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Description of a New Species Named *Cabillus wui* of Genus *Cabillus* (Teleostei: Gobiiformes: Gobiidae) from Southeastern China Sea

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Abstract: A tiny goby collected from Taiwan Strait which has been identified as a member of genus *Cabillus* seems individual, named *Cabillus wui* sp. nov.. Many pieces of evidence point to it as a new species. This species could be distinguished as follows. There is a dark blotch on the first-dorsal-fin membrane; predorsal scales 6; the first dorsal spine very depressed, is the longest, and is very close to the second dorsal spine; pelvic sucker is emarginated; median predorsal scales is present; all pectoral-fin elements are 20 branched soft rays; every fin nearly completely patternless and transparent except slightly patterned first dorsal fin; dorsal fin possesses 10 soft rays. This species is described in this article with the comparison of the other species in the genus *Cabillus*. An overview of this genus is also given. Besides, a key for distinguishing the species in this genus is also provided.

Keywords: *Cabillus; Cabillus wui* sp. nov.; Distinguish; New Species; Characteristic.

1. Introduction

Smith first established the genus *Cabillus* in 1959[2]. Then, more other described species and new species are put in this genus.

The genus *Cabillus* are established and could be distinguished according to these following characteristics. First dorsal fin possesses VI spines only, second dorsal fin possessing I spine and 8~10 branched soft rays; anal fin possesses I spine and 8~9 branched soft rays; all connected by membrane; pelvic fin possesses I spine and 5 branched soft rays, frenum present. Scales cycloid anteriorly; no scales on head and prepectoral area. Head width at preopercular margin greater than head depth; eye diameter far greater than ocular distance, eye diameter also greater than snout length; no spines on preopercle; no median dermal crest or frontal crest; no barbels ventrally on head; sensory canal pores and sensory papillae present on head, and sensory pores usually present with canals, albeit them might be short; gill opening extend from lateral position to ventral position; first gill slit open; mouth oblique; teeth present on both jaws; no palatine teeth; tongue bilobed; anterior naris tubular; posterior naris a simple pore. Lateral lines on body absent. Anterior oculoscapular canal pores and preopercular canal pores. Total vertebral count 26, 10 before anus + 16 after anus. [1,4,5]

Smith first established the genus *Cabillus* in 1959[2]. Then, more other described species and new species are put in this genus. Including this new species described in this article, there are 9 species belongs to this genus, which are *Cabillus atripelvicus*, *Cabillus caudimacula*, *Cabillus lacertops*, *Cabillus macrophthalmus*, *Cabillus nigromarginatus*, *Cabillus nigrostigmus*, *Cabillus pexus*, *Cabillus tongarevae* [3,6], and a new species *Cabillus wui*.

All of the species of this genus are tiny, given that their standard length could hardly exceed 50 mm. All of them inhabit seas, from shallow to deep. All the species under this genus are distributed in Indo-Pacific Ocean.

The aim of this paper is to describe a new genus under the genus *Cabillus*, and renew the key to distinguish the species of this genus.

2. Materials and Methods

All the specimens in the pictures are from trawls in the seas of China. Using a 200mm scale for measuring the length; the unit is mm; the values are accurate to the nearest 0.1 mm. The holotype is collected while alive, and then frozen while alive immediately. Calculations are accurate to their significant decimals. Use magnifiers to observe the minute structures, such as sensory papillae and nares. All the measurements, counts, and structures follow Randall, Bogorodsky and Wu, including the standard length measured from the anterior tip of the mouth to the rearmost tip of hypural plate; the sensory canal pores laterally distributed, before the rear margin of the opercle, above the plates covering the gill are called oculoscapular canals. [3,5] Reference including paper and cyber material; articles and books. Keys to distinguish the species under the genus *Cabillus* of the species described before are summarized from reference and the keys to distinguish the new species are based both on the reference and the author's own research.

- **Specimens for comparison and distinguishing**

Firsthand: "*Cabillus wui*, 29.3 mm TL, holotype, frozen, 117.10°E, 22.30°N, 60 m deep, 23 Nov. 2023, Wu / 25 Nov. 2023, Ba" "PRVT-AlFr 00002".

