Records of anglerfishes (Lophiiformes: Lophiidae) from the western South Pacific Ocean, with descriptions of two new species

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Species of Lophiidae collected from the western South Pacific Ocean are examined. Nine nominal species are recognized, all but one species with their distributions extended eastwards and southwards from the western Pacific Ocean. Two new species are described from Polynesia. *Lophiodes iwamotoi* n. sp. is described from five specimens collected from Savannah Seamount. It is characterized by a relatively long third dorsal-fin spine (56·9–70·8% standard length, *L*<sub>S</sub>) that extends (when retracted) to between the end of the soft dorsal fin and caudal-fin base; a relatively short fifth dorsal-fin spine (10·5–13·1% *L*<sub>S</sub>); a relatively short and narrow head; 19–20 pectoral-fin rays. *Lophiodes maculatus* n. sp. is described from 20 specimens collected from Marquesas Islands. It is characterized by an extremely long third dorsal-fin spine (71·9–87·2% *L*<sub>S</sub>), extending well beyond the caudal-fin base; a relatively short fifth dorsal-fin spine (11·4–16·5% *L*<sub>S</sub>); 17–18 pectoral-fin rays. A key to the lophiids in the western South Pacific Ocean is provided.

Key words: French Polynesia; *Lophiodes iwamotoi* n. sp.; *Lophiodes maculatus* n. sp.; Pisces; taxonomy.

INTRODUCTION

The anglerfish family Lophiidae, also known as monkfishes, is poorly known in the western South Pacific Ocean. Although 10 species have been reported from the western Pacific Ocean (Caruso, 1981, 1983, 1999; Saruwatari & Mochizuki, 1985; Ho & Shao, 2008), only blackmouth anglerfish *Lophiomus setigerus* (Vahl 1797), goosefish *Lophiodes naresi* (Günther 1880) and smooth anglerfish *Lophiodes mutilus* (Alcock 1894) have been reported from the coast of eastern Australia (Caruso, 1981, 1983) and only *L. setigerus* and *L. mutilus* have been reported from the western South Pacific Ocean (Caruso, 1999, Fricke, 1999). Recently, Ho et al. (2009) redescribed shortspine goosefish *Lophiodes infrabruneus* Smith & Radcliffe 1912 and reported it from the Solomon Islands.

Since 1976, the French Institut de recherche pour le développement (IRD) has undertaken a series of exploratory cruises in the Indo-Pacific Ocean to investigate
the marine fauna of this region. Accounts of these cruises and their results are available online (www.mnhn.fr/musorstom) and in a series of publications (Crosnier 1991, 2000; Séret, 1997).

A large number of unidentified lophiiform specimens were obtained on these cruises and deposited in the Muséum national d’Histoire naturelle, Paris (MNHN), and the Museum of New Zealand Te Papa Tongarewa, Wellington (NMNZ). Examination of these specimens revealed two genera and nine species present in those collections from the western South Pacific Ocean: *L. setigerus*, *L. naresi* and *Lophiodes endoi* Ho & Shao 2008 from New Caledonia; *Lophiodes miacanthus* (Gilbert 1905) from New Caledonia and Wallis and Futuna; *Lophiodes bruchius* Caruso 1981 from Marquesas Islands; *L. mutilus* from Solomon Islands, New Caledonia, Vanuatu, Chesterfield Islands, Wallis and Futuna and Lifou Island (Loyalty Islands); *L. infrabrunneus* from Solomon Island and a new species *Lophiodes maculatus* n. sp. from Marquesas Islands described here.

Five additional specimens collected from Savannah Seamount, c. 300 km south of the Society Islands, were also found in the collections of the National Science Museum, Tokyo (NSMT). Those specimens were collected by the Japanese R.V. *Kaiyo-maru* in 1977 in one of many cruises conducted by the Fisheries Agency of Japan to investigate the fishery resources of the Indo-Pacific Ocean region. These specimens are now described as *Lophiodes iwamotoi* n. sp. in this study.

Both new species belong to the *L. mutilus* species group (Caruso, 1981:538) and are most similar to *L. mutilus* in having a relatively long third dorsal-fin spine, many membranous flaps (so-called tendrils, Caruso, 1981) on the third dorsal-fin spine and the presence of an inner frontal spine. Both species, however, differ from *L. mutilus* and other congeners in having a substantially longer third dorsal-fin spine and the combination of additional characters.

The objectives of this paper are to (1) document all the lophiid species from the western South Pacific Ocean, (2) describe and name the new species and (3) provide a key to all species from the study area.

**MATERIALS AND METHODS**

Methods and definitions of the characters and cranial spines used in this study followed Caruso (1981, 1983). The definition of western South Pacific Ocean is from the Equator south to 60° S, from Papua New Guinea and the east coast of Australia eastwards to French Polynesia. Standard length (*L*<sub>s</sub>, mm) is used throughout. Terminology for describing the angling apparatus follows Bradbury (1988). The definitions for species groups in *Lophiodes* follows Caruso (1981) and are not repeated in this work. Specimens used in this study are deposited at Biodiversity Research Center, Academia Sinica, Taipei, Taiwan (ASIZP); Faculty of Fisheries, Kichi University, Kochi, Japan (BSKU); Musée national d’Histoire naturelle, Paris, France (MNHN); Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand (NMNZ); National Science Museum, Tokyo, Japan (NSMT-P) and Natural History Museum, Smithsonian Institution, Washington D.C., U.S.A. (USNM). Comparative data are those taken from Caruso (1981) and Ho & Shao (2007, 2008). Data from a 124 mm *L*<sub>s</sub> paratype was not used due to its poor condition. The illicial length and spine lengths of the second, third and fifth dorsal-fin were measured from 69 specimens for *L. mutilus*. 

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RESULTS

FAMILY LOPHIIDAE

Lophiodes iwamotoi n. sp., long-spine anglerfish (Figs 1 and 2 and Table I)

Materials: Holotype: NSMT-P 95089 (226 mm $L_S$), R.V. Kaiyo-maru, station (sta.) T31, 19° 17·2′ S, 151° 35·2′ W, Savannah Seamount, 300 km south of Society Islands, 706–710 m, 6 February 1977.

Paratypes: NSMT-P 95088 (1, 222 mm $L_S$) and NSMT P95090 (1, 169 mm $L_S$), collected with the holotype. NSMT-P95093 (2, 124–196 mm $L_S$), 19° 17·8′ S; 151° 35·2′ W, Savannah Seamount, 300 km south of Society Islands, 706–710 m, 6 February 1977.

Diagnosis: A member of the $L$. mutilus species group (Caruso, 1981:538) with a relatively long third dorsal-fin spine (56·9–70·8% $L_S$); appressed third dorsal-fin spine reaches between soft dorsal fin and caudal-fin bases (Fig. 3); a relatively narrow head [head width (HW) = 52·1–53·8% head length, $L_H$]; a relatively short distance between lower quadrate and anterior palatine spines (66·7–72·6% $L_H$); a relatively short fifth dorsal-fin spine (10·5–13·1% $L_S$), not extending beyond the origin of soft dorsal-fin base; and 19–20 pectoral-fin rays.

