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***Callionymus madangensis*, a new species of dragonet from Papua New Guinea, southwestern Pacific Ocean (Teleostei: Callionymidae)**

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Abstract

A new species of dragonet, *Callionymus madangensis* from Madang, Papua New Guinea, is described on the basis of a single male specimen collected with a trawl in about 30–40 m depth near Madang. The new species is characterised within the subgenus *Pseudocalliurichthys* by a small branchial opening; head short (3.7 in SL); eye large (2.3 in head length); preopercular spine with a short, straight main tip, six to seven curved serrae on its dorsal margin and a strong antrorse spine at its base, ventral margin smooth, slightly concave; first dorsal fin much higher than second dorsal fin, with 4 spines, first spine with a long filament (male); second dorsal-fin distally straight, with 8 unbranched rays (last divided at base); anal fin with 7 unbranched rays (last divided at base); 17 pectoral-fin rays; caudal fin elongate, distally rounded, nearly symmetrical in male (upper rays not much shorter than lower rays); sides of head, membrane connecting pelvic fin pectoral fin, and body with small ocelli; first dorsal fin plain dark grey; second dorsal fin translucent, rays spotted; anal fin dark grey; lower margin of caudal fin dark grey, remainder with vertical rows of brown spots. The new species is compared with similar species. Revised keys to callionymid fish species of New Guinea, as well as of the subgenus *Pseudocalliurichthys*, are presented.

Key words: fishes, taxonomy, systematics, identification keys.

Introduction

Dragonets of the family Callionymidae are a group of benthic-living fishes occurring in the upper 900 metres of all temperate, subtropical, and tropical oceans of the world, and a few species found in estuarine and freshwater habitats. They are characterised by a depressed body, a triangular head when seen from above, the eyes large and situated dorsally on the head, the presence of a preopercular spine bearing additional points and/or serrae, the gill opening reduced to a small pore, swimbladder absent, two dorsal fins, the first with thin, flexible spines, the second with soft rays, and jugular pelvic fins which are separated from each other, but each connected with the pectoral-fin base by a membrane. The Indo-Pacific species of the family were revised by Fricke (1983a), who distinguished 126 valid species from the area, including three species from the Mascarenes. Fricke (2002), in a

checklist of the callionymid fishes of the world, listed a total of 182 valid species in 10 genera. Subsequently, eight additional species were described [*Callionymus kanakorum* and *Protogrammus antipodum* from New Caledonia (Fricke 2006), *Tonlesapia tsukawakii* from Cambodia (Motomura & Mukai 2006), *T. amnica* from Vietnam (Ng & Rainboth 2011), *Synchiropus tudorjonesi* from Papua, Indonesia (Allen & Erdmann 2012), *Callionymus profundus* from the northern Red Sea (Fricke & Golani 2013), *Diplogrammus paucispinis* from the eastern Red Sea (Fricke *et al.* 2014b), *Callionymus omanensis* from the northwestern Indian Ocean (Fricke *et al.* 2014c)], and *Eleutherochir mccaddeni* Fowler 1941 was removed from the synonymy of *E. opercularis* by Yoshigou *et al.* (2006), bringing the worldwide total to 191 species in the family.

Fricke (1982: 128) defined the *variegatus* species-group of the genus *Callionymus* as having a combination of 4 spines and 8 soft rays in the dorsal fin and 7 soft rays in the anal fin and a usually asymmetrical caudal fin of males, with the lower rays more elongate than the upper rays first dorsal-fin. He distinguished 6 species in the group, which is restricted to the Indo-West Pacific. Nakabo (1982: 104) described the genus *Pseudocalliurichthys* with *Callionymus variegatus* Temminck & Schlegel 1844 as the type species. Fricke (2002: 7, 101) treated *Pseudocalliurichthys* (the former *variegatus* species-group) as a subgenus of the genus *Callionymus*, and distinguished 12 species. *Callionymus comptus* Randall 1999 from the Hawaiian Islands and *Callionymus ikedai* Nakabo, Senou & Aizawa 1998 from the Ryukyu Islands, however, have been found to be members of the subgenus *Spinicapitichthys*, due the presence of one of more small spinules on the ventral side of the preopercular spine: the number of species of *Pseudocalliurichthys* is accordingly reduced to 10.

Species of the subgenus *Pseudocalliurichthys* live on shallow to moderately deep soft bottoms, mainly in lagoons of coral reefs or on the upper continental slope and oceanic island slopes; they bury in the substrate, usually only leaving the eyes visible. Callionymid fishes typically occur in harem groups, with one male controlling a larger home range living together with several females. Spawning usually takes place around dusk; the courting pair ascends and releases the eggs well above the ground, following a complex courtship behaviour where the spreading of the first dorsal fin or flashing blue 'lights' (iridescent blue spots) are frequent motor patterns. The eggs and larvae are pelagic; during transformation into juveniles they shift to a benthic life style (Fricke *et al.* 2014c).

A single specimen of an undescribed species of the subgenus was collected during the PAPUA NIUGINI 2012 expedition in Madang Bay, Papua New Guinea, southwestern Pacific Ocean (Fricke *et al.* 2014a: 154). As the species is apparently extremely rare, and appears to be locally endemic in the deeper parts of the Madang Lagoon system, it is described herein on the basis of a single specimen, bringing the total number of species known in the subgenus to 11.

Materials and Methods

The holotype of the new species is deposited in the National Taiwan University, University Museum, Taipei, Taiwan (NTUM). The exact collection data for the holotype in November 2012 were unfortunately lost, but the specimen was probably collected using a dredge, in the deeper parts of Madang Lagoon.

Comparative materials are listed below. Abbreviations of museum collections (see below) follow Fricke & Eschmeyer (2014a).