Secondhand: SAIAB 66631, male, 23.4+7.2mm, the Western Indian Ocean, Rodrigues, Grand Baie, 19° 39.02' S, 63° 26.42' E, coll. Heemstra, P.C., Smale, M.J., Aumeeruddy, R., Pelicier, D., 13 Oct. 2001; SAIAB 66631, male, 23.4+7.2mm, the Western Indian Ocean, Rodrigues, Grand Baie, 19° 39.02' S, 63° 26.42' E, coll. Heemstra, P.C., Smale, M.J., Aumeeruddy, R., Pelicier, D., 13 Oct. 2001; PMR VP2846, female, 37.9+9.9 mm, Red Sea, Sharm el Sheikh, Sharm el Moya Bay, 34° 17' 30.94" N, 27° 51' 30.21" E, coll. Bogorodsky, S.V., 13 Jul. 2011; PMR VP3046, female, 42.0+11.1 mm, Red Sea, Gulf of Aqaba, Dahab, 34° 31' 06.91" N, 28° 29' 54.14" E, coll. Bogorodsky, S.V., 13 Nov. 2012; Holotype, ZMA.PSIC.110952, female, SL 22.9 mm (caudal fin too damaged to measure), off Tanahdjampea

Island, Flores Sea, Indonesia, coll. M. Weber, 06 May 1899; USNM 313499, 2 males 24.5+7.0 mm and 19.9+5.9 mm, Western Indian Ocean, Seychelles, Amirante Islands, close to St. Joseph Island, southwest of Ressource Island, coll. D. Dockins, 10 Mar. 1964; USNM 313501, male, 25.0+6.8 mm, Red Sea, Gulf of Aqaba, bay at El Himeira, coll. V.G. Springer, 08 Sep. 1969; SAIAB 66631, female, 22.9+7.4mm, Western Indian Ocean, Rodrigues, Grand Baie, 19° 39.02' S, 63° 26.42' E, coll. Heemstra, P.C., Smale, M.J., Aumeeruddy, R., Pelicier, D., 13 Oct. 2001; SAIAB 66628, female, 24.8+7.5 mm, and juvenile, 18.2 mm SL with damaged caudal fin, Western Indian Ocean, Rodrigues, Grand Baie, 19° 39.6' S, 63° 27.05' E, coll. Heemstra, P.C., Smale, M.J., Aumeeruddy, R., Pelicier, D., 25 May 2001; NSMT-P 34803, juvenile (sex indeterminable), 15.5 mm SL, Oshima Strait, Sokari, Setouchi-cho, Amami-oshima Island, Amami Group of Ryukyu Islands, Japan (28°7.6′N, 129°21.2′E), 12 m depth, 11 June 1991, collected by M. Aizawa; NSMT-P 34861, female, 22.4 mm SL, Oshima Strait, Sakinome, Atetsu, Setouchicho, Amami-oshima Island, Amami Group of Ryukyu Islands, Japan (28°11′13″N, 129°16′04″E), 12 m depth, 16 June 1991, collected by M. Aizawa; Holotype of *Cabillus* atripelvicus, NSMT-P 72568, 40.6 mm SL, Chichi-jima, Ogasawara Islands; BPBM 28773, 34 mm SL, collected on a lagoon reef of Enewetak Atoll, Marshall Islands, by Patrick L. Colin on 19 February 1981; *Cabillus* lacertops n. sp. Type, 35 mm.

3. Results

3.1. New Species

Holotype: *Cabillus wui*

Type locality: PRC, Taiwan Strait, 117.10°E, 22.30°N, tropical water, 60 m under the surface, 23 November 2023. *Cabillus wui*.

Original label: "*Cabillus wui*, 29.3 mm TL, holotype, frozen, 117.10°E, 22.30°N, 60 m deep, 23 Nov. 2023, Wu / 25 Nov. 2023, Ba" "PRVT-AlFr 00002".

Etymology: This species is named after Junjie Wu, the collector of the holotype, who is the captain of a trawler that has collected lots of other more quality living specimens and preserved specimens than have been expected for the research institutions and researchers nationwide, and has been being willing to do that for a long period.

Diagnosis: This species is unique given its vestigial pelvic frenum; 6 median predorsal scales; patternless fins except first dorsal fin, long and thin first dorsal-fin spine; 10 soft rays in the dorsal fin; a posterior epiopercular sensory canal pore on the upper rear part of the opercle present.

Description: Trunk and head depressed. Tail high, slightly compressed. Heights of tail have a trend to decrease very slightly from anus to caudal fin base. Trunk cylinder. Tail tapered. Anus oval. Lateral lines on body absent.

