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A NEWLY RECORDED SANDBORER, *SILLAGO (SILLAGINOPODYS) CHONDROPUS* BLEEKER, WITH A SYNOPSIS OF THE FISHES OF FAMILY SILLAGINIDAE OF TAIWAN[1]

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Kwang-Tsao Shao, Shih-Cheih Shen and Lih-Wen Chen (1986) A newly recorded sandborer, *Sillago (Sillaginopodys) chondropus* Bleeker, with a synopsis of the fishes of family Sillaginidae of Taiwan. *Bull. Inst. Zool., Academia Sinica* **25**(2): 141-150. A sandborer fish, *Sillago (Sillaginopodys) chondropus* Bleeker 1849 distributed abundantly at Hwalien, mid-eastern coast of Taiwan, is first reported in Taiwan. Descriptions based on 12 specimens of this species were provided. The color picture and the radiograph of this species and that of *S. asiatica* McKay, 1983 are also included. According to recent revision work of this family (McKay 1985), many specimens of sandborers collected in the past and at the present by the authors were re-examined to check their taxonomic status. There are a total number of one genus, three subgenera and eight species: *Sillago chondropus*, *S. sihama*, *S. parvisquamis*, *S. maculata aeolus*, *S. irgenuua*, *S. asiatica*, *S. japonica*, and *S. microps* found in Taiwan. Among them, the first belongs to the subgenus *Sillaginopodys*, the second and the third belong to the subgenus *Sillago*, and the fourth to the seventh are *Parasillago*. The subgenus of the last species is still uncertain. A synopsis and a key of eight species are also provided.

Key words: *fish taxonomy, sandborer, Sillago.*

Sandborers is a popular sea food in Taiwan which are distributed abundantly along the sandy coast of northern, eastern, and western Taiwan as well as the Penghu Island. Shao and Chang (1978) previously revised the Formosan sandborers and reported only five species. They were *Sillago sihama* (Forskal 1775); *S. japonica* Termminck et Schlegel, 1842; *S. maculata* Quoy et Gaimard, 1824; *S. argentifasciata* Martin & Montalban, 1935; and *S. parvisquamis* Gill, 1861. McKay (1985) identified one specimen from Taiwan as *S. asiatica* McKay, 1983 based on the morphology of swimbladder and also proposed two new species, *S. microps* and *S. ingenuua*. The former species which characterized by its small eye was established based on the examination of the two specimems found from Taiwan by Dr. K. Lawless from Taipei fish market, but registered in the United States National Museum. Unfortunately, we have not yet collected any specimens of this species so far. The latter species

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which probably a junior synonym of *S. argentifasciata* was described in his paper to replace the original *S. argentifasciata* although he did not examine any specimens of this species from Taiwan. In his paper, the species of *S. maculata* from Taiwan was also changed to be a subspecies of *S. maculata aeolus* Jordan & Evermann, 1902 of north Indo-Pacific region to distinguish from the *S. maculata burrus* Richardson, 1842 of northern Australia, and *S. maculata maculata* Quoy & Gaimard, 1824 of eastern Australia. In addition to the above seven species, the eighth species, *S. chondropus* Bleeker, 1849, is identified from the specimens of Hwalien and is reported in the present paper. Interestingly, this species has been a common angle fishing object since a long times ago.

Because the systematic position of this group of fishes was remarkably changed by McKay (1985) based on the morphology of swimbladder, vertebral formula, and cranial osteology, it is necessary to revise the species of the Formosan sandborers again. The specimens we have examined were from recent collections from Yenliao, Wanli, Tanshui, Hsinchu, Tainan, Kaohsiung, and Penghu and from the specimens inventoried in the Institute of Zoology, Academia Sinica and the Department of Zoology, National Taiwan University, R. O. C. These study results are briefly described as one paragraph in this report. Since the morphology of swimbladders of our specimens show certain intraspecific geographical variation in some sandborers species, the figures of these modified swimbladders are furnished as well. Finally, a diagnostic key to all of the above eight species of family Sillaginidae in Taiwan is attached.

For easy to compare our examining results with McKay's, all methods of meristic counting, vertebrae counting, and morphometric measurements follow his methods (McKay, 1985).

