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TWO NEW SPECIES OF *PROTOMYCTOPHUM* (PISCES, TELEOSTEI, MYCTOPHIDAE) FROM THE SOUTHERN OCEAN

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ABSTRACT

Two new species of the genus *Protomyctophum* from the Southern Ocean are described. *P. mcginnisi* n. sp. (from off the Southern Shetland Islands) is most closely related to *P. bolini* (Fraser-Brunner, 1949), from which it differs in photophore arrangement, in metallic shine of the photophores, and in higher number of gill-rakers on the first gill arch. *P. kolaevi* n. sp. (from off the Balleny Islands) is most closely related to *P. tenisoni* (Norman, 1930) and especially to *P. choriodon* Hulley, 1981, but differs from both these species by its much wider interorbital space, and in photophore arrangement. A key to the species of *Protomyctophum* known south of the subtropic convergence is included.

Key words: lanternfishes, *Protomyctophum*, new species, key of species, Southern Ocean

INTRODUCTION

Protomyctophum Fraser-Brunner, 1949 is one of most diverse lineages of lanternfishes in the Southern Ocean. It is composed of two subgenera, *Protomyctophum* s. str. and *Hierops* Fraser-Brunner, 1949, hitherto comprising a total of 14 described species, nine of which (including all of the nominotypic subgenus) occur in temperate and cold waters of the Southern Hemisphere (Becker 1983). Species within this genus differ from each other in the photophore arrangement, structure of caudal luminous glands, sexual dimorphism in caudal glands, direction of eyes, body depth, relative position of fins, width of interorbital space, proportions of maxillary plate, gill-raker counts, and in some cases in the shape of palatine tooth-patch (Fraser-Brunner 1949; Becker 1963a, 1983; Paxton 1972; Hulley 1981, 1986). In spite of several revisions of this genus in areas within and outside the Southern Ocean (Andriashev 1962; Becker 1963a, 1963b; Wisner, 1976; Hulley 1981, 1986) it remains yet insufficiently known. At least four undescribed species have been reported previously (McGinnis in Becker 1983: 109), all from southward of the subtropic convergence. Also materials of the former Soviet Antarctic expeditions indicate that the number of species of *Protomyctophum* may further increase (unpublished data). Ahead of a forth-

