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# Revision of the Indo-West Pacific Bathyal Fish Genus *Glyptophidium* (Ophidiiformes, Ophidiidae)

Jørgen G. Nielsen and Yoshihiko Machida

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**Abstract** The ophidiid genus *Glyptophidium* is revised on the basis of 280 specimens. The seven recognized species fall into two well-defined species-groups: I. *argenteum* species-group with *argenteum* Alcock, 1889, *effulgens* sp. nov. and *lucidum* Smith et Radcliffe, 1913 is characterized i.a. by having 1 ray in each ventral fin, 1 median basibranchial tooth patch, 11 precaudal vertebrae, origin of dorsal fin above vertebrae nos. 3–4. II. *macropus* species-group with *macropus* Alcock, 1894 (lectotype selected), *longipes* Norman, 1939, *oceanium* Smith et Radcliffe, 1913 and *japonicum* Kamohara, 1936 (re-established and neotype described) is characterized i.a. by having 2 rays in each ventral fin, 2 median basibranchial tooth patches, 12–13 precaudal vertebrae, origin of dorsal fin above vertebra no. 1 or in front.

Specimens of the bathyal genus *Glyptophidium* are often represented in collections based on continental slope trawlings from the Indian Ocean and the westernmost part of the Pacific Ocean. Even though the specimens derive from relatively shallow depth (40–823 m), compared to many other ophidiid genera, their general condition is often poor with the caudal tip missing, broken ventral and pectoral finrays and with the fragile bones of the head damaged. Consequently, specimens are often incorrectly or not identified. In the present revision we recognize 7 species, one of which is here described as a new species, and we make use of some hitherto overlooked characters which should facilitate the specific identification of *Glyptophidium* material in poor condition.

## Material and methods

This revision is based on 280 specimens. Only 20% of the specimens from the long-tailed *argenteum* species-group have complete tails while 70% of the specimens from the short-tailed *macropus* species-group are complete. Specimens with broken caudal often have developed a pseudo-caudal fin formed by the posterior dorsal and anal finrays. Consequently, some of the morphometric characters are expressed in percentage of head and preanal length as well as of standard length. Radiographs were taken of most of the specimens examined.

The material is deposited in the following museums:

AMS—Australian Museum, Sydney.
BMNH—British Museum (Natural History), London.
BSKU—Kochi University, Department of Biology.
LACM—Los Angeles County Museum.
MMSU—Moscow State University, Zoological Museum.
MNHN—Museum National d'Histoire Naturelle, Paris.
RUSI—J. L. B. Smith Institute of Ichthyology, Grahamstown.
SAM—South African Museum, Cape Town.
USNM—National Museum of Natural History, Washington, D. C.
WAM—Western Australian Museum, Perth.
ZIL—Zoological Institute, Leningrad.
ZMA—Zoological Museum, Amsterdam.
ZMB—Zoological Museum, Berlin.
ZMUC—Zoological Museum, University of Copenhagen.
ZSI—Zoological Survey of India, Calcutta.

## *Glyptophidium* Alcock, 1889

*Glyptophidium* Alcock, 1889: 390 (type species by monotype *G. argenteum* Alcock, 1889).
*Glyptophidium*: Smith, 1968: 16; Cohen and Nielsen, 1978: 32 (generic diagnosis).

**Generic diagnosis.** The diagnosis given by Cohen and Nielsen (1978: 32) included an un-

described species. When described the species was referred to a new genus (*Leptobrotula* Nielsen, 1986) which involves a modification of the diagnosis:

Neobythitine fishes (Cohen and Nielsen, 1978: 17) with a prominent head and trunk and an attenuate caudal part. Head bone with large, thin crests. Supraethmoid and lachrymal form a raised bony structure enveloping olfactory organ. Diameter of eye equal to or greater than snout. Opercular spine flat, broad and weak. Basibranchials with 1 or 2 median and a pair of tooth patches. Developed rakers on anterior gill arch 14–41. Pseudobranchial filaments 7–15. Origin of dorsal fin above 1st–4th vertebrae or in front. Pectoral finrays 20–26. Ventral fin with 1 or 2 rays in each. Precaudal vertebrae 11–13. Sagitta with compressed or subcircular outline. Ventral rim smooth, dorsal rim flat, with incision or concavity. Sulcus long, reaching close to posterior and anterior tips of otolith. Colliculi usually separated. Ostium at least 4 times length of cauda.

**Generic description.** This section includes characters which are common to the genus but not necessarily of diagnostic value.

Origin of dorsal fin close to head; dorsal finrays 2–3 times as long as corresponding anal finrays; pectoral fins placed below midline of body; caudal fin small with 6–10 rays. Cycloid scales, deciduous; head scaleless. Lateral line indistinct. Mouth large with maxillary reaching posterior margin of orbit, numerous granular teeth in irregular rows in dentary, premaxillary, vomer and palatine; vomerine teeth often somewhat longer than those on other bones, dentigerous part Λ-formed; lower jaw symphysis with distinct knob. Distinct nostrils placed midway between upper lip and orbit; posterior nostril largest. Relative length of developed gill rakers decreases with increasing total length. Parapophyses not developed on anterior 4–6 vertebrae (Fig. 4), pleural ribs on all precaudal vertebrae, neural spines on vertebrae 4–10 with broad proximal part. Abdominal cavity small; 8–10 short pyloric caeca; intestine with 3–5 bends. Swimbladder large and thick-walled, in males with an opening covered by a thin membrane located at either posterior end or on posterior third of ventral side of swimbladder; no similar opening in swimbladder of females.

**Similarity.** *Glyptophidium* seems closest to *Leptobrotula* Nielsen, 1986 with which it shares some advanced characters such as presence of paired basibranchial tooth patches, a large eye and head bones with thin crests. *Glyptophidium* differs from *Leptobrotula* i.a. by having a flat, weak opercular spine (narrow and pointed), 7–15 pseudobranchial filaments (0–2), greatly attenuate caudal part of body (not attenuate), and trunk subcylindrical (compressed and high). *Glyptophidium* has often been grouped with *Lamprogrammus* mainly because of the crested head bones, but it seems unlikely that these two genera are related.

**Species.** The following recent species have been referred to *Glyptophidium*:

*G. argenteum* Alcock, 1889.
*G. macropus* Alcock, 1894.
*G. lucidum* Smith et Radcliffe, 1913.
*G. oceanium* Smith et Radcliffe, 1913.
*G. japonicum* Kamohara, 1936.
*G. longipes* Norman, 1939.
*G. effulgens* sp. nov.

Cohen and Nielsen (1978: 32) mentioned an additional species under description. When described it was placed in another and new genus *Leptobrotula breviventralis* Nielsen, 1986.

*G. litheus* Sato, 1962 is based on a Miocene fossil.

Finally, four species are based on fossil otoliths (Schwarzhans, 1985):

*G. major* (Schubert, 1905).
*G. polli* (Casier, 1946).
*G. barbadicum* (Casier, 1958).
*G. nielseni* Schwarzhans, 1985.

