

A REVISION OF THE SANDBORERS (GENUS *SILLAGO*) OF TAIWAN¹

KWANG-TSAO SHAO AND KUN-HSIUNG CHANG

Institute of Zoology, Academia Sinica,
Taipei, Taiwan. 115. R. O. C.

Received for publication, May 26, 1978

ABSTRACT

Kwang-Tsao Shao, and Kun-Hsiung Chang (1978). *A Revision of the sandborers (Genus Sillago) of Taiwan*, Bull. Inst. Zool., Academia Sinica, 17(1): 1-11. A large sample size of sandborers specimens were used to the systematic studies of five species of sandborers (Genus *Sillago*) from the waters around Taiwan. A revision with a key were made according to the external appearances, squamation on head and L-form of hemal arch studies. The results of meristic or non-meristic studies were also employed in the article. The five species are *S. maculata*, *S. parvisquamis*, *S. sihama*, *S. argentifaciata* and *S. japonica*.

Sandborers is a popular sea food in Taiwan with considerably economic value. The fishes belonging to family Sillaginidae have three genera^(7,9) and less than twenty species in the entire world. *Sillago* is the largest genus in the family and also it is the only genus occurring in Taiwan. *Sillago* is widely distributed over the entire western Indo-Pacific, from the Red Sea (Kuwait) to Samoa, and extending from S.E. Australia to north Japan (Hakodate).

The works on taxonomic and phylogenetic studies of this family were incomplete. However, a world wide revision of the family completed by Mckay in 1977 (personal communication) might give us a reliable accounts of the family.

In Taiwan, only three species including *S. maculata*, *S. sihama* and *S. japonica* were recorded early by Chen⁽⁴⁾. Later in 1974, *S. parvisquamis* was recorded by Chang⁽¹⁾, and *S.*

argentifaciata was collected by Mr. C. P. Chen. All together, five species are now contained in the family Sillaginidae. Species of sandborers are not easy to recognize due to their similar external features and some morphological characters. Keys written by earlier authors were not perfect resulting a misidentification of species. Therefore, the authors applied modern taxonomical concepts (numerical and chemical) with a large number of specimens to review the exact systematic status of five Formosan species of sandborers⁽¹⁵⁾. The present results is the first part concerning with the taxonomic accounts of the family Sillaginidae in Taiwan. It is believed that the revised key in this article will be more useful for specific identification.

MORPHOLOGY OF THE FISHES OF *SILLAGO*

A. General appearances

It is difficult to distinguish five Formosan

1. Paper No. 194 of the Journal Series of the Institute of Zoology, Academia Sinica.

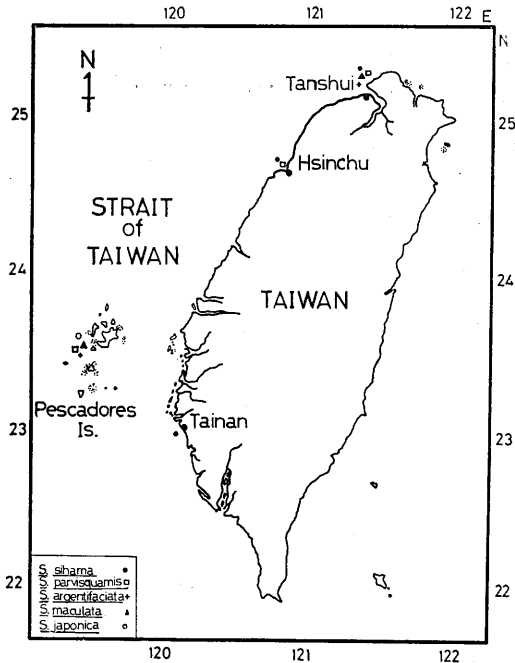


Fig. 1. Sampling area of Sillaginidae in Taiwan waters.

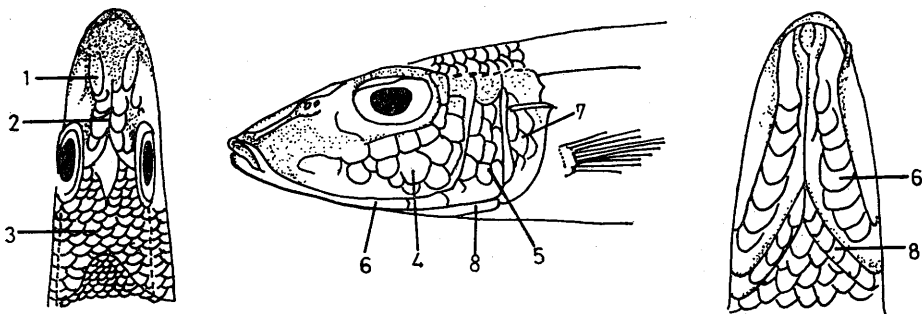
Sillago species by their external appearances when they are alive. Even after death, black blotches on body side is the only recognizable character to distinguish *S. maculata* from the other species of *Sillago*. However, through