Description: Morphometric and meristic values are given in Tables I and II. Dorsal-fin spines III-0-II; dorsal-fin rays 8; anal-fin rays 6; pectoral-fin rays 19–20 (20 in four of five specimens, including the holotype).

Head relatively short ($L_H$ = 36·2–37·2% $L_S$) and narrow (HW = 52·1–53·8% $L_H$); interorbital space flat; eyes large, directed dorsolaterally. Anterior half of premaxilla with three rows of enlarged teeth, those on the innermost row largest, followed by a single row of small teeth on posterior half; lower jaw with three rows of teeth, those on the innermost row largest; vomer with one single row of small teeth on each end, the outer teeth largest; palatine with a single row of small teeth;

Fig. 1. Lophiodes iwamotoi n. sp., NSMT-P 95089, holotype, 226 mm standard length, from Savannah Seamount.
fifth ceratobranchial with two rows of small teeth, forming a V-shaped patch; those on second and third pharyngobranchials forming small and rounded patches. No gill rakers. Pseudobranch present.

Illicium relatively short (23.0–26.7% $L_S$), slightly extending beyond base of third dorsal-fin spine (when retracted); esca a small simple bulb, without cirri at tip; second dorsal-fin spine moderately long (27.2–31.7% $L_S$), generally longer than illicium (except for the 124 mm paratype in which it is shorter), extending to the posterior end of skull in small specimens (<200 mm $L_S$) and to the cleithral spines in large specimens (>200 mm $L_S$); third dorsal-fin spine relatively long (56.9–70.8% $L_S$ v. up to 65.4% $L_S$ in all congeners, except for $L. maculatus$ n. sp. described below), bearing many tendrils along the entire length, extending to the end of soft dorsal-fin base in large specimens to caudal-fin base in small specimens; fourth dorsal-fin spine absent; fifth dorsal-fin spine relatively short (10.5–13.1% $L_S$), extending to origin of soft dorsal fin; sixth dorsal-fin spine close to the fifth one, embedded under skin.

Palatine spines sharp; frontal ridge smooth, without knobs; frontal spines low and blunt, relatively compressed [Fig. 2(a)]; inner frontal spine small and blunt; inner sphenotic spines low and blunt, directed upwards and not recurved, outer sphenotic spines broad and compressed [Fig. 2(b)]; epiotic spines present, relatively strong; quadrate and anterior articular spines blunt, posterior articular spines strongly reduced; hyomandibular bears three low and blunt spines [Fig. 2(c)]; opercular spines blunt, forming small knobs; subopercular and interopercular spines strong and sharp; cleithral spines strong and blunt; humeral spines well developed, simple with three to four small knobs on its base [Fig. 2(d)].

Colouration in alcohol: Colour strongly faded due to preservation. Background colouration grey to brown with many large light brown patches on dorsal surface,
pale to light grey on ventral surface; colour of illicium and esca as on dorsal surface; all fins pale distally; peritoneum black.

Distribution: Represented by the type series collected from Savannah Seamount, 300 km south of Society Islands, at depths of 706–710 m (Fig. 4).

Size: Adults attain an \( L_S \) of at least 226 mm.

Etymology: Named for T. Iwamoto, senior curator of the California Academy of Sciences, San Francisco, in recognition of his contributions to deep-sea fish studies, especially the macrourids.

Remarks: *Lophiodes iwamotoi* is most similar to *L. mutilus* but can be distinguished by having modally 20 pectoral-fin rays (\( v. \) 16; Table II), a relatively long third dorsal-fin spine (Fig. 5; 56.9–70.8% \( L_S \) \( v. \) 36.6–65.4% \( L_S \)), extending to between soft dorsal fin and caudal-fin bases (Fig. 3, \( v. \) never extending beyond the anterior two-thirds of the soft dorsal-fin base); a relatively short fifth dorsal-fin spine.

Fig. 3. Difference in the range where the tip of appressed third dorsal-fin spine reaches in three *Lophiodes* species.

Fig. 4. Distribution map of lophiid species in the western South Pacific Ocean. *Lophiodes bruchius*: 1; *Lophiodes endoi*: 3; *Lophiodes infrabrunneus*: 5; *Lophiodes iwamotoi*: 2; *Lophiodes maculatus*: 1; *Lophiodes micanthus*: 3 and 4; *Lophiodes mutilus*: 3, 4, 5, 6, 7 and 8; *Lophiodes naresi*: 3 and 8; *Lophiomus setigerus*: 3 and 8 [8, based on literature records of Caruso (1981, 1983)]. One dot may represent more than one species and one capture in near area. Some species also have their distribution outside this area.
<table>
<thead>
<tr>
<th>Specimen</th>
<th>Lophioides iwamotoi n. sp.</th>
<th>L. maculatus n. sp.</th>
<th>L. bruchi L. endoi L. miacanthus L. naresi L. mutilus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Holotype</td>
<td>All types</td>
<td>Holotype</td>
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</tbody>
</table>

