391 pinkish orange color when fresh (Hubbs and Follett 1978). The largest specimen studied from  
392 the same area collected drifting at the surface in 1996 was still entirely dark brown when  
393 studied in 2019. Long-term preserved HT (collected in 1877), is pale, creamy whitish (Fig.  
394 1).

395

396 **Distribution**

397 W to NE Pacific; 1496 to 3431 m depth.

398

399 **Remarks**

400 Otolith length appears to follow the negative allometric trend as in the other three  
401 *Spectrunculus* species and the two largest *S. grandis* have particularly short pelvic fins (Fig.  
402 4). However, too few specimens were available for study to allow us to investigate  
403 intraspecific variation (sex- size- or population-related) more closely.

404 Small-sized specimens (< 200 mm SL) not known, the smallest specimen studied is 200  
405 mm SL.

406

407 *Spectrunculus radcliffei* Jordan and Thompson, 1914

408 (Figures 1–4; Table 2,3,5,7)

409 *Spectrunculus radcliffei* Jordan and Thompson, 1914 (type locality: NW Pacific, Japan,  
410 35°10'N, 139°37'E)

411 *Spectrunculus grandis non* (Günther, 1877), in part: Nielsen & Hureau 1980; Uiblein et al.  
412 2008

413

414 **Material studied (n=24)**

415 Holotype, FMNH 57123, postlarva (pale; described as translucent in original description  
416 by Jordan & Thompson 1914), 56 mm SL, NW Pacific, Japan, Misaki, 35°10'N, 139°37'E.

417 Non-types, S Atlantic (n=6): CAS-ICH 40233, female, 378 mm SL (light brown), off  
418 Cape of Good Hope, 35°07'S, 18°25.6'E, ca. 1000 m depth; SAIAB 47240, 541 mm SL  
419 (dark), off Cape Columbine, Western Cape, 32°22'S, 16°09'E, 1150 m depth, trawl, 14 Jan

420 1995; SAM F023413, 188 mm SL (pale), 33°52'S 16°51'E, RV Africana II, 2440 m depth, 9  
421 Dec 1959; SAM F027093, 190 mm SL (pale), 33°49'S, 16°30'E, RV Africana II, 2743 m  
422 depth, 27 Aug 1959; ZMUC P77702, 196 mm SL (light brown), 33°36'S, 16°15'E, R/V  
423 AFRICANA II, sta. 191, 3080 m depth, beam trawl, 24 Aug 1959; ZMUC P77704, 192 mm  
424 SL (light brown), 34°46'S, 16°42'E, R/V AFRICANA II, sta. 316, 3360 m depth, beam trawl,  
425 8 December 1959.

426 S Indian Ocean: MNHN OTO 354-49 (only otolith and photo of freshly collected fish  
427 retained), 910 mm SL (light brown), Kerguelen, 50°50'S, 69°53.8'E, 1769 m depth, F/V  
428 Albius, longline, 20 Sept 2012.

429 NW Pacific ( $n=3$ ): ZMUC P2397424, male, 1020 mm SL (pale), 2500 m depth and  
430 ZMUC P2397444, female, 950 mm SL (light brown) and ZMUC P2397445, male, 945 mm  
431 SL (light brown), 2000 m depth, Suruga Bay, Central Japan (34°N, 138°E), caught in 2020

432 SW Pacific ( $n=2$ ): NMNZ P.041951, male, 332 mm SL (pale), 34°31.5'S, 166°21'E,  
433 2930 m depth, Sept 1982; NMV A25135.002, female, 423 mm SL (pale), 32°3.98'S,  
434 159°52.8'E to 32°2.26'S, 159°51.11'E, NORFANZ cruise, R/V TANGAROA, sta. TAN  
435 0308/071, 1920–1934 m depth, 24 May 2003.

436 NE Pacific ( $n=11$ ): OSUO 11722, 88 mm SL (dark), off Oregon Coast, 44°48.8'N,  
437 125°36.5'W, ca. 2800 m depth, 8 March 1972; OSUO 11738, 94 mm SL (light brown),  
438 45°56.4'N, 127°39.1'W, 2763 m depth, 13 March 1973; CAS-ICH 246805, male, 478 mm SL  
439 (light brown), 45°18'42"N, 126°34'24"W, R/V Yaquina, beam trawl, 2750 m depth, 2 Dec  
440 1974; CAS-ICH 32364, male, 495 mm SL (light brown), off Oregon, 44°57'18"N,  
441 126°37'18"W to 44°58'0"N 126°42'42"W, 2850 m depth, beam trawl; CAS-ICH 33083, male,  
442 665 mm SL (light brown) and female, 536 mm SL (dark), off Oregon, near Cascadia  
443 Channel, 45°22'24"N, 127°27'48"W to 45°23'54"N 127°28'36"W, 2788 m depth, beam trawl;  
444 CAS-ICH 39821, male, 640 mm SL (light brown), off Oregon, 45°21'30"N, 127°33'0"W to

445 45°21'42"N, 127°38'30"W, 2800 m depth, beam trawl; CAS-ICH 40234, male, 446 mm SL  
446 (pale), off Oregon, Cascadia Abyssal Plain., 45°27'48"N, 126°17'24"W to 45°27'0"N,  
447 126°21'0"W, 2606 m depth, beam trawl; CAS-ICH 40235, 307 mm SL (light brown), off  
448 Oregon, Cascadia Abyssal Plain, 45°27'48"N, 126°17'24"W to 45°27'0"N, 126°21'0"W, 2606  
449 m depth, beam trawl; CAS-ICH 62566, 340 mm SL (light brown), off Oregon, Cascadia  
450 Abyssal Plain, 44°5'18"N, 125°23'35"W to 44°7'6"N, 125°21'48"W, 2940 m depth, beam  
451 trawl; LACM 45789, 1205 mm SL (light brown), ca 37°N 123°W, ca. 3000 m depth.