Basic proportion: SL/TL≈0.78; BD/SL≈0.16; SNL/ SL≈ 0.048; HL/SL≈0.22; TRL/SL≈0.29 CL/SL≈0.79; ML/SL≈ 0.075 CPL/SL≈0.25.

Scales present on body, includes belly and neck; on the anterior part are cycloid scales, while on the posterior part are very-weak ctenoid scales, which are spinoid scales, except the scales on the caudal fin base; the scales cover the caudal fin base returned to cycloid scales; head naked; scales' shape irregular but scales aligned; median predorsal scales 6; longitudinal scale series 26; latitudinal scale series 9.

Table 1. Each measurement of the neotype (unit: mm)

Measurements	Holotype
Standard length (SL)	22.8
Total length (TL)	29.3
Body depth (BD)	3.7
Body width	3.8
Length of base of pectoral fin	1.2
Length of base of dorsal fin	10.2
Length of base of anal fin	6.5
Length of base of caudal fin	1.3
Length of base of pelvic fin	0.5
Length of pectoral fin	4.9
Length of dorsal fin	3.3
Length of anal fin	2.5
Length of caudal fin	5.1
Length of pelvic fin	4.0
Snout length (SNL)	1.1
Major axis of eye	1.9
Minor axis of eye	1.2
Ocular distance	0.2
Head length (HL)	5.0
Head width	4.2
Trunk length (TRL)	6.5
Caudal length (CL)	17.9
Mouth length (ML)	1.7
Caudal-peduncle length (CPL)	5.8

Mouth sub-superior, large; oblique but nearly even; front edge slightly higher than rictus; rictus under eye, slightly anterior to pupil. Tongue long and narrow, tapered from base to tip; tip free. Isthmus wide and slightly widened in posterior part, with several longitudinal shallow pleats, connected with gill membrane. Snout short, isosceles trapezoid. Oval eye developed, laterosuperjacent to head, prominent from head; pupil teardrop, point forward; ocular distance very small. No frontal crest or nape crest. Anterior naris immediately above and near upper jaw, tube-liked, extend to but not exceed upper jaw. Posterior naris in front of eye, smaller than pupil; margin budged. No palatine nor vomerine teeth; teeth on both jaws not arranged in rows, but arranged in clusters; tapered and bent backward; canine-liked; transparent; about 20 teeth on both jaws.

Fin formula: D. VII—10; A. I—8; V. I—5; P. 20; C. iii14ii;

Dorsal fin long, high in the spinous part and low in the soft part; base long and narrow; membrane thin and flimsy; first dorsal fin possesses VI spines only; the first spine is the longest, and the first spine is very depressed; the length of the spines in the first dorsal fin have a trend to decrease; all of the spines not prolonged and fully connected by membrane; second dorsal fin possesses I spine and 10 segmented and branched soft rays, and the seventh soft ray is the longest; lengths of the elements in second dorsal fin have a trend to increase then decrease; total elements 17; as a whole, the first spine is also the longest; gap between the sixth spine and the seventh spine is the greatest; gap between the first spine and the second spine is the shortest, which at the base is less than the width of the second dorsal fin at the base; two dorsal fins continuous. Anal fin with I spine and 8 branched and segmented soft rays; begins before the mid-point of the full length, immediately behind anus, and far behind dorsal-fin origin; first element is a spine, which is the shortest element; then come 8 soft rays, seventh soft ray longest; lengths of all of the elements have a trend to increase then decrease; total

elements 9. Two pelvic fins fused into a sucker, whose first element is a spine, which is the shortest element; then are the five segmented and multi-branched soft rays; fourth soft ray longest; total elements 6 on each side; lengths of elements have a trend to increase then decrease; rear emarginated; frenum present but considerably vestigial. Pectoral fin round; bifurcated and segmented soft rays only; fourteenth soft ray is the longest; base before dorsal-fin origin, tip behind dorsal-fin origin; lengths of soft rays have a trend to increase then decrease. Caudal fin long, has a rounded rear; not connected with dorsal fin and anal fin; first two simples, third segmented into two parts and not branched, central 15 branched and segmented, then follow one element segmented into two parts, last one simple; unbranched soft rays tapered, and thinner than branched ones; lengths of soft rays have a trend to increase then decrease; twelfth one longest; total elements 21.