Diagnostic keys to the subgenera and the species of Sillaginidae of Taiwan:

1. Ventral fin spine very small and situated at the base of a thickened club-shaped outer ventral ray; swimbladder reduced, no duct-like process; no modified caudal vertebrae. (subgen. *Sillaginopodys*).....*Sillago chondropus*

   Ventral fin spine normal, swimbladder does not reduced; duct-like process present; modified caudal vertebrae present or absent.....2
2. Swimbladder divided posteriorly into two tapering extensions; modified caudal vertebrae present. (subgen. *Sillago*)...3

   Swimbladder with posterior extension single and tapering to a fin point, or round; modified caudal vertebrae present or absent. (subgen. *Parasillago*).. 4
3. Vertebrae 34 (rarely 33), haemal arch 0-7 (mostly 5); dorsal spine XI..... .....*Sillago sihama*

   Vertebrae 39 (rarely 40), haemal arch 5-6 (mostly 6); dorsal spine XII..... .....*Sillago parvisquamis*
4. Body with irregular blackish blotches after death; scales absent on the prenasal area.....*Sillago maculata aeolus*

   Body without any blackish blotches after death; scales present on the prenasal area.....5
5. Haemal arch below 7.....6

   Haemal arch above 7.....7
6. Haemal arch 5-6; eye diameter as percent of head length 19-23; extensions of swimbladder extend posteriorly to one fifth to one fourth length of swimbladder.....*Sillago asiatica*

   Haemal arch 5; eye diameter as percent of head length 14-16....*Sillago microps*
7. Vertebrae 33 (occasionally 32), usually 13 abdominal vertebrae, haemal arch 9-11 (mostly 10); ctenoid scales present on prenasal area and cycloid absent on lower part of operculum.... .....*Sillago ingenuua*

Vertebrae 35, usually 14 abdominal vertebrae, haemal arch 8–10 (mostly 9); ctenoid scales present on the prenasal area and cycloid present on lower part of operculum .....*Sillago japonica*

Sillago (*Sillaginopodys*) *chondropus* Bleeker club-foot whiting

(Fig. 1)

Sillago chondropus Bleeker 1849, p. 61 (Batavia); Weber & de Beaufort 1931, p. 176. Fig. 34. Fowler, 1933, pp. 430-1; 1949, p. 96. Munro 1967, p. 346; Dutt and Sujatha 1980, p. 372; McKay 1980, pp. 382-3; 1985, pp. 1-73.

Material examined: 12 specimens, 90.12 mm (SL), ASIZP 055824, Muguashi, Hwalien, September 20, 1985.

Diagnosis: Ventral fin spine expanded as thick cartilaginous pad, jointed with first ventral ray.

Description: Dorsal fins XI, 1, 20–22; anal fin II, 22–23 (Table 1). Lateral line scales 70–71 (Table 2); l. tr. 5–6 above, 9–10 below. Cheek scales in 4–5 rows; all ctenoid.

Proportional dimensions as percent of SL with mean value in the parenthesis: greatest depth of body 14.2–17.9 (15.0); head length 25.2–27.3 (26.2); snout tip to ventral fin origin 25.5–28.1 (26.7); snout tip to spinous dorsal fin origin 29.6–32.0 (30.5); snout tip