452

### 453 **Diagnosis**

454 Number of dorsal-fin rays 135–147, anal-fin rays 103–112, total vertebrae 78–83, pre-  
455 anal length 40–45 % in SL, pelvic- to anal-fin origin 28–33 % in SL, orbit length 8.0–16 in %  
456 head length, otolith ostium width 24–30 in % sulcus length and 32–40 in % ostium length,  
457 maximum size to 130 cm SL.

458

### 459 **Description**

460 The most important meristic and morphometric characters as well as the otolith  
461 characters are shown in Tables 2,3,5 and 7. Body moderately elongate, laterally compressed,  
462 tapering towards tail. Pectoral-fin depth 6.1–10 times in SL, tail length 1.67–1.81 times in SL  
463 and preanal length 1.24–1.43 times in tail length. Head length 4.2–5.4 in SL and 1.75–2.38 in  
464 preanal length; head depth through eye 6.8–12 times in SL. Orbit circular, shorter than snout,  
465 1.27–3.18 times in snout length, slightly larger in small specimens. Anterior gill arch with 8–  
466 9 long and 9–13 rudimentary rakers. Pseudobranchial filaments 0–3.

467 Origin of dorsal fin above vertebra 7–11, well in front of distal tip of pectoral fin.

468 Pelvic fins with two rays each reaching about 1/3 from its base to anal-fin origin. Pectoral



469 fins on lower half of body, rather short, 8.8–12 times in SL, and moderately wide at fin base  
470 in most specimens, the width 18–24 times in SL.

471 Otolith (Fig. 2) oval in larger fish (length to height ratio 1.40–1.58) and elongate in  
472 smaller fish (length to height ratio 1.72–1.76), with slightly pointed posterior tip, anteriorly  
473 rather blunt. Sulcus long in larger specimens, 61–74 % of otolith length and shorter in  
474 juveniles (51–57 % of otolith length), with separate colliculi and located at the center of inner  
475 face. Ostium width 24–30 % of sulcus length and 32–40 % of ostium length in fish of 192  
476 mm SL and larger; ostium width 44–49 % of ostium length in two 188 and 190 mm SL  
477 juveniles.

478 **Coloration.**— Two freshly collected specimens from Japan, NW Pacific (ZMUC P2397444  
479 and P2397445; 945–950 mm SL) with light brown body and head, unpaired fins slightly  
480 darker, especially posteriorly in tail region. A slightly larger fresh specimen (ZMUC  
481 P2397724) from same area (1020 mm SL) is entirely whitish. Long-term preserved  
482 specimens including HT (larva) pale creamy or pale yellowish.

483

#### 484 **Distribution**

485 Pacific and SE Atlantic; ca. 1000 to 3360 m depth. No records from the Indian Ocean.

486

#### 487 **Remarks**

488 Among the studied specimens the four females and eight males showed no sex-related  
489 differences in morphological or color characters.

490 Head, orbit and ostium length show negative allometry when the entire size range (i.e.  
491 small-sized juveniles to largest-sized adults) is considered (Fig. 4). No such pattern was  
492 found for pre-anal and pelvic-fin length and ostium width. Two of the three smallest  
493 specimens (size range 188–196 mm) showed a relatively wide ostium compared to all other

494 conspecifics (including the 192 mm SL specimen shown in Fig. 3F; Fig. 4), possibly  
495 indicating a rather abrupt early life-history modification in otolith form. Like in  
496 *Spectrunculus grandis*, the largest specimen of *S. radcliffei* showed a clearly shorter pelvic  
497 fin (Fig. 4).

498       Specimens from the S Atlantic show slightly shorter heads, narrower interorbitals and  
499 deeper bodies than in the other areas of occurrence. However, data are insufficient for  
500 detailed quantitative population comparisons.

501

#### 502 **Distinction of each of the four *Spectrunculus* species (Table 8)**

503       *Spectrunculus stenostio* differs from the other three species by the clearly narrower  
504 ostium and by the mostly higher number of total vertebrae; *S. crassus* differs from the other  
505 three species in the combination of low dorsal-fin, anal-fin and vertebrae counts, mostly  
506 larger eyes and lower maximum size; *S. radcliffei* differs from the other three species in the  
507 combination of a mostly shorter preanal length, shorter pelvic-to anal-fin origin distance and  
508 by higher anal-fin rays counts; *S. grandis* differs from the other three species in the  
509 combination of all nine characters.

510       Color patterns have no significance in species distinction except for fresh or recently  
511 collected specimens of the two North Atlantic species, with body and head color in *S. crassus*  
512 being mostly darker than in *S. stenostio* (see also Uiblein et al. 2008).

513

#### 514 **Identification key**

515       The key below is prepared to allow identification among the four *Spectrunculus* species  
516 without necessary extraction of otoliths (see also Material & Methods section). Consequently,  
517 distinction in otolith shape is indicated in parentheses.

