Journal of Marine Science and Technology

Volume 15 | Issue 1 Article 7

NEW RECORD OF THE RARE AMPHIDROMOUS GOBIID GENUS, LENTIPES (TELEOSTEI:GOBIIDAE) FROM TAIWAN WITH THE COMPARISON OF JAPANESE POPULATION

I-Shiung Chen
Institute of Marine Biology, National Taiwan Ocean University, Keelung, Taiwan 20224, R.O.C., isc@mail.ntou.edu.tw

Toshiyuki Suzuki
Amagasaki Senior High School, 5-40-1, Tsukaguchimachi, Amagasaki, Hyogo, 661-0002 Japan.

You-Hua Cheng
Institute of Marine Biology, National Taiwan Ocean University, Keelung, Taiwan 20224, R.O.C.

Chiao-Chuan Han
National Museum of Marine Biology & Aquarium, 2 Houwan Road, Checheng, Pingtung, Taiwan 944, R.O.C.

Yu-Min Ju
National Museum of Marine Biology & Aquarium, 2 Houwan Road, Checheng, Pingtung, Taiwan 944, R.O.C.

See next page for additional authors

Recommended Citation

Chen, I-Shiung; Suzuki, Toshiyuki; Cheng, You-Hua; Han, Chiao-Chuan; Ju, Yu-Min; and Fang, Lee-Shing (2007) "NEW RECORD OF THE RARE AMPHIDROMOUS GOBIID GENUS, LENTIPES (TELEOSTEI:GOBIIDAE) FROM TAIWAN WITH THE COMPARISON OF JAPANESE POPULATION," *Journal of Marine Science and Technology*: Vol. 15: Iss. 1, Article 7.
DOI: 10.51400/2709-6998.2032
Available at: https://jmstt.ntou.edu.tw/journal/vol15/iss1/7

NEW RECORD OF THE RARE AMPHIDROMOUS GOBIID GENUS, LENTIPES (TELEOSTEI:GOBIIDAE) FROM TAIWAN WITH THE COMPARISON OF JAPANESE POPULATION

Acknowledgements

First author (ISC) wishes to thank the research students who have ever been supported and helped on the several field work of this research around Taiwan. This research is part supported from the Agriculture Council for grants of biodiversity resources research in southern Taiwan (2001-2002).

Authors

I-Shiung Chen, Toshiyuki Suzuki, You-Hua Cheng, Chiao-Chuan Han, Yu-Min Ju, and Lee-Shing Fang

NEW RECORD OF THE RARE AMPHIDROMOUS GOBIID GENUS, *LENTIPES* (TELEOSTEI: GOBIIDAE) FROM TAIWAN WITH THE COMPARISON OF JAPANESE POPULATION

I-Shiung Chen*, Toshiyuki Suzuki**, You-Hua Cheng*, Chiao-Chuan Han***, Yu-Min Ju***, and Lee-Shing Fang***,****

Key words: *Lentipes*, critically endangered species, gobies, amphidromous fish, Taiwan, first record, fish taxonomy.

ABSTRACT

The very rare species of sicydiine gobiid genus, *Lentipes* Günther, 1861 has been found first time from Taiwanese waters. The species can be identified as *Lentipes armatus* Sakai and Nakamura, 1979 previously proposed as Japanese endemic species, and was listed in the 5-star ranking red-list as one critically endangered species of Japan. The diagnosis and redescription of current species from Taiwanese and Japanese specimens are reported herein. The distribution range of current rare species extends to Taiwan including Lanyu (Orchid island) off eastern coast proved that this species is not Japanese endemic. The morphological comparison of Taiwan and Japanese populations are indistinct except a few meristic counts.