**Species-groups.** The recent species of *Glyptophidium* can be divided into two distinct species-groups (Table 1):

1. *argenteum* species-group (*argenteum*, *effulgens*, *lucidum*).
2. *macropus* species-group (*macropus*, *oceanium*, *japonicum*, *longipes*).

According to the description and illustration of *G. litheus* (Sato, 1962: 14, fig. 25) which i.a. shows that the dorsal fin origin is anterior to the first vertebra, *G. litheus* seems to belong to the *macropus* species-group.

**Relationship.** Fig. 1 shows the supposed relationship between the seven recognized, recent

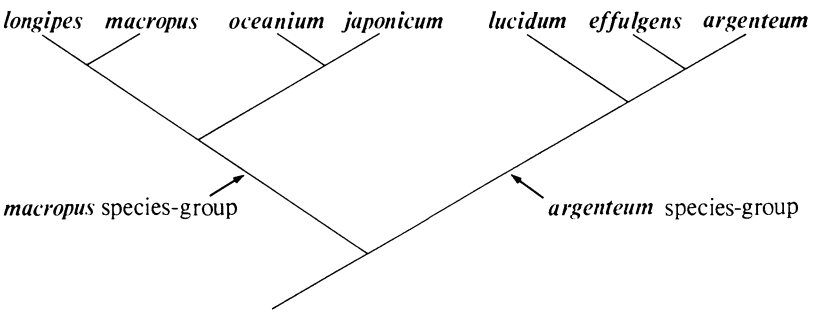


Fig. 1. Relationship between recent *Glyptophidium* spp.

*Glyptophidium* species. The figure is based on an all-over similarity as it seems difficult to decide whether a character is in a primitive or in an advanced state. The arguments for the proposed relationships are given in connection with the description of the two species-groups above and in the seven species descriptions.

### Key to species of *Glyptophidium*

1a. Ventral finray 1, precaudal vertebrae 11, median basibranchial tooth patch 1, anterior dorsal finray above vertebrae nos. 2–4, anterior anal finray below dorsal finrays nos. 18–24, developed rakers on anterior gill arch 14–23....*argenteum* species-group...2

1b. Ventral finrays 2, precaudal vertebrae 12–13, median basibranchial tooth patches 2, anterior dorsal finray above vertebrae nos. 1–2 or in front, anterior anal finray below dorsal finrays nos. 27–34, developed rakers on anterior gill arch 21–24 ..... .....*macropus* species-group...4

2a. Horizontal diameter of orbit 31.5–40.5% of head length, pseudobranchial filaments 11–15, pectoral finrays 23–26 (mean 24.5) ..... .....*lucidum* Smith et Radcliffe, 1913

2b. Horizontal diameter of orbit 21.5–31.0% of head length, pseudobranchial filaments 7–12, pectoral finrays 20–24 (mean 22) .....3

3a. Horizontal diameter of orbit 21.5–28.5% of head length, sagitta most often thick with flat dorsal rim (Fig. 6) ..... .....*argenteum* Alcock, 1889

3b. Horizontal diameter of orbit 29.0–31.0% of head length, relatively thin and large sagitta with depression in dorsal rim (Fig. 12)..... .....*effulgens* sp. nov.

4a. Ventral fin length 180–200% of head length (finrays often broken), pectoral finrays 20–22, caudal finrays 7–8, horizontal diameter of orbit 4.6–5.6% of SL, pseudobranchial filaments with dark stem..... .....*longipes* Norman, 1939

4b. Ventral fin length 60–125% of head length, pectoral finrays 22–26, caudal finrays 8–10,

Table 1. Some characters which distinguish between the two species-groups of the genus *Glyptophidium*.

| | Species-group | |
|---|---|---|
| | *argenteum*-group | *macropus*-group |
| Rays in each ventral fin | 1 | 2 |
| Median basibranchial tooth patches | 1 | 2 |
| Precaudal vertebrae | 11 | 12–13 |
| Caudal vertebrae | 70–85 | 53–72 |
| Origin of dorsal fin above vertebrae nos. | (2)3–4 | (2)1 or in front |
| Developed rakers on anterior gill arch | 14–23 | 21–41 |
| Caudal part of colliculum | rel. large | rel. small |

Table 2. Frequency distribution for eight characters of *Glyptophidium* species.

| | Number of dorsal finrays | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 110 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 120 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 130 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 140 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 150 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| *argenteum* species-group | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *argenteum* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 | 1 | | 2 | | 1 | 3 | 1 | 1 | 1 | 2 | | | 1 | | | | 1 |
| *effulgens* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | | | | | |
| *lucidum* | | | | | | | | | | | | | | | | | | | | | | | | 1 | 2 | 1 | | | | 1 | 2 | | 1 | 2 | | | 1 | | | | | | | | | | | | |
| *macropus* species-group | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *longipes* | | | | | | | | | | | | 1 | | 1 | 2 | 1 | 2 | 3 | 5 | 2 | 2 | 2 | 1 | | | 1 | 1 | 1 | | 1 | 1 | | | | | 1 | | | | | | | | | | | | | |
| *macropus* | | | | | | | | 2 | 1 | 3 | 3 | 1 | 3 | 2 | 2 | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *oceanium* | | | | | | | | | | | | | | | | | | 1 | | | 1 | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| *japonicum* | | | | | | | | | | | | | | 1 | | 1 | 1 | 1 | 1 | 3 | 2 | 7 | 1 | 3 | 2 | | | | | | | | | | | | | | | | | | | | | | | | |

| | Number of anal finrays | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 90 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 100 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 110 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 120 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 130 | 1 | 2 | 3 | 4 |
| *argenteum* species-group | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *argenteum* | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | 2 | 2 | | 1 | | | 2 | 2 | | 2 | 1 | | | 1 | 1 | | 1 | |
| *effulgens* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 | | | | | | | | | |
| *lucidum* | | | | | | | | | | | | | | | | | | | | 1 | | 1 | | 1 | 1 | 1 | | 1 | 1 | 1 | 2 | | 1 | | | | | | | | | | | | |
| *macropus* species-group | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *longipes* | | | | | | | | 3 | 5 | 1 | 4 | 5 | 2 | 2 | 1 | | | | | | 1 | 2 | | | 1 | | 1 | | | | | | | | | | | | | | | | | | |
| *macropus* | 1 | 1 | 2 | 2 | 3 | 1 | 1 | 4 | 1 | 3 | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *oceanium* | | | | | | | | | | | 1 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *japonicum* | | | | | | | | | 1 | | 2 | 2 | 3 | 3 | 5 | 1 | 5 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | |