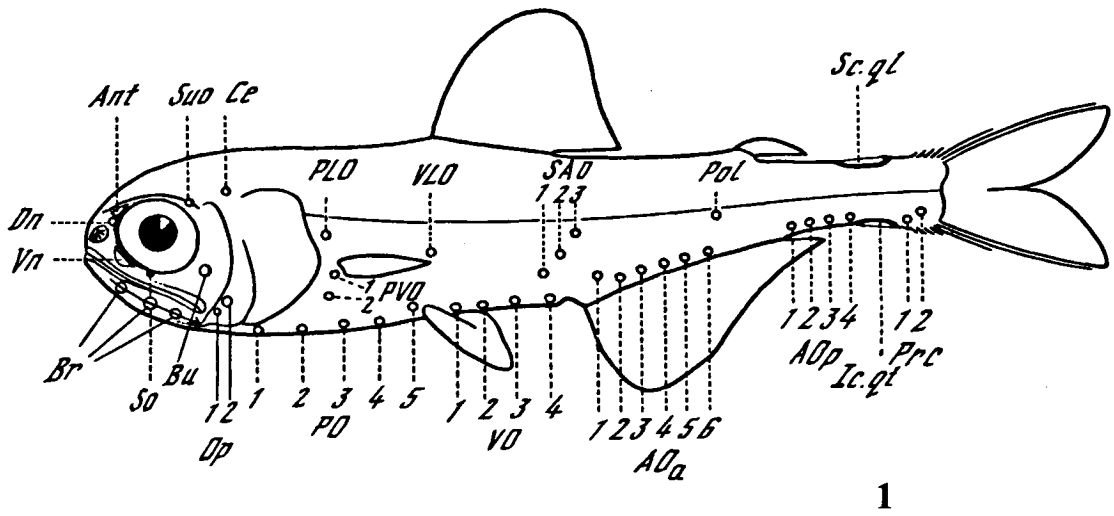


Fig. 1. Arrangement of photophores and luminous glands in Myctophidae (modified from Becker 1983). Abbreviations: *Ant* = antorbital gland; *AOa* = anterior portion of the anal series of photophores; *AOp* = posterior portion of the anal series of photophores; *Br* = branchiostegal photophores; *Bu* = cheek photophore; *Cl* = postorbital photophore; *Dn* = dorsonasal gland; *Ic.gl* = infracaudal gland; *Op* = opercular photophores; *PLO* = pectoral-lateral photophore; *PO* = prepelvic series of photophores; *Pol* = any photophores between the *AOa* and *AOp* series which is above a horizontal line tangent to the dorsal margin of the last, level *AOa* photophore; *Prc* = precaudal photophores; *PVO* = pectoral-ventral photophores; *SAO* = supraanal photophores; *Sc.gl* = supracaudal gland; *So* = suborbital photophore; *Suo* = supraorbital photophore; *VLO* = ventral-lateral organ; *Vn* = ventronasal gland; *VO* = postpelvic series of photophores. Remark: none of myctophid species have such arrangement of photophores and luminous glands. This figure is combined to show terminology of all the various photophore groups and luminous glands found in lanternfishes.

coming revision two well-delimited new species are described in the present paper.

The type material is deposited in the Zoological Institute of the Russian Academy of Sciences, Saint-Petersbourgh.

The limits of the Southern Ocean here are accepted following Andriashev (1986) (from 50°S southwards). The standard ichthyological counts and measurements were made following Hubbs and Lagler (1958), except where otherwise mentioned. Pectoral-pelvic distance is measured from the base of the uppermost pectoral-fin ray to the base of the outermost pelvic-fin ray. Pelvic-anal distance is measured from the base of the outermost pelvic-fin ray to the anteriormost point of first anal-fin ray. Upper jaw length is measured from the tip of snout to the posteroventral point of the maxillary. Depth of maxillary is measured between most opposed points of the posterior expanded portion of this bone. The photophore's abbreviations (Fig. 1) are standard and given according Nafpaktitis (1968) and Becker (1983). If angle between photophores exceeds 30° they are considered strongly angled; if angle equals 10-30° they are considered weakly angled, and if angle between photophores is less than 10° they are considered as nearly on a straight line. The counts and measurements of the holotype are given by first, following these for paratype(s) in parentheses.

Abbreviations: SL = standard length; HL = head length; ZIN = Zoological Institute of the Russian Academy of Sciences, Saint-Petersbourgh.

DESCRIPTIONS OF SPECIES

Protomyctophum (Protomyctophum) mcginnisi n. sp.

Fig. 2

MATERIAL. - Holotype: ZIN 39057, male, SL 41 mm (Fig. 2), off South Shetland Islands (approximately 60-65°S 60-65°W), R/V 'Akademik Knipovitsch', station 741, trawl no. 17 (no data about exact coordinates and depth of catching are available now), 1-II-1967, coll. Yu. E. Permitin.
Paratype: ZIN 39057a, female, SL 55 mm, collected with the holotype. In the paratype both eyes and a part of the photophores are lost.

Table 1. Morphometric data of *Protomyctophum mcginnisi* n. sp.