Running Head: *I-S. Chen et al.: New record of rare gobiid,* Lentipes *from Taiwan*

INTRODUCTION

The gobioid fishes are the most important fish family with the highest species diversity in the world especially in the marine habitats. Unlike the varieties of predominant freshwater gobiid fishes in Taiwan. Most of gobioid fishes in freshwater which can be found as amphidromous and brackish species, and very few of them can only found in freshwaters. The sicydiine gobies are the major member of amphidromous gobioid fishes in low degree of polluted or unpolluted river habitat especially with good status of lowland areas. Thus, the rivers and coastal habitat of eastern Taiwan is a very good nursing ground for such sicydiine gobies (Chen and Fang [4, 5]). Several genera of sicydiine gobies have been discovered by senior author since August 1990 in Taiwan (Chen and Shao [7]; Shen *et al.* [20]; Watson and Chen [21]; and Chen and Fang [4]) as 2 species of genus *Sicyopterus*, 1 species of genus, *Sicyopus* and 2 species of genus *Stihpodon*. However, it is still in lacking any formal record for a very rare group, *Lentipes*, Günther, 1861 [11] compared with Japanese freshwater fish fauna. In Japanese waters, *Lentipes armatus* Sakai and Nakamura, 1979 [17] have been regarded as Japanese endemic species in southern Archipelagos and very recently this species has been assigned as top, 5-star ranking red-listed, critically endangered fishes of Japan (Kawanabe *et al.* [13]).

In 1990, the first author (ISC) had ever been snorkeling in the hill-stream of Fong-Kang River, Pingtung County and it was the first time to make the underwater witness of *Lentipes* species in Taiwan. The species was recently collected and identified as the amphidromous gobiid fish, *Lentipes armatus* Sakai et Nakamura, 1979 [17]. Thus, this species can be documented in Taiwanese freshwater fish fauna. Herein we reported the morphological diagnosis, distribution records, as well as its underwater photos of current species from Taiwan. The morphological comparison of Taiwanese and Japanese populations of this species is also discussed firstly in following sections.

MATERIALS AND METHODS

The sicydiine gobiid fish from Taiwan was col-

Paper Submitted 02/15/06, Accepted 05/17/06. Author for Correspondence: I-Shiung Chen. E-mail: isc@mail.ntou.edu.tw.

**Institute of Marine Biology, National Taiwan Ocean University, Keelung, Taiwan 20224, R.O.C.*

***Amagasaki Senior High School, 5-40-1, Tsukaguchimachi, Amagasaki, Hyogo, 661-0002 Japan.*

****National Museum of Marine Biology & Aquarium, 2 Houwan Road, Checheng, Pingtung, Taiwan 944, R.O.C.*

*****Cheng-Shiu University, 840, Cheng-Ching Rd., Niau-Song, Kaohsing County, Taiwan 833, R.O.C.*

lected by the hand-net while snorkeling. The morphological measurements follow Miller [15] and meristic counts from Chen and Shao [8] and Chen and Kottelat [6]. Terminology of cephalic sensory canals and free neuromast organ (sensory papillae) is from Miller [15], Chen and Shao [9] based on Sanzo [18]. Meristic abbreviation: A, anal; C, caudal; D1, D2, first and second dorsal fins; LR, longitudinal scale series; P, pectoral fin; PreD, predorsal scales; SDP, scale series from origin of first dorsal fin to upper pectoral origin; TR, transverse scale series; V, pelvic fin; VC, vertebral count. All lengths are standard length (SL). The examined materials of Taiwanese gobies are deposited in National Taiwan Ocean University, Keelung (NTOU). Comparative material of *Lentipes* is from the Osaka Museum of Natural History, Osaka (OMNH).

SYSTEMATICS

Lentipes Günther, 1861

Type species: *Sicyogaster concolor* Gill, 1860. Monotypic designation [10].

Lentipes armatus Sakai & Nakamura, 1979

Lentipes armatus Sakai & Nakamura, 1979: 46 [17]. (Type locality: Arakawa R., ca. 500 m from river mouth, Ishigaki Is., Ryukyu Is., Okinawa Pref., Japan, 24°20'N, 124°15'E.).

Lentipes armatus, Hayashi *et al*., 1981: 12 [12]; Akihito *et al*. in Masuda *et al*., 1984: 285 [14]; Kanwanabe *et al*., 2001: 583 [13]; Akihito *et al*., in Nakabo *et al*., 2002: 1158 [16]; Senou *et al*., 2004: 41 [19].