### Ls (mm)

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<tr>
<th></th>
<th>Mean ± s.d. (range)</th>
<th>Mean ± s.d. (range)</th>
<th>Range</th>
<th>Mean (range)</th>
<th>Range</th>
<th>Range</th>
<th>Mean (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size as % Ls Ls</td>
<td>36.2 ± 36.6 ± 0.5 (36.2–37.2)</td>
<td>36.1 ± 36.9 ± 1.0 (34.8–38.2)</td>
<td>40.9</td>
<td>32.4 (30.5–34.9)</td>
<td>35.2–35.3</td>
<td>30.9–32.8</td>
<td>38.6 (34.4–41.2)</td>
</tr>
<tr>
<td>Illicial length</td>
<td>26–7 ± 24.8 ± 1.7 (23.0–26.7)</td>
<td>27.2 ± 28.0 ± 2.2 (23.8–33.7)</td>
<td>25.9</td>
<td>24.6 (21.0–27.4)</td>
<td>27.4–27.6</td>
<td>23.6–27.0</td>
<td>27.1 (20.7–35.0)</td>
</tr>
<tr>
<td>Second dorsal-spine length</td>
<td>31–7 ± 28.8 ± 2.0 (27.2–31.7)</td>
<td>33–0 ± 31.6 ± 3.2 (28.0–38.6)</td>
<td>26.8</td>
<td>28.3 (27.6–31.3)</td>
<td>29.5–31.2</td>
<td>34.4–36.5</td>
<td>26.9 (19.7–35.9)</td>
</tr>
<tr>
<td>Third dorsal-spine length</td>
<td>69 ± 66.4 ± 6.4 (56.9–70.8)</td>
<td>81–1 ± 79.9 ± 5.2 (71.9–87.2)</td>
<td>54.3</td>
<td>38.9 (33.2–43.1)</td>
<td>42.3–46.8</td>
<td>38.7–39.9</td>
<td>54.0 (36.6–64.5)</td>
</tr>
<tr>
<td>Fifth dorsal-spine length</td>
<td>13–1 ± 11.4 ± 1.4 (10.5–13.1)</td>
<td>11–9 ± 13.4 ± 2.1 (11.4–16.5)</td>
<td>7.1</td>
<td>17.5 (14.4–19.5)</td>
<td>7.3–9.1</td>
<td>16.0–27.0</td>
<td>22.8 (16.9–29.3)</td>
</tr>
<tr>
<td>Tail length</td>
<td>26–3 ± 28.0 ± 1.2 (26.3–29.0)</td>
<td>26–8 ± 25.5 ± 2.0 (22.2–29.1)</td>
<td>25.1</td>
<td>25.4 (22.9–26.9)</td>
<td>24.4–25.0</td>
<td>27.8–28.2</td>
<td>28.8 (24.3–30.3)</td>
</tr>
<tr>
<td>Size as % Lh</td>
<td>36–2 ± 36.6 ± 0.5 (36.2–37.2)</td>
<td>36–1 ± 36.9 ± 1.0 (34.8–38.2)</td>
<td>40.9</td>
<td>32.4 (30.5–34.9)</td>
<td>35.2–35.3</td>
<td>30.9–32.8</td>
<td>38.6 (34.4–41.2)</td>
</tr>
<tr>
<td>Head width</td>
<td>52–1 ± 52.8 ± 0.9 (52.1–53.8)</td>
<td>61–6 ± 64.9 ± 1.6 (61.6–67.5)</td>
<td>54.5</td>
<td>62.9 (59.2–64.1)</td>
<td>57.2–65.3</td>
<td>60.0–62.6</td>
<td>54.1 (51.6–58.9)</td>
</tr>
<tr>
<td>Head depth</td>
<td>56–8 ± 67.1 ± 0.9 (65.8–67.9)</td>
<td>76–4 ± 76.0 ± 1.5 (73.3–78.9)</td>
<td>71.6</td>
<td>75.4 (73.6–78.2)</td>
<td>75.1–78.4</td>
<td>67.3–74.8</td>
<td>64.1 (61.1–68.5)</td>
</tr>
<tr>
<td>Snout length</td>
<td>57–5 ± 56.9 ± 1.0 (55.4–57.5)</td>
<td>66–1 ± 66.4 ± 1.4 (63.2–68.5)</td>
<td>58.4</td>
<td>66.3 (64.3–67.7)</td>
<td>65.9–67.6</td>
<td>66.4</td>
<td>55.3 (51.5–59.1)</td>
</tr>
<tr>
<td>Snout width</td>
<td>19–2 ± 20.5 ± 1.6 (19.2–22.5)</td>
<td>22–4 ± 24.9 ± 2.1 (21.7–28.6)</td>
<td>18.1</td>
<td>24.9 (23.4–27.7)</td>
<td>18.1–22.7</td>
<td>21.8–27.1</td>
<td>17.7 (16.9–19.4)</td>
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### Table I. Continued

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<thead>
<tr>
<th>Specimen</th>
<th>( L. ) iwamotoi n. sp.</th>
<th>( L. ) maculatus n. sp.</th>
<th>( L. ) bruchius</th>
<th>( L. ) endoi</th>
<th>( L. ) miacanthus</th>
<th>( L. ) naresi</th>
<th>( L. ) mutilus</th>
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<td>Specimen</td>
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<td>All types</td>
<td>Ho1otype</td>
<td>All types</td>
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<td></td>
<td>226</td>
<td>169–226 (( n = 4 ))</td>
<td>137</td>
<td>93–141 (( n = 20 ))</td>
<td>105–259 (( n = 1 ))</td>
<td>93–106 (( n = 9 ))</td>
<td>163–178 (( n = 2 ))</td>
</tr>
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<td>( L )S (mm)</td>
<td>Mean ± s.d.</td>
<td>Mean ± s.d.</td>
<td>Range</td>
<td>Range</td>
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<td>Distance between inner</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>sphenotic spines</td>
<td>42·5</td>
<td>41·8 ± 0·5 (41·1–42·5)</td>
<td>47·8</td>
<td>50·5 ± 1·5 (47·8–53·3)</td>
<td>42·4</td>
<td>51·6 (49·2–53·3)</td>
<td>48·4–50·9 (40·1 (38·8–45·1)</td>
</tr>
<tr>
<td>Distance between posterior frontal spines</td>
<td>42·5</td>
<td>42·4 ± 1·0 (41·0–43·2)</td>
<td>50·7</td>
<td>52·0 ± 1·9 (47·4–56·0)</td>
<td>41·0</td>
<td>45·0 (41·8–50·0)</td>
<td>47·6–51·5 (31·8–41·1)</td>
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<td>Distance between pterotic and sphenotic spines</td>
<td>20·5</td>
<td>19·9 ± 0·7 (19·2–20·5)</td>
<td>20·3</td>
<td>21·7 ± 1·0 (20·0–23·4)</td>
<td>20·5</td>
<td>21·5 (20·8–22·0)</td>
<td>18·2–22·1 (18·2–20·1)</td>
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<td>Distance between quadrate and anterior palatine spines</td>
<td>67·1</td>
<td>68·6 ± 2·7 (66·7–72·6)</td>
<td>80·9</td>
<td>77·0 ± 3·2 (70·0–82·4)</td>
<td>77·3</td>
<td>76·3 (73·4–80·6)</td>
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<tr>
<td>Distance between opercular and subopercular spines</td>
<td>45·2</td>
<td>44·6 ± 2·4 (41·6–47·4)</td>
<td>52·4</td>
<td>53·8 ± 2·4 (50·0–60·3)</td>
<td>45·2</td>
<td>51·2 (50·2–53·1)</td>
<td>45·4–46·9 (43·9–44·5)</td>
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Table II. Distributions of pectoral-fin ray numbers of all lophiid species reported in present study. All values are counted on both sides

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<th>Species</th>
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<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
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<th>21</th>
<th>22</th>
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<td>Lophiodes bruchius</td>
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<td></td>
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<tr>
<td>Lophiodes endoi</td>
<td>9</td>
<td>6</td>
<td>10</td>
<td>1</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Lophiodes infrabrunneus</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
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<td></td>
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<tr>
<td>Lophiodes iwamotoi n. sp.</td>
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<td></td>
<td></td>
<td>2</td>
<td>8</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Lophiodes maculatus n. sp.</td>
<td>20</td>
<td></td>
<td>18</td>
<td>22</td>
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<tr>
<td>Lophiodes mutilus</td>
<td>44</td>
<td>4</td>
<td>74</td>
<td>8</td>
<td>2</td>
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<tr>
<td>Lophiomus setigerus</td>
<td>1</td>
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</table>

n, sample size.

(Fig. 6; 10.5–13.1% $L_S$ v. 16.9–29.3% $L_S$), extending to the origin of soft dorsal fin (v. second to fourth soft dorsal-fin ray bases). Although most morphometric values of the type series of *L. iwamotoi* overlap with those of *L. mutilus*, the values of illicial length, $L_H$, and HW in *L. iwamotoi* are all below the average values of those in *L. mutilus*, whereas head depth and snout width in *L. iwamotoi* are all above the average values of those in *L. mutilus*.