(Table 2, continued 1)

| | Number of pectoral finrays | | | | | | |
|---|---|---|---|---|---|---|---|
| | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| *argenteum* species-group | | | | | | | |
| *argenteum* | 5 | 18 | 26 | 15 | 10 | | |
| *effulgens* | | 1 | 2 | | | | |
| *lucidum* | | | | 1 | 17 | 18 | 4 |
| *macropus* species-group | | | | | | | |
| *longipes* | 5 | 26 | 13 | | | | |
| *macropus* | | | 5 | 13 | 11 | | |
| *oceanium* | | | | 2 | 1 | | 1 |
| *japonicum* | | | | 2 | 13 | 10 | 2 |

| | Developed rakers on anterior left gill arch | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 20 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 30 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 40 | 1 |
| *argenteum* species-group | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *argenteum* | | | | | | | | 5 | 9 | 24 | 32 | 29 | 91 | | | | | | | | | | | | | | | | | | | |
| *effulgens* | | | | | | | | | | 3 | | | | | | | | | | | | | | | | | | | | | | |
| *lucidum* | | | | | 1 | 1 | 2 | 13 | 13 | 3 | 6 | | | | | | | | | | | | | | | | | | | | | |
| *macropus* species-group | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *longipes* | | | | | | | | | | | | | | | | | 1 | 12 | 8 | 14 | 9 | 3 | | | | | | | | | | |
| *macropus* | | | | | | | | | | | | | | | | | | | | | | | | | | | 6 | 7 | 7 | 5 | 5 | 2 |
| *oceanium* | | | | | | | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | | | | | | | | |
| *japonicum* | | | | | | | | | | | | 1 | 2 | 7 | 3 | 9 | 6 | | | | | | | | | | | | | | | |

(Table 2, continued 2)

| | Number of caudal vertebrae | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 50 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 60 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 70 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 80 | 1 | 2 | 3 | 4 | 5 |
| *argenteum* species-group | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *argenteum* | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 2 | 1 | 4 | 2 | 3 | 1 | 1 | | 1 | 1 |
| *effulgens* | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 | | | | | | | | | | | |
| *lucidum* | | | | | | | | | | | | | | | | | | | | | 1 | 5 | 3 | 1 | 1 | | | | | | | 1 | | | | |
| *macropus* species-group | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *longipes* | | | | | | | | | | | | 1 | | 2 | 2 | 7 | 7 | 5 | 1 | | | 1 | 3 | | | | | | | | | | | | | |
| *macropus* | | | | 1 | 3 | 5 | 5 | 4 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *oceanium* | | | | | | | | | 2 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *japonicum* | | | | | | | | | | | 7 | 7 | 10 | 1 | | | | | | | | | | | | | | | | | | | | | | |

| | Number (mean of right and left sides) of pseudobranchial filaments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| *argenteum* species-group | | | | | | | | | |
| *argenteum* | 1 | 19 | 42 | 30 | 15 | 3 | | | |
| *effulgens* | 1 | 2 | | | | | | | |
| *lucidum* | | | | | 5 | 11 | 12 | 5 | 6 |
| *macropus* species-group | | | | | | | | | |
| *longipes* | 6 | 14 | 13 | 11 | 2 | | | | |
| *macropus* | 1 | 5 | 13 | 8 | 5 | | | | |
| *oceanium* | | | | | | 2 | 1 | | 1 |
| *japonicum* | | | | 8 | 11 | 5 | 3 | 1 | |

(Table 2, continued 3) * In front of anterior vertebra.

| | Horizontal diameter of orbit in % of head | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 30 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 40 | 1 |
| *argenteum* species-group | | | | | | | | | | | | | | | | | | | | | | |
| *argenteum* | | 1 | 3 | 5 | 8 | 20 | 19 | 29 | 16 | 2 | | | | | | | | | | | | |
| *effulgens* | | | | | | | | | | 1 | 1 | 1 | | | | | | | | | | |
| *lucidum* | | | | | | | | | | | | | 2 | 2 | 6 | 13 | 8 | 3 | 5 | | | 1 |
| *macropus* species-group | | | | | | | | | | | | | | | | | | | | | | |
| *longipes* | | | | 2 | | 6 | 9 | 10 | 5 | 8 | 2 | | | | | | | | | | | |
| *macropus* | | | | | | 1 | 3 | 1 | 7 | 7 | 6 | 4 | 2 | | | | | | | | | |
| *oceanium* | | | | | | | | | | | | | | 2 | 1 | 1 | | | | | | |
| *japonicum* | | | | | | | | | | 2 | 4 | 5 | 13 | 4 | | | | | | | | |

| | Dorsal fin origin above vertebra no. | | | | |
|---|---|---|---|---|---|
| | 0* | 1 | 2 | 3 | 4 |
| *argenteum* species-group | | | | | |
| *argenteum* | | | 1 | 66 | 11 |
| *effulgens* | | | | 3 | |
| *lucidum* | | | | 38 | 2 |
| *macropus* species-group | | | | | |
| *longipes* | 1 | 40 | 5 | | |
| *macropus* | 27 | | | | |
| *oceanium* | 4 | | | | |
| *japonicum* | 18 | 10 | | | |

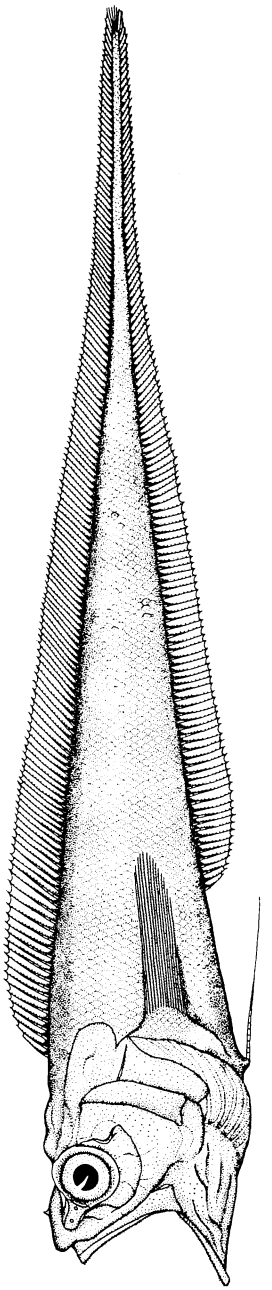

Fig. 2. *Glyptophidium argenteum*, USNM 199678, SL 210 mm. Scale indicates 1 cm.

horizontal diameter of orbit 5.9–7.5% of SL, pseudobranchial filaments with light stem.....5

5a. Developed rakers on anterior gill arch 36–41, head length 22.0–25.5% (mean 23.3) of SL, ventral fin length 90–125% of head length, pseudobranchial filaments 7–11 .....*macropus* Alcock, 1894

5b. Developed rakers on anterior gill arch 21–33, head length 19.0–23.5% of SL, ventral fin length 57–81% of head length, pseudobranchial filaments 10–15.....6

6a. Developed rakers 30–33 and total rakers on anterior gill arch 35–38, anterior anal finray below dorsal finray nos. 31–34, pseudobranchial filaments 12–15, diameter of horizontal orbit 32.5–34.5% of head length, depth at anterior end of dorsal fin 14.0–16.0% and anal fin 10.5–12.0% of SL.....*oceanium* Smith et Radcliffe, 1913

6b. Developed rakers 21–26 and total rakers on anterior gill arch 28–33, anterior anal finray below dorsal finray nos. 28–31, pseudobranchial filaments 10–14, diameter of horizontal orbit 28.5–33.0% of head length, depth at anterior end of dorsal fin 15.0–19.5% and anal fin 11.5–14.5% of SL.....*japonicum* Kamohara, 1936

### ***Glyptophidium argenteum*** Alcock, 1889
(Fig. 2)

*G. argenteum* Alcock, 1889: 390 (type locality Andaman Sea).