Materials examined

Taiwan NTOU-P 2006-02-324, 34.3 mm SL, the upper tributary, Lan-Len River as branch of Kan-Kou River basin near southern tip of Taiwan, coll. I-S. Chen *et al*., September 10, 2001; NTOU-P 2006-02-325, 3 specimens, 35.5-36.3 mm SL, the upper tributary of Lan-Len River as branch of Kan-Kou River basin near southern tip of Taiwan, coll. I-S. Chen *et al*., February 08, 2002; NTOU-P 2006-02-326, 2 specimens, 31.5-35. 6 mm SL, the upper reaches of Dong-Chin River of Lanyu (Orchid Island) off eastern coast, Taitung County, Taiwan, coll. c.c. Han *et al*., April 18, 2002; NTOU-P 2006-02-327, 37.2 mm SL, the upper reaches of Dar-Niao River from the Hai-Ang Mountain Ridge, Taitung County, Taiwan, coll. C. C. Han, November 30, 2004. **Japan.**- OMNH-P 20485, 40.0 mm SL, the hill stream region of the Arakawa River, Ishigaki Is. Okinawa Pref., Japan, coll. T. Suzuki & M. Suzuki, August 18, 1991; OMNH-P 20486, 47.0 mm SL, the hill stream region of the Arakawa River, Ishigaki Is. Okinawa Pref., Japan, coll. T. Suzuki & M. Suzuki, August 18, 1991; OMNH-P 20487, 38.4 mm SL, the hill stream region of the Arakawa River, Ishigaki Is. Okinawa Pref., Japan, coll. T. Suzuki & M. Suzuki, August 18, 1991; OMNH-P 20488, 4 specimens, 37.3-41.1 mm SL, the hill stream region of the Arakawa River, Ishigaki Is. Okinawa Pref., Japan, coll. T. Suzuki & M. Suzuki, August 18, 1991; OMNH-P 20496, 31.6 mm SL, the hill stream region of the Arakawa River, Ishigaki Is. Okinawa Pref., Japan, coll. T. Suzuki & M. Suzuki, August 19, 1993; OMNH-P 20497, 35.0 mm SL, the hill stream region of the Arakawa River, Ishigaki Is. Okinawa Pref., Japan, coll. T. Suzuki & M. Suzuki, August 19, 1993; OMNH-P 20498, 41.1 mm SL, the hill stream region of the Arakawa River, Ishigaki Is. Okinawa Pref., Japan, coll. T. Suzuki & M. Suzuki, August 19, 1993; OMNH-P 20526, 33.5 mm SL, the hill stream region of the Yutungawa River, Iriomote Is. Okinawa Pref., Japan, coll. T. Suzuki *et al*., August 16, 2002; OMNH-P 20527, 38.7 mm SL, the hill stream region of the Yutungawa River, Iriomote Is. Okinawa Pref., Japan, coll. T. Suzuki *et al*., August 16, 2002.

Diagnosis

The species can be distinguished from other congeners by the following combinations of features: (1) fin shape and rays counts: second dorsal fin rays I/10; anal fin rays I/10; pectoral fin rays 17-19. First dorsal fin with all rays about equal without filaments, and 3-4 rays slightly longer in male. Second dorsal fin with higher rays in anterior and posterior rays shorter; (2) squamation: longitudinal scale series 35-38; predorsal region naked, body with median-size ctenoid scales; and (3) specific coloration pattern: a dark purple cross band below second dorsal fin base. Dorsal half of lateral with irregularly dark brown bars and marks in female. Belly greenish blue with three vertical brown stripes in male. Second dorsal fin brownish with a diagnostic deep black spot between the first and second branched rays in male.

Redescription

Body slender and cylindrical anteriorly and compressed posteriorly. All morphometrics shown in Table 1. Head rather depressed and as triangular shape in the view of cross-section. Mouth sub-terminal as horseshoe shape. Mouth larger in male which the maxillary extending beyond the midline of orbit. Eye rather high and somewhat small. Interorbital region wide. Upper lip more prominent than lower jaw with a single median