Measurements	Holotype	Paratype
Standard length (SL), mm	41	55
Head length (HL), %SL	34.1	27.3
Greatest depth of body, %SL	26.8	23.6
Least depth of caudal peduncle, %SL	8.5	6.8
Caudal peduncle length, %SL	12.2	14.5
Length of snout to origin of dorsal fin, %SL	51.2	50.9
Length of snout to origin of pelvic fin, %SL	48.8	47.3
Length of snout to origin of anal fin, %SL	63.4	65.5
Pectoral-pelvic distance, %SL	14.6	20.0
Pelvic-anal distance, %SL	14.6	18.2
Pectoral-fin length, %SL	19.5	18.2
Pelvic-fin length, %SL	14.6	14.6
Dorsal-fin base length, %SL	12.2	14.5
Anal-fin base length, %SL	24.4	20.0
Caudal-fin length, %SL	24.4	21.8
Dorsal-fin height, %SL	24.4	18.2
Anal-fin height, %SL	24.4	18.2
Snout length, %HL	21.4	20.0
Horizontal diameter of eye, %HL	35.7	33.3
Interorbital width, %HL	14.3	16.7
Upper jaw length, %HL	67.9	66.7
Depth of maxillary, %HL	14.3	16.7

ETYMOLOGY. - Species named in honour of Dr R. F. McGinnis for his contribution to study of the lanternfishes of the Southern Hemisphere.

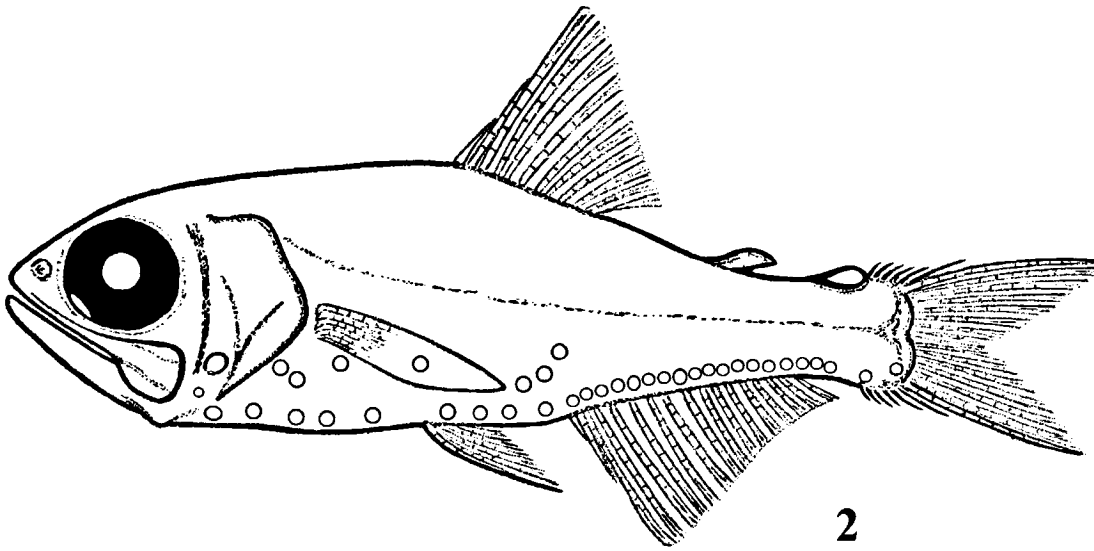
DIAGNOSIS. - A species of *Protomyctophum* s. str., with *Prc* photophores well-spaced; *SAO* photophores weakly angled; three *AO* photophores behind the vertical of last anal-fin ray; Op_1 positioned below the level of lower margin of orbit; photophores bold-metallic; single supracaudal gland in male, which occupies nearly one-third of distance between first procurrent caudal ray and adipose-fin origin, and single small infracaudal gland in female; 16-17 pectoral-fin rays; 23-24 gill-rakers on first arch; body moderate in depth, nearly 23-27% of SL; interorbital space nearly equal to half-diameter of orbit, and depth of maxillary plate nearly equal to length of ventral maxillary expansion.

DESCRIPTION. - Dorsal-fin rays, 12 (12), first two unbranched; anal-fin rays, 17 (17), first two unbranched; pectoral-fin rays, 17 (16); principal caudal-fin rays, 10+9 (10+9); procurrent caudal-fin rays, 10+6 (10+7); gill-rakers on first gill arch, 6+1+17=24 (5+1+17=23). Measurements in Table 1.