*G. argenteum*: Alcock, 1892: pl. II, fig. 3 and 1899: 93; Brauer, 1906: 303; Weber, 1913: 552; Beaufort and Chapman, 1951: 411; Menon and Yazdani, 1968: 148; Cohen and Nielsen, 1978: 32; Shcherbachev, 1980: 148; Schwarzhans, 1981: 97, figs. 98–99; Fourmanoir, 1984: 94.

**Material.** 118 specimens:

Holotype: ZSI F11661 (SL 170+ mm, ♀), "Investigator" st. 8, off Port Blair, Andaman Isls., 489 m, Agassiz trawl, 2 Jan. 1888.

Non-type material: BMNH 1898.7.13.11 (SL ca. 195 mm), Malabar coast, 658 m.—ZMB 17697 (SL 243+ mm, ♂), "Valdivia" st. 196 (0°27′3″N, 98°7′4″E), 646 m, trawl, 1 Feb. 1899.—ZMA 119.619 (SL 235+–287 mm, ♀+2♂), "Siboga" st. 85 (0°36.5′S, 119°29.5′E), 724 m, trawl, 17 Jun. 1899.—USNM 122814 (SL 137 mm), "Albatross" st. D-5124 (12°52′N, 121°48′30″E), 514 m, beam trawl, 2 Feb. 1908.—USNM 99058 (SL 253 mm), "Albatross" st. D-5292

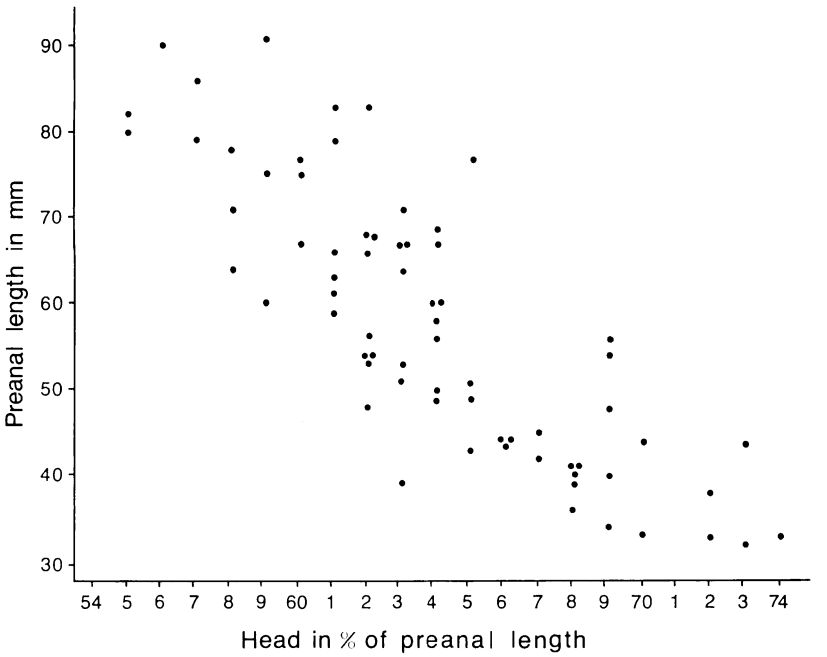


Fig. 3. Preanal length in relation to head in % of preanal length in *Glyptophidium argenteum*.

(13°28′45″N, 121°01′12″E), 296 m, beam trawl, 22 Jul. 1908.—USNM 99161 (SL 193–230 mm, 3 spms.) and USNM 99179 (SL 170–232 mm, 3 spms.), "Albatross" st. D-5373 (13°40′N, 121°31′10″E), 619 m, beam trawl, 2 Mar. 1909.—USNM 99159 (SL 200+–203 mm, 2 spms.), USNM 99182 (SL 125+–185 mm, 2 spms.) and USNM 99271 (SL 198 mm), "Albatross" st. D-5378 (13°17′45″N, 122°22′E), 216 m, Agassiz trawl, 4 Mar. 1909.—USNM 99160 (SL 179–219 mm, 3 spms.), "Albatross" st. D-5405 (10°49′20″N, 124° 24′23″E), 479 m, Agassiz trawl, 17 Mar. 1909.—USNM 99049 (SL 85+–196 mm, 7 spms.), USNM 99063 (SL 120+–183 mm, 3 spms.) and USNM 99155 (SL 167–234 mm, 3 spms.), "Albatross" st. D-5406 (10°49′03″N, 124°22′30″E), 545 m, Agassiz trawl, 17 Mar. 1909.—USNM 99050 (SL 175+–245 mm, 6 spms.) and USNM 99178 (SL 220+–225+ mm, 2 spms.), "Albatross" st. D-5407 (10°51′38″N, 124° 20′54″E), 640 m, Agassiz trawl, 17 Mar. 1909.—USNM 99057 (SL 193–248 mm, 6 spms.) and USNM 99164 (SL 220–245 mm, 2 spms.), "Albatross" st. D-5410 (10°28′45″N, 124°05′30″E), 705 m, Agassiz trawl, 18 Mar. 1909.—USNM 99162 (SL 173+ mm), "Albatross" st. D-5505 (8°37′15″N, 124°36′E), 479 m, beam trawl, 4 Aug. 1909.—USNM 99157 (SL 200+–257 mm, 3 spms.) and USNM 99268 (SL 275 mm), "Albatross" st. D-5511 (8°15′20″N, 123°57′E), 814 m, beam trawl, 7 Aug. 1909.—USNM 99180 (SL 225+ mm), "Albatross" st. D-5512 (8°16′02″N, 123°58′26″E), 814 m, 7 Aug. 1909.—USNM 99181 (SL 228–247 mm, 2 spms.) and USNM 99269 (SL 242–257 mm, 2 spms.), "Albatross" st. D-5527 (9°22′30″N, 123° 42′40″E), 717 m, beam trawl, 11 Aug. 1909.—ZMUC P77765-771 (SL 116+–250 mm, 6 ♀+♂), "Galathea" st. 423 (10°27′N, 124°18′E), 750 m, sledge trawl, 25 Jul. 1951.—ZMUC P77772-777 (SL 135+–236+ mm, ♀+5 ♂), "Galathea" st. 436 (10°12′N, 124°14′E), 710 m, sledge trawl, 9 Aug. 1951.—USNM 199678 (SL 115+–210 mm, 12 ♀+16 ♂), "Anton Bruun" cr. 1st. 17 (7°40′N, 97°9′E), 503–512 m, 21 Mar. 1963.—MNHN 1985-383 (SL 188+–280 mm, 8 ♀+5 ♂) and MNHN 1985-398 (SL 235+–270+ mm, 3 ♀), "Corindon" st. 240 (0°37.6′S, 119°33.5′E), 675 m, bottom trawl, 5 Nov. 1980.