detail comparison of external features from a total of 720 fresh specimens, the slight differences among species can be detected from some external characters; such as body color, snout shape, caudal shape and curvature of lateral line. These differences will be described separately in the next part of species accounts.

B. Squamation on head

Squamation on head is an important character for specific identification of the sandborers. However, there are three types of scales including cycloid, sparoid and ctenoid scales found all together on the head of sandborers. Because the type of scale show a great extent of intraspecific and interspecific variations, it is necessary to study them detailly in order to clarify the different results from earlier authors.

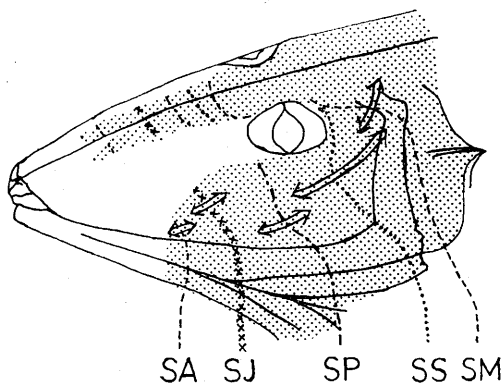
Firstly, twenty juveniles of *S. sihama* were used for studying the morphology and development of scales. It was found that the scales are originated from caudal peduncle (BL. 0.95 cm), then gradually extend toward trunk (after BL. 1.9 cm), and finally reached to operculum and occipital regions as the fish grows to 2.6 cm. Because the type of scales on head are formed genetically which couldn't change with the growth of fish. Also, the pattern of squamation showed the intraspecific similarity and interspecific differences. Therefore, it can be



1. Prenasal area.
2. Anterior part of interorbital region.
3. Posterior part of interorbital region
4. Cheek.

5. Preoperculum.
6. Lower part of preoperculum.
7. Operculum.
8. Lower part of operculum.

Fig. 2. Eight portions of head region discriminated for the use of quantitative analysis of scales.



■ Squamation area.

Fig. 3. Distribution pattern of scales in head region of the species in *Sillago*. Each of five different lines distinguish from cycloid scales (lower left area) and ctenoid scales (upper right area) for each species. Arrows show the range of variation of each line. Species name in abbreviated.

TABLE I
Comparison in lateral line scales number, squamation on head in the species of *Sillago*.

<i>S. sihama</i>	<i>S. japonica</i>	<i>S. argentifaciata</i>	<i>S. maculata</i>	<i>S. parvisquamis</i>	Literature Cited
L. l. 70-75 L. tr. 4/?	L. l. 70-75 L. tr. 3/?		L. l. 70-75 L. tr. 5-6/? (2), (4): ●	L. l. 82-86 L. tr. 7/?	Matsubara 1963
L. l. 70+6-8 L. tr. 4-6/? (2), (4): ●	L. l. 75-78 L. tr. 3/? (2), (4): ▲			L. l. 75-86 L. tr. 6.5-7.5/? (2), (4): ▲	Lindberg, G. U. 1969
L. l. 68-75 L. tr. 5/11 (2), (3), (7): ▲	L. l. 70-72 L. tr. 3/10				Chu, Y. D. <i>et al.</i> 1963
L. l. 64-69 L. tr. 5-6/11	L. l. 70 L. tr. 3/9		L. l. 66-67 L. tr. 5/11 (3), (4): ●		Cheng, C. T 1962
L. l. 70 L. tr. 4/11	L. l. 74 L. tr. 3/? (1), (2): ●		L. l. 70 L. tr. 5-6/7		Gunther, A. 1860
	L. l. 71+7 L. tr. 3.5/11				Tanaka, A. 1911
L. l. 68-70 L. tr. 5/11 (4): ●		L. l. 66 L. tr. 5/9 (4): ●	L. l. 69 L. tr. 6/13 (5): ● (4), (7): ▲		Martin, C. & H. R. Montaban 1934
L. l. 70-75 L. tr. 4/? (2), (4): ●	L. l. 70-75 L. tr. 3/? (2), (4): ▲		L. l. 70-75 L. tr. 5-6/? (2), (4): ●	L. l. 82-86 L. tr. 7/? (2), (4): ●	Fowler, H. W. 1933
L. l. 69-73 L. tr. 5-6/10-12 (5), (7): ●	L. l. 68-70 L. tr. 3/10 (5), (7): ▲		L. l. 70-74 L. tr. 5-6/10-12 (5), (7): ▲		Weber, M. & L. F. de Beaufort 1831
L. l. 68-74+4-7 L. tr. 4½-5½/8-11 (2)-(5):⊙; (7):▲; (1), (6), (8): ●	L. l. 70-73+4-6 L. tr. 3-3½/8-10 (6), (8): ⊙; (1):●; (2)-(5), (7): ●	L. l. 66-71+4-5 L. tr. 5/8-9 (1) (6):⊙ (2)-(5)(7)(8):▲	L. l. 68-71+3-5 L. tr. 5½-6/10-11 (2), (3), (5):⊙ (7):▲ (4), (6), (8): ●	L. l. 78-81+3-6 L. tr. 6½-7/11-12 (1), (2), (4), (6), (8):⊙ (3), (5), (9): ▲	Present Study