Ho & Shao (2008) noted that *L. bruchius* also has a relatively long third dorsal-fin spine length that overlaps with that of *L. iwamotoi*. It differs from *L. iwamotoi* in having a black escal tip with several cirri, many tendrils on entire length of third dorsal-fin spine and in cranial spine morphology.

Although the humeral spines are sometimes variable in members of *Lophiodes*, ranging from simple to multifid, all specimens in the type series of *L. iwamotoi* have a simple humeral spine with few short bumps on its base. Additional specimens may show this to be a useful diagnostic character.

**Lophiodes maculatus** n. sp., spotted anglerfish (Figs 7 and 8)

Materials: Holotype: MNHN 2001-0159 (137 mm $L_S$), MUSORTOM 9, sta. cp1271, 7° 53.6′ S; 140° 42.2′ W, Eiao, Marquesas Islands, French Polynesia, 600 m, 4 September 1997.

![Fig. 5](image.png)  
Fig. 5. Length of third dorsal-fin spine (DS3) as per cent $L_S$ and standard length ($L_s$) of *Lophiodes maculatus* (▲), *Lophiodes iwamotoi* (■) and *Lophiodes mutilus* (○). Data from four of five specimens are available for *L. iwamotoi* n. sp. due to damage of one.
Fig. 6. Length of fifth dorsal-fin spine (DS5) as per cent $L_S$ and standard length ($L_s$) of *Lophiodes maculatus* ( ), *Lophiodes iwamotoi* ( ■) and *Lophiodes mutilus* ( ○). Data from three of five specimens are available for *L. iwamotoi* n. sp. due to damage of two.

Paratypes: Nineteen specimens, all collected from Marquesas Islands, French Polynesia. MNHN 2000-4518 (4, 98–105 mm $L_S$), MUSORSTOM 9, sta. cp1269, 7° 56.3' S; 140° 43.3' W, Eiao, 420–430 m, 4 September 1997. MNHN 2000-4524 (6, 93–141 mm $L_S$), MUSORSTOM 9, sta. cp1251, 9° 47.2' S; 139° 38.2' W, Dumont d'Urville, 500–650 m, 2 September 1997. MNHN 2000-4574 (3, 99–100 mm $L_S$), MUSORSTOM 9, sta. cp1268, 7° 57.3' S; 140° 42.6' W, Eiao, 420–430 m, 4 September 1997. MNHN 2003-1245 (1, 105 mm $L_S$), MUSORSTOM 9, sta. cp1169, 8° 58.6' S; 140° 4.6' W, Nuku Hiva, 391–408, 24 August 1997. MNHN 2003-0969 (1, 101 mm $L_S$), MUSORSTOM 9, sta. cp1300, 8° 55.2' S; 140° 14.8' W, 283–448 m, 10 September 1997. MNHN 2003-0988 (4, 105–124 mm $L_S$), MUSORSTOM 9, sta. cp1306, 8° 55.2' S; 140° 14.8' W, 283–448 m, 10 September 1997.

Diagnosis: A species in the *Lophiodes mutilus* species group characterized by the presence of many diffuse black spots on the dorsal surface of head and body; an extremely long third dorsal-fin spine (71.9–87.2% $L_S$), extending to the anterior third of caudal fin (Fig. 3); a relatively wide and deep head [HW = 61.6–67.5% $L_H$, head depth (HD) = 73.3–78.9% $L_H$]; a relatively long snout (63.2–68.5% $L_H$); a relatively short fifth dorsal-fin spine (11.4–16.5% $L_S$); and 17–18 pectoral-fin rays.

Description: Morphometric and meristic values are given in Tables I and II. Dorsal-fin spines III-0-II; dorsal-fin rays 8; anal-fin rays 6; pectoral-fin rays 17–18 (17 in holotype).

Head relatively wide (HW = 61.6–67.5% $L_H$) and deep (HD = 73.3–78.9% $L_H$); interorbital space relatively wide (IF = 47.4–56.0% $L_H$) and flat; eyes large, directed dorsolaterally. Anterior half of premaxilla with three rows of enlarged teeth, those on the innermost rows largest, followed by a single row of small teeth on posterior half; lower jaw with three rows of teeth, those on the inner row largest; vomer with a single row of small teeth, the outer teeth largest; palatine with a single row of small teeth; fifth ceratobranchial with two rows of small teeth, forming a V-shaped patch; those on second and third pharyngobranchials forming small and rounded patches. No gill rakers. Pseudobranch present.
Illicium moderately long (23.8–33.7% $L_S$), reaching base of third dorsal-fin spine; esca a small simple bulb, without cirri at tip, same as the background of body colouration; second dorsal-fin spine moderately long (28.0–38.6% $L_S$), generally longer than illicium, extending to posterior end of skull in all specimens; third dorsal-fin spine longest for the genus (71.9–87.2% $L_S$ up to 70.8% $L_S$ in all congeners), bears many tendrils along entire length, extending to the anterior third of caudal-fin length; fourth dorsal-fin spine absent; fifth dorsal-fin spine relatively short, not extending to origin of soft dorsal fin, embedded in some paratypes; sixth dorsal-fin spine close to fifth dorsal-fin spine, embedded under skin.
Fig. 8. Selected cranial spines of *Lophiodes maculatus* n. sp., from the holotype: (a) laterodorsal view of right posterior frontal region shows the relatively blunt frontal spines, (b) anterior view of inner (right) and outer (left) sphenotic spines, (c) dorsal view of right hyomandibular spines and (d) dorsal view of left humeral spine. Scale bar = 5 mm. Arrows indicate anterior.

Inner palatine spine short and blunt, outer palatine spine of moderate size, slightly blunt; frontal ridge smooth, without knobs; frontal spine low and blunt [Fig. 8(a)]; inner frontal spine small and blunt; inner sphenotic spine low and blunt, directed upwards and not recurved, outer sphenotic spine broad and blunt [Fig. 8(b)]; epiotic spines present, relatively strong; quadrate spine short and blunt; anterior and posterior articular spines strongly reduced; hyomandibular bears two low and blunt spines [Fig. 8(c)]; opercular spine blunt; interopercular spines strong and sharp; subopercular with two spines, anterior spine slightly blunt in holotype and sharp in all paratypes, posterior spine moderately sharp; cleithral spines strong and blunt; humeral spines well developed, with three to four sharp spinules at its tip [Fig. 8(d)].

Colouration in alcohol: Light brown body colour with many small black spots on the dorsal surface; ventral surface pale; two to four contiguous stripes on pectoral and caudal fins; all fin rays darker than body; outer margin of pectoral fin pale; interradial membrane of dorsal and anal fins transparent.

Distribution: Represented by the type series collected from Marquesas Islands, French Polynesia. Bathymetric range 283–650 m (Fig. 4).

Size: Adults attain an $L_S$ of at least 141 mm.

Etymology: The name *maculatus* is from the Latin *macula*, meaning spot, in reference to the black spots on the dorsal surface.