Condition: The holotype is in a very poor condition and only 19 of the 118 specimens examined have a complete tail.

**Diagnosis.** *G. argenteum* differs from other species in the *argenteum* species-group by the diameter of the orbit (21.5–28.5% of length of head) and by the combination of number of pseudobranchial filaments (7–12) and pectoral finrays (20–24).

**Relationship.** The closest related species is *G. effulgens* with which it shares the following characters: few pseudobranchial filaments (7–12) and few pectoral finrays (20–24). It differs from

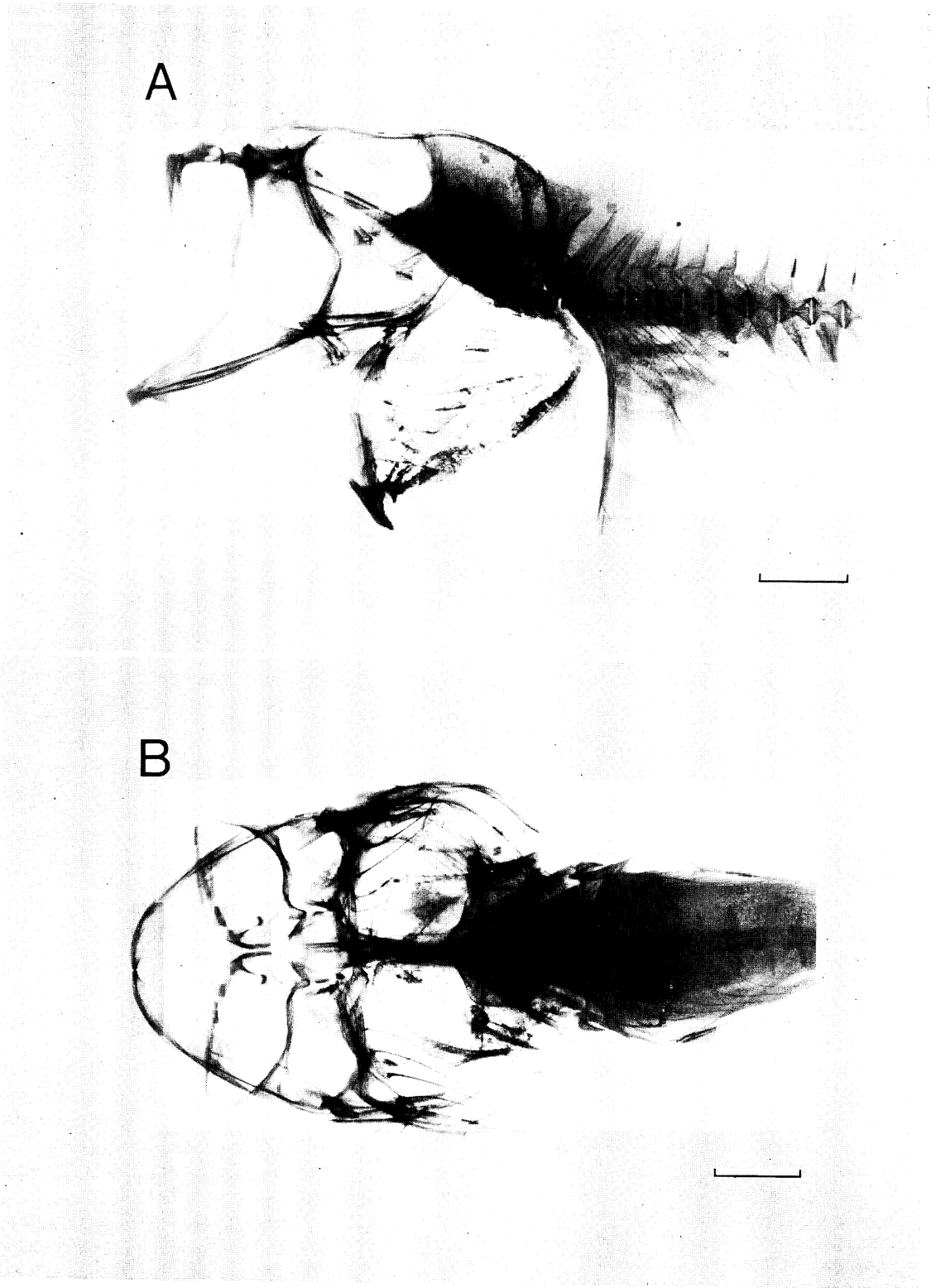


Fig. 4. Radiograph of *Glyptophidium argenteum*, BMNH 1898.7.13.11, SL ca. 195 mm. A, lateral view; B, dorsal view. Each scale indicates 1 cm.

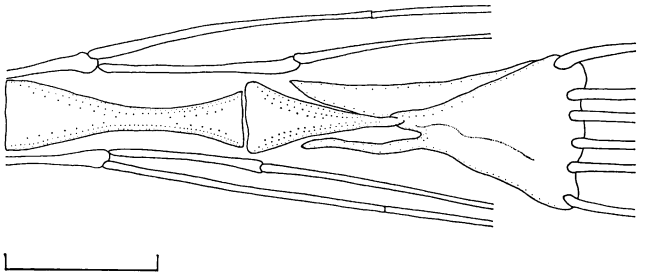

Fig. 5. Caudal skeleton of *Glyptophidium argenteum*, ZMUC P77765, SL 250 mm. Scale indicates 0.5 mm.

*effulgens* by the smaller orbit (21.5–28.5 vs. 29.0–31.0% of length of head) and for the major part of the material by the form of the sagitta (Fig. 6 vs. Fig. 12).