Body moderately deep and rather stout, with relatively low caudal peduncle. Least depth of caudal peduncle 1.5 (2.1) times in length of caudal peduncle, 3.1 (3.5) times narrower than maximum body depth. Head and eyes large; eyes not semi-telescopic. Interorbital width equal to depth of posterior plate of maxillary, 2.0 (2.1) times narrower than orbit diameter. Mouth terminal. Jaws short, extending one-quarter or less eye diameter behind posterior margin of orbit. Maxillary with a well-developed ventral expansion, nearly equally long as depth of maxillary plate. Supramaxillary small. Jaw teeth small, conical, arranged in a band along length of premaxillary and dentary. Palatine teeth evenly spaced along bone.

Dorsal-fin origin approximately on mid-length of the body. Anal-fin origin at a vertical line from last dorsal-fin ray. Pelvic fins slightly anterior to a vertical line from dorsal-fin origin, tips reaching anal-fin origin. Tips of pectoral fins reach to anus.

Photophores and luminous glands. *Dn* and *So*



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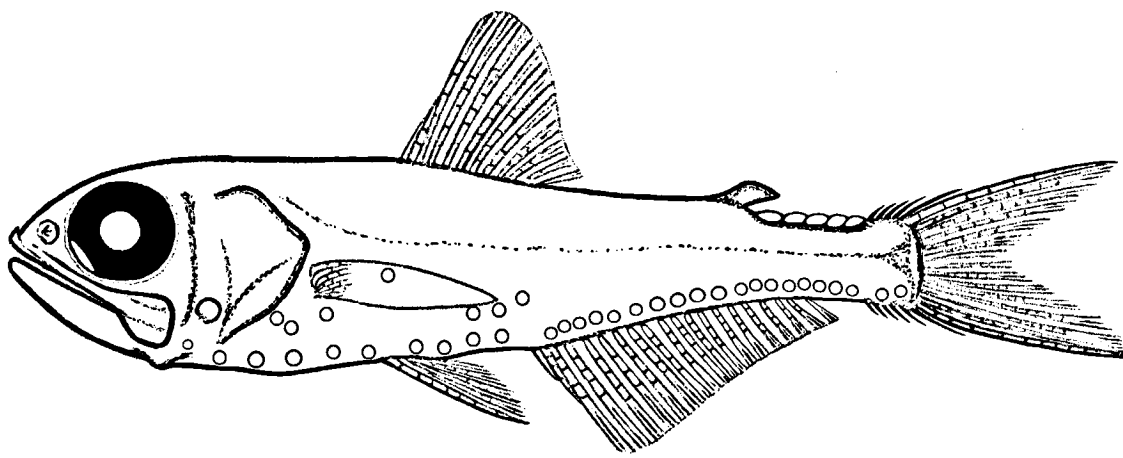

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Figs. 2-3. Fig. 2, *Protomyctophum mcginnisi* n. sp., outline drawing of the holotype, SL 41 mm (ZIN 39057). Fig. 3, *Protomyctophum kolaevi* n. sp., outline drawing of the holotype, SL 72 mm (ZIN 46004).

absent; *Vn* present, small, along anteroventral margin of the eye. Four *Br* and two *Op*. Op_1 is twice as large than Op_2, at the level of the upper margin of the maxillary, on one horizontal line with *PLO* and *VLO*. Op_2 at the level of the mid-depth of the maxillary plate. *PVO* on a nearly horizontal line below pectoral-fin base; PVO_1 half a diameter above PVO_2. *PLO* ventral from pectoral-fin base, posterior to *PVO* series, at one level with *VLO*. Five *PO* and four *VO*, none of the *VO* photophores are raised. Three *SAO*. SAO_{1-2} on a straight line through space between VO_1 and VO_2. SAO_1 above space between VO_3 and VO_4; SAO_2 above VO_4. SAO_3 above line through SAO_{1-2} in an angle approximately 25° with this line. No *Pol. AO* series not divided on anterior and posterior portions, with 18 photophores, last three behind last anal-fin ray. Two *Prc* near ventral margin of caudal peduncle. Prc_1 separated from Prc_2 at one diameter of photophore. Photophores metallic blue-white, surrounded by black tissue. Male with a single small drop-shaped supracaudal gland surrounded by black pigment; length of supracaudal gland approximately twice as short than distance between adipose-fin origin to anterior margin of this gland. No supracaudal glands in