Remarks: *Lophiodes maculatus* is similar to *L. mutilus* but different in having an extremely long third dorsal-fin spine (Fig. 5; 71.9–87.2% $L_S$ v. 36.6–65.4% $L_S$),
which when retracted reaches to the anterior third of the caudal fin (Fig. 3; v. not extending beyond the posterior third of the soft dorsal-fin base); a relatively short fifth dorsal-fin spine (Fig. 6; 11.4–16.5% $L_S$ v. 16.9–29.3% $L_S$); black spots on the dorsal surface (v. irregular brown patches may present when fresh, faded when preserved); modally 17–18 pectoral-fin rays (v. 16; Table II). The species is also similar to the *L. iwamotoi* but differs in having 17–18 pectoral-fin rays (v. 19–20; Table II), a longer third dorsal-fin spine (71.9–87.2% $L_S$ v. 56.9–70.8% $L_S$), black spots on the dorsal surface, and humeral divided into three to four spines [Fig. 8(d); v. simple with sort bumps at its base; Fig. 2(d)].

All specimens in the type series consistently have their humeral spines divided into three to four spinelets at its tip. Additional specimens may show this to be a useful diagnostic character.

**Lophiodes bruchius Caruso 1981 (Fig. 9)**


**Materials:** MNHN 2009-0900 (1, 137 mm $L_S$), MUSORSTOM 9, cp1268, 7° 57′ S; 140° 42.6′ W, Eiao, Marquesas Islands, French Polynesia, 285–320 m, 4 September 1997, collected with type series of *L. maculatus* n. sp.

**Description:** Morphometric and meristic data provided in Tables I and II. Illicium relatively short, lightly pigmented; esca an elongated bulb with a single terminal cirrus; second dorsal-fin fin spine slightly longer than illicium, slightly extending beyond third dorsal-fin spine base; third dorsal-fin spine relatively long, with a pair of small tendrils and a pair of large back tendrils at near its tip, extending to seventh soft dorsal-fin ray; fifth dorsal-fin spine very short, not extending to the origin of soft dorsal fin; sixth dorsal-fin spine embedded; inner frontal spine well developed; posterior frontal ridge with three sharp spines; outer sphenotic spine well

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**Fig. 9. Lophiodes bruchius** Caruso 1981. MNHN 2009-0900, 137 mm standard length, $L_S$, from Marquesas Islands, French Polynesia.
developed, directed upwards; inner sphenotic spine stout and broad; pterotic spine stout but sharp; hyomandibular bears two short, sharp and slightly depressed spines; interopercular spine sharp; subopercular with two sharp spines; humeral spine well developed, divided into two spinelets at tip. Colouration of dorsal surface and pectoral fins brownish with numerous small irregular grayish patches; ventral surface pale to greyish; pectoral-fin margin pale.

Remarks: *Lophiodes bruchius* was previously recorded from Hawaii and Kyushu-Palau Ridge, south of Japan (Ho & Shao, 2008). The specimen reported here was collected together with the type series of *L. maculatus* n. sp. and represents the first record of this species in the South Pacific Ocean. Although the specimen otherwise agrees with the original description, there are some differences that should be mentioned: there is only one terminal cirrus at the tip of the esca (*v*. more than five in all other specimens); there is one extra pair of small tendrils below the large one on the third dorsal-fin spine (*v*. absent), and the appressed anal fin extends well beyond the caudal-fin base (*v*. reaches or extends slightly beyond). The significance of these differences cannot be evaluated without additional specimens for comparison.

*Lophiodes endoi* Ho & Shao 2008 (*Fig. 10*)


![Fig. 10. Lophiodes endoi Ho & Shao 2008. MNHN 1999-1890, 160 mm standard length, L5, from New Caledonia.](image-url)
Materials: MNHN 1999-1890 (2, 127–160 mm $L_S$), Campagne Chalcal, sta. ch7, 24° 55·5′ S; 168° 21·1′ E, New Caledonia, 494–590 m, 28 October 1986. MNHN 2003-1093 (156 mm $L_S$), Campagne Lithist, sta. cp02, 23° 7·1′ S; 167° 1·1′ E, Norfolk Ridge, New Caledonia, 442 m, 10 August 1999. MNHN 2003-1508 (105 mm $L_S$), Campagne Lithist, sta. cp08, 24° 4·2′ S; 168° 1·3′ E, Norfolk Ridge, New Caledonia, 540 m, 11 August 1999. NMNZ P.27460 (2, 143–169 mm $L_S$), Beryx 2, sta. 5, 24° 26·6′ S; 168° 21·1′ E, Seamount B, south of New Caledonia, 522–575 m, 24 October 1991, coll. C. Roberts. NMNZ P.29412 (2, 249–259 mm $L_S$) and NMNZ P.45632 (1, 114 mm $L_S$), Beryx 11, sta. 3, 24° 55·1′ S; 168° 21·6′ E, Seamount B, south of New Caledonia, 502–610 m, 14 October 1991, coll. C. Roberts & C. Paulin.

Remarks: Morphometric and meristic values are given in Tables I and II. Nine specimens collected from New Caledonia otherwise agree with the original description of $L. endoi$. One specimen (MNHN 2003-1508) has 22 and 23 (right and left, respectively) pectoral-fin rays, slightly more than the numbers in the type series (18–22, modally 20–21). The length of illicium, second and third dorsal-fin spines of all the specimens are slightly greater than the average values of the type series (21·0–27·4% $L_S$, 27·6–31·3% $L_S$ and 33·2–43·1% $L_S$, respectively). Thus, the morphological and meristic values for this species are revised here accordingly.

This species was originally described from the western Pacific Ocean off Japan, Taiwan and Australia. The distribution of present species is now extended eastwards from east coast of Australia to New Caledonia.

Lophiodes infrabrunneus Smith and Radcliffe 1912 (Fig. 11)

_Lophiodes infrabrunneus_ Smith & Radcliffe in Radcliffe, 1912:202 [between Leyte and Mindanao, 10° N; 125° 06′ 45″ E, Philippines, depth 772 fathoms (1412 m)]. Ho et al., 2009:63.

_Lophiodes abdituspinus_ Ni, Wu & Li, 1990:341 (South China Sea, 649–665 m).

Fig. 11. _Lophiodes infrabrunneus_ Smith and Radcliffe 1912. MNHN 2005-3434, 258 mm standard length, $L_S$, from Salomon Island.
Materials: MNHN 2005-3434 (1, 258 mm $L_S$), SALOMON 2, cp2180, 8° 48' S; 159° 41' E, Solomon Islands, 708–828 m, 22 October 2004. MNHN 2005-2569 (1, 81 mm $L_S$), SALOMON 2, dw2236, 6° 51'S; 156° 23' E, Solomon Islands, 208–230 m, 30 October 2004.

Remarks: Ho et al. (2009) recently redescribed *L. infrabrunneus* and recorded the same two specimens collected from the Solomon Islands. Caruso (1981) gave measurements of the third dorsal-fin spine length as 2.5–7.3% $L_S$, but present measurements from all known specimens, including the type series, were 9.1–20.6% $L_S$ (Ho et al., 2009). This species represents the deepest living form within the family, it is found at depths from 208 to 1412 m.