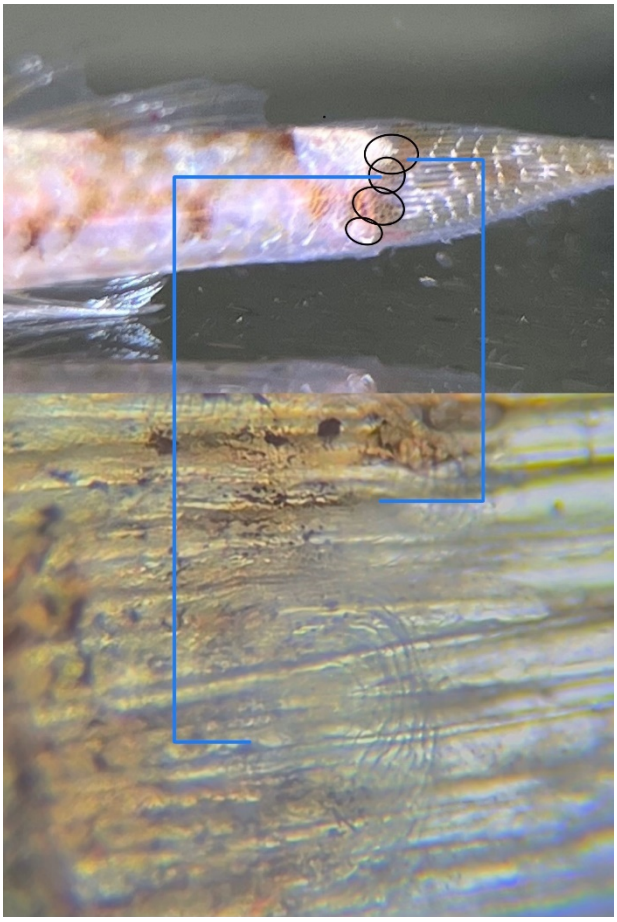

Figure 1. Scales which cover the caudal fin base, with a 40-time-amplified view under microscope

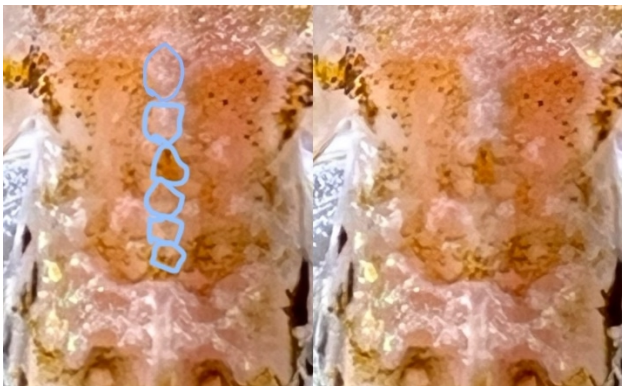

Figure 2. Predorsal scales of the Holotype marked on the left, with the cleaned photo on the right.

Figure 3. Pelvic fin of the Holotype

An anterior oculoscapular sensory canal pore before the narrowest area between the two eyes; an anterior oculoscalupar sensory canal pore before the narrowest area between the two eyes; they are median sensory canal pores, which are only one, on the axis of body, and all the following mentioned sensory papillae and sensory canal pores are paired and considerably symmetric, so is described in one side. A sensory canal pore behind eye and above the pupil; three sensory pores generally in one line directly behind the pupil and above the plates covering the gill, and the last one almost reaches the rear margin of the preopercle; they are all anterior oculoscapular sensory pores, which are before the rear margin of the preopercle. Three sensory canal pores alone the rear margin of the preopercle is preopercular sensory canal pores. There isn't any canal pore above the plate covering the gill and behind the preopercle, representing posterior oculoscapular sensory canal pores absent.