female at hand. Female with small infracaudal gland, which was torn off, as a pocket is present. No infracaudal gland in male.

COMPARISON. - This species is unique within *Protomyctophum* s. str. in the combination of a) well-spaced *Prc*, b) three *AO* photophores posterior to last anal-fin ray, and c) metallic colour of photophores. The only other *Protomyctophum* s.str., which has the distance between Prc_1 and Prc_2 equal to or slightly greater than diameter of photophore, is *P. bolini* (Fraser-Brunner, 1949), while in the other species these photophores are close-set with a distance between them less than half the diameter of photophore. *P. mcginnisi* and *P. bolini* both differ in size, structure and position of the caudal luminous glands in both males and females. However, *P. mcginnisi* differs from *P. bolini* in the possession of three (vs. four in *P. bolini*) *AO* photophores posterior to last anal-fin ray, low position of Op_1 (at the level of upper margin of pectoral-fin base in *P. bolini*), weakly angled *SAO* (vs. nearly straight in *P. bolini*), and metallic blue-white photophores (vs. dim-grey in *P. bolini*). The number of gill-rakers on the first arch is slightly greater in *P. mcginnisi* than in *P. bolini* (23-24 vs. 21-22). These characters distinguish *P. mcginnisi* and *P. bolini* as different species, although they are apparently closely related. The combination of characters in the diagnosis distinguish *P. mcginnisi* from all *Protomyctophum* s. str., see key below.

COMPARATIVE MATERIAL. - *Protomyctophum bolini*, ZIN 36248, 15 specimens, SL 35-65 mm, 59°28'S 67°41'W, mid-water trawl, 500-0 m, R/V 'Ob', April - May, 1958, coll. A.P. Andriashev, Yu. E. Permitin.

Protomyctophum (Protomyctophum) kolaevi n. sp.
Fig. 3

MATERIAL. - Holotype: ZIN 46004, male, SL 72 mm (Fig. 3), off Balleny Islands, 66°06'S 161°38'E, depth 540-500 m, R/V 'Mys Yunony', trawl no. 4, 29-I-1981, coll. V. F. Kolaev.
Paratypes: ZIN 52711, two males, SL 67 and 65 mm, collected with the holotype.

ETYMOLOGY. - Species named in honour of the collector of the type material, V. F. Kolaev.

DIAGNOSIS. - A *Protomyctophum* s. str., with *Prc* photophores closely spaced; *SAO* photophores weakly angled; three *AO* photophores behind a vertical through last anal-fin ray; Op_1 twice as large than Op_2, and below level of lower margin of orbit; supracaudal gland of male occupying whole distance between first procurrent caudal ray and adipose-fin origin, consisting of five small unfused elements; 16 pectoral-fin rays; 24-25 gill-rakers on first arch; body rather low, nearly 20-22% of SL; interorbital space more than half-diameter of orbit, and depth of maxillary plate nearly equal to length of ventral maxillary expansion.

DESCRIPTION. - Dorsal-fin rays, 13 (12, ?), first two unbranched; anal-fin rays, 20 (20, 18), first two unbranched; pectoral-fin rays, 16 (16, 16); principal caudal-fin rays, 10+9 (10+9, 10+9); procurrent caudal-fin rays, 8+6 (8+6, 7+6); gill-rakers on the first arch, 6+1+18=25 (6+1+17=24, 6+1+17=24). Measurements in Table 2.