●: cycloid only ▲: ctenoid only ⊙: both present

confirmed as a good character for specific identification.

Secondly, a total of ninety specimens were chosen randomly for making the frequency distribution of cycloid and ctenoid scales (the regenerate scales and accessory scales were excluded) from eight portions of the head (Fig. 2). The sample size respectively for each species were *S. maculata*, 21 (BL. 9.5–18.9 cm); *S. parvisquamis*, 7 (6.2–19.4 cm); *S. sihama*, 27 (4.2–18.1 cm); *S. argentifaciata*, 18 (8.0–15.8 cm) and *S. japonica*, 17 (13.4–21.2 cm). Fig. 3 was the summarized results for the number of ctenoid scales with decreasing order of *S. argentifaciata*, *S. japonica*, *S. parvisquamis*, *S. sihama* and *S. maculata*. In other words, the number of cycloid decreased from snout toward occipital. Because the distributional pattern of scales in each species has its certain intraspecific variation that make the intraspecific difference indistinct (Fig. 3), then, the opinion given by Abe⁽¹⁷⁾ might be incorrect to use only five head scales to identify species. The differences of scale number between the result of present studies and other earlier reports were summarized in Table 1. Three reasons probably could explain these differences: (1) various counting standard (2) small sample size (3) the mistake caused by the dediduous scales of the fish.

C. L-ferm hemal arch

The morphology of vertebrae of each species are shown in Plate II. The criteria adapted from Horite⁽¹¹⁾ are summarized as follows: parapophysis originate from 3rd centrum, the section from the centrum with the first rib attached on the tip of parapophysis to the centrum with the last rib is abdominal vertebrae. Then, the parapophysis connected in subsequent centrum is the begining of hemal arch. The distal end of hemal arch of sandborers (especially *S. maculata*, *S. argentifaciata* and *S. japonica*) bend backward in parallel with the centrum appear L-form in lateral view. The parapophysis after the last hemal arch completely fused and more straight form the begining

of hemal spines. The caudal vertebrae is then consisted of hemal arch and hemal spine.

The comparative studies of hemal arch among species (Fig. 4) showed a slight difference in number, size, shape and the degree of curvature.

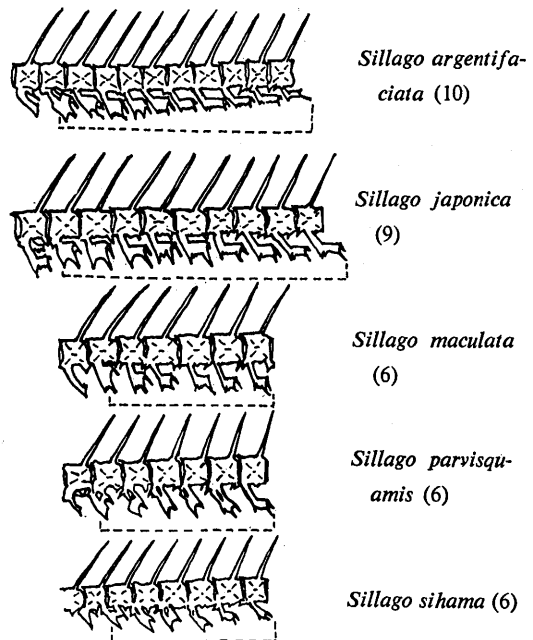


Fig. 4. Comparison of the lateral view and the numbers (in parenthesis) of the hemal arch in *Sillago*.