518 1 – Dorsal-fin rays 135–148, anal-fin rays 101–112, total vertebrae 77–88, eye diameter in  
519 subadult or adult specimens 6.4–13 times in head length, maximum size to 100 cm SL or  
520 larger, body and head color in freshly caught or recently fixated and/or preserved specimens  
521 pale grey or pale whitish, light brown or dark brown, all major oceans ..... 2  
522 – Dorsal-fin rays 121–139, anal-fin rays 91–102, total vertebrae 72–79, eye diameter in  
523 subadult or adult specimens 5.8–8.2 times in head length, maximum size 60 cm SL, body and  
524 head color in freshly caught or recently fixated and/or preserved specimens light brown in  
525 juveniles or subadults and dark grey or dark brown (rarely speckled) in larger specimens,  
526 Atlantic and E Pacific ..... *Spectrunculus crassus*  
527 2 – Pre-anal length 1.83–2.15 times in SL and 1.01–1.15 in tail length (=subequal or only  
528 slightly shorter), distance between pelvic- and anal-fin origins 2.28–3.17 times in SL, total  
529 vertebrae 80–88, all major oceans .....3  
530 – Pre-anal length 2.22–2.48 times in SL and 1.24–1.43 in tail length, distance between pelvic-  
531 and anal-fin origins 3.02–3.58 times in SL, total vertebrae 78–83, Pacific and S Atlantic  
532 ..... *S. radcliffei*  
533 3 – Dorsal-fin rays 135–137, anal-fin rays 101–105, total vertebrae 77–80, maximum size  
534 130 cm SL (otolith ostium width 2.56–2.86 in its length and 4.2–4.4 times in sulcus length),  
535 Pacific ..... *S. grandis*  
536 – Dorsal-fin rays 137–148, anal-fin rays 102–112 (106–108 in the SW Pacific population [co-  
537 occurrence with *S. grandis*]), total vertebrae 80–88, maximum size 110 cm SL (otolith ostium  
538 width 3.45–5.3 in its length and 4.8–6.7 times in sulcus length), N Atlantic, S Indian Ocean  
539 and SW Pacific .....*S. stenostio.*

540

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605  
606

607 **Figure captions**

608 Figure 1. A-C: *Spectrunculus stenostio* (A) HT, ZMUB 18493, 825 mm SL, N. Atlantic (F.  
609 Uiblein); (B) SAIAB 11892, 706 mm SL, S Indian Ocean (F. Uiblein); (C) NMNZ P.033111,  
610 1030 mm SL, SW Pacific (P.R. Møller). D-F: *S. crassus*. (D) ZMUB 18355, 187 mm SL, N.  
611 Atlantic (MAR-ECO cruise); (E) HT, MNHN 1886-0552, 284 mm SL, N Atlantic (J.  
612 Pfliger); (F) ZMUB 18463, 500 mm SL, N. Atlantic (MAR-ECO cruise); G-I: *S. grandis*. (G)

613 HT, BMNH 1887, 675 mm SL (F. Uiblein); (H) NMNZ P.041204, 840 mm SL, SW Pacific  
614 (P.R. Møller); (I) CAS 25724, 1270 mm SL, NE Pacific (Moulin Studios, San Francisco); J-  
615 M: *S. radcliffei*. (J) HT (postlarva), FMNH 57123, 56 mm SL, NW Pacific (FMNH  
616 Zoological Collections); (K) SAM 47240, 541 mm SL, S Atlantic (F. Uiblein); (L)  
617 ZMUCP2397445, 945 mm SL, NW Pacific (M. Krag); (M) ZMUC P2397724, 1020 mm SL,  
618 NW Pacific (M. Krag). Length of black or white scale bars is 5 cm.

619

620 Figure 2. Distribution map showing the occurrence of studied specimens the genus  
621 *Spectrunculus*. For areas with multiple occurrences numbers are added to the respective  
622 symbols. Type localities are indicated by filled symbols.

623

624 Figure 3. Images of otoliths of *Spectrunculus*. (A) *S. stenostio*, ZMUB 18480, 670 mm SL, N  
625 Atlantic (F. Uiblein); (B) *S. crassus*, ZMUB 18464, 575 mm SL, N Atlantic (F. Uiblein); (C-  
626 E) *S. grandis*. (C) HT, BMNH 1887, 675 mm SL, NW Pacific (CT scan, B. Clark); (D) CAS  
627 25724, 1270 mm SL, NE Pacific (F. Uiblein); (E) LACM 43564, 200 mm SL, SW Pacific  
628 (M.A. Krag); (F-H) *S. radcliffei*. (F) ZMUC P77704, 192 mm, S Atlantic (M.A. Krag); (G)  
629 ZMUCP2397445, 945 mm SL, NW Pacific (from left head side, shown side-reversed; M.  
630 Krag); (H) ZMUC P2397724, 1020 mm SL, NW Pacific (M. Krag). All otoliths from right  
631 head side, if not otherwise indicated. Dotted lines with arrows indicate the approximate  
632 measurement positions for ostium width (left side of figure) and sulcus length (right side of  
633 figure). Length of black or white scale bars is 5 mm.

634

635 Figure 4. Relationships between morphological characters in the four *Spectrunculus* species.

636

637

**The Systematics of the ophidiid genus *Spectrunculus* (Teleostei, Ophidiiformes)  
revisited with description of a new species and resurrection of *S. radcliffei***

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## Tables

Table 1. *Spectrunculus stenostio*, types and areas separated.