Table 1. Morphometry of *Lentipes amartus* from Japan and Taiwan

	Southern Japan		Taiwan	
Sex	Male	Female	Male	Female
No. of specimens	**10**	**2**	**1**	**5**
Size (mm SL)	31.6-41.1 (37.8)	38.7-47.0 (42.9)	31.5	34.3-37.2 (35.8)
% in SL				
Head length	22.5-26.8(24.6)	22.3-22.9(22.6)	26.4	20.3-23.0(21.8)
Predorsal length	37.0-40.4(38.4)	38.4-38.5(38.4)	38.3	36.4-39.6(38.1)
Snout to 2nd dorsal origin	57.4-60.7(58.9)	60.3-61.5(60.8)	60.2	57.1-60.3(58.5)
Snout to anus	52.2-56.2(54.1)	57.8-58.9(58.4)	54.1	51.3-56.2(54.1)
Snout to anal fin origin	56.1-60.4(58.8)	60.5-62.5(61.5)	60.2	58.7-61.7(60.3)
Prepelvic length	19.8-27.2(22.5)	20.6-27.7(24.1)	23.4	18.2-22.0(20.2)
Caudal peduncle length	14.9-17.9(16.5)	15.8-15.8(15.8)	17.9	14.5-16.6(15.8)
Caudal peduncle depth	10.6-11.8(11.3)	10.0-10.3(10.2)	10.7	9.1-10.4(9.8)
First dorsal fin base	20.0-22.1(21.0)	18.0-18.2(18.1)	19.9	12.9-19.7(16.0)
Second dorsal fin base	24.2-27.6(25.9)	23.1-24.0(23.6)	28.5	23.9-29.8(26.0)
Anal fin base	21.2-24.6(23.7)	21.7-22.4(22.1)	26.7	19.9-24.0(21.9)
Caudal fin length	19.5-24.5(22.3)	20.6-21.6(21.1)	24.9	17.0-22.8(19.8)
Pectoral fin length	21.8-25.7(23.7)	21.4-21.6(21.5)	24.9	18.1-20.9(19.8)
Pelvic fin length	14.5-18.7(17.0)	17.1-18.3(17.7)	19.8	13.0-16.1(14.7)
Body depth of pelvic fin origin	12.0-15.3(14.0)	12.9-13.7(13.3)	14.4	11.3-13.0(12.5)
Body depth of anal fin origin	14.3-17.0(15.8)	13.9-14.3(14.1)	16.8	10.5-14.8(12.2)
Body width of anal fin origin	11.1-14.3(12.9)	12.9-13.3(13.1)	14.8	9.4-15.2(11.3)
Pelvic fin origin to anus	28.5-33.8(31.5)	33.2-34.0(33.6)	30.9	31.0-35.4(34.2)
% in HL				
Snout length	29.1-44.2(36.3)	28.8-35.9(32.3)	36.6	33.6-41.0(36.3)
Eye diameter	16.9-23.0(20.1)	18.2-19.7(19.0)	23.5	21.8-23.9(22.6)
Postorbital length	38.2-53.1(48.0)	37.8-47.9(42.8)	52.8	47.8-51.8(49.9)
Cheek depth	19.3-28.3(23.7)	18.5-20.5(19.5)	28.3	23.1-27.1(24.6)
Head width in upper gill opening	58.6-67.1(62.4)	70.3-70.8(70.6)	58.6	57.6-66.6(62.6)
Head width in maximum	59.4-77.3(67.7)	71.5-72.5(72.0)	71.4	73.0-88.4(82.8)
Fleshy interorbital width	41.2-49.4(45.5)	43.9-47.6(45.7)	43.2	41.5-47.7(44.2)
Bony interorbital width	25.3-34.9(31.1)	27.0-30.6(28.8)	39.7	24.0-34.1(28.7)
Lower jaw length	30.6-37.7(34.5)	33.0-35.5(34.3)	31.3	26.1-32.6(29.8)
% in caudal peduncle length				
Caudal peduncle depth	61.7-68.7(64.7)	61.0-64.9(63.0)	61.4	60.3-68.4(62.9)

notch but no lateral notch. Snout tip projected. Gill opening restricted, merely extend to lower margin of pectoral fin base. Isthmus broad. 10 + 16 = 26 vertebrae.

Fins D1 VI, D2 I/10; A I/10; P 17-19; V I/5+I/5. (frequency distribution shown in Table 2). First dorsal fin with all rays about equal without filaments, and 3-4 rays slightly longer in male. First dorsal fin base larger in male. The gap between first and second dorsal fin larger than orbit in female, but rather small and even almost connected together for large adult male. Second dorsal fin with higher rays in anterior and lower in posterior rays. Anal fin inserted below the vertical of first branched ray. Anal fin similar to second dorsal fin and anterior part with longer fin ray. Both and anal fins rays not extending to procurrent rays of caudal fin when depressed. Pectoral fin median large about equal to head length, but rear tip not extending to vertical of anus. Caudal fin oblong. Pelvic fin as a round and strong sucking disc.