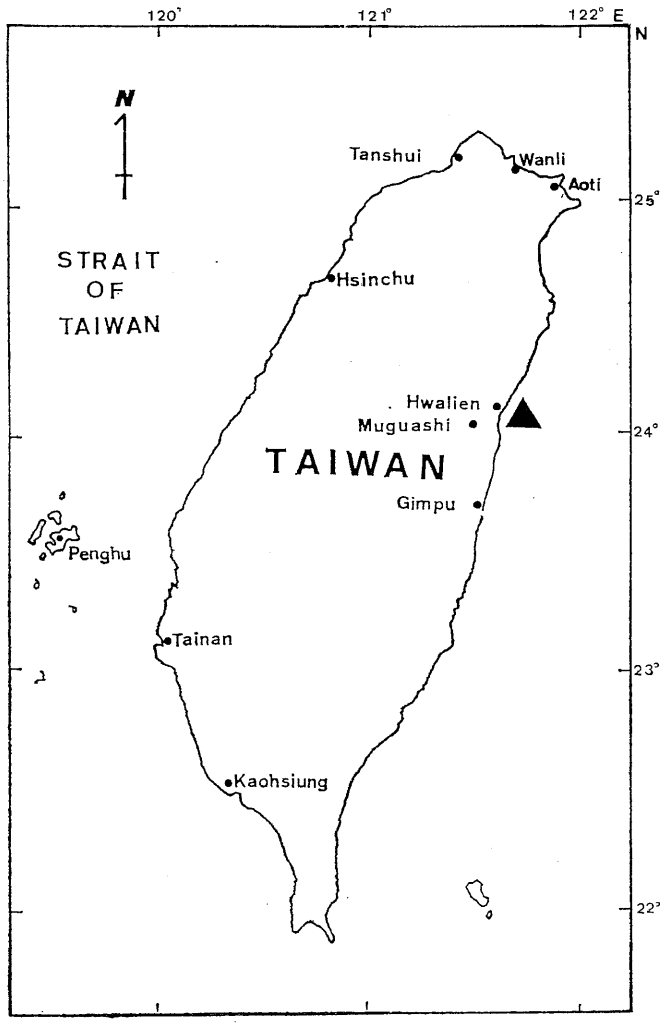

Fig. 1. Sampling area (triangular mark) of *Sillago chondropus*.

to second dorsal fin origin 48.0–52.7 (51.3); snout tip to the anus 43.8–46.5 (45.3); least depth of caudal peduncle 7.8–9.1 (8.4); anal fin length 36.9–41.3 (39.2).

Proportional dimensions as percent of head: length of snout 35.8–40.2 (38.8); horizontal diameter of eye 19.2–25.7 (22.5); least width of interorbital 11.5–16.0 (13.7).

Vertebrae: 13 abdominal, 22 caudal, total 35 (Table 3). This counting was based on the radiographs (Fig. 3). It is noted that the last abdominal or the first caudal vertebrae looks like a modified haemal arch as other *Sillago* species (Shao & Chang, 1978).

Color: Body color when alive dull silvery above and silvery-white below with a dark longitudinal stripe below the laternal line (Fig. 2), the body color turned to sandy grey above and pearly-white below when preserved in alcohol, and the brown color gradually appeared when preserved in formalin. Scales on back edges with dusky marking. Dorsal sprinckled with fine dusting of black spots; ventral and anal fins whitish.

Swimbladder: Generally, its morphology agrees with McKay's (1985) description (Fig. 6A). It is very flattened, attached to the vertebrae, and then abruptly narrows to a fine point terminating on the ninth abdominal vertebra. No duct-like process from its ventral surface.

Distribution: In Taiwan, it only distributed at the mid-eastern coast, especially from Muguashi to Gimpu, Hwalien county (Fig. 1). In the world, it has been recorded in South Africa, Mozambique, West Pakistan, India, Burma, Indonesia, New Guinea, Thailand and Philippines (McKay, 1985).

Remarks: The reason that this species only occurs at eastern Taiwan may be relates to its particular ecological habitat. Relatively stronger wave or current and the black instead of yellow sandy bottom along the eastern coast compare to the western side might delimit the distribution of this species only at eastern Taiwan. More dusky or blackish color above lateral line of this species than other *Sillago* species reveals its ecological adaptation to the black sand. Meanwhile, short sandy coastal line in the east also limit the extension of the distribution of this species and the other *Sillago* species.

TABLE 1
Frequency distribution of dorsal and anal fin rays of *Sillago chondropus*. The frequencies data of each area except Taiwan in this table and in the subsequent tables are cited from McKay (1985)

Dorsal fin rays / Anal fin rays	20 / 23	21 / 22	21 / 23	22 / 23
South Africa	1	—	1	—
Pakistan	1	—	4	2
India	—	—	2	1
New Guinea	—	—	1	2
Thailand	—	1	—	—
Philippines	2	—	4	3
Taiwan	2	8	—	2

TABLE 2
Frequency distribution of lateral line scales of *Sillago chondropus*

Leteral line scales	66–67	68–69	70–71	72–73
South Africa	—	1	1	—
Pakistan	1	3	2	—
India	—	—	2	1
New Guinea	—	2	1	—
Thailand	—	—	1	—
Philippines	—	2	4	2
Taiwan	—	—	12	—

TABLE 3
Vertebrae counts of *Sillago chondropus*

Abdominal / Caudal	12 / 23	13 / 22
South Africa	—	1
Pakistan	2	—
India	1	1
New Guinea	—	2
Thailand	1	—
Philippines	—	4
Taiwan	—	12

Fig. 2. Photograph of fresh specimen of ***Sillago chondropus***, SL-186.0 mm, ASIZP 055824.