SPECIES ACCOUNT

Family Sillaginidae

Genus *Sillago* Cuvier, 1817

Key to species of the genus *Sillago*

1. Body sides with irregular blackish blotches after death; scales absent on the prenasal area. *S. maculata*
Body sides without any blackish blotches after death; scales present on the prenasal area. 2
2. Vertebrae 38 (rarely 39); scales between lateral line and origin of first dorsal $6\frac{1}{2}$ – $7\frac{1}{2}$ *S. parvisquamis*

- Vertebrae less than 35; scales between lateral line and origin of first dorsal less than 6... 3
3. Vertebrae 33 (rarely 31, 32, 34); hemal arch 4-7 (mostly 6); ctenoid scales absent on lower parts of preoperculum and operculum; scales between lateral line and origin of first dorsal 4-6.*S. sihama*
Vertebrae less than 33; hemal arch 8-11; ctenoid scales present on lower parts of preoperculum and operculum. 4
4. Vertebrae 32 (occasionally 31); hemal arch 9-11 (mostly 10); second dorsal I, 15-17; anal II, 16-17; ctenoid scales present on the prenasal area and cycloid absent on lower part of operculum.*S. argentifaciata*
Vertebrae 34 (occasionally 35); hemal arch 8-10 (mostly 9); second dorsal I, 20-22; anal II, 21-24; ctenoid scales absent on the prenasal area and cycloid present on lower part of operculum; scales between lateral line and anterior dorsal 3.*S. japonica*

1. *Sillago maculata* Quoy & Gaimard

(pl. 1, fig. 1; pl. 2, fig. 1)

Sillago maculata Quoy & Gaimard, 1824: 261, pl. 53, fig. 2 (type locality: Sydney; Port Jackson) not seen by the authors; Weber & de Beaufort⁽¹⁸⁾, 1931: 170; Martin & Montalban⁽¹⁹⁾, 1934: 224, pl. 1, fig. 2; Fowler⁽⁹⁾, 1933: 423; Chen⁽⁴⁾, 1969: 372; Cheng⁽⁶⁾, 1962: 349, fig. 294; Matsubara⁽¹⁴⁾, 1963: 646.

Material examined: 70 fish, 11.3-18.9 cm FL, offshore waters of Penghu, trawl net, 15-30 m deep, Dec. 7, 1974, Jul. 18, 1975; 15 fish, 12.0-16.0 cm FL, bay near Makung harbor, Penghu, gill net, 3 m deep, Sept. 8, 1975; 2 fish, 13.2-15.4 cm FL, artificial reef sites between Makung and Yuweng, hand linear, 18 m deep, Sept. 10, 1975; 5 fish, 10.2-17.8 cm FL, offshore waters of Tanshui, trawl net, depth unknown, Jun. 18, 1974.

Diagnosis: Rostro-frontal and ventral lines of head slightly convexed. Lateral line complete, the arched portion steeper than in other

species. Scales on cheek, lower parts of preoperculum with cycloid. Tiny scales present on vertical fins, absent in prenasal canal. Anal length relatively shorter than that of other species. Caudal fin slightly emarginate with dull-round margin on upper and lower leaves. Vertebrae 33, the number same as *S. sihama* but different in abdominal and caudal vertebrae, *S. maculata* is 14+19 vs. *S. sihama* is 13+20.

A median silvery longitudinal stripe on body side with some irregular blackish blotches after death. Upper half of spinous dorsal blackish with dark spots basally; soft dorsal with a dusky distal margin and two longitudinal stripes below. Ventral and anal yellowish with a white margin.

Meristic and morphometrics: see Table 2.

Distribution: E. Africa through Indian Ocean and Archelago (Andamans) to Malay, SE. Australia, Philippine and Formosa.

2. *Sillago parvisquamis* Gill

(pl. 1, fig. 2; pl. 2, fig. 2)

Sillago parvisquamis Gill, 1861: 505 (type locality: Kanagawa, near Yokohama); Fowler⁽⁹⁾, 1933: 427; Matsubara⁽¹³⁾, 1963: 646; Lindberg⁽¹²⁾, 1969: 150; Tomiyama & Abe⁽¹⁷⁾, 1958: 1171; Chang & Chen⁽¹⁾, 1974: 35.
Sillago sihama Tanaka⁽¹⁶⁾, 1958: 1177.