Methods follow Fricke (1983a); fin-ray counts follow Fricke (1983b). The starting point for length measurements is the middle of the upper lip. The standard length (measured from the tip of the upper lip to the middle of the urohyal/caudal fin base) is abbreviated SL. The predorsal (1) length is measured from the middle of the upper lip to the base of the first spine of the first dorsal fin; the predorsal (2) length correspondingly to the base of the first ray of the second dorsal fin. The last ray of the second dorsal and anal fins is always divided at its base; counts in the key include this divided ray as one. In the identification keys, males and females are keyed out separately only if there are significant differences between male and female morphology and colouration, and if females of two different species are more similar to each other than to the males of the same species.

Species classification is based on Fricke (2002). Nomenclature follows Eschmeyer (2014). References and journals follow Fricke (2014) and Fricke & Eschmeyer (2014b).



Figure 1. *Callionymus madangensis* n. sp., NTUM 10146, holotype, male, 19.3 mm SL, Papua New Guinea, Madang, Madang Bay; Photograph taken immediately after collection (photo by Wei-Jen Chen).

Callionymus madangensis, n. sp.

Madang Dragonet

Figures 1–2, Table 1.

Callionymus sp. Fricke *et al.* 2014a: 154 (Papua New Guinea, Madang).

Holotype. NTUM 10146, 19.3 mm SL, male, Papua New Guinea, Madang District, Madang Bay, approximately 30–40 m depth, Wei-Jen Chen, R/V *Alis*, November 2012.

Diagnosis. A species of the subgenus *Callionymus* (*Pseudocalliurichthys*) with a small branchial opening; head short (3.7 in SL); eye large (2.3 in head length); preopercular spine with a short, straight main tip, six to seven curved serrae on its dorsal margin and a strong antrorse spine at its base, ventral margin smooth, slightly concave; first dorsal fin much higher than second dorsal fin, with 4 spines, first spine with a long filament (male); second dorsal-fin distally straight, with 8 unbranched rays (last divided at base); anal fin with 7 unbranched rays (last divided at base); 17 pectoral-fin rays; caudal fin elongate, distally rounded, nearly symmetrical in male (upper rays not much shorter than lower rays); small ocelli on sides of head and membrane connecting pelvic fin pectoral fin, and body; first dorsal fin plain dark grey; second dorsal fin translucent, rays spotted; anal fin dark grey; lower margin of caudal fin dark grey, remainder with vertical rows of brown spots.

Description. D IV + vii,1; A vi,1; P1 i,14,ii (total 17; left pectoral fin damaged); P2 I,5; C (ii),i,7,ii,(iii). Proportions are given in Table I.

Body elongate and slightly depressed. Head moderately depressed. Eye large. Interorbital narrow, 9.2 in eye diameter. Preopercular spine with a short, straight main tip, six to seven curved serrae on its dorsal margin and a strong antrorse spine at its base, ventral margin smooth, slightly concave; preopercular spine formula 1–~~6~~–1. Cephalic lateral-line system with a short preorbital branch, a short suborbital branch, a disconnected preopercular branch, and a supraoccipital commissure connecting lines of opposite sides. Occipital region smooth, with two low bony protuberances. Body lateral-line system without dorsal branches. Urogenital papilla short.

First dorsal fin slightly higher than second dorsal fin in the male, with a long filament of the first spine, the membranes not slightly incised [sexual dimorphism of the first dorsal fin presumed, judging from the situation in the other species of the subgenus]. Second dorsal fin distally slightly concave, rays unbranched, the last divided at its base, posterior branch of last ray slightly elongate in male. Anal fin beginning on vertical through second ray of