	HT		PTs, N Atlantic				S Indian Ocean				SW Pacific		
	N Atlantic	Min	Mean	Max	<i>n</i>	Min	Mean	Max	<i>n</i>	Min	Mean	Max	<i>n</i>
SL (mm)	825	625	809.1	975	22	702	854.8	1001	4	248	691.6	1060	5
<b>Meristic characters</b>													
Dorsal-fin rays	143	139	142.5	148	20	137	140.0	143	4	137	139.8	144	5
Caudal-fin rays	8	8	8.2	9	19	8	8.3	9	4	8	8.0	8	4
Anal-fin rays	109	102	107.1	112	17	105	107.0	110	4	106	107.0	108	5
Precaudal vertebrae	24	23	24.4	26	20	22	23.5	25	4	23	23.6	24	5
Total vertebrae	84	81	83.9	88	20	81	82.0	83	4	80	80.8	82	5
First dorsal-fin ray above vertebra nr.	10	9	9.8	11	20	9	9.8	10	4	9	9.4	10	5
Dorsal-fin ray above anal-ray nr.	41	35	38.8	41	14	34	34.3	35	3	34	38.6	42	5
First anal-fin rays below vertebra nr.	30	26	28.2	30	14	26	27.0	28	3	25	28.2	31	5
Pectoral-fin rays	28	27	27.7	28	3	24	26.3	28	4	25	26.8	29	4
Developed gill rakers	10	9	9.5	10	4	9	9.0	9	2	8	9.0	10	4
Total gill rakers	20	19	20.3	21	4	20	20.5	21	2	19	20.8	22	4
<b>Morphometric characters in % SL</b>													
Head length	20	18	20.0	21	21	18	19.0	20	4	19	19.7	20	4
Body depth at anus	17	16	17.5	20	21	18	19.8	22	2	15	19.6	25	4
Snout length	4.6	4.6	5.3	5.9	21	5.1	5.2	5.4	2	5.3	5.6	5.9	4
Upper jaw length	9.6	8.9	9.9	11	21	9.9	9.9	10	2	9.5	10.1	11	4
Head width at postmaxilla	8.4	8.1	9.3	10.1	19	8.3	8.8	9.4	2	9.1	10.6	13	4
Depth of postmaxilla	2.61	2.24	2.67	3.19	21	2.13	2.29	2.44	2	2.04	2.23	2.43	2
Orbit length	2.19	1.95	2.20	2.50	21	2.30	2.37	2.45	2	2.06	2.16	2.23	4
Intorbital length	5.9	5.2	6.1	6.9	21	6.0	6.2	6.3	2	6.4	6.9	7.2	4
Postorbital length	14	12	13.8	15	21	13	13.7	14	2	13	13.6	15	4
Preanal distance	50	47	49.3	55	21	47	50.1	53	4	47	48.1	50	4
Predorsal distance	27	26	29.0	33	21	25	25.5	26	2	25	28.0	31	4
Distance between pelvic- and anal-fin origin	41	34	38.0	44	21	39	38.8	39	2	34	36.1	37	4
Pelvic-fin length	15	11	13.7	18	16	11	12.5	14	2	12	12.7	15	4
<b>in % head length</b>													
Upper jaw length	48	47	49.7	53	21	49	49.9	50	2	48	51.1	54	4
Orbit length	11	9.9	11.0	12	21	11	11.9	12	2	10	10.9	11	4
<b>Otolith characters in % SL</b>													
Otolith length	2.21	1.50	2.17	2.55	16	1.88	2.01	2.15	3		2.84		1
Otolith height	1.19	1.06	1.22	1.35	16	1.14	1.17	1.18	3		1.70		1
Sulcus length	1.41	1.19	1.49	1.73	16	1.38	1.40	1.44	3		1.55		1
Ostium length	1.00	0.84	1.09	1.22	16	0.89	0.93	0.95	3		1.15		1
Ostium width	0.26	0.20	0.26	0.31	16	0.24	0.25	0.26	3		0.31		1
<b>in % otolith length</b>													
Otolith height	54	44	56.6	71	16	55	58.1	61	3		60		1
Sulcus length	64	60	69.0	81	16	67	69.9	74	3		54		1
Ostium length	45	45	50.2	58	16	44	46.1	47	3		40		1
Ostium width	12	9	12.1	16	16	12	12.5	14	3		11		1
<b>Ostium width in % of:</b>													
Otolith height	22	15	21.5	25	16	20	21.6	22	3		18		1
Sulcus length	71	67	73.0	79	16	64	66.0	67	3		74		1
Ostium length	26	19	24.1	29	16	26	27.2	29	3		27		1



Table 3. Larger-sized ( $\geq 200$  mm SL) specimens of four *Spectrunculus* species compared