Body rather elongate, relatively stout, with rather narrow caudal peduncle. Least depth of caudal peduncle 1.5 (1.6, 1.8) times in length of caudal peduncle, 2.5 (2.8, 2.8) times narrower than maximum body depth. Head and eyes large; eyes not semi-telescopic. Interorbital space wide, considerably greater than depth of posterior plate of the maxillary, 1.7 (1.6, 1.7) times narrower than orbit diameter. Mouth terminal. Jaws short, extending one-quarter of eye diameter or less behind posterior margin of the orbit. Maxillary with well-developed ventral expansion, nearly equal in length to depth of maxillary plate. Supramaxillary small. Jaw teeth small, conical, arranged in a band along entire length of the premaxillary and dentary. Palatine teeth along length of the bone, anterior portion of tooth patch twice or more wider than posterior portion. Dorsal-fin origin closer to snout tip than to base of caudal fin. Anal-fin origin on a vertical line with last ray of dorsal fin. Pelvic fins anterior to a vertical line through dorsal-fin origin in the holotype and 67 mm paratype, but through the same vertical line in the 65 mm paratype. Tips of pelvic fins reach to or just beyond anal-fin origin. Tips of pectoral fins extend almost to anus.

Photophores and luminous glands. *Dn* and *So*

Table 2. Morphometric data of *Protomyctophum kolaevi* n. sp.

Measurements	Holotype	Paratype	Paratype
Standard length (SL), mm	72	67	65
Head length (HL), %SL	30.6	29.9	30.8
Greatest depth of body, %SL	20.8	21.0	21.5
Least depth of caudal peduncle, %SL	8.3	7.5	7.7
Caudal peduncle length, %SL	12.5	11.9	13.8
Length of snout to origin of dorsal fin, %SL	45.8	47.8	44.6
Length of snout to origin of pelvic fin, %SL	44.4	44.8	44.6
Length of snout to origin of anal fin, %SL	61.1	61.2	60.0
Pectoral-pelvic distance, %SL	13.9	13.4	13.9
Pelvic-anal distance, %SL	16.7	14.9	13.9
Pectoral-fin length, %SL	19.4	17.9	18.5
Pelvic-fin length, %SL	16.7	14.9	15.4
Dorsal-fin base length, %SL	13.9	14.2	? (damaged)
Anal-fin base length, %SL	26.4	26.9	27.7
Caudal-fin length, %SL	26.4	25.4	27.5
Dorsal-fin height, %SL	22.2	19.4	? (damaged)
Anal-fin height, %SL	16.7	17.9	18.5
Snout length, %HL	20.5	17.5	21.2
Horizontal diameter of eye, %HL	31.8	32.5	35.0
Interorbital width, %HL	18.2	20.0	20.0
Upper jaw length, %HL	63.6	65.0	65.0
Depth of maxillary, %HL	15.9	17.5	16.3

absent; moderately large *Vn* along anteroventral margin of eye. Three *Br*, partially missing in specimens of the type series. Two *Op*. Op_1 is twice as large than Op_2, at level of upper margin of maxillary, on one horizontal line with *PLO*. Op_2 close to lower margin of maxillary plate. *PVO* positioned on nearly horizontal line ventral from pectoral-fin base; PVO_1 above PVO_2 on half the diameter. *PLO* behind *PVO* series, on a line through middle of pectoral-fin base. *VLO* at least one of its own diameter above a line through *PLO*. Five *PO* and four *VO*, no *VO* photophores raised. Three *SAO*. SAO_{1-2} on a straight line through PO_2. SAO_1 above VO_3; SAO_2 above VO_4. SAO_3 on a line through space between anal-fin origin and AO_1. SAO_3 above a line through SAO_{1-2}, it forms an angle approximately 20-25° with this line. No *Pol. AO* series not divided on the anterior and posterior portions, with 16-18 photophores, last three are behind the last anal-fin ray. Two *Prc* close to ventral margin of caudal peduncle. Prc_1 is separated from Prc_2 on a distance slightly smaller than half a diameter of photophore. All photophores are metallic blue-white, surrounded by black tissue. Males with supracaudal gland consisting of five small equal elements covered by black tissue; this gland occupies entire length between adipose fin and first procurrent caudal ray. No infracaudal glands in males. Females unknown.