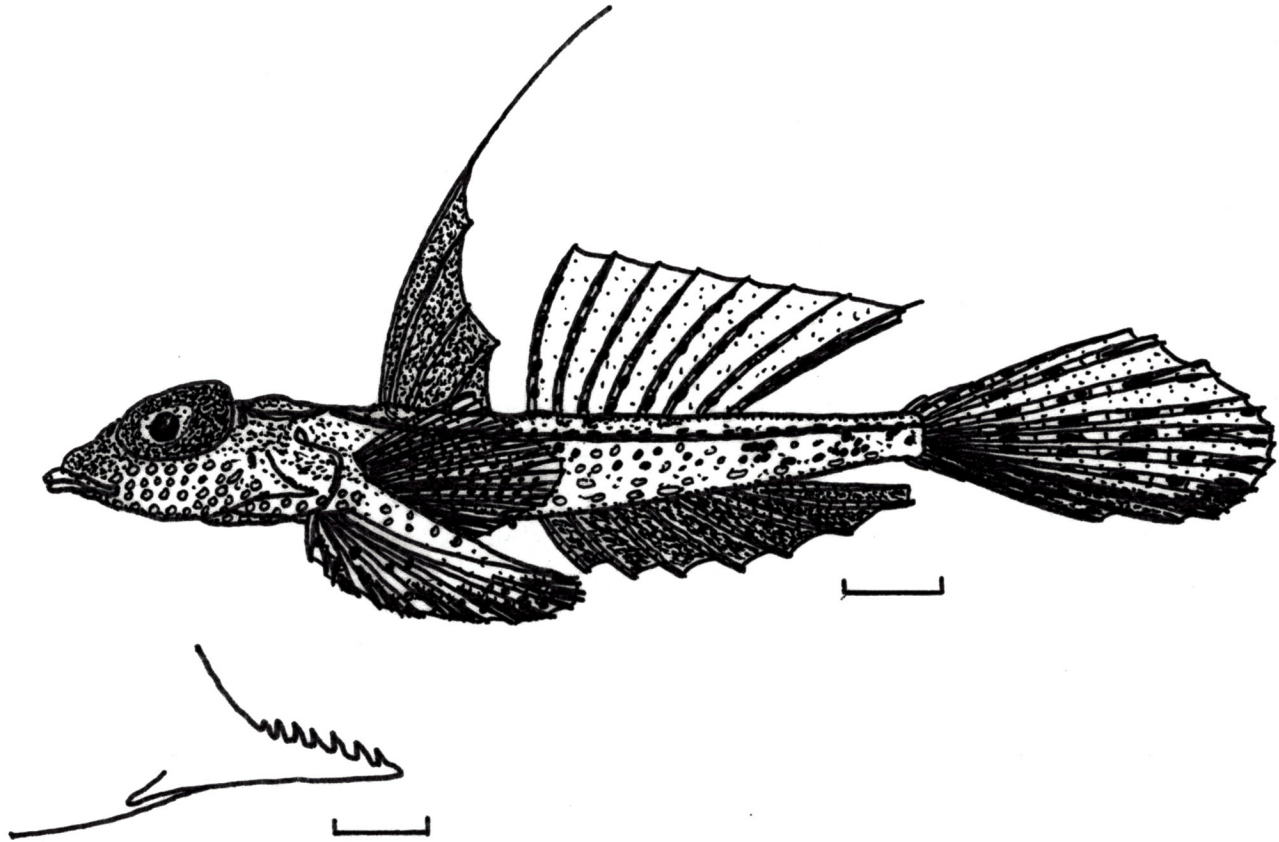


Figure 2. *Callionymus madangensis* n. sp., NTUM 10146, holotype, male, 19.3 mm SL, Papua New Guinea, Madang, Madang Bay [left pectoral fin reconstructed based on right side]. A Lateral view, left side (scale bar indicates 0.5 mm); B Left preopercular spine (scale bar indicates 3 mm).

second dorsal fin. Anal fin distally slightly convex; anal-fin rays unbranched, the last divided at its base. Pectoral fin reaching to base of first anal-fin membrane when adpressed. Pelvic fin reaching to base of second anal fin ray when adpressed. Membrane connecting 5th pelvic-fin ray with pectoral fin base ending opposite sixth pectoral-fin ray (counted from above). Caudal fin in male elongate, symmetrical, without filaments.

Colour immediately after collection (Fig. 1). Head and body yellowish brown, dorsally dark brown, cheeks orange yellow with several bluish white ocelli, thorax yellowish white. Back with irregularly arranged grey and pale white spots. Eye dorsally yellowish brown, laterally bluish silver. Sides of body with groups of dark grey spots below lateral line; lateral line with double short blackish streaks; back with irregular brown and creamy white spots; ventrally with short creamy lines. First dorsal fin in the male plain dark grey, without spots or blotches. Second dorsal fin pale, with brown spots on the rays. Anal fin dark grey. Caudal fin pale, upper two thirds with vertical rows of brown spots and short lines, lower one-fifth dark grey. Pelvic fin with groups of brown spots, basal parts and membrane connecting pelvic with pectoral fin with bluish white ocelli. Pectoral fin yellowish, with vertical rows of brown spots.

Colour in preservative. Similar to fresh colouration, except that the bluish ocelli fade to white, and the orange cheeks fade to brownish yellow.

Sexual dimorphism. Unknown (only the male holotype known).

Distribution. The species is only known from the type locality, Madang Bay, Papua New Guinea. The holotype was collected on soft bottom in the deeper parts of the lagoon. The species is possibly restricted to lagoon habitats of the Madang area at depths of approximately 30–40 m.

Etymology. The name of the new species refers to its type locality, Madang.

Comparisons. The new species is a member of the subgenus *Callionymus* (*Pseudocalliurichthys*) as defined by Fricke (1982: 128; 2002: 7, 101) and Nakabo (1982: 104) (see above in the introduction). It is similar to *Callionymus brevianalis* Fricke 1983 (Fricke 1983: 323, fig. 98) from New Guinea and New Caledonia, and

TABLE 1

Callionymus madangensis n. sp., NTUM 10146, holotype,
Papua New Guinea, Madang Bay: meristic data and proportions

	Measurement [mm]	Proportion of standard length	Proportion as percentage of standard length
Standard length	19.3		
Caudal-fin length	7.6	2.5	39.4
Predorsal(1) length	7.0	2.8	36.3
Predorsal(2) length	10.4	1.9	53.9
Preanal length	10.7	1.8	55.4
Prepelvic fin length	5.5	3.5	28.5
Prepectoral fin length	6.5	3.0	33.7
Length from tip of snout to end of preopercular spine	5.8	3.3	30.0
Head length	5.2	3.7	26.9
Body depth	2.4	8.0	12.4
Body width	2.8	6.9	14.5
Orbit diameter	2.3	8.4	11.9
Preorbital length	1.4	13.8	7.2
Bony interorbital	0.25	77.2	1.3
Caudal peduncle length	3.2	6.0	16.5
Caudal peduncle depth	1.0	19.3	5.2
Upper-jaw length	1.7	11.4	8.8
Urogenital papilla length	0.1	193.0	0.5
Length of left preopercular spine	1.45	13.3	7.4
Length of first spine of first dorsal fin	10.3	1.9	53.4
Length of second spine of first dorsal fin	4.2	4.6	21.8
Length of third spine of first dorsal fin	2.4	8.0	12.4
Length of fourth spine of first dorsal fin	1.8	10.7	9.3
Length of first spine of second dorsal fin	3.8	5.1	19.7
Length of last spine of second dorsal fin	4.5	4.3	23.3
Length of first anal-fin ray	1.7	11.4	8.8
Length of last anal-fin ray	3.7	5.2	19.2
Pectoral-fin length (right side)	5.4	3.6	28.0
Length of first pelvic-fin spine	1.2	16.0	6.2
Pelvic-fin length	6.1	3.2	31.6
Length of first dorsal-fin base	2.1	9.2	10.9
Length of second dorsal-fin base	4.4	4.4	22.8
Length of anal-fin base	4.5	4.3	23.3
Length of pectoral-fin base	1.4	13.8	7.3
Length of pelvic-fin base	1.1	17.5	5.7