SL (mm)	<i>S. stenostio</i>				<i>S. crassus</i>				<i>S. grandis</i>				<i>S. radcliffei</i>			
	Min	Mean	Max	n	Min	Mean	Max	n	Min	Mean	Max	n	Min	Mean	Max	n
248	796.9	1060	32	216	416.1	575	54	200	726.9	1283	7	307	623.6	1205	17	
<b>Meristic characters</b>																
Dorsal-fin rays	137	141.7	148	30	121	128.3	139	44	135	136.1	137	7	135	139.3	144	16
Caudal-fin rays	8	8.2	9	28	7	8.0	10	31	8	8.0	8	5	7	8.2	10	16
Anal-fin rays	102	107.1	112	27	91	97.9	102	44	101	103.7	105	7	103	107.0	112	16
Precaudal vertebrae	22	24.1	26	30	20	21.3	22	47	22	22.6	23	7	20	22.8	24	16
Total vertebrae	80	83.1	88	30	72	75.3	79	44	77	79.0	80	7	78	80.2	83	16
First dorsal-fin ray above vertebra nr.	9	9.7	11	30	7	8.4	10	44	9	9.2	10	5	7	9.3	11	16
Dorsal-fin ray above anal-ray nr.	34	38.3	42	23	27	32.8	38	43	35	38.0	41	5	32	35.6	38	16
First anal-fin rays below vertebra nr.	25	28.1	31	23	22	24.4	27	44	26	27.2	28	5	24	25.9	28	16
Total vertebrae	80	83.1	88	30	72	75.3	79	44	77	79.0	80	7	78	80.2	83	16
Pectoral-fin rays	24	26.9	29	12	25	25.9	27	14	26	28.2	31	5	25	26.9	29	16
Developed gill rakers	8	9.3	10	11	8	8.9	10	15	7	7.8	10	5	8	8.5	9	15
Total gill rakers	19	20.5	22	11	17	19.2	22	14	19	22.6	26	5	17	19.2	21	15
<b>Morphometric characters in % SL</b>																
Head length	18	19.8	21	30	18	19.5	22	45	17	19.7	22	6	19	20.0	22	15
Body depth at anus	15	17.9	25	28	15	18.3	22	45	17	19.4	22	5	14	16.5	19	15
Snout length	4.6	5.3	5.9	28	4.7	5.4	6.1	45	5.0	5.5	6.1	5	4.9	5.4	6.0	15
Upper jaw length	8.9	9.9	11	28	8.1	9.1	10.5	44	8.7	10.4	11	6	8.4	10.2	12	15
Head width at postmaxilla	8.1	9.4	13	26	6.3	8.4	12	43	9.1	11.0	12	4	7.5	9.8	13	15
Depth of postmaxilla	2.04	2.60	3.19	26	1.93	2.50	3.02	43	2.20	2.78	3.29	5	2.18	2.65	3.31	14
Orbit length	1.95	2.20	2.50	28	2.27	2.87	3.25	45	1.73	2.22	2.95	6	1.67	2.39	3.24	15
Intorbital length	5.2	6.2	7.2	28	3.9	6.0	7.4	45	6.8	7.2	7.6	6	4.9	6.1	7.1	15
Postorbital length	12	13.8	15	28	11	12.4	13	45	13	13.6	15	4	12	13.3	15	15
Preanal distance	47	49.3	55	30	42	46.2	54	44	47	48.3	51	6	40	43.0	45	16
Predorsal distance	25	28.5	33	28	24	26.8	32	45	25	27.4	30	6	24	27.2	31	15
Distance between pelvic- and anal-fin origin	34	37.9	44	28	29	34.1	41	44	32	34.6	36	5	28	30.2	33	15
Pelvic-fin length	11	13.5	18	23	10	13.5	18	36	6.4	11.2	15	5	3.6	11.8	16	15
<b>in % head length</b>																
Upper jaw length	47	49.8	54	28	43	46.8	52	44	51	52.9	55	6	45	51.0	57	15
Orbit length	9.9	11.0	12	28	12	14.8	17	45	9.3	11.2	14	6	8.0	11.9	16	15
<b>Otolith characters in % SL</b>																
Otolith length	1.50	2.19	2.84	21	2.02	2.78	3.27	31	0.96	1.77	2.80	3	1.35	1.80	2.85	5
Otolith height	1.06	1.23	1.70	21	1.30	1.65	2.16	31	0.80	1.23	1.68	3	0.96	1.19	1.83	5
Sulcus length	1.19	1.48	1.73	21	1.23	1.70	2.17	30	0.57	0.97	1.39	3	1.00	1.18	1.75	5
Ostium length	0.84	1.06	1.22	21	0.92	1.25	1.63	31	0.44	0.70	0.97	3	0.68	0.88	1.34	5
Ostium width	0.20	0.26	0.31	21	0.35	0.44	0.58	31	0.16	0.26	0.34	3	0.26	0.31	0.43	5
<b>in % otolith length</b>																
Otolith height	44	56.8	71	21	48	59.7	75	31	60	73.7	83	3	63	66.8	72	5
Sulcus length	54	68.2	81	21	47	61.4	72	30	49	56.6	61	3	61	66.6	74	5
Ostium length	40	48.9	58	21	34	45.2	54	31	34	41.8	46	3	47	49.6	54	5
Ostium width	9.3	12.1	16	21	12	15.8	20	31	12	15.5	18	3	15	18.0	19	5
<b>Ostium width in % of:</b>																
Otolith height	64	71.9	79	21	63	73.9	79	30	70	73.6	76	3	68	74.6	78	5
Sulcus length	15	17.8	21	21	22	25.8	30	30	24	27.2	29	3	24	26.9	30	5
Ostium length	19	24.8	29	21	31	35.1	40	31	35	36.9	39	3	32	36.2	40	5

Table 4. *Spectrunculus crassus*, larger-sized ( $\geq 200$  mm SL) specimens, type and areas separated