**Description.** *G. argenteum* is dealt with in more detail, including more illustrations, than are the other species of the genus as *G. argenteum* is the type species. Tables 2 and 3 show the main

Table 3. Meristic and morphometric characters of *Glyptophidium argenteum*. [1] 99 incomplete specimens with TL 85+–275+ mm. [2] Number of specimens examined.

| | | Holotype ZSI F11661 | Total material (117 specimens) | |
|---|---|---|---|---|
| Standard length (mm) | | 170+ | 127–287[1] | 19[2] |
| Counts | | | | |
| Dorsal finrays | | — | 140 (147.4) 158 | 16 |
| Caudal finrays | | — | 6 (6.1) 7 | 11 |
| Anal finrays | | — | 114 (123.1) 133 | 16 |
| Pectoral finrays | | 22 | 20 (22.1) 24 | 74 |
| Ventral finrays | | 1 | 1 | 48 |
| Gill rakers on | upper small | 3 | 0 (1.7) 5 | 47 |
| anterior arch | long | 20 | 17 (19.9) 23 | 109 |
| | lower small | 4 | 3 (4.8) 8 | 47 |
| | total | 27 | 23 (26.1) 31 | 47 |
| Vertebrae | precaudal | 11 | 11 (11.0) 12 | 78 |
| | caudal | — | 74 (79.1) 85 | 18 |
| Anterior dorsal ray above vertebra no. | | 3 | 2 (3.1) 4 | 78 |
| Anterior anal ray below dorsal ray no. | | 23 | 18 (21.1) 23 | 78 |
| Anterior anal ray below vertebra no. | | 15 | 13 (14.3) 16 | 78 |
| Pseudobranchial filaments | | 8 | 7 (9.4) 12 | 110 |
| In % of SL | | | | |
| Head length | | — | 16.5 (18.1) 19.5 | 18 |
| Body depth at anterior dorsal ray | | — | 14.0 (14.9) 15.5 | 10 |
| Body depth at anterior anal ray | | — | 10.0 (11.0) 12.0 | 11 |
| Diameter of horizontal orbit | | — | 4.1 (4.6) 5.2 | 10 |
| Postorbital length | | — | 9.4 (9.7) 10.0 | 4 |
| Preanal length | | — | 26.0 (28.2) 31.5 | 19 |
| Predorsal length | | — | 15.0 (16.1) 17.5 | 10 |
| Ventral fin length | | — | 12.0 (13.2) 15.0 | 3 |
| In % of head length | | | | |
| Diameter of horizontal orbit | | 27.5 | 21.5 (26.0) 28.5 | 103 |
| Body depth at anterior dorsal ray | | — | 66 (80.5) 91 | 45 |
| Body depth at anterior anal ray | | — | 52 (60.1) 69 | 45 |
| In % of preanal length | | | | |
| Head length | | — | 55 (63.6) 74 | 69 |

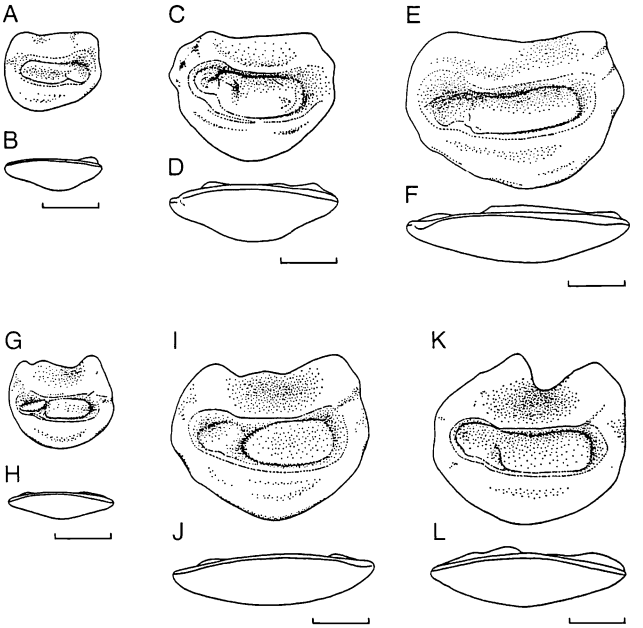


Fig. 6. Median and ventral views of sagitta from *Glyptophidium argenteum*. A, B, right sagitta, USNM 199678, SL 152 mm, preanal length (PL) 40 mm; C, D, left sagitta from holotype, ZSI F11661, SL 170+ mm, PL 80 mm; E, F, left sagitta, ZMA 119619, SL 287 mm, PL 91 mm; G, H, left sagitta, USNM 99049, SL 85+ mm, PL 32 mm; I, J, left sagitta, USNM 99049, SL 177+ mm, PL 60 mm; K, L, left sagitta, USNM 99182, SL 185+ mm, PL 60 mm. Each scale indicates 2 mm. (W. Schwarzhans illstr.)

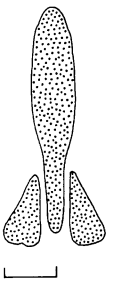

Fig. 7. Basibranchial tooth patches of *Glyptophidium argenteum*, USNM 199678, SL 210 mm. Scale indicates 2 mm.

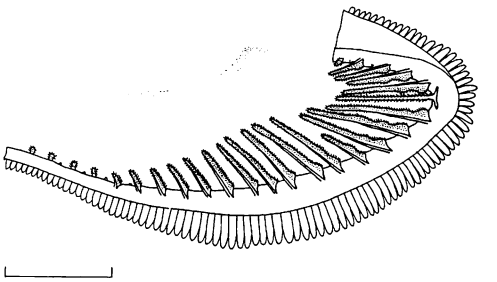

Fig. 8. Anterior, left gill arch of *Glyptophidium argenteum*, USNM 199678, SL 210 mm. Scale indicates 5 mm.

meristic and morphometric characters. Only characters not mentioned in the generic diagnosis and description (p. 289) are here given: Table 3 indicates surprisingly little variation considering the number of specimens examined; as could be expected, "depth of body", especially at origin of dorsal fin, is highly variable; the variation in "head in % of preanal length" is caused by allometric growth (Fig. 3). Head large with thin bones (Fig. 4); long, slender tail with reduced caudal part (Fig. 5); dorsal fin origin above 2nd–4th vertebrae, one ray in each ventral fin not reaching origin of anal fin. Sagitta described and discussed in chapter below. Basibranchials (Fig. 7) with one median and a pair of greatly overlapping tooth patches. Anterior gill arch (Fig. 8) with many long rakers; those near angle between epi- and ceratobranchiale often with 2–4 knobs on inner surface (Fig. 9). Pseudobranchial filaments (7–12) of varying length, all light. Precaudal vertebrae

11, except for one specimen with 12. Colour of holotype much faded. Newly caught specimens with dark oral and branchial cavities, blue peritoneum and much brown pigmentation all over body especially on head, gill cover and at basis of dorsal fin. Swimbladder in males with opening placed at posterior end.

**Biology.** The material includes 39 females, 40 males, and 39 sex undetermined; largest eggs measured 0.6 mm in diameter. Most specimens had empty intestines, but a few contained remains of unidentifiable crustaceans.

**Sagitta.** Examination of sagitta from about 25 specimens shows a very high variation compared to the other *Glyptophidium* spp. They seem to split into four groups which are all included in Fig. 6. The preanal length (PL) is added to the text to Fig. 6 in order to make the sagitta's comparable as the tails are often incomplete. Group 1 (Fig. 6A–D): This group includes the holotype. The compressed sagitta is thick and reduced in size compared to specimens of equal length from groups 2–4. The ostium is about 3 times as long as the cauda which ends near the posterior rim of the sagitta. The dorsal rim is flat and the dorsal field reduced in width.