Callionymus grossi Ogilby 1910 (Fricke, 1983: 376, fig. 113) from northern Australia in bearing a long filament on the first spine of the first dorsal fin and the male caudal fin nearly symmetrical. Other species of the subgenus have an asymmetrical caudal fin in the male, with the upper rays much shorter than the lower rays, and often no filament of the first spine of the first dorsal fin. The new species differs from *Callionymus brevianalis* in having 8 rays in the second dorsal fin (7 in *C. brevianalis*), 7 anal-fin rays (6 in *C. brevianalis*), 6–7 spinules on the dorsal margin of the preopercular spine (2–4 in *C. brevianalis*), and the first dorsal and anal fins in the male dark grey (pale in *C. brevianalis*). The new species is distinguished from *Callionymus grossi* by its smaller body size with maturity reached at 19.3 mm SL (*C. grossi* reaching maturity at ca. 25 mm SL, and growing to 142.3 mm), the preopercular spine with relatively large, curved spinules on its dorsal margin (very small, straight serrae in *C. grossi*), the predorsal (1) length 2.8 in SL (4.0–4.9 in *C. grossi*), the base of the first dorsal fin 2.4 in head length (0.8–0.9 in *C. grossi*), a larger head (head length 3.7 in SL, vs. 3.9–5.1 in *C. grossi*), a higher body (body depth 8.0 in SL, vs. 8.7–12.8 in *C. grossi*), a wider body (body width 6.9 in SL, vs. 4.1–6.5 in SL), the dorsal fin plain dark grey in the male (light and with spots in *C. grossi*, only the first spine dark grey), and the anal fin plain dark grey (hyaline and without markings in *C. grossi*). From other species of *Callionymus*, it differs in having a preopercular spine with a straight main tip and serrae on the dorsal margin, no spines on the ventral margin, in combination with 8 second dorsal-fin rays and 7 anal-fin rays.

A key to the callionymid fish species of New Guinea is presented below to distinguish *Callionymus madangensis* n. sp. from potentially co-occurring species. Also, a revised key to species of the subgenus *Pseudocalliurichthys* is provided to characterise the new species among other related species (updated, based on a key presented by Fricke 1983). So far, four endemic species to New Guinea are known to science: *Callionymus colini* from Port Moresby region, *Callionymus madangensis* and *C. zythros* from Madang, and *Synchiropus claudiae* from eastern New Guinea (Madang and Port Moresby). The callionymid endemism rate therefore amounts to 18.2%, which is relatively high. Madang plays a special role for callionymids as an endemism centre; three of the four callionymids endemic to New Guinea occur at Madang, two even exclusively. The total number of endemic fishes in Madang Lagoon now amounts to 9 species. As the endemic callionymid species are restricted to soft bottoms of the lagoon and the barrier reef, and as these habitats are subjected to pressure from anthropogenic activities like sewage disposal, fishing activities and industrial development (Fricke *et al.* 2014a: 204), these habitats in Madang Lagoon are in urgent need of special attention, monitoring, and conservation measures.

Key to the Species of the Family Callionymidae of New Guinea

(those occurring in Madang District in *bold type*)

- 1a. Opercle with a free flap of skin.....2
- 1b. Opercle without a free flap of skin.....3

- 2a. Body with lateral fold of skin below the lateral line; lower lip without fleshy papillae; anal-fin rays unbranched.....***Diplogrammus goramensis*** (Bleeker 1858)
- 2b. Body without lateral fold of skin below the lateral line; dorsal margin of lower lip with a row of erect fleshy papillae; anal-fin rays branched ***Eleutherochir opercularis*** (Valenciennes in C. & V. 1837)

- 3a. Sides of body with a number of small dermal cirri; few but relatively large teeth on the jaws.....***Anaora tentaculata*** Gray 1835
- 3b. Sides of body without small dermal cirri; many small villiform teeth in bands in the jaws.....4

- 4a. Snout shorter than eye diameter; soft dorsal-fin rays branched (in specimens longer than three cm); gill opening sublateral; no antrorse spine present at preopercular spine base.....(*Synchiropus*) 5
- 4b. Snout equal to, or longer than, eye diameter; soft dorsal-fin rays unbranched; gill opening dorsal; antrorse spine at base of preopercular spine.....(*Callionymus*) 12
- 5a. Colour in life bright red with black pectoral-fin base; first dorsal fin in male without ocelli, but with four oblique ocellated bands reaching from first to third membranes; first dorsal fin in female mainly black
.....*Synchiropus tudorjonesi* Allen & Erdmann 2012
- 5b. Colour in life not bright red with black pectoral-fin base; first dorsal fin in males not as described above, if ocellated bands are present they would not reach the first membrane; first dorsal fin in female not mainly black.....6
- 6a. Preopercular spine with one or two dorsal points additional to main tip.....7
- 6b. Preopercular spine with three to five dorsal points additional to main tip.....8
- 7a. Preopercular spine with one dorsal point additional to main tip.....9
- 7b. Preopercular spine with two dorsal points additional to main tip.....*Synchiropus bartelsi* Fricke 1981
- 8a. Lateral line with two ventral branches below the occipital region; in males first dorsal fin with ocelli on second and third membranes.....10
- 8b. Lateral line without two ventral branches below the occipital region; in males first dorsal fin with ocelli on first and second membranes.....*Synchiropus ocellatus* (Pallas 1770)
- 9a. First dorsal fin in male at least twice as high as second dorsal fin and bearing ocelli; sides of body mottled with dark brown, but without distinct ocelli.....*Synchiropus stellatus* Smith 1963
- 9b. First dorsal fin in male not higher than second dorsal fin and without ocelli; sides of body with series of large ocelli.....*Synchiropus circularis* Fricke 1984
- 10a. Distal margin of second dorsal fin straight or concave; rays of second dorsal fin unbranched (except last which is divided at base).....*Synchiropus claudiae* Fricke 1990
- 10b. Distal margin of second dorsal fin convex; rays of second dorsal fin branched (last divided at base).....11
- 11a. Caudal peduncle depth less than 5.6 in SL; interorbital more than 1.8 in eye; brown, with blue lines and spots*Synchiropus splendidus* (Herre 1927)
- 11b. Caudal peduncle depth more than 5.7 in SL; interorbital less than 1.5 in eye; olive green (preserved: light blue), with large ocellate dark olive blotches.....*Synchiropus picturatus* (Peters 1877)