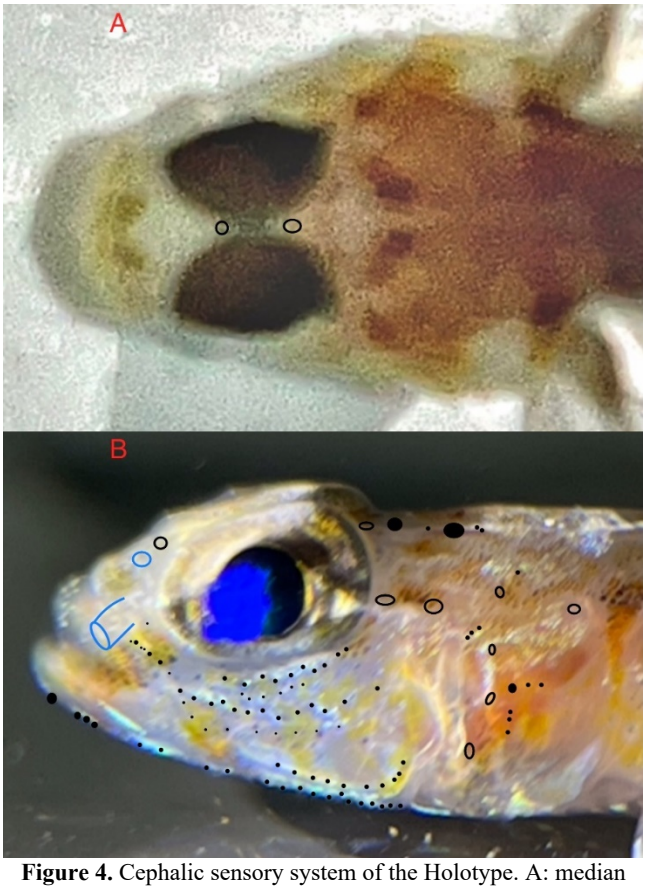

Figure 4. Cephalic sensory system of the Holotype. A: median sensory organs; B: paired sensory organs

A sensory canal pore present on the upper and rear tip of the opercle is an epiopercluar sensory canal pore. Six sensory papillae on bottom of the lower jaw; first four enlarged, especially the first one. One small sensory papilla behind the anterior naris. Three curved longitudinal rows of sensory papillae under eye; upper row short, comprised of 6 small papillae, completely under pupil; middle row longest, comprised of 20 papillae with different sizes, extend from snout to the rear part of parasphenoid, where behind eye; lower row comprised of 9 small papillae, completely under eye, begin at the anterior part of the middle row, near the upper jaw, extend to the upper margin of preopercle. A curved row along on the lower orbit comprised of 10 papillae. One curved row of sensory papillae along the lower rear margin of preopercle comprised of 10 papillae. One comparatively straight row of sensory papillae on the lower margin of interopercle comprised of 14 papillae. A series of sensory papillae at the centre of opercle forming a capital gamma (Γ), while the one at the corner larger than others. One sensory papilla above and behind the last oculoscapular sensory canal pore. Three sensory papillae above and in front of the upper preopercle sensory pores. A longitudinal row of sensory papillae directly behind the highest oculoscapular sensory canal pore comprised of 5 papillae; the first and the third on is comparatively very large and specialized into fleshy flaps.

Coloration:

Fresh (alive): Skin and inner tissues translucent; black, white, pink, brown and golden patterns randomly happen, and these patterns are formed with tiny pigment dots; five clusters of dark patterns along the vertebrae, and five shallow ones above them. An irregular brown bar at the caudal-fin base and the pectoral-fin bases; colours at the fin base extend to fin membrane on the elements or very near the elements; membrane connects two dorsal fins pigmented with a dark pattern extended from body; high part of first dorsal fin pigmented with irregular white patterns; lower margin of anal fin white; central part of caudal fin pigmented with irregular golden and white patterns; other fin membranes transparent. A line which leans backward from lower section to higher section divides sclera into 2 parts, and the upper parts pale, while the lower part pigmented.

Figure 5. Lateral view of the holotype. A: fresh (alive); B: frozen

Frozen: Compare to the fresh coloration, skin and inner tissues more opaque but still translucent; some of the black patterns randomly disappeared; sclera darkened; other patterns become shallow, except the bar at the caudal fin base.

Distribution: This neotype is collected in Taiwan Strait, at the depth of 60m, in a base fully covered with shells. 117.10°E, 22.30°N. This specimen could live in seawaters a least whose salinity range is from 29‰ to 36‰, and temperature range is from 15℃ to 28℃. Thus, this species might be more wide-distributed.

Comparison and Remarks: The cycloid scales on the caudal-fin base are unique in this genus.