Fig. 3. Radiograph of ***Sillago chondropus***, SL-123.3 mm.

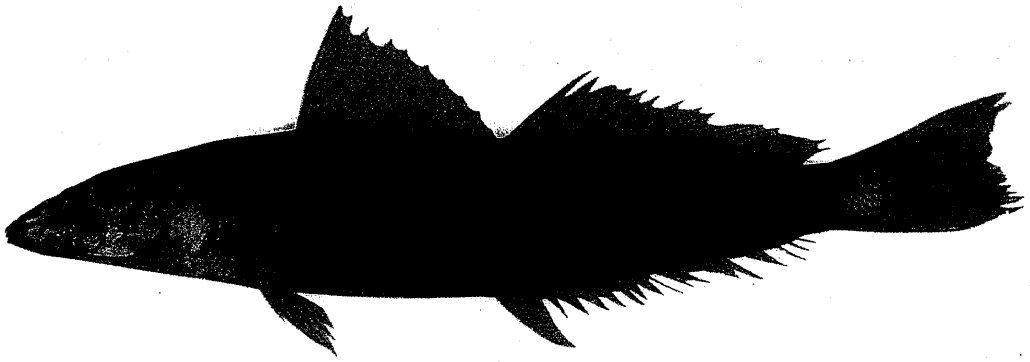

Fig. 4. Photograph of fresh specimen of ***Sillago asiatica***, SL-112.2 mm, ASIZP 055825.

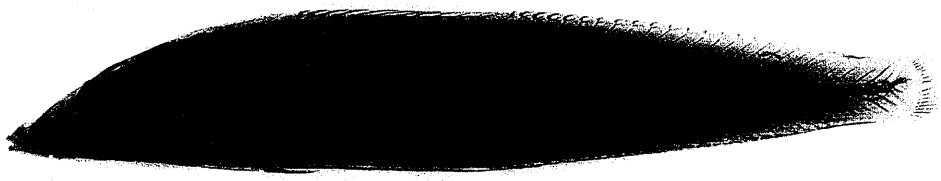

Fig. 5. Radiograph of ***Sillago asiatica***, SL-106.4 mm.