12a.	Upper margin of preopercular spine with small antrorse serrae	13
12b.	Upper margin of preopercular spine with large curved points.....	21
13a.	Second dorsal fin with seven or eight rays (the last divided at base).....	14
13b.	Second dorsal fin with nine rays (the last divided at base).....	16
14a.	Second dorsal fin with seven rays (the last divided at base); anal fin with six rays (the last divided at base). <i>Callionymus brevianalis</i> Fricke 1983	
14b.	Second dorsal fin with eight to nine rays (the last divided at base); anal fin with seven rays (the last divided at base).....	15
15a.	Caudal fin in male nearly not asymmetrical, length of upper rays similar to lower rays; first dorsal fin in male plain dark grey..... <i>Callionymus madangensis</i> n. sp.	
15b.	Caudal fin in male strongly asymmetrical, length of upper rays much shorter than lower rays; first dorsal fin in male light, with a few indistinct dark spots..... <i>Callionymus pleurostictus</i> Fricke 1982	
16a.	Anal fin with nine rays (the last divided at base).....	17
16b.	Anal fin with eight rays (the last divided at base).....	18
17a.	First spine of first dorsal fin in male detached from second spine, with a long filament; ventral margin of preopercular spine convex..... <i>Callionymus filamentosus</i> (Valenciennes in C. & V. 1837)	
17b.	First spine of first dorsal fin in male connected with second spine, not filamentous; ventral margin of preopercular spine concave..... <i>Callionymus belcheri</i> Richardson 1844	
18a.	Caudal fin in male extremely elongate, at least nearly as long as standard length.....	19
18b.	Caudal fin in male relatively short, at most half of standard length..... <i>Callionymus colini</i> Fricke 1993	
19a.	First to third dorsal spines in male with filaments..... <i>Callionymus neptunius</i> (Seale 1910)	
19b.	Dorsal fin without filaments in both sexes.....	20
20a.	Dorsal margin of preopercular spine with 7–10 antrorse serrae; third membrane of first dorsal fin with large black blotch..... <i>Callionymus afilum</i> Fricke 2000	
20b.	Dorsal margin of preopercular spine with 5–6 antrorse serrae; third membrane of first dorsal fin without black blotch..... <i>Callionymus zythros</i> Fricke 2000	
21a.	Anal fin with seven rays (the last divided at base).....	22
21b.	Anal fin with 8–10 rays (the last divided at base).....	23

- 22a. First dorsal fin in male low, first spine at most with a short filament..*Callionymus russelli* Johnson 1976
- 22b. First dorsal fin in male very high, first spine with a long filament..*Callionymus enneactis* Bleeker 1879

- 23a. At least first and second spines of first dorsal fin in male with long filaments.....24
- 23b. First dorsal fin without filaments.....*Callionymus macdonaldi* Ogilby 1911

- 24a. Only first and second spines of first dorsal fin filamentous in males.....*Callionymus keeleyi* Fowler 1941
- 24b. First dorsal fin high in male, all four spines filamentous.....*Callionymus octostigmatus* Fricke 1981

Key to the Species of the Subgenus *Callionymus* (*Pseudocalliurichthys*)

- 1a. Second dorsal fin with 7 or 8 rays; base of first dorsal fin 1.4–2.4 in head length.....2
- 1b. Second dorsal fin with 9 rays; base of first dorsal fin 0.8–0.9 in head length.....*Callionymus grossi*

- 2a. Second dorsal fin with 7 rays, anal fin with 6 rays.....*Callionymus brevianalis*
- 2b. Second dorsal fin with 8 rays; anal fin with 7 rays.....3

- 3a. Main tip of preopercular spine upcurved.....4
- 3b. Main tip of preopercular spine straight.....6

- 4a. First dorsal fin in both sexes higher than second dorsal fin; anal fin of male pale, without markings
.....*Callionymus marquesensis*
- 4b. First dorsal fin as high as or lower than second dorsal fin: anal fin of male distally dusky or with a black streak.....5

- 5a. Ventral margin of preopercular spine straight; first dorsal fin as high as second dorsal fin; third and fourth membranes of first dorsal fin in female with irregular brownish mottlings.....*Callionymus curvispinis*
- 5b. Ventral margin of preopercular spine concave; first dorsal fin lower than second dorsal fin; third and fourth membranes of first dorsal fin in female with a large black blotch.....*Callionymus flavus*

- 6a. First dorsal fin with one or two filamentous spines.....7
- 6b. First dorsal fin without filamentous spines.....8