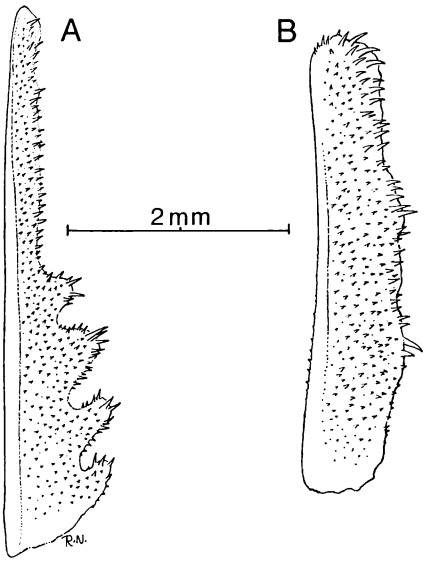


Fig. 9. Angle-raker from anterior, left gill arch. A, *Glyptophidium argenteum*, ZMUC P77772, SL 228 mm, preanal length 71 mm; B, *G. lucidum*, USNM 99109, SL 212+ mm, preanal length 82 mm.

Group 2 (Fig. 6E, F): Rather similar to group 1, but more elongate and less thick-set.

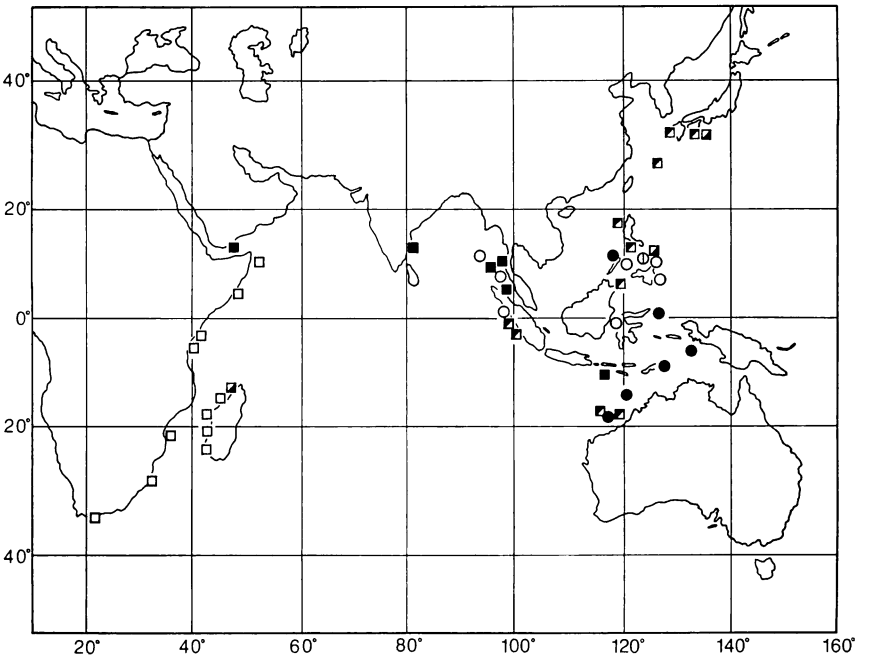


Fig. 10. Records of *Glyptophidium* spp. □, *G. longipes*; ■, *G. macropus*; ◪, *G. oceanium*; ◩, *G. japonicum*; ○, *G. argenteum*; ⦶, *G. effulgens*; ●, *G. lucidum*.

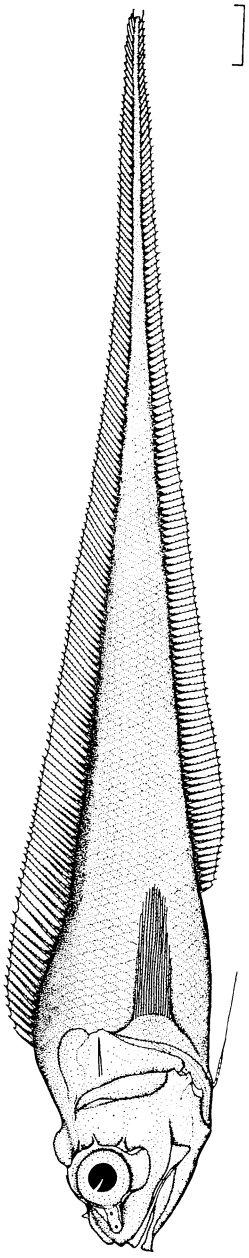

Fig. 11. Holotype of *Glyptophidium effulgens*, USNM 99158, SL 202 mm. Scale indicates 1 cm.

Group 3 (Fig. 6G–J): Similar in proportions to group 1, but much thinner and with a more pronounced and wide concavity in the dorsal rim.

Group 4 (Fig. 6K, L): Differs from groups 1–3 by the subcircular form, a wide dorsal field and the sharp, deep incision in the dorsal rim.

Groups 1 and 2 are morphologically close to each other and the difference could be explained by the fact that specimens from group 2 are longer than those from group 1. However, it should be noted that the two groups are geographically separated: group 1 from 7–12°N, 92–97°E and group 2 from 1–3°S, 118–124°E. Groups 3 and 4 are overlapping in lengths but are both from the same area (10–14°N, 122–124°E). Group 4, however, is very distinct and seems closer to both *effulgens* and *lucidum* than to groups 1–3 of *argenteum*.

We have considered whether *argenteum* should be divided into e.g. subspecies on the basis of the differences in otolith morphology and geographical distribution, but there is no meristic or morphometric character which supports an eventual subspecific separation. Consequently, for the present we have to accept a much wider variation in the morphology of the *argenteum* sagitta than within the other *Glyptophidium* species.

**Distribution.** Fig. 10 shows that *G. argenteum* is distributed from the western Bay of Bengal to the northern Philippine Is. and southwards to Celebes. All specimens were taken in bottom trawls at depths between 296 and 814 m.

### ***Glyptophidium effulgens*** sp. nov.
(Fig. 11)

*Glyptophidium* sp.: Schwarzhans, 1981: 97, fig. 103 (otholith).

**Material.** 3 specimens:

Holotype: USNM 99158 (SL 202 mm, ♀), "Albatross" st. D-5410 (10°28′45″N, 124°05′30″E), 705 m, bottom trawl, 18 Mar. 1909.

Paratypes: USNM 272001 (SL 212+ mm, ♀) and ZMUC P77783 (SL 228 mm, ♂) with same data as holotype.

Condition: Except for broken ventral finrays and the missing caudal tip of one of the paratypes the material is in a good condition.

**Diagnosis.** *G. effulgens* differs from other species in the *argenteum* species-group by the following combination of characters: orbit 29.0–31.0% of head length, pseudobranchial filaments

7–8, and a relatively thin sagitta with a distinct depression in the dorsal rim.

**Relationship.** The most closely related species is *G. argenteum* (p. 297). The morphology of the sagitta, however, seems most similar to that of *G. lucidum* (Fig. 16) and to group 4 of *G. argenteum* (Fig. 6K, L).

**Description.** Table 4 shows the main meristic and morphometric characters. Only characters that are not mentioned in the generic diagnosis and description (p. 289) are here given.