*Lophiodes miacanthus* (Gilbert 1905) (Fig. 12)


Materials: MNHN 2006-1426 (1, 93 mm $L_S$), MUSORSTOM 7, sta. cp629, 11° 53-7' S; 179° 32-3' E, 300 km north-west of Wallis and Futuna Islands, 500 m, 29 May 1992. NMNZ P.29328 (1, 106 mm $L_S$), Beryx 11, sta. 53, 23° 48-8' S;

Fig. 12. *Lophiodes miacanthus* (Gilbert 1905). MNHN 2006-1426, 93 mm standard length, $L_S$, from Wallis and Futuna.

Description: Morphometric and meristic values are given in Tables I and II. Illicial stem black; esca transparent with a terminal cirrus; second dorsal-fin spine slightly longer than illicium, without tendrils, when retracted reaches epiotic spine; third dorsal-fin spine long and stout, with a pair of dark tendrils two-thirds up length from base; fourth dorsal-fin spine absent; fifth dorsal-fin spine black in colour, sixth dorsal-fin spine embedded; three outer frontal spines; inner frontal spine present; inner sphenotic spine low and blunt; outer sphenotic spine moderately broad; opercular spine low and blunt; interopercular spine stout; hyomandibular bears two low and stout spines; humeral spines well developed, divided into three spines at tip. Colouration of head and body light brown with many irregular large black patches; ventral surface pale to greyish; pectoral-fin margin pale.

Remarks: *Lophiodes miacanthus* was described from Hawaii with additional records from Japan and Taiwan (Ho & Shao, 2007, 2008). All museum specimens were collected between 417 and 576 m depth (Caruso, 1981), except for one of New Caledonia specimen taken from 540–950 m. Chave & Jones (1991) mentioned that an underwater photograph referred to *L. miacanthus* was taken at 960 m and Chave & Mundy (1994) mentioned that *L. miacanthus* was observed in 294–700 m depth. There are 120 photographs of *Lophiodes* spp. (all tentatively referred to *L. miacanthus*) deposited in the Hawaii Undersea Research Laboratory, however, all were taken at depths between 241 and 591 m (C. Kelley, pers. comm.). Lacking the direct evidence of photograph or specimen, the records from deeper than 591 m are questionable.

*Lophiodes mutilus* (Alcock 1894) [Fig. 13(a), (b)]

*Lophius mutilus* Alcock 1894:179 [Bay of Bengal, depth 128 fathoms (234 m)].


Materials: Chesterfield Islands: MNHN 1999-1632 (4, 150–174 mm LS), MUSORSTOM 5, sta. cc383, 19° 40-98' S; 158° 46-02' E, 600–615 m, 21 October 1986. MNHN 1999-1884 (3, 69–130 mm LS), MUSORSTOM 5, sta. cc365, 19° 43-02' S; 158° 48-00' E, 710 m, 19 October 1986. MNHN 1999-1885 (1, 284 mm LS), MUSORSTOM 5, sta. cc383, 19° 40-98' S; 158° 46-02' E, 600–615 m, 21 October 1986. MNHN 1999-1886 (1, 200 mm LS), MUSORSTOM 5, sta. cc366, 19° 45-00' S; 158° 46-02' E, 650 m, 19 October 1986. MNHN 1999-1887 (1, 202 mm LS), MUSORSTOM 5, sta. cc384, 19° 42-00' S; 158° 49-98' E, 756–772 m, 21 October 1986. MNHN 1999-1889 (2, 226–259 mm LS), MUSORSTOM 5, sta. cc365, 19° 43-02' S; 158° 48-00' E, 710 m, 19 October 1986. MNHN 2003-2672 (1, 370 mm LS), MUSORSTOM 5, sta. dc385, 20° 54' S; 160° 49-02' E, 745–750 m, 22 October 1986. MNHN 2003-2674 (1, 320 mm LS), MUSORSTOM 5, sta. cc384, 29° 42-00' S; 158° 49-98' E, 756–772 m, 21 October 1986. Wallis and Futuna: MNHN 1995-0674 (1, 80 mm LS) and MNHN 1995-0675 (1, 60 mm LS), MUSORSTOM 7, sta. cp629, 11° 53-7' S; 179° 32-3' E, 400–420 m, 29 May 1992. MNHN 1995-0676

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Fig. 13. Lophiodes mutilus (Alcock 1894). (a) MNHN 2003-2674, 320 mm standard length, $L_S$, from Chesterfield Island and (b) ASIZP 63173, 235 mm $L_S$, from north-east Taiwan, showing live colouration of a fresh-caught specimen.

(1, 70 mm $L_S$), MUSORSTOM 7, sta. dw604, 13° 21'4' S; 176° 08-3' E, 415–420 m, 26 May 1992. Solomon Islands: MNHN 2005-2522 (1, 68 mm $L_S$), SALOMON 2, sta. cp2206, 7° 43' S; 158° 29' E, 391–623 m, 25 October 2004. MNHN 2005-3425 (1, 162 mm $L_S$), SALOMON 2, sta. cp2304, 564–582 m, 14 November 2004. MNHN 2005-0349 (1, 82 mm $L_S$), SALOMON 2, sta. cp2227, 6° 37' S; 156° 13' E, 508–522 m, 28 October 2004. MNHN 2005-3503 (1, 116 mm $L_S$), SALOMON 2, cp2194, 8° 25' S; 159° 27' E, 440–521 m, 24 October 2004. MNHN 2005-3506 (4, 54–64 mm $L_S$), SALOMON 2, sta. cp2175, 9° 06' S; 159° 00' E, 579–585 m, 21 October 2004. MNHN 2006-0110 (1, 123 mm $L_S$), SALOMON 2, sta. cp2264, 7° 52' S; 156° 51' E, 515–520 m, 3 November 2004. MNHN 2006-0494 (1, 80 mm $L_S$), SALOMON 2, cp2184, 8° 17' S; 160° 00' E, 464–523 m, 23 October 2004. MNHN 2006-0540 (3, 92–124 mm $L_S$), SALOMON 2, cp2260, 8° 04' S; 156° 54' E, 399–427 m, 3 November 2004. MNHN
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2006-0585 (1, 47 mm \(L_S\)), SALOMON 2, cp2199, 7° 43' S; 158° 30' E, 296–304 m, 25 October 2004. MNHN 2006-1463 (1, 52 mm \(L_S\)), SALOMON 2, cp2180, 8° 48' S; 159° 41' E, 708–828 m, 22 October 2004. New Caledonia: MNHN 1999-1629 (1, 220 mm \(L_S\)), MUSORSTOM 4, sta. cp170, 18° 57' S; 163° 12' E, 485 m, 17 September 1985. MNHN 1999-1630 (1, 151 mm \(L_S\)), MUSORSTOM 4, sta. cc201, 18° 55' 98" S; 163° 13' 98" E, 600 m, 17 September 1985. MNHN 1999-1645 (1, 273 mm \(L_S\)), BIOCAL, dw40, 22° 55' 06" S; 167° 23-30' E, 650 m, 30 August 1985. Vanuatu: MNHN 1997-4026 (1, 73 mm \(L_S\)), MUSORSTOM 7, sta. cc1057, 16° 35-76' S; 167° 58-08' E, 625 m, 1 October 1992. MNHN 1997-4027 (1, 65 mm \(L_S\)), MUSORSTOM 8, sta. cp1053, 16° 29-23' S; 167° 57-70' E, 519–536 m, 1 October 1992. MNHN 1999-4028 (1, 100 mm \(L_S\)), MUSORSTOM 8, sta. cp1054, 16° 27-95' S; 167° 57-44' E, 522–527 m, 1 October 1992. MNHN 2002-0097 (2, 190–202 mm \(L_S\)), MUSORSTOM 8, sta. cp1052, 16° 31-98' S; 168° 00-00' E, 561–564 m, 1 October 1994. Lifou Island (Loyalty Islands): MNHN 1999-1888 (1, 163 mm \(L_S\)), MUSORSTOM 6, sta. cc470, 21° 4-02' S; 167° 33-00' E, 560 m, 21 February 1989.