7a.	First dorsal fin with one filament (first spine).....	9
7b.	First dorsal fin with two filaments (first and second spine).....	11
8a.	Lower part of head and body without ocellate blotches; first dorsal fin with a black blotch surrounding distal part of third spine.....	<i>Callionymus goodladi</i>
8b.	Lower part of head and body with ocellate blotches; first dorsal fin without a black blotch, may be plain dark grey.....	9
9a.	Anal fin pale; serrae on dorsal margin of preopercular spine very small and straight.....	<i>Callionymus pleurostictus</i> (male)
9b.	Anal fin dark grey; serrae on dorsal margin of preopercular spine relatively large and curved.....	<i>Callionymus madangensis</i> (male)
10a.	Dorsal margin of preopercular spine with 5–6 serrae; pelvic-fin length in head length 0.9–1.1; caudal-fin length in SL 1.3–1.5; anal fin with a distal dark streak.....	<i>Callionymus variegatus</i> (male)
10b.	Dorsal margin of preopercular spine with 8–15 serrae; pelvic-fin length in head length 0.6–0.8; caudal-fin length in SL 1.9–3.2; anal fin without a distal dark streak.....	<i>Callionymus delicatulus</i> (male)
11a.	First spine of first dorsal fin in head length 1.0–1.45; eighth ray of second dorsal fin 1.4–2.0 times longer than seventh ray.....	<i>Callionymus simplicicornis</i> (male)
11b.	First spine of first dorsal fin in head length 1.6–2.7; eighth ray of second dorsal fin as long or up to 1.2 times longer than seventh ray.....	12
12a.	Throat with a large dark blotch; caudal fin asymmetrical, lower rays shorter than upper rays.....	<i>Callionymus pleurostictus</i> (female)
12b.	Throat without a dark blotch; caudal fin nearly symmetrical.....	13
13a.	Caudal-fin length 2.8–3.0 in SL; anal fin with a distal dark streak; pelvic-fin length 0.9–1.1 in head length.....	<i>Callionymus variegatus</i> (female)
13b.	Caudal-fin length 3.2–4.4 in SL; anal fin without a distal dark streak; pelvic-fin length 0.6–0.9 in head length.....	14
14a.	First spine of first dorsal fin 1.9–2.5 in head length; black blotch only on third membrane of first dorsal fin.....	<i>Callionymus delicatulus</i> (female)
14b.	First spine of first dorsal fin 1.6–1.8 in head length; black blotch in first dorsal fin mainly on third membrane, but an anterior branch reaching to first membrane.....	<i>Callionymus simplicicornis</i> (female)

Discussion. The exact depth of collection of the new species *Callionymus madangensis* is unknown, but most deeper parts of Madang Lagoon range from 30–40 m, with very limited parts close to the northern channel leading out of the lagoon ranging to 60 m. Most probably, the holotype was collected at depths around 30–40 m.

About half of the species of the subgenus *Pseudocallurichthys* have narrow, restricted distribution ranges, while the others are more widespread in the Indo-West Pacific. The typical habitat is soft bottom (mainly sand or coral gravel) near reefs or on the upper continental slope. Ecologically, the species either live in nutrient-rich or nutrient-poor oceanic habitats. Among the widespread species, *Callionymus pleurostictus* lives exclusively in continental, nutrient-rich waters, while *C. delicatulus* (mainly Indian Ocean) and *C. simplicicornis* (Pacific) live in shallow reef lagoons with few nutrients, which mainly occur near low oceanic islands. Among the species with restricted distribution ranges, *C. brevianalis*, *C. madangensis* sp. nov., *C. marquesensis* and *C. variegatus* mainly live in nutrient-rich waters, while *C. curvispinis* and *C. flavus* are found in habitats with few nutrients.

Though the deeper parts of Madang Lagoon were extensively sampled, only a single specimen of the new species was collected. Similar extensive deep lagoon systems are scarce in the area; therefore, despite its rarity, the new species is probably restricted to Madang Lagoon.

The new species is most similar to species from New Guinea and New Caledonia (*C. brevianalis*) and northern Australia (*C. grossi*). A barrier separating the distribution ranges of *C. madangensis* n. sp. from that of the neighbouring *C. brevianalis*, a species that is known from depths of 1–41 m, is unknown; however, that species is unknown from northern New Guinea, so it is possible that former tectonic events in northwestern and northeastern New Guinea prevented *C. brevianalis* from dispersal. *Callionymus grossi*, a species that is restricted to a region further south around the northern half of Australia, may be prevented from dispersal further north by climatic reasons, i.e. a warmer climate and water temperature in Papua New Guinea during the winter.

In an alternative classification by Nakabo (1982), *Callionymus madangensis* n. sp. would be a member of the genus *Pseudocallurichthys*. Here, *Pseudocallurichthys* is treated as a subgenus of *Callionymus* (see introduction).

The callionymid fish fauna of New Guinea now includes 22 species; 13 of these are known from Madang District (see above, identification key).

Comparative material (subgenus *Pseudocallurichthys*):

Callionymus brevianalis Fricke 1983: USNM 243038 (holotype), Indonesia, Papua; AMS I.37929-050 (3), Vanuatu, Ureparapara Island; ANSP uncat. (1), Australia, Queensland, Endeavour Reef; MNHN 1993-0118 (1), Coral Sea, Chesterfield Bank; SMNS 8551 (1), Papua New Guinea, Port Moresby; SMNS 9047 (1), Papua New Guinea, Port Moresby; SMNS 12521 (1), Coral Sea, Chesterfield Bank; SMNS 12522 (1), New Caledonia, Récifs d'Entrecasteaux; SMNS 12523 (1), New Caledonia, Nouméa; SMNS 12524 (1), New Caledonia, Récifs d'Entrecasteaux; SMNS 12525 (1), New Caledonia, Nouméa; SMNS 12526 (1), New Caledonia, Nouméa; SMNS 12527 (1), New Caledonia, Récifs d'Entrecasteaux; SMNS 21309 (2), New Caledonia, Récifs d'Entrecasteaux; SMNS 21323 (1), New Caledonia, Nouméa; SMNS 22119 (1), New Caledonia, Nouméa; WAM P29595-021 (1), Papua New Guinea, Madang.

Callionymus curvispinis Fricke & Zaiser Brownell 1993 (all Japan, Izu Islands, Miyake-jima): NSMT-P 35106 (holotype); NSMT-P 35107 (1 paratype); NSMT-P 35108 (1 paratype); NSMT-P 35109 (1 paratype); NSMT-P 35110 (2 paratypes); NSMT-P 35111 (1 paratype); SMNS 12078 (1 paratype); SMNS 12079 (2 paratypes).