COMPARISON. - This species appears to be closely related with *P. tenisoni* (Norman, 1930) and *P. choriodon* Hulley, 1981 judging from its narrow body, structure of the male supracaudal gland and absence of an infracaudal gland in males. However, *P. kolaevi* n. sp. differs from both in a considerably greater interorbital width (less than half the diameter of orbit in *P. tenisoni* and *P. choriodon*), Op_1 twice as large than Op_2, and *VLO* well above a horizontal line through *PLO* (at the same horizon or nearly so in the compared species). It differs from *P. tenisoni* in smaller elements of the supracaudal gland, which consists of 5 (vs. 6-8, usually 7) elements, in the weakly angled *SAO* (vs. straight or nearly so in *P. tenisoni*), SAO_{1-2} on a line through PO_2 (vs. through PO_5 or

more posterior in *P. tenisoni*), SAO_1 on the level of VO_3 (vs. slightly behind the level of VO_3 in *P. tenisoni*). From the most similar *P. choriodon*, known only from the southeastern Atlantic (Hulley 1981, Becker 1983), *P. kolaevi* n. sp. differs in the less numerous gill rakers (24-25 vs. 25-28, mean 27) and in a shorter ventral expansion of the maxillary, which exceeds the depth of the maxillary plate in *P. choriodon*. The combination of characters in the diagnosis distinguish *P. kolaevi n. sp.* from all *Protomyctophum* s. str., see key below.

KEY TO SPECIES OF *PROTOMYCTOPHUM* KNOWN SOUTH OF THE SUBTROPIC CONVERGENCE

(for easier determination of species in thefield, characters distinguishing species in appropiated couplets from at least one of several species under subsequent couplets are included in the key and given in brackets)

1a. Eyes not semi-telescopic; interorbital space equal in width to depth of maxillary plate, or wider; anal-fin origin on same level with last dorsal-fin ray (subgenus *Protomyctophum*) 2

b. Eyes semi-telescopic; interorbital width narrower than depth of maxillary plate; anal-fin origin under mid-base of dorsal fin (subgenus *Hierops*) 10

2a. Distance between Prc_1 and Prc_2 equal to or slightly greater than photophore diameter; single supracaudal gland in males containing 50 % or less in the distance between adipose fin and first procurrent caudal ray; no infracaudal gland in males 3

b. Distance between Prc_1 and Prc_2 equal to or less half the diameter of photophore; male supracaudal gland single or divided on several elements, containing 50% or more in the distance between adipose fin and first procurrent caudal ray, if less than 60% of this distance, males always have infracaudal gland [three *AO* photophores behind the last anal-fin ray; photophores with metallic shine] 4

3a. Op_1 on same level with lower margin of eye and distinctly above the line connecting *PLO* and *VLO*; *SAO* straight; four *AO* photophores behind the last anal-fin ray; photophores without metallic shine; 21-22 gill rakers on first arch ..... *P. (P.) bolini* (Fraser-Brunner, 1949)

b. Op_1 below level of lower margin of eye, on same line with *PLO* and *VLO*; *SAO* weakly angled; three *AO* photophores behind the last anal-fin ray; photophores with metallic shine; 23-24 gill rakers on first arch ..... *P. (P.) mcginnisi* n. sp.