Remarks: Morphometric and meristic values are given in Tables I and II.

Fricke (1999) recorded \(L.\) mutilus from Madagascar, Vanuatu, and Wallis and Futuna. This species has the widest geographic range in the Indo-West Pacific Ocean among all of its congeners and is newly recorded from New Caledonia, Chesterfield, Salomon Islands and Loyauté Lifou. It is also the most common species of the genus to be collected in the tropical Pacific Ocean area. According to a recent molecular study, however, \(L.\) mutilus represent a species complex and several cryptic species are present (H. C. Ho, unpubl. data).

Two specimens [MNHN 2003-2674, Fig. 13(a), and MNHN 2003-2672] are notable in having a relatively large body size (320 and 370 mm \(L_S\), respectively). Although Fischer et al. (1990) recorded the maximum size of this species as 45 cm total length \((L_T)\), no specimen has been examined with size >370 mm \(L_S\). In fact, all remaining specimens (including comparative materials) are <300 mm \(L_S\).

A fresh-caught specimen [Fig.13(b)] shows the irregular brown patches on the dorsal surface. These brown patches usually fade in preservation.

Lophiodes naresi (Günther 1880) [Fig. 14(a), (b)]

\(Lophius\) naresi Günther 1880:56 [Nares Harbor, Admiralty Islands, depth 152 fathoms (278 m)].


Description: Morphometric and meristic values are given in Tables I and II.

All dorsal-fin spines but illicium with well-developed black tendrils. Illicium relatively short to very long, when retracted reaches third dorsal-fin spine base to origin of soft dorsal-fin base; esca with a pennant-like flap and two small black eye-like
appendages; second dorsal-fin spine reaches base of fourth dorsal fin, longer than illicium in MNHN 1999-1628 and shorter than that in MNHN 2004-2701; third dorsal-fin spine relatively long, reaches origin of soft dorsal fin; fourth dorsal-fin spine present, reaches the midpoint soft dorsal-fin base; fifth and sixth dorsal-fin spines well developed, reaches midpoint of soft dorsal-fin base. Palatine with two well-developed spines, very sharp; inner frontal spine absent; posterior frontal ridge serrated, with six broad spines; outer sphenotic spine reduced; inner sphenotic spine strong, recurved; pterotic spine stout and blunt; hyomandibular spines blunt; interopercular spine sharp; subopercular with a single sharp spine; quadrate with a single small spine; humeral spine well developed, simple, not branched at tip. Pigmentation of dorsal surface and pectoral fin brownish; ventral surface pale to greyish; pelvic and anal fin greyish; tendrils on dorsal-fin spines darker.

Remarks: Ho & Shao (2007) reported that all Taiwanese specimens of *L. naresi* have a relatively greater distance between the inner sphenotic spines than reported by Caruso (1981) for specimens from off New Guinea and eastern Australia. The New Caledonia specimens are similar to those Taiwanese specimens.

It was notable that one specimen (MNHN 2004-2701) has an extremely long illicium (53.7% $L_S$) and relatively short postcephalic spines. This specimen might represent an undescribed species. Caruso (1981) gave the illicial length range of this species as 21.7–54.9% $L_S$. The specimen or specimens with very long illicium examined by Caruso (1981) were not located and therefore no detailed examination could be made.

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Fig. 14. *Lophiodes naresi* (Günther 1880). (a) MNHN 1999-1628, 178 mm standard length, $L_S$ and (b) MNHN 2004-2701, 163 mm $L_S$. Both from New Caledonia.
Lophiodes naresi was previously recorded from the western Pacific Ocean off the coast of the Philippines, New Guinea, eastern Australia and Taiwan (Caruso, 1981, Ho & Shao, 2007). The present specimens represent the first record from New Caledonian waters.

Lophiomus setigerus (Vahl 1797) (Fig. 15)

*Lophius setigerus* Vahl, 1797:215 (China, no type known).


Materials: MNHN 2003-2676 (male, 194 mm $L_s$), Campagne Musorstom 4, sta. CC248, 22°9’5’ N; 167°10’0’ E, New Caledonia, 380–385 m, 4 October 1985.

Remarks: *Lophiomus setigerus* can be easily distinguished from all other lophiids from the western South Pacific Ocean in having gill openings reaching the pectoral-fin base, the presence of bright white patches on the floor of mouth; many small knobs on the frontal ridge and outer surface of the maxilla, and generally more pectoral-fin rays (21–25). It is widespread in the Indo-western Pacific Ocean and reported from the western South Pacific Ocean by Caruso (1983, 1999).

Despite the depth range of 750–800 m reported from the Red Sea by Khalaf & Zajonz (2007), most specimens were collected at depths between 50 and 300 m. The New Caledonia specimen, however, was from relatively deep waters (380–385 m).

**DISCUSSION**

Notably variation exists in south-west populations of *L. bruchius*, *L. endoi* and *L. naresi*. The esca of the only specimen of *L. bruchius* is very different from all other specimens in the western Pacific Ocean. More materials may prove it to be
a unique species. One specimen of *L. naresi* with an extremely long third dorsal-fin spine was initially identified as a different species. Lacking more specimens to support these hypotheses, however, the identifications are temporary. In contrast, the south-western Pacific population of *L. endoi* showed consistent morphological change that may represent intraspecies variation.

Although Caruso (1981) described the length of the third dorsal-fin spine of *L. mutilus* as 35.9–64.0% *L* S, his material might represent more than one species. In a recent molecular study, at least three different species are recognized from the north-western Pacific Ocean (H. C. Ho, unpubl. data). With the two species described here, there are up to six nominal species in the *L. mutilus* species complex which need further review.

Among the eight species in the *L. mutilus* species group, *L. iwamotoi* n. sp. and *L. maculatus* n. sp. are most similar to *L. mutilus*. All share the following characters: (1) many tendrils on third dorsal-fin spine (*v.* one to two pairs in others), (2) a small bulb-like esca (*v.* relatively large and complex) and (3) a relatively long third dorsal-fin spine (*v.* relatively short, except for *L. bruchius*). *Lophiodes mutilus* is considered to be the primitive sister group in the *L. mutilus* species groups (Caruso, 1981:547). The relationship of these three species, however, cannot be determined without a phylogeny.