Callionymus delicatulus Smith 1963: SAIAB 143 (1 paratype), Seychelles, Connan Reef; CAS 35058 (3), Comores, Grande Comore; CAS 46952 (2), Palau; CAS 46981 (9), Palau; HUI 10460 (1), Eritrea, Dahlak Archipelago; HUI 10466 (2), Eritrea, Dahlak Archipelago; HUI 10467 (2) Eritrea, Dahlak Archipelago; ROM 36669 (1), Chagos Archipelago; ROM 36670 (8), Chagos Archipelago; ROM 36671 (1), Chagos Archipelago; ROM 36672 (1), Chagos Archipelago; ROM 36673 (1), Chagos Archipelago; ROM 36674 (1), Chagos Archipelago; ROM 36682 (1), Chagos Archipelago; SIO 73-196 (4), Timor Sea, Ashmore Reef; SMF 16038 (1), Egypt, Gulf of Aqaba; SMNS uncat. (5), Egypt, Sharm el Shejkh; USNM 232276 (7), Solomon Islands, New Georgia.

Callionymus flavus Fricke 1983 (all Saudi Arabia, Jeddah, Red Sea): USNM 232244 (holotype); BPBM 28419 (2 paratypes); USNM 242160 (3 paratypes).

Callionymus goodladi (Whitley 1944): WAM P.2568 (holotype), Western Australia, Cheyne Bay; AMS

IB.3047 (1), Western Australia, Shark Bay; AMS I.15371-008 (1), Western Australia, Point Peron; WAM P.4377 (1), Western Australia, Exmouth Gulf; WAM P.4967 (1), Western Australia, Michaelmas Island; WAM P.9340 (1), Western Australia, Careening Bay; WAM P.22173 (1), Western Australia, Cockburn Sound; WAM P.25396-002 (25), Western Australia, Rowley Shoals).

Callionymus grossi Ogilby 1910 (all Australia): AMS A.7416 (1), Queensland, Torres Strait; AMS IA.1800 (1), Queensland, Port Denison; AMS IB.2983 (1), Western Australia, Exmouth Gulf; AMS IB.3020 (1), Western Australia, Exmouth Gulf; AMS I.11368-001 (1), Queensland, Moreton Bay; AMS I.15421-011 (1), Queensland, Magnetic Island; AMS I.15557-219 (1), Queensland, Gulf of Carpentaria; AMS I.20785-029 (1), Western Australia, Hartley's Creek; AMS I.20827-021 (1), Queensland, Cape York; BMNH 1961.8.16.69 (1), Western Australia, Montebello Islands; NTM S.10016-026 (4), Northern Territory, Cobourg Peninsula; NTM S.10030-001 (1), Northern Territory, Melville Island; NTM S.10033-008 (1), Northern Territory, Darwin; NTM S.10182-005 (1), Northern Territory, Shoal Bay; SIO 69-222 (2), Queensland, Flinders Island; USNM 229935 (1), Queensland, North Escape Reef.

Callionymus marquesensis Fricke 1989 (all Marquesas Islands): BPBM 12824 (holotype), Nuku Hiva; BPBM 11868 (2 paratypes), Fatu Hiva; BPBM 11935 (3 paratypes), Tahuata; BPBM 12825 (1 paratype), Nuku Hiva; BPBM 16422 (1 paratype), Nuku Hiva; BPBM 17721 (1 paratype), Nuku Hiva; BPBM 17726 (1), Tahuata.

Callionymus pleurostictus Fricke, 1982: BPBM 15566 (1), Solomon Islands, Guadalcanal; AMS I.20781-010 (4), Australia, Queensland, Lizard Island; AMS I.20982-055 (1), Australia, Queensland, Lizard Island; AMS I.22613-001 (1), Australia, Queensland, Escape Reef; AMS I.25109-067 (1), Australia, Queensland, Osprey Reef; ANSP 128766 (1), Indonesia, West Papua; ANSP 170854 (6), Australia, Queensland, Endeavour Reef; ANSP 170856 (19), Australia, Queensland, Endeavour Reef; ANSP 170859 (20), Australia, Queensland, Endeavour Reef; ANSP 170861 (5), Australia, Queensland, Endeavour Reef; ANSP 170862 (2), Australia, Queensland, Endeavour Reef; ANSP 170863 (14), Australia, Queensland, Endeavour Reef; ANSP 170865 (4), Australia, Queensland, Endeavour Reef; ANSP uncat. (8), Australia, Queensland, Endeavour Reef; ANSP uncat. (1), Australia, Queensland, Little Hope Island; BPBM 15747 (1), Papua New Guinea, New Britain; CAS 46723 (holotype), Vietnam, Nhatrang; CAS 46719 (1 paratype), Vietnam, Nhatrang; CAS 46724 (1 paratype), Thailand, Rayong; CAS 46725 (1 paratype), Vietnam, Nhatrang; CAS 46726 (1 paratype), Thailand, Rayong; NMNZ uncat. (1), New Caledonia, Grande Terre; NTM S.10015-035 (5), Australia, Northern Territory, Cobourg Peninsula; NTM S.10016-025 (20), Australia, Northern Territory, Cobourg Peninsula; NTM S.10022-007 (1), Australia, Northern Territory, Cobourg Peninsula; ROM 65535 (3), New Caledonia, Grande Terre; ROM 65536 (13), New Caledonia, Grande Terre; ROM 65537 (1), New Caledonia, Grande Terre; ROM uncat. (1), Australia, Queensland, Lizard Island; SMNS 8467 (3), Papua New Guinea, Port Moresby; SMNS 8469 (5), Papua New Guinea, Port Moresby; SMNS 11565 (1), Papua New Guinea, Port Moresby; SMNS 12528 (1), New Caledonia, Grande Terre; SMNS 17848 (1), New Caledonia, Grande Terre; SMNS 21243 (2), New Caledonia, Grande Terre; SMNS 21294 (4), New Caledonia, Grande Terre; SMNS 21297 (3), New Caledonia, Grande Terre; SMNS 21302 (3), New Caledonia, Récif d'Entrecasteaux; SMNS 21319 (1), New Caledonia, Grande Terre; SMNS 21324 (1), New Caledonia, Grande Terre; USNM 232252 (11), Indonesia, Maluku, Ambon; USNM 232275 (1), Indonesia, Maluku, Ambon; USNM 242161 (6), Indonesia, Maluku, Ambon; WAM P.30366-016 (1), Papua New Guinea, Madang.