Scales LR 35-38; TR 12-13; PreD 0; SDP 0 (frequency distribution shown in Table 2). Body with median-size ctenoid scales. Lateral side with some ctenoids in having several large, coarse spines in adult male but none of such scales in female. Head including cheek and opercle and nape naked. Prepeoctral, preanal, and predorsal regions including anterior half of first dorsal fin base are all naked.

Table 2. Distribution frequency of varied fin and scale counts of *Lentipes* compared with populations of Japan and Taiwan.

	P				LR						TR			
	17	18	19	X	35	36	37	38	39	X	11	12	13	X
Japan	1	1	8	18.7	4	4	1	1	-	35.9	-	-	5	13.0
Taiwan	2	14	2	18.0	1	2	5	9	1	37.3	1	7	1	12.0

Note: P and LR counting from both side of fish specimens.

Head lateral-line system

Head canals Anterior extension of anterior oculoscapular canal as paired pore σ1 which just above anterior nostril. A paired of pore σ near above posterior nostril. Paired pore λ in anterior area of interorbital region. Single pore κ in rear of interoprbital region. Paired *ω* in front of nape above orbit. Lateral extension of anterior oculoscapular canal with pore *α* behind orbit and with terminal pore *ω*. Posterior oculoscapular canal short with terminal pores *θ* and *τ*. Opercular canal with two terminal pores as *γ* and *ε* but in lacking pore *δ*.

Sensory papillae The infra-orbital papillae as slightly reduced transverse pattern. Row *a* as transverse pattern Row *b* short and oblique. Row *c* as four main rows of transverse papillae joined with row *a*. Row *cp* as a transverse row. Row *z* short. Opercular rows as row *ot* interrupted as two sections. The lower one joined with row *oi*. Rows *e* and *i* loosely arranged.

Colouration in fresh and in alcoholic preservation (Figures 1, 2)

Body light brown in male and creamy yellow and somewhat translucent in female. A dark purple cross band below second dorsal fin base. Dorsal half of lateral with irregularly dark brown bars and marks in female. A median longitudinal deep brown stripe from snout to pectoral fin base along midline of lateral to caudal fin base in female. Belly in male as shiny, metallic light greenish blue with three vertical, thin brown stripes. Belly pale in female without such coloration and unmarked. Head light brown unmarked in male and snout slightly greenish blue in large male; but translucent in female.

First dorsal fin brown in male but translucent in female. Second dorsal fin brownish with a diagnostic, conspicuous round deep black spot on fin membrane in between the first and second branched rays in male but translucent and unmarked in female. Anal fin unmarked and all grayish in male or translucent in female. Caudal fin unmarked and inform dark grayish in male but whitish and translucent in female. Pectoral fin grayish in male but translucent in female. Pelvic fin grayish in male and translucent in female.

Fig. 1. ***Lentipes armatus*****, A. male, 31.5 mm SL; B. female, 37.2 mm SL, upper tributary of the Dong-Ching River, Lanyu (Orchid Island), taitung County, Taiwan. Photograph by I-S. Chen.**

Fig. 2. Alive specimen of male *Lentipes armatus*, CA 45 mm SL, Upper tributary of the Fong-Kang River, Pingtung County, Taiwan. Photograph by I-S. Chen.

While the specimens transferred into the alcoholic preservation, the fishes especially in male, all brilliant coloration faded except the dark and deep pigmentations. The black spot of second dorsal fin in male is still visible. The dark longitudinal band in female is still conspicuous in preservation.

Distribution The species have been regarded as the endemic species of Japanese waters which is very rare in population size (Sakai and Nakamura [17]; Hayashi

et al. [12]; Kawanabe *et al*. [13]; Akihito *et al*. in Nakabo [16]; Senou *et al*. [19]). However, current discovery in Taiwan have been proved the existence of this species in several river basins with more tropical climate of Taiwan including: the Dar-Niao River from the Hai-Ang Mountain Ridge, and the Dong-Chin River of Lanyu (Orchid Island) off eastern coast, Taitung County; the small hill brook as upper reaches of Fong-Kang River, and the upper tributary of Kan-Kou River basin near southern tip of Taiwan, Pingtung County (as Figure 3). It is highly possible to see the species may occur in other shorter and clear water streams and brooks of the eastern drainages of Taiwan, although their populations density exists in Taiwan is very low.