A detailed comparison of selected characters of all known species in the study area is provided in Table III.

In recent studies, several examples were found representing the Hawaiian exception-type distribution proposed by Springer (1982). They are *Oneiroides pietschi* Ho & Shao 2004 from Hawaii, Japan and Taiwan; *Halieutopsis margaretae* Ho & Shao 2007 from Hawaii, Japan, Taiwan and New Caledonia (Ho & Shao, 2008); *Malthopsis mitrigera* Gilbert & Cramer 1897 and *Halieutopsis bathyoreos* Bradbury 1988 from the Indo-West Pacific Ocean and Hawaii; *L. bruchius*, *L. endoi* and *L. miacanthus* reported here. Although Springer’s (1982) hypothesis was mainly demonstrated by shorefishes, all examples provided above are deep-sea fishes.

In contrast, *Chaunax umbrinus* Gilbert 1905, *Malthopsis jordani* Gilbert 1905 and *Halieutaea retifera* Gilbert 1905 are considered to be endemic to Hawaii (Ho & Shao, 2010; H. C. Ho, unpubl. data), and may have evolved independently on Hawaii, and thus does not demonstrate this Hawaiian exception-type distribution pattern.

**KEY TO SPECIES OF LOPHIIDAE FROM THE WESTERN SOUTH PACIFIC OCEAN**

1a. Small knobs on frontal ridge and outer surface of maxilla............ *Lophiomus setigerus* (Indo-West Pacific Ocean)

1b. Frontal ridge and outer surface of maxilla without any knob .... (Lophiodes) 2

2a. Six dorsal-fin spines ............................................ *L. naresi* (West Pacific)

2b. Five or fewer dorsal-fin spines........................................ 3

3a. Illicium black ............... *L. miacanthus* (Hawaii, Japan, Taiwan and Wallis and Futuna)
<table>
<thead>
<tr>
<th></th>
<th>Lophiomus setigerus</th>
<th>Lophiodes naresi</th>
<th>Lophiodes endoi</th>
<th>Lophiodes macanthurus</th>
<th>Lophiodes bruchius</th>
<th>Lophiodes mutulus</th>
<th>Lophiodes iwamotai</th>
<th>Lophiodes maculatus</th>
<th>Lophiodes infrabrunneus</th>
</tr>
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<tbody>
<tr>
<td>Frontal ridge</td>
<td>Rough</td>
<td>Smooth</td>
<td>Smooth</td>
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<td>Smooth</td>
<td>Smooth</td>
<td>Smooth</td>
<td>Smooth</td>
</tr>
<tr>
<td>Outside surface of maxilla</td>
<td>Rough</td>
<td>Smooth</td>
<td>Smooth</td>
<td>Smooth</td>
<td>Smooth</td>
<td>Smooth</td>
<td>Smooth</td>
<td>Smooth</td>
<td>Smooth</td>
</tr>
<tr>
<td>Gill opening extends in front of pectoral-fin base</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of DS</td>
<td>6</td>
<td>6</td>
<td>5 (no DS4)</td>
<td>5 (no DS4)</td>
<td>5 (no DS4)</td>
<td>5 (no DS4)</td>
<td>5 (no DS4)</td>
<td>5 (no DS4)</td>
<td>3 (no DS4–6)</td>
</tr>
<tr>
<td>Inner frontal spine</td>
<td>Absent</td>
<td>Absent</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
</tr>
<tr>
<td>Illicial colour</td>
<td>As body ground</td>
<td>As body ground</td>
<td>As body ground</td>
<td>Black</td>
<td>As body ground</td>
<td>As body ground</td>
<td>As body ground</td>
<td>As body ground</td>
<td>Leaf-like</td>
</tr>
<tr>
<td>Escal morphology</td>
<td>Complex</td>
<td>Complex</td>
<td>A large simple bulb</td>
<td>A transparent bulb with a terminal cirrus</td>
<td>A small simple bulb</td>
<td>Black-tipped with few cirri</td>
<td>A small simple bulb</td>
<td>Leaf-like</td>
<td></td>
</tr>
<tr>
<td>Number of tendrils on DS3 and colour</td>
<td>Many, as body ground</td>
<td>Many, as body ground</td>
<td>2 pairs, black</td>
<td>1 pair, black</td>
<td>1 pair, black</td>
<td>Many, as body ground</td>
<td>Many, as body ground</td>
<td>Many, as body ground</td>
<td>Absent</td>
</tr>
<tr>
<td>Tip of DS3 reaches</td>
<td>Humeral spine</td>
<td>Origin to third ray of D</td>
<td>Origin of D</td>
<td>Origin of D</td>
<td>Middle base of D</td>
<td>Origin to two-thirds of D base</td>
<td>Origin to second to fourth rays of D</td>
<td>Anterior half of caudal fin</td>
<td>Humeral spine</td>
</tr>
<tr>
<td>Tip of DS5 reaches</td>
<td>Anterior to origin of D</td>
<td>Middle base of D</td>
<td>Second to third rays of D</td>
<td>Anterior to origin of D</td>
<td>Anterior to origin of D</td>
<td>Origin of D</td>
<td>Anterior to origin of D</td>
<td>Absent</td>
<td></td>
</tr>
</tbody>
</table>

D, soft dorsal fin; DS, dorsal-fin spine.
3b. Illicium colour same as background colouration ........................................ 4
4a. Many tendrils same as background colouration on third dorsal-fin spine ........ 5
4b. One or two pairs of black tendrils on third dorsal-fin spine .......................... 7
5a. Pectoral-fin rays 15–18 ................................................................. 6
5b. Pectoral-fin rays 19–20 ............... L. iwamotoi n. sp. (Savannah Seamount)
6a. Appressed third dorsal-fin spine reaches between one-third and half-way across
length of caudal fin; many black spots on the dorsal surface when preserved;
fifth dorsal-fin spine not extending beyond the origin of soft dorsal fin .......... ...................................... L. maculatus n. sp. (Marquesas Islands)
6b. Appressed third dorsal-fin spine not extending beyond middle of soft dorsal
fin; no black spots on the dorsal surface when preserved; fifth dorsal-fin spine
extends beyond the origin of the soft dorsal fin ........................................ L. mutilus (Indo-West Pacific Ocean)
7a. Esca bears one to several cirri at tip, colour at tip of esca darker than at
base ............. L. bruchius (Hawaii, Kyushu-Palau Ridge and Marquesas Islands)
7b. Esca without cirri or a very short apical prolongation may be present, colour at
tip of esca paler than at base ...................... L. endoi (West Pacific Ocean)

COMPARATIVE MATERIALS

As listed in Ho & Shao (2007), c. 100 lots of additional specimens of L. mutilus
collected from the Indo-Pacific Ocean are deposited in ASIZP, BSKU, NMHN,
NSMT-P and USNM collections.

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