Holotype: Dorsal fin origin above 3rd vertebra; one ray in each ventral fin. Sagitta (Fig. 12) subcircular and rather thin, caudal end of sulcus close to posterior rim, dorsal rim with moderate incision and sulcus deep. Basibranchials (Fig. 13) with one median and a pair of overlapping tooth patches. Anterior gill arch (Fig. 14) with relatively few long rakers, those near angle between epi- and ceratobranchiale with 2–3 knobs on inner surface; gill filaments about half length of rakers near angle. Pseudobranchial filaments 7, with a light stem. Precaudal vertebrae 11. Colours faded, but eyes and branchial cavity are dark and gill covers and peritoneum silvery. It is a female

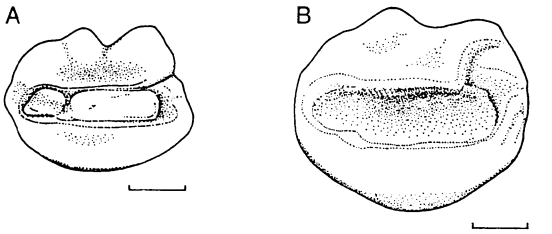


Fig. 12. Median view of left sagitta from *Glyptophidium effulgens*. A, holotype, USNM 99158, SL 202 mm, preanal length 59 mm; B, paratype, USNM 272001, SL 212+ mm, preanal length 68 mm. Each scale indicates 2 mm. (W. Schwarzhans illstr.)

Table 4. Meristic and morphometric characters of *Glyptophidium effulgens*.

| | Holotype | Paratypes | |
|---|---|---|---|
| | USNM 99158 | USNM 272001 | ZMUC P77783 |
| Standard length (mm) | 202 | 212+ | 228 |
| Counts | | | |
| Dorsal finrays | 141 | 107+ | 141 |
| Caudal finrays | — | — | — |
| Anal finrays | 124 | 89+ | 125 |
| Pectoral finrays | 21 | 22 | 22 |
| Ventral finrays | 1 | 1 | 1 |
| Gill rakers on anterior arch (small+long+small) | 1+19+5 | 2+19+6 | 3+19+6 |
| Vertebrae precaudal | 11 | 11 | 11 |
| caudal | 74 | 51+ | 73 |
| Anterior dorsal ray above vertebra no. | 3 | 3 | 3 |
| Anterior anal ray below dorsal ray no. | 20 | 20 | 21 |
| Anterior anal ray below vertebra no. | 14 | 13 | 14 |
| Pseudobranchial filaments | 7 | 8 | 8 |
| In % of SL | | | |
| Head length | 17.5 | — | 17.0 |
| Body depth at anterior dorsal ray | 14.0 | — | 13.5 |
| Body depth at anterior anal ray | 11.0 | — | 11.0 |
| Diameter of horizontal orbit | 5.0 | — | 5.3 |
| Postorbital length | 9.9 | — | 9.4 |
| Preanal length | 29.5 | — | 31.5 |
| Predorsal length | 17.0 | — | 16.0 |
| Ventral fin length | — | — | — |
| In % of head length | | | |
| Diameter of horizontal orbit | 29.5 | 29.0 | 31.0 |
| Body depth at anterior dorsal ray | 80 | 78 | 81 |
| Body depth at anterior anal ray | 63 | 64 | 65 |

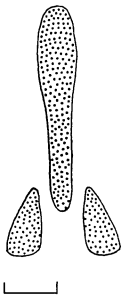

Fig. 13. Basibranchial tooth patches of holotype of *Glyptophidium effulgens*. Scale indicates 2 mm.

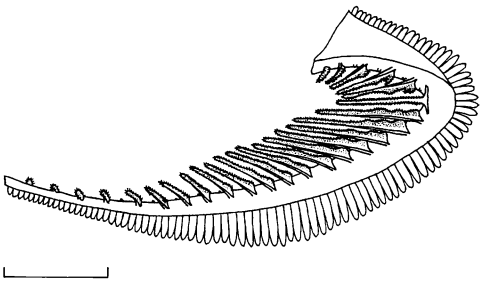

Fig. 14. Anterior, left gill arch of holotype of *Glyptophidium effulgens*. Scale indicates 5 mm.

Table 5. Meristic and morphometric characters of *Glyptophidium lucidum*. [1] 28 incomplete specimens with TL 95+–214+ mm. [2] Number of specimens examined.

| | | Holotype USNM 74144 | Total material (40 specimens) | |
|---|---|---|---|---|
| Standard length (mm) | | 212+ | 115–196[1] | 12[2] |
| Counts | | | | |
| Dorsal finrays | | — | 133 (139.0) 146 | 11 |
| Caudal finrays | | — | 7 (7.3) 8 | 9 |
| Anal finrays | | — | 109 (116.2) 122 | 11 |
| Pectoral finrays | | 24 | 23 (24.6) 26 | 40 |
| Ventral finrays | | 1 | 1 | 40 |
| Gill rakers on anterior arch | upper small | 2 | 0 (1.2) 3 | 39 |
| | long | 15 | 14 (17.8) 20 | 39 |
| | lower small | 7 | 4 (6.0) 9 | 39 |
| | total | 24 | 23 (25.0) 27 | 39 |
| Vertebrae | precaudal | 11 | 11 | 40 |
| | caudal | — | 70 (72.5) 81 | 12 |
| Anterior dorsal ray above vertebra no. | | 3 | 3 (3.1) 4 | 40 |
| Anterior anal ray below dorsal ray no. | | 21 | 20 (22.0) 24 | 40 |
| Anterior anal ray below vertebra no. | | 15 | 12 (14.8) 15 | 40 |
| Pseudobranchial filaments | | 15 | 11 (12.9) 15 | 39 |
| In % of SL | | | | |
| Head length | | — | 17.0 (18.5) 20.0 | 12 |
| Body depth at anterior dorsal ray | | — | 13.5 (14.7) 17.0 | 12 |
| Body depth at anterior anal ray | | — | 10.5 (12.0) 13.0 | 12 |
| Diameter of horizontal orbit | | — | 5.4 (6.6) 7.4 | 12 |
| Postorbital length | | — | 8.3 (9.0) 10.0 | 11 |
| Preanal length | | — | 26.0 (31.1) 34.0 | 12 |
| Predorsal length | | — | 17.0 (18.4) 19.5 | 12 |
| Ventral fin length | | — | 12.0 (14.1) 15.5 | 6 |
| In % of head length | | | | |
| Diameter of horizontal orbit | | 34.5 | 31.5 (35.4) 40.5 | 40 |
| Body depth at anterior dorsal ray | | 79 | 75 (81.1) 88 | 35 |
| Body depth at anterior anal ray | | 71 | 61 (67.2) 77 | 36 |
| Ventral fin length | | — | 71 (76.1) 84 | 11 |
| In % of preanal length | | | | |
| Head length | | 59 | 53 (59.1) 66 | 40 |