Habitat preference The species is a one of typical amphidromous Sicydiine fishes with the capability of climbing upward to very swift river habitats. Like most congeners, they occur in hill creeks or river hilly terrain within 20-30 km of sea (Allen [1]). In our collections from Taiwan, all specimens were found from moderate or very swift current of upper reaches of hill streams with rather rocky substratum which reflects the *Lentipes* species is a very good swimmer.

Comparison and remarks

Species diversity and distribution of genus *Lentipes* of the Indo-Pacific region

So far, this small size amphidromous gobiid, *Lentipes* Gunther comprises at least 10 valid species in the Indo-Pacific region (Watson and Kottelat [21]; Allen [1]; Allen [2]; Chen [3]). In Pacific region, this genus is widely distributed around tropical central and western Pacific including the Marquesas; Hawaiian islands; southern Japan; Bali and Irian Jaya, Indonesia; and New Guinea (Allen [1]; [2]).

Fig. 3. The recorded localities of different River basins for *Lentipes armatus* in Taiwan. The solid star indicated the sampling drainages of current specimens except no. 3 which collected with above color photos but not preserved. The number indicated different localities as follows: 1. Dar-Niao River, Taitung County; 2. Kan-Kou River, Pingtung County; 3. Fong-Kang River, Pingtung County; and 4. Dong-Chin River, Lanyu, Taitung County, Taiwan.

Recent research for genus *Lentipes* in the Philippines

In the recent survey of this genus, Chen [3] published a new species, *Lentipes mindanaoensis*, from southern Philippines based on a male holotype with rather specific coloration pattern. This species with lower count of pectoral fin rays as16 compared with *Lentipes armatus*. It is likely that *Lentipes armatus* can occur in from the Philippines since the major passway of Kuroshio current from the Philippines via the coast of eastern Taiwan and towards the Ryukyus Isles including Iriomote Is., Ishigaki Is., Okinawa Is., and Amami O-Shima of southern Japan. We may predict at least no less than two species of genus, *Lentipes* exist from isles of the Philippines. Similar case for some other endemic sicydiines in Ryukyus of Japanese waters are still highly possible. Thus, this species should be not an endemic species for Ryukyu islands based on the passway theory of the Kuroshio current.

Comparison of Taiwanese and Japanese populations of *Lentipes armatus*

In comparison of the size of this goby, the Taiwanese specimens seem to be slightly smaller than Japanese ones. The difference may probably due to the collecting season and method. Since the fish is very rare and considered as endangered species in Japan, we would not to sample comprehensively in nature habitat since the conservation issue for such amphidromous goby. About the meristic features, which would not be influenced by body size of this goby, most of the

features are the same like dorsal fin rays and anal fin rays. The pectoral fin rays varied 17-19 which is somewhat differed by average of specimens between two populations. In Taiwanese specimens, the counts modally 18 (average 18.0) which is less than Japanese ones as modally 19 (average 18.7). The Taiwanese population seems to be as slightly lower average of pectoral fin ray counts. The longitudinal scales rows seem to be higher in Taiwanese specimens which 37.3 in average of Taiwanese specimens versus 35.9 in average of Japanese ones.

Furthermore, the genetic survey is still undergoing for revealing the possible differences and population structure of current gobies from Taiwanese and Japanese waters. Extended research of geographical distribution of *Lentipes armatus* by molecular markers will be progressed.

ACKOWLEDGEMENTS

First author (ISC) wishes to thank the research students who have ever been supported and helped on the several field work of this research around Taiwan. This research is part supported from the Agriculture Council for grants of biodiversity resources research in southern Taiwan (2001-2002).