SL (mm)	S. <i>crassus</i> HT					NE Pacific				
	N Atlantic	Min	Mean	Max	<i>n</i>	282	Min	Mean	Max	<i>n</i>
	284	216	429.1	575	47	282	239	347.6	458	5
<b>Meristic characters</b>										
Dorsal-fin rays	133	121	128.3	139	37	135	121	125.6	129	5
Caudal-fin rays	10	7	8.0	9	27		8	8.0	8	3
Anal-fin rays	100	91	97.7	102	37	102	96	97.8	100	5
Precaudal vertebrae	20	20	21.3	22	40	22	20	21.2	22	5
Total vertebrae	75	73	75.5	79	37	72	73	74.4	76	5
First dorsal-fin ray above vertebra nr.	8	7	8.4	10	37	8	8	9.0	10	5
Dorsal-fin ray above anal-ray nr.	31	30	33.2	38	36	35	27	30.0	31	5
First anal-fin rays below vertebra nr.	23	22	24.5	27	37	25	22	23.8	25	5
Total vertebrae	75	73	75.5	79	37	72	73	74.4	76	5
Pectoral-fin rays	26	25	25.9	27	7	25	25	26.0	27	5
Developed gill rakers	8	8	8.9	9	8	9	8	9.0	10	5
Total gill rakers	17	17	19.0	21	8	18	18	19.8	22	5
<b>Morphometric characters in % SL</b>										
Head length	21	18	19.4	22	38	19	18.7	20.1	21.3	5
Body depth at anus	22	16	18.3	21	38	17	15.4	17.2	19.1	5
Snout length	5.3	4.7	5.4	6.0	38	5.2	5.0	5.5	6.1	5
Upper jaw length		8.1	9.0	10	38	8.8	9.0	9.6	10.5	5
Head width at postmaxilla		6.3	8.2	12	37	11	6.9	9.4	10.8	5
Depth of postmaxilla	2.89	1.93	2.46	2.98	37	2.20	2.61	2.86	3.02	5
Orbit length	2.82	2.42	2.90	3.25	38	2.84	2.27	2.66	2.88	5
Intorbital length	7.4	4.9	6.0	7.0	38	6.2	3.9	5.9	7.2	5
Postorbital length	13.2	11	12.4	13	38	12	11.5	12.7	13.3	5
Preanal distance	46.4	43	46.4	54	37	45	41.9	44.4	46.2	5
Predorsal distance	26.9	24	26.9	32	38	24	25.5	27.0	29.9	5
Distance between pelvic- and anal-fin origin	32.0	29	34.5	41	37	30	30.3	32.0	34.7	5
Pelvic-fin length	11.1	10	13.6	18	29	12	13.0	14.3	15.3	5
<b>in % head length</b>										
Upper jaw length		43	46.7	51	38	45	45.5	47.7	51.8	5
Orbit length	14	13	15.0	17	38	15	12.2	13.2	14.0	5
<b>Otolith characters in % SL</b>										
Otolith length		2.02	2.78	3.27	31					
Otolith height		1.30	1.65	2.16	31					
Sulcus length		1.23	1.70	2.17	30					
Ostium length		0.92	1.25	1.63	31					
Ostium width		0.35	0.44	0.58	31					
<b>in % otolith length</b>										
Otolith height		48	59.7	75	31					
Sulcus length		47	61.4	72	30					
Ostium length		34	45.2	54	31					
Ostium width		12	15.8	20	31					
<b>Ostium width in % of:</b>										
Otolith height		21	26.5	33	31					
Sulcus length		22	25.8	30	30					
Ostium length		31	35.1	40	31					

Table 5. Small-sized (<200 mm SL) specimens of two *Spectrunculus* species

SL (mm)	<i>S. crassus</i>				<i>S. radcliffei</i>			
	Min	Mean	Max	<i>n</i>	Min	Mean	Max	<i>n</i>
106	136.3	187	4	56	143.4	196	7	
<b>Meristic characters</b>								
Dorsal-fin rays	129	130.8	134	4	138	140.9	147	7
Caudal-fin rays	8	8.0	8	2	8	8.3	9	3
Anal-fin rays	97	99.5	101	4	104	106.3	110	7
Precaudal vertebrae	20	21.3	22	4	22	23.0	24	7
Total vertebrae	74	75.3	78	4	80	81.0	83	7
First dorsal-fin ray above vertebra nr.	7	7.5	8	2	8	9.0	10	4
Dorsal-fin ray above anal-ray nr.	33	33.5	34	2	34	36.0	37	4
First anal-fin rays below vertebra nr.	24	24.0	24	2	25	26.3	27	4
Total vertebrae	74	75.3	78	4	80	81.0	83	7
Pectoral-fin rays	25	26.0	27	2	27	27.7	28	3
Developed gill rakers		9		1	9	9.0	9	2
Total gill rakers		18		1	20	20.5	21	2
<b>Morphometric characters in % SL</b>								
Head length	18	19.6	21	2	18	20.9	24	4
Body depth at anus	16	17.3	19	2	14	15.5	17	4
Snout length	5.2	5.4	5.6	2	4.6	5.2	5.8	4
Upper jaw length	7.7	8.9	10	2	7.9	9.5	10	4
Head width at postmaxilla	7.1	7.8	8.6	2	7.7	8.4	9.3	4
Depth of postmaxilla	2.32	2.53	2.73	2	2.40	2.86	3.30	4
Orbit length	2.89	2.99	3.10	2	2.55	3.28	4.09	4
Intorbital length	4.2	4.3	4.4	2	4.5	4.8	5.3	4
Postorbital length	11	12.1	13	2	11	12.8	15	4
Preanal distance	41	43.0	45	2	42	42.6	45	4
Predorsal distance	24	25.5	27	2	24	24.3	26	4
Distance between pelvic- and anal-fin origin	29	30.1	31	2	29	30.9	32	4
Pelvic-fin length	13	13.8	15	2	12	13.7	15	3
<b>in % head length</b>								
Upper jaw length	43	45.2	48	2	41	45.9	54	4
Orbit length	15	15.3	16	2	13	15.5	18	4
<b>Otolith characters in % SL</b>								
Otolith length	2.91	2.92	2.93	2	2.83	3.18	3.63	3
Otolith height	1.76	1.87	1.97	2	1.61	1.82	2.06	3
Sulcus length	1.27	1.33	1.38	2	1.45	1.74	2.06	3
Ostium length	0.65	0.80	0.95	2	0.97	1.19	1.47	3
Ostium width	0.34	0.36	0.38	2	0.43	0.49	0.55	3
<b>in % otolith length</b>								
Otolith height	60	64.0	68	2	57	57.3	58	3
Sulcus length	43	45.5	47	2	51	54.5	57	3
Ostium length	22	27.4	33	2	34	37.1	40	3
Ostium width	12	12.3	13	2	13	15.6	18	3
<b>Ostium width in % of:</b>								
Otolith height	17	19.4	22	2	24	27.1	31	3
Sulcus length	24	27.2	30	2	24	28.6	32	3
Ostium length	35	47.3	59	2	33	42.3	49	3