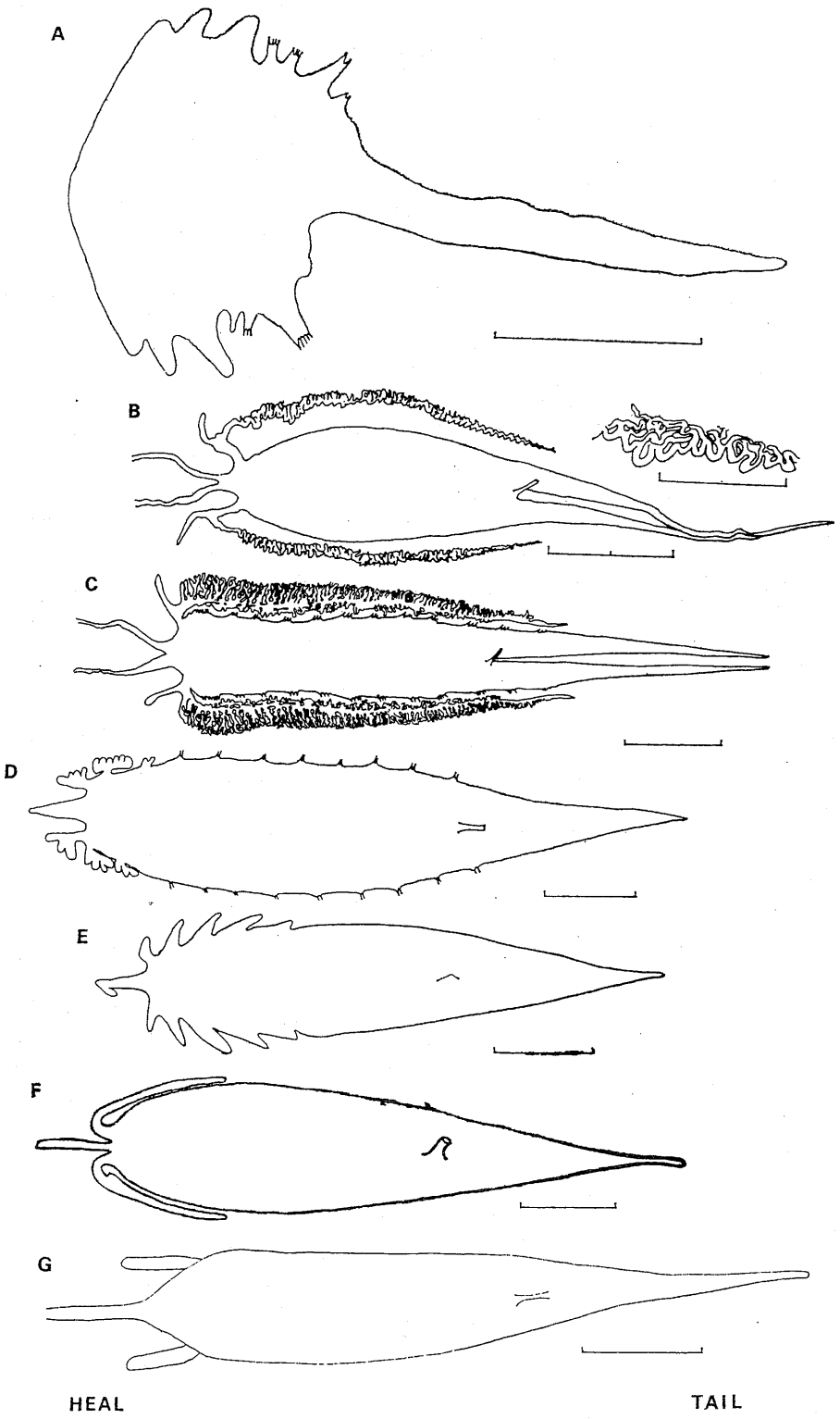

Fig. 6. Swimbladders of A. *S. chondropus*, B. *S. sihama*, C. *S. parvisquamis*, D. *S. maculata aeolus*, E. *S. ingenuua*, F. *S. asiatica*, G. *S. japonica*.

Because we examined more specimens, the range of measurements are all larger than those of McKay's (1985) (Table 1, 2, 3). However, the mean values of most of our measurements agree with previous reports. The only notably difference is the proportion of length of snout to the head, 38.8 in this report which is greater than 32-35 in McKay's (1985) but falling within the range of 32-40 of his early paper (McKay 1971). Nevertheless, the more compressed and shorter snout of the local specimens at Hwalien might be due to the geographical variation.

The local fishermen used to called this species as Chin-Sa-Suo in Chinese but this local name is actually a Chinese scientific name of *S. japonica* which has not yet been recorded at that area.

Synopsis of other *Sillago* Species

Sillago sihama

S. sihama distributed most widely throughout the Indo-West Pacific region (McKay, 1985). Its geographical variations on the number of modified vertebrate, anal fin rays and dorsal fin rays are the greatest among all sandborers species. In this species, the number of L-shapes haemal spine seems to have a geographical cline from none in Japan (Sano and Mochizuki, 1984), 0-7 in Taiwan of present study, to 4-8 in New Guinea (South coast) and 5-7 in Western Australia (McKay, 1985). According to our recent collections, *S. sihama* always occurs together with *S. asiatica* at Hsinchu, Kaoshiung, and Ilan. Especially at the Hsinchu area the ratio of the abundance of both species is nearly half to half. The result showed that *S. sihama* is mixed with *S. asiatica* in Taiwan instead of mixed with *S. vincenti* in India (McKay, 1985). The sympatric of these two species, *S. sihama* and *S. asiatica*, also differ as McKay's (1985) prediction that *S. asiatica* is sympatric with *S. japonica* in Taiwan because we have not yet collected the latter two species together in the same place. Although the external morphology or meristic counts among the above *Sillago* species are very similar to each other that make the identification of these species difficult. The morphology of swimbladder can positively make up this problem. The swimbladder of *S. sihama* has two unequal lengths of posterior tapering extensions which is quite unique among similar species (Fig. 6B). However, the morphology of swimbladder will have intraspecific variation as well. The swimbladder of our specimen fully agreed with that of Queensland's specimen (McKay 1985).