REFERENCES

1. Allen, G.R., "*Lentipes watsoni*, a New Species of Freshwater Goby (Gobiidae) from Papua New Guinea," *Ichthyological Exploration of Freshwaters*, Vol. 8, pp. 33-40 (1997).
2. Allen, G.R., "*Lentipes multiradiatus*, a New Species of Freshwater Goby (Gobiidae) from Irian Jaya, Indoneisa," *Journal of Ichthyology and Aquatic Biology*, Vol. 4, pp. 121-124 (2001).
3. Chen, I-S., "*Lentipes mindanaoensis*, a New Species of Freshwater Goby (Teleostei: Gobiidae) from Southern Philippines," *Platax*, Vol. 1, pp. 37-42 (2004).
4. Chen, I-S. and Fang, L.S., *The Freshwater and Estuarine Fishes of Taiwan*. The Preparatory Office of National Museum of Marine Biology & Aquarium Press, Piungtung, Taiwan (1999).
5. Chen, I-S. and Fang, L.S., *The River Fishes of Taitung*, Taitung County Government Press, Taitung, Taiwan (2001).
6. Chen, I-S. and Kottelat, M., "Three New Species of Genus *Rhinogobius* (Teleotsei: Gobiidae) from Northern Laos," *Raffles Bulletin of Zoology*, Vol. 51, 87-95. (2003).
7. Chen, I-S. and Shao, K.T., "Two New Records of Freshwater Gobies from Southern Taiwan," *Acta Zoologica Taiwanica*, Vol. 4, pp. 75-79 (1993).
8. Chen, I-S. and Shao, K.T., "A Taxonomic Review of the Gobiid Fish Genus, *Rhinogobius* Gill,1859 from Taiwan, with Descriptions of three New Species," *Zoological Studies*, Vol. 35, pp. 200-214 (1996).
9. Chen, I-S. and Shao, K.T., "A New Species of Goby, *Sicyopus lcbuensis* (Teleostei: Gobiidae) from Cebu Island, the Philippines," *Acta Zoologica Taiwanica*, Vol. 9, 97-103 (1998).
10. Gill, T.N., "Conspectus Piscium in Expeditione ad Oceanum Pacificum Septentrionalem, C. Ringold et J. Rodgers Ducibus, a Gulielmo Stimpson Collectorum. Sicydianae," *Proceedings of the Academy of Natural Sciences of Philadelphia*, Vol. 12, pp. 100-102 (1860).
11. Günther, A., *Catalogue of the Acanthopterygian Fishes in the Collection of the British Museum*, Vol. 3, British Museum, pp. 1-586 (1861).
12. Hayashi, M., Suzuki, T., Ito, T., and Senou, H., "Gobiid Fishes of the Ryukyu Islands, Southern Japan (III) Suborder GOBIOIDEI," *Science Report of Yokosuka City Museum*, Vol., 28, pp. 1-15 (1981).
13. Kawanabe, H., Mizuno, N., and Hosoya, K., *Freshwater Fishes of Japan*, Yama-Kei Publishers Co., Tokyo, Japan (2001).
14. Masuda, H., Amaoka, K., Araga, C., Uyneo, T., and Yoshino, T., *The Fishes of Japan with Pictorial Keys to the Species*, Tokai University Press, Tokyo, Japan (1984).
15. Miller, P.J., "New Species of *Coryrogobius, Thorogobius, and Wheelerigobius* from West Africa," *Journal of Natural History*, Vol. 22, pp. 1245-1262 (1988).
16. Nakabo, T., *Fishes of Japan with Pictorial Keys to the Species*, Vol. II, Tokai University Press, Tokyo, Japan (1984).
17. Sakai, H. and Nakamura, M., "Two New Species of Freshwater Gobies (Gobiidae: Sicydiaphiinae) from Ishigaki Island, Japan," *Japanese Journal of Ichthyology*, Vol. 26, pp. 43-54 (1979).
18. Sanzo, L., "Distribuzoine Della Papille Cutanee (Organi Ciatiformi) e suo Valore Sistematico nei gobi," *Mitteilungen Zoologischen Station Neapel*, Vol. 20, pp. 249-328 (1911).
19. Senou, H., Suzuki, T., Shibukawa, K., and Yano, K., *A Photographic Guide to the Gobioid Fishes of Japan*, Heibonsha, Tokyo, Japan (2004).
20. Shen, S.C., Lee, S.C., Shao, K.T., Mok, H.K., Chen, C. Y., and Tzeng, C.S., *Fishes of Taiwan*, Department of Zoology, National Taiwan University, Taipei, Taiwan (1993).
21. Watson, R. and Kottelat, M., "*Lentipes whitenorum* and *Sciyopus auxilimentus*, Two New Species of Freshwater Gobies from Western Pacific (Teleostei: Gobiidae: Sicydiinae)," *Ichthyological Exploration of Freshwaters*, Vol. 5, 351-374 (1994).