Table 6. *Spectrunculus grandis*, type and areas separated.

SL (mm)	HT									
	NW Pacific	SW Pacific				NE Pacific				
	675	Min	Mean	Max	<i>n</i>	Min	Mean	Max	<i>n</i>	<i>n</i>
<b>Meristic characters</b>										
Dorsal-fin rays	136	135	136.0	137	3	135	136.3	137	3	
Caudal-fin rays	8	8	8.0	8	2	8	8.0	8	2	
Anal-fin rays	104	103	104.3	105	3	101	103.0	105	3	
Precaudal vertebrae	22	22	22.7	23	3	22	22.7	23	3	
Total vertebrae	77	79	79.7	80	3	78	79.0	80	3	
First dorsal-fin ray above vertebra nr.	9	9	9.0	9	2	9	9.5	10	2	
Dorsal-fin ray above anal-ray nr.	38	39	40.0	41	2	35	36.0	37	2	
First anal-fin rays below vertebra nr.	27	28	28.0	28	2	26	26.5	27	2	
Total vertebrae	77	79	79.7	80	3	78	79.0	80	3	
Pectoral-fin rays	29	26	28.5	31	2	27	27.5	28	2	
Developed gill rakers	7	8	9.0	10	2	7	7.0	7	2	
Total gill rakers	19	21	21.5	22	2	25	25.5	26	2	
<b>Morphometric characters in % SL</b>										
Head length	22	19	19.9	20	2	17	19.0	21	3	
Body depth at anus	22	17	18.7	20	2	18	18.6	19	2	
Snout length	6.1	5.0	5.0	5.1	2	5.7	5.8	6.0	2	
Upper jaw length	11	10.5	10.6	11	2	8.7	10.1	11	3	
Head width at postmaxilla	11	9.1	10.3	11	2		12		1	
Depth of postmaxilla	3.29		2.72		1	2.20	2.63	2.92	3	
Orbit length	2.25	2.18	2.27	2.37	2	1.73	2.18	2.95	3	
Intorbital length	7.1	6.8	7.1	7.4	2	7.0	7.3	7.6	3	
Postorbital length	15	13	12.9	13	2	14	14.1	14	1	
Preanal distance	51	47	47.1	48	2	47	48.1	49	3	
Predorsal distance	27	26	28.1	30	2	25	27.1	28	3	
Distance between pelvic- and anal-fin origin	36	35	35.3	36	2	32	33.1	35	2	
Pelvic-fin length	13	13	13.6	15	2	6.4	7.8	9.2	2	
<b>in % head length</b>										
Upper jaw length	51	51.6	53.5	55	2	52	53.0	55	3	
Orbit length	10	11	11.4	12	2	9.3	11.3	14	3	
<b>Otolith characters in % SL</b>										
Otolith length	1.56		2.80		1		0.96		1	
Otolith height	1.22		1.68		1		0.80		1	
Sulcus length	0.95		1.39		1		0.57		1	
Ostium length	0.71		0.97		1		0.44		1	
Ostium width	0.28		0.34		1		0.16		1	
<b>in % otolith length</b>										
Otolith height	78		60		1		83		1	
Sulcus length	61		49		1		60		1	
Ostium length	46		34		1		45		1	
Ostium width	18		12		1		17		1	
<b>Ostium width in % of:</b>										
Otolith height	23		20		1		20		1	
Sulcus length	29		24		1		28		1	
Ostium length	39		35		1		37		1	

Table 7. Larger-sized *Spectrunculus radcliffei*, areas separated, with small-sized HT