4a. Supracaudal gland in males consists of five to eight elements and occupies whole space between adipose fin and first procurrent caudal ray, or nearly so; no infracaudal gland in males; greatest depth of body less than 25% SL (usually 20-22%) 5

b. Single supracaudal gland in males, or, if this gland consists of four to five partially fused elements, it occupies approximately 60% of space between adipose fin and first procurrent caudal ray; males with infracaudal gland; greatest depth of body more than 25% SL 7

5a. Interorbital width larger than half a diameter of orbit; Op_1 twice as large as Op_2; *VLO* considerably higher than *PLO* [*SAO* weakly angled; SAO_{1-2} on line passing through PO_2; SAO_1 on same level with VO_3; supracaudal gland in males consists of five small elements; 24-25 gill-rakers on first arch; length of ventral expansion of maxillary equal to depth of maxillary plate] ..... *P. (P.) kolaevi* n. sp.

b. Interorbital width distinctly smaller than half a diameter of orbit; Op_1 not considerably larger than Op_2; *VLO* at same level as *PLO* or nearly so 6

6a. Supracaudal gland in males consists of five to six small elements; *SAO* weakly angled; SAO_{1-2} on line through PO_2 or PO_3; SAO_1 on same level with VO_3; 25-28 gill-rakers on first arch; length of ventral expansion of maxillary greater than depth of maxillary plate ..... *P. (P.) choriodon* Hulley, 1981

b. Supracaudal gland in males consists of six to eight (usually seven) relatively large elements; *SAO* straight; SAO_{1-2} on line through PO_5 or more posteriorly; SAO_1 slightly behind level of VO_3; 23-25 (rarely 22 or 26) gill-rakers on first arch; length of ventral expansion of maxillary nearly equal to depth of maxillary plate ..... *P. (P.) tenisoni* (Norman, 1930)

7a. Interorbital width equal to half a diameter of orbit or nearly so; 19-20 (rarely 18 or 21) gill-rakers on first arch; single supracaudal gland in males occupies whole distance between adipose fin and first procurrent caudal ray [16 pectoral-fin rays] ..... *P. (P.) andriashevi* Becker, 1963

b. Interorbital width distinctly smaller than half a diameter of orbit; 23 or more gill-rakers on first arch; single or subdivided supracaudal gland in males occupies 50-70% of distance between adipose fin and first procurrent caudal ray 8

8a. 16-17 pectoral-fin rays; males with single supracaudal gland, which occupies nearly 70% of distance between adipose fin and first procurrent caudal ray [*SAO* strongly angled] ... *P. (P.) gemmatum* Hulley, 1981

b. 13-15 pectoral-fin rays; males with single or subdivided supracaudal gland, which occupies nearly 50-60% of distance between adipose fin and first procurrent caudal ray 9

9a. Male supracaudal gland subdivided on 4-5 partially fused elements, occupies nearly 60% of distance between adipose fin and first procurrent caudal ray; *SAO* strongly angled; 25-26 (rarely 24, 27, or 28) gill-rakers on first arch ..... *P. (P.) normani* (Taaning, 1932)

b. Male supracaudal gland not subdivided, occupies nearly 50% of distance between adipose fin and first procurrent caudal ray; *SAO* weakly angled; 22-24 (rarely 25) gill-rakers on first arch ..... *P. (P.) luciferum* Hulley, 1981

10a. SAO_1 situated above space between VO_2 and VO_3, on mid-length between *VLO* and SAO_2 or closer to *VLO*; distance between Prc_1 and Prc_2 equal to or greater than distance between the last *AO* photophore and Prc_1; *AO* 17-19, 6-7 (rarely 4 or 5) *AO* photophores behind the last anal-fin rav .... *P. (H.) parallelum* (Lönnberg, 1905)

10b. SAO_1 situated above space between VO_3 and VO_4 (rarely above VO_3 or VO_4), closer to SAO_2 than to *VLO*; distance between Prc_1 and Prc_2 smaller than distance between the last *AO* photophore and Prc_1; *AO* 13-15, 2-3 (rarely 1 or 4) *AO* photophores behind the last anal-fin rav .... *P. (H.) subparallelum* (Taaning, 1932)

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