Sillago parvisquamis

This is the only other species that belongs to the subgenus *Sillago* in Taiwan. It is easy to use the high number of vertebrae (39) and dorsal spine (12) to identify this species from *S. sihama*. The morphology of swimbladder of this species is similar to McKay's figure (1985) but the origin of lateral extension of our specimens located more anteriorly as shown in Fig. 6C.

Sillago maculata aeolus

Based on the morphology of swimbladder, McKay (1985) identified many Taiwan specimens as *S. maculata aeolus*. The morphology of swimbladder of our specimens (Fig. 6D) is intermediate between the figures of Sano and Mochizuki's (1984) and McKay's (1985). Additionally the dark blotches on the body side of our specimen is more similar to *S. intermedius* of Tailand and India rather than the figure of the same species (McKay, 1985). Nevertheless this species (*Parasillago*) can easily be identified by single posterior extension of swimbladder.

Sillago ingenuua

This species was nominated as new by McKay (1985) based on the following three points: 1) five projections in the front of swimbladder; 2) upper two rows of cheek scales are ctenoid, but in *S. argentifasciata* it is cycloid; 3) lacks a longitudinal silvery band on the body side. Probably according

to the above second point, McKay considered the species of *S. argentifasciata* in Shao and Chang (1978) as *S. ingenuua*. After re-examined all of these specimens we agreed with his judgement but based on the above first two points only. The third point seems to be doubtful since our specimens had silvery band although it was not so clearly shown on the stale specimens when we collected it from the fish market. As McKay (1985) had mentioned that *S. ingenuua* might be a junior synonym of *S. argentifasciata* since the specimens he had examined might not be enough. It is shown in Fig. 6E that the posterior part of swimbladder of this species has a poorly developed duct-like process.

Sillago asiatica

Table 4 is the meristic counts of fifteen specimens arbitarily selected from various sampling localities. Generally, *S. asiatica* is externally very similar to *S. sihama* and has been frequently confused with the latter species. Positive identification is afforded by the shape of the swimbladder only. Before *S. asiatica* was proposed in 1983, all previous specimens of *S. sihama* in Taiwan actually contained both species in a ratio that *S. asiatica* slightly more abundant than *S. sihama*. Fig. 6F shows that the length of the lateral extensions only attain 1/4–1/5 of swimbladder which is different from almost 1/2 of McKay's description (McKay, 1985). Our recent collection data shows that *S. asiatica* is much more abundant than *S. sihama* at Kaohsiung area but seems to have shorter body length, always less than 15 cm. Whereas, concurrently collected specimens of *S. sihama* may reach 20 cm. *S. asiatica* also seems to distribute more widely than *S. sihama* in Taiwan. However, more study on their population structure and interspecies relationship from electrophoresis, chromosome, as well as some comparative biological studies should be very interested since these two species are so closely related.

Sillago japonica

The morphology of swimbladder of our specimens (Fig. 6G) is more similar to Sano and Mochizuki's (1984) drawing than McKay's (1985). Since *S. asiatica* and *S. japonica* of Taiwan can be easily identified from their vertebrae formula and swimbaldder structure. McKay's (1985) suspection that *S. asiatica* is a subspecies of *S. japonica* is not supported from our data.