	HT, NE Pacific	NW Pacific			SW Pacific			NE Pacific			S Indian Ocean	SE Atlantic		
	(small) 56	Min 925	Mean 968.3	Max 1020	<i>n</i> 3	423	332	307	Min 568.0	Mean 1205	<i>n</i> 9	910	541	378
SL (mm)														
<b>Meristic characters</b>														
Dorsal-fin rays	140	138	138.3	139	3	135	139	138	140.4	144	9		136	140
Caudal-fin rays	8	8	8.0	8	3	8	10	7	8.1	9	9		8	8
Anal-fin rays	104	106	107.3	109	3	103	108	104	107.3	112	9		105	108
Precaudal vertebrae	23	22	22.7	23	3	23	20	22	23.2	24	9		22	23
Total vertebrae	80	78	78.7	79	3	78	79	79	81.0	83	9		79	82
First dorsal-fin ray above vertebra nr.		7	8.7	10	3	9	7	9	9.8	11	9		9	10
Dorsal-fin ray above anal-ray nr.		35	36.3	38	3	37	35	32	35.2	38	9		35	37
First anal-fin rays below vertebra nr.		27	27.7	28	3	26	24	24	25.6	27	9		25	27
Pectoral-fin rays	28	25	26.3	27	3	27	25	25	27.6	29	9		26	26
Developed gill rakers		8	8.0	8	3	9	9	8	8.6	9	8		8	9
Total gill rakers		20	20.3	21	3	18	21	18	19.1	21	8		17	18
<b>Morphometric characters in % SL</b>														
Head length		19	19.6	21	3	21	19	19	20.5	22	8		19	19
Body depth at anus		14	15.2	16	3	17	17	14	16.3	19	8		19	19
Snout length		4.9	5.1	5.3	3	5.7	5.1	5.0	5.5	6.0	8		4.9	5.6
Upper jaw length		9.6	10.1	11	3	10	9.0	10	10.7	12	8		8.4	9.6
Head width at postmaxilla		7.5	8.2	9.2	3	9.6	13	8.5	10.3	12	8		8.5	8.9
Depth of postmaxilla		2.29	2.37	2.42	3	2.50		2.62	2.88	3.31	8		2.18	2.30
Orbit length		1.67	1.96	2.20	3	2.24	2.61	2.09	2.50	3.24	8		2.47	2.59
Interorbital length		5.1	5.4	5.7	3	6.8	7.0	4.9	6.3	7.1	8		5.4	5.7
Postorbital length		13	13.6	15	3	14	12	12	13.4	15	8		13	13
Preanal distance		43	43.9	45	3	44	44	40	42.6	45	9		42	44
Predorsal distance		29	30.0	31	3	26	24	26	26.9	29	8		27	26
Distance between pelvic- and anal-fin origin		31	31.8	33	3	33	30	28	29.1	31	8		31	31
Pelvic-fin length		10	11.5	13	3	12	12	3.6	11.5	16	8		12	15
<b>Morphometric characters in % head length</b>														
Upper jaw length		51	51.3	52	3	50	48	49	52.1	57	8		45	51
Orbit length		8.0	10.1	12	3	11	14	11	12.2	16	8		13	14
<b>Otolith characters in % SL</b>														
Otolith length		1.35	1.51	1.68	3							1.62	2.85	
Otolith height		0.96	1.03	1.07	3							1.04	1.83	
Sulcus length		1.00	1.04	1.07	3							1.04	1.75	
Ostium length		0.68	0.77	0.81	3							0.77	1.34	
Ostium width		0.26	0.28	0.29	3							0.31	0.43	
<b>Otolith characters in % otolith length</b>														
Otolith height		63	68.5	72	3							64	64	
Sulcus length		63	69.1	74	3							65	61	
Ostium length		48	51.0	54	3							48	47	
Ostium width		17	18.5	19	3							19	15	
<b>Ostium width in % of:</b>														
Otolith height		27	27.0	28	3							30	23	
Sulcus length		26	26.8	27	3							30	24	
Ostium length		35	36.3	38	3							40	32	

Table 8. Ranges of major characters separating the four species of *Spectrunculus* (morphometric data referring to specimens  $\geq 200$  mm SL). The most important distinguishing characters (singly or in combination) from the three other species, respectively, are emphasized in bold italics.

	<i>S. stenostio</i>	<i>S. crassus</i>	<i>S. grandis</i>	<i>S. radcliffei</i>
Maximum standard length	< 110 cm	< <b><i>60 cm</i></b>	< <b><i>130 cm</i></b>	<130 cm
Dorsal-fin rays	137–148	<b><i>121–139</i></b>	<b><i>135–137</i></b>	135—147
Anal-fin rays	102–112	<b><i>91–102</i></b>	<b><i>101–105</i></b>	<b><i>103–112</i></b>
Vertebrae	<b><i>80–88</i></b>	<b><i>72–79</i></b>	<b><i>77–80</i></b>	78–83
Preanal length in % SL	47–55	42–54	<b><i>47–51</i></b>	<b><i>40–45</i></b>
Base of pelvic fin to anal-fin origin in % SL	34–44	29–41	<b><i>32–36</i></b>	<b><i>28–33</i></b>
Orbit length in % head length	9.9–12	<b><i>12–17</i></b>	<b><i>9.3–14</i></b>	8.0–16
Otolith ostium width in % sulcus length	<b><i>15–21</i></b>	22–30	<b><i>24–29</i></b>	24–30
Otolith ostium width in % ostium length	<b><i>19–29</i></b>	31–40	<b><i>35–39</i></b>	32–40