It could be distinguished from *C. macrophthalmus* by body depth about 6.2 in standard length (vs. body depth 4.4-5.1 in standard length). It could be distinguished from *C. altripelvicus* by pelvic fins and anal fin nearly completely transparent (vs. nearly completely dark); caudal fin bright patterned (vs. backed patterned); posterior epiopercular sensory canal pore present (vs. posterior epiopercular sensory canal pores absent); first dorsal-fin spine is the longest element in both dorsal fins (vs. shorter than the longest soft ray). It could be distinguished from *C. pexus* by no large dark patterns on the tip of the first dorsal fin (vs. a black spot as large as eye on fin membrane between first and fourth spines of first dorsal fin); posterior epiopercular sensory canal pore present (vs. posterior epiopercular sensory canal pores absent); first dorsal-fin spine is the longest element in both dorsal fins (vs. shorter than the longest soft rays and the second and third spine). It could be distinguished from *C. nigrostigmus* by median predorsal scales 6 (vs. median predorsal scales 7); first dorsal-fin spine is the longest element in both dorsal fins (vs. shorter than some of the dorsa-fin spines); posterior epiopercular sensory canal pore present (vs. posterior epiopercular sensory canal pores absent) body depth about 6.2 in standard length (vs. body depth 5.8-6.0 in standard length). It could be distinguished from *C. nigromarginatus* by median predorsal scales 6 (vs. no median predorsal scales); posterior oculoscapular canal pores absent (vs. posterior oculoscapular canal pores present); posterior epiopercular sensory canal pore present (vs. posterior epiopercular sensory canal pores absent); first dorsal-fin spine is the longest element in both dorsal fins (vs. shorter than the longest soft rays and the second and third spine). It could be distinguished from *C. caudimacula* by median predorsal scales 6 (vs. no median predorsal scales); first dorsal-fin spine is the longest element in both dorsal fins (vs. shorter than the longest soft rays and the second third and fourth spine). It could be distinguished from *C. tongarevae* by median predorsal scales 6 (vs. no median predorsal scales); first dorsal-fin spine is the longest element in both dorsal fins (vs. shorter than the third spine). It could be distinguished from *C. lacertops* by median predorsal scales 6 (vs. no median predorsal scales); first dorsal-fin spine is the longest element in both dorsal fins (vs. shorter than the longest soft rays and the second, third and fourth spine). [1-5]

3.2. Key to Distinguish the Species under this Genus [1-6]

1(10) Median predorsal scales present
2(3) Body depth less than 5.2 in standard length……*C. macrophthalmus*
3(2) Body depth more than 5.2 in standard length
4(7) First dorsal-fin spine longest among dorsal-fin spines
5(6) Pelvic fin pale……*C. wui*
6(5) Pelvic fin dark……*C. altripelvicus*
7(4) First dorsal-fin spine not longest among dorsal-fin spines
8(9) Median predorsal scales less than 6……*C. pexus*

9(8) Median predorsal scales more than 6……*C. nigrostigmus*
10(1) Median predorsal scales absent
11(14) Prepelvic area naked
12(13) Posterior oculoscapular canal pores present……*C. nigromarginatus*
13(12) Posterior oculoscapular canal pores absent……*C. caudimacula*
14(11) Prepelvic area covered with scales
15(16) Length of regular dark bar on caudal-fin base 1.2 in rear-caudal-peduncle height or less.……*C. tongarevae*
16(15) No dark patterns or only dark spots present on caudal-fin base……*C. lacertops*

4. Prospect

There is only one neotype collected, and according to its macroscopic characters, it should be identified as a new species, but the molecular evidence is needed to clarify this position. Besides, given the poor description of its inner characteristics, the inner structures of this species are needed to be expounded, too. The sensory system of the head is very complex, and the author is not fully confident, so more larger specimens are needed for summarizing. Therefore, more specimens are required for doing further research.

The structural keys to distinguish these 2 species, *C. tongarevae*, and *C. lacertops* still remains opaque. Although there are many structural keys, the keys to distinguish them usually overlap at the extremums [1,3]. Thus, they could only be distinguished according to their colorations, which is vague while in a well-preserved condition. Aforementioned conditions represent these 2 species are still waiting for being researched more deeply.

All the species under the genus *Cabillus* are diminutive, destining themselves that they are mysterious, given that they are too tiny to be identified with naked eyes, and that's why it's an early-established genus, but recently, it is found that there are still many undescribed species in quick succession. Hence, the genus *Cabillus* as well as other groups of tiny fishes still needs more research urgently.

Acknowledgments

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