Sillago microps

This is another species proposed as new by McKay (1985) based on two specimens from Taiwan. This species is characterized by its small eyes and XI-1, 19 dorsal and II, 19 anal fin rays. Eye diameter of this species is 14–16% of head length and 33.3–37.8% of snout length. Comparatively, the eye diameter of *S. sihama* is usually 21–26% of head

TABLE 4

Meristic counts of *Sillago asiatica* from five different localities of Taiwan. Three individuals were arbitrarily selected from the samples of each locality

	Wanli	Tanshui	Hsinchu	Kaohsiung	Penghu
Dorsal fin rays	XI-I, 20-21	XI-I, 20-21	XI-I, 21	XI-I, 21	XI-I, 20-21
Anal fin rays	II, 21	II, 21	II, 21	II, 21	II, 20-21
Lateral-line scales	69	69	71-73	69	67-69
Transverse scales	5/9	5/9	4-5/9-10	4-5/9-10	4-5/9
Vertebrae	34	34	34	34	34
Abdominal	14	14	14	14	14
Modified	5	5-6	5	5-6	5-6
Caudal	15	14-15	15	14-15	14-15

TABLE 5
Comparison of meristic characters of eight Formosan sandborers

Species	*S. chondropus*	*S. sihama*	*S. parvisquamis*	*S. maculata aeolus*
1st DF	XI	X-XI (mostly XI)	XII-XIII (mostly XII)	XI-XII (mostly XI)
2nd DF	I, 22-23 (mostly 21)	I, 17-21 (mostly 20)	I, 19-22 (mostly 21)	I, 17-19 (mostly 19)
AF	II, 22-23 (mostly 22)	II, 16-23 (mostly 21)	II, 21-24 (mostly 23)	II, 16-18 (mostly 18)
L. l.	70-71	68-74	78-81	68-71
L. tra.	5-6/9-10	4-5/8-11	6-7/11-12	5-6/10-11
Vertebrae	13+22=35	13+21=34	16+23=39	14+20=34
Modified	0	0-7 (mostly 5)	5-6 (mostly 6)	5-7 (mostly 6)

Species	*S. ingenuua*	*S. asiatica*	*S. japonica*	*S. microps*
1st DF	XI	XI	X-XI (mostly XI)	XI
2nd DF	I, 15-17 (mostly 16)	I, 20-21 (mostly 21)	I, 20-22 (mostly 21)	I, 19
AF	II, 16-17 (mostly 16)	II, 20-21 (mostly 21)	II, 21-24 (mostly 22)	II, 19
L. l.	66-71	67-73	70-72	68-69
L. tra.	5/8-9	4-5/9-10	3/8-10	5/?
Vertebrae	13+20=33	14+20=34	14+21=35	13+21=34
Modified	9-11 (mostly 10)	5-6 (mostly 5)	8-10 (mostly 9)	5

and 58% of snout (McKay 1985). The subgenus of this species is still unknown since McKay had not examined its swimbladder. Unfortunately, we have not yet collected this species so far.

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臺灣海域產沙鮻科魚類之再檢討兼記一種新記錄之沙鮻魚類 *Sillago (Sillaginopodys) chondropus*

邵廣昭　沈世傑　陳立文

本文首先記錄產於東臺灣花蓮海域一帶，產量豐富之一種新記錄之沙鮻科魚類 *Sillago* (*Sillaginopodys*) *chondropus* Bleeker（擬稱大指沙鮻）。本文中除了根據12尾標本描述其形態特徵外並附以本種及另種 *Sillago asiatica*（擬稱亞洲沙鮻）之照片及X-光透視片。由於 Mckay (1985) 曾對本科魚類之分類系統作重大修正，作者等乃重新檢查所有過去及目前在本省所採集之此科魚類標本。經整理結果獲知臺灣產之沙鮻共計有八種，分屬於一個屬及三個亞屬，它們分別是大指沙鮻 *Sillago chondropus*，沙鮻 *S. sihama*，野沙鮻 *S. parvisquamis*，灣沙鮻（擬稱）*S. ingenuua*，青沙鮻 *S. japonica*，亞洲沙鮻 *S. asiatica*，星沙鮻 *S. maculata aeolus*，及小眼沙鮻（擬稱）*S. microps* 等。其中第一種屬於大指沙鮻亞屬 *Sillaginopodys*，第二及第三種屬於沙鮻亞屬 *Sillago*，第四至第七種是準沙鮻亞屬 *Parasillago*。最後一種沙鮻之亞屬別尚未知。本文最後並記述臺灣產八種沙鮻分類地位再檢討之結果，同時並附檢索表以利查考。