Callionymus simplicicornis Valenciennes in Cuvier & Valenciennes, 1837: MNHN A.1518 (holotype), Guam; ANSP 117180 (1), Commonwealth of the Northern Marianas, Saipan; BPBM 10713 (7), Cook Islands, Aitutaki; CAS 42344 (1), Caroline Islands, Kapingamarangi Atoll; CAS 43076 (3), Caroline Islands, Kapingamarangi Atoll; CAS 43219 (1), Caroline Islands, Kapingamarangi Atoll; CAS 43334 (5), Caroline Islands, Kapingamarangi Atoll; CAS 43390 (1), Caroline Islands, Kapingamarangi Atoll; CAS 43569 (1), Caroline Islands, Kapingamarangi Atoll; CAS 46977 (1), Tuamotu Archipelago, Raroia; CAS 46979 (1), Society Islands, Moorea; CAS 46980 (6), Caroline Islands, Kapingamarangi Atoll; CAS 46982 (1), Guam; MNHN 1990-0099 (1), Gambier Islands; SIO 78-14 (2), Marshall Islands, Enewetak; SMNS 23041 (2), Loyalty Islands, Lifou; SNMBR 37010 (3), Samoa, Upolu; UG 6374 (1), Guam; USNM 223162 (1), Caroline Islands, Pohnpei; USNM 231441 (1), Philippines, Batangas; USNM 235715 (8), Fiji, Ono-Ilau; USNM 235716 (1), Fiji, Viti Levu; USNM 235718 (1), Fiji, Ono-Ilau; USNM 235719 (1), Fiji, Ono-Ilau; USNM 246706 (1), Fiji, Lau Group.

Callionymus variegatus Temminck & Schlegel 1845 (all Japan, Kyushu, Nagasaki): RMNH 2096 (lectotype of Boeseman 1947), SU 7760 (39); ZMUC P64135 (1); ZUMT 43720-43722 (3).

Comparative material (New Guinea):

Anaora tentaculata Gray 1835: CAS 92051 (1), Madang; NTM S.13680-024 (2), Madang.

Callionymus afilum Fricke 2000: KFRS F.01705 (1), Bramble Cay; KFRS F.02709 (1), Yule Island.

Callionymus belcheri Richardson 1844: BMNH 1879.5.14.570 (1); KFRS 0969 (2), Kinikini Bay; USNM 243034 (2), Sepik.

Callionymus colini Fricke 1993: SMNS 12260 (holotype), Port Moresby; BPBM 34754 (2 paratypes), Port Moresby; SMNS 12261 (1 paratype), Port Moresby; SMNS 12263 (2 paratypes), Port Moresby.

Callionymus enneactis Bleeker 1879: CAS 63291 (2), Madang; CSIRO B.1583 (1), Sek; SMF uncat. (1), Madang; SMNS 8541 (4), Port Moresby; SMNS 8548 (5), Port Moresby; SMNS 8553 (1), Port Moresby; SMNS 11564 (2), Port Moresby; SMNS 11566 (3), Port Moresby; SMNS 11567 (1), Port Moresby; SMNS 11568 (1), Port Moresby; SU 39953 (1), East Sepik; USNM 228958 (6), Milne Bay; USNM 228964 (1), Port Moresby; USNM 236385 (21), Hermit Islands; USNM 236390 (1), Madang; USNM 243037 (1), Trobriand Islands; USNM 243040 (4), Port Moresby.

Callionymus filamentosus Valenciennes in Cuvier & Valenciennes 1837: KFRS F.1709 (3), Yule Island; KFRS 3050 (2), Oreke.

Callionymus keeleyi Fowler 1941: KFRS F.2151 (1), Port Moresby.

Callionymus macdonaldi Ogilby 1911: SMNS 21194 (1), West Papua, mouth of Ajkwa River (new record); SMNS 21195 (2), West Papua, mouth of Minajerwi River (new record).

Callionymus neptunius (Seale 1910): ZMB 12674 (2), New Britain.

Callionymus octostigmatus Fricke 1981: USNM 243033 (1), Cape Ward Hunt; USNM 243041 (2), Cape Ward Hunt.

Callionymus russelli Johnson 1976: USNM 232259 (3), Daru.

Callionymus zythros Fricke 2000: BPBM 38532 (holotype), Madang; NTUM uncat. (3), Madang.

Diplogrammus goramensis (Bleeker 1858): SMF uncat. (1), Madang; USNM 236387 (2), Ninigo Islands; USNM 236388 (1), Ninigo Islands.

Eleutherochir opercularis (Valenciennes in Cuvier & Valenciennes 1837): BPBM 15731 (3), New Britain; KFRS 1766 (1), Bougainville; KFRS 3749 (1), Yule Island.

Synchiropus bartelsi Fricke 1981: BMNH 1982.6.18.2 (1), New Britain.

Synchiropus claudiae Fricke 1990: SMNS 9048 (holotype), Madang; SMNS 8466 (1), Port Moresby; SMNS 8479 (1), Port Moresby; SMNS 9049 (2), Madang.

Synchiropus ocellatus (Pallas 1770): AMS I.17504-012 (2), New Britain; SMNS 8473 (1), Port Moresby; SMNS 8475 (1), Port Moresby; SMNS 8476 (1), Port Moresby; USNM 236386 (3), Ninigo Islands; ZMB 13291 (1), Finschhafen.

Synchiropus picturatus (Peters 1876): ZMB 4770 (1), Salawaty.

Synchiropus splendidus (Herre 1927): BMNH 1974.5.25.3557 (1), Madang; USNM 236383 (2), Hermit Islands; USNM 236384 (2), Ninigo Islands.

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