Material examined: 18 fish, 6.2-12.0 cm FL, tidal pools of beach, Hsinchu, poisoning, 0.2-1.5 m deep, Aug. 22, Nov. 25, 1974, May 24, Jun. 28, 1975; 1 fish, 19.4 cm FL, off beach waters of Hsinchu, hand linear, 1.5 m deep, Dec. 25, 1974; 2 fish, 10.6-12.0 cm FL, fish market of Tanshui, Sept. 5, 1975.

Diagnosis: Body slender than the rest of species, its rostro-frontal line nearly straight. Lateral line complete, almost straight. Scales on body, nape, occipit, preoperculum and operculum ctenoid; interorbital, cheek and lower parts of preoperculum and operculum with both ctenoid and cycloid; tiny scales present on prenasal canal and vertical fins. Scales smaller

TABLE 2
Body proportions and meristic characters of Formosan sandborers.

Species	<i>S. maculata</i>	<i>S. parvisquamis</i>	<i>S. sihama</i>	<i>S. argentifaciata</i>	<i>S. japonica</i>
In standard length:					
Head	3.5-3.8	3.5-4.2	3.6-3.8	3.6-3.9	3.9-4.2
Body depth	4.7-5.4	6.1-6.8	5.3-6.1	5.1-5.7	5.6-6.2
Predorsal	2.6-2.9	2.6-2.9	2.6-2.9	2.8-3.1	2.8-3.2
1st dorsal base	4.8-5.4	5.1-6.3	5.2-5.9	4.6-5.2	4.9-5.6
1st dorsal height	7.0-8.5	6.5-7.2	2.8-7.0	7.8-9.1	6.7-7.7
Preanal	1.6-1.7	1.7-1.8	1.7-1.9	1.6-1.8	1.8-1.9
Anal base	3.4-3.7	2.9-3.2	2.8-3.1	3.0-3.3	2.6-2.8
Length of caudal peduncle	8.5-9.5	8.8-10.5	9.3-10.9	8.9-10.0	9.9-11.4
Depth of caudal peduncle	13.1-14.6	15.4-17.5	13.1-15.1	13.1-14.7	13.3-14.6
In head length:					
Snout	2.2-2.3	2.2-2.4	2.3-3.3	2.2-2.3	2.2-2.4
Eye	3.3-3.6	3.8-4.1	3.5-4.3	3.2-3.6	3.6-3.9
In eye diameter:					
Interorbital	1.4-1.5	1.3-1.6	1.3-1.6	1.4-1.6	1.3-1.4
Postorbit-preopercular angle	1.3-1.4	1.2-1.4	1.3-1.5	1.5-1.7	1.4-1.5
First dorsal	XI-XII (mostly XI)	XII-XIII (mostly XII)	XI-XII (mostly XI)	XI	X-XI (mostly XI)
Second dorsal	I, 17-18	I, 19-22	I (occasionally II), 17-21 (mostly 20)	I, 15-17 (mostly 16)	I, 20-22 (mostly 21)
Anal	I-II (mostly II), 16-18	II, 20-23	II, 16-23 (mostly 21)	II, 16-17 (mostly 16)	II, 21-24 (mostly 22)
Pectoral	14-16	16-17	14-17 (mostly 16)	15-16	15-17 (mostly 16)
Ventral	I, 5	I, 5	I, 5	I, 5	I, 5
L. l.	68-71+3-5	78-81+3-6	68-74+4-7	66-71+4-5	70-72+4-6
L. tr.	5½-6/10-11	6½-7/11-12	4½-5½/8-11	5/8-9	3-3½/8-10
Vertebrae	14+19=33	16+22=38 (occasionally 39)	13+20=33 (rarely 31-34)	13+19=32 (rarely 31)	13+21=34 (rarely 35)
Hemal arch	5-7 (mostly 6)	5-6 (mostly 6)	4-7 (mostly 6)	9-11 (mostly 10)	8-10 (mostly 9)

than the rest of four species. L. l., 78-81+3-6, L. tr., 6½-7/11-12. Caudal fin nearly truncate. Vertebrae 16+22=38 (occasionally 39). First dorsal spine XII-XIII (mostly XII).

Body colour when alive silvery-olive with a silvery longitudinal stripe in larger individuals, the stripe turned black when the preserved in

formalin. Scales on back edged with dusky marking. Dorsal sprinkled with dusky markings at distal halves; ventral and anal fins yellowish with whitish margin.

Meristics and morphometrics: see Table 2.

Distribution: From Pacific coast of central Japan, southward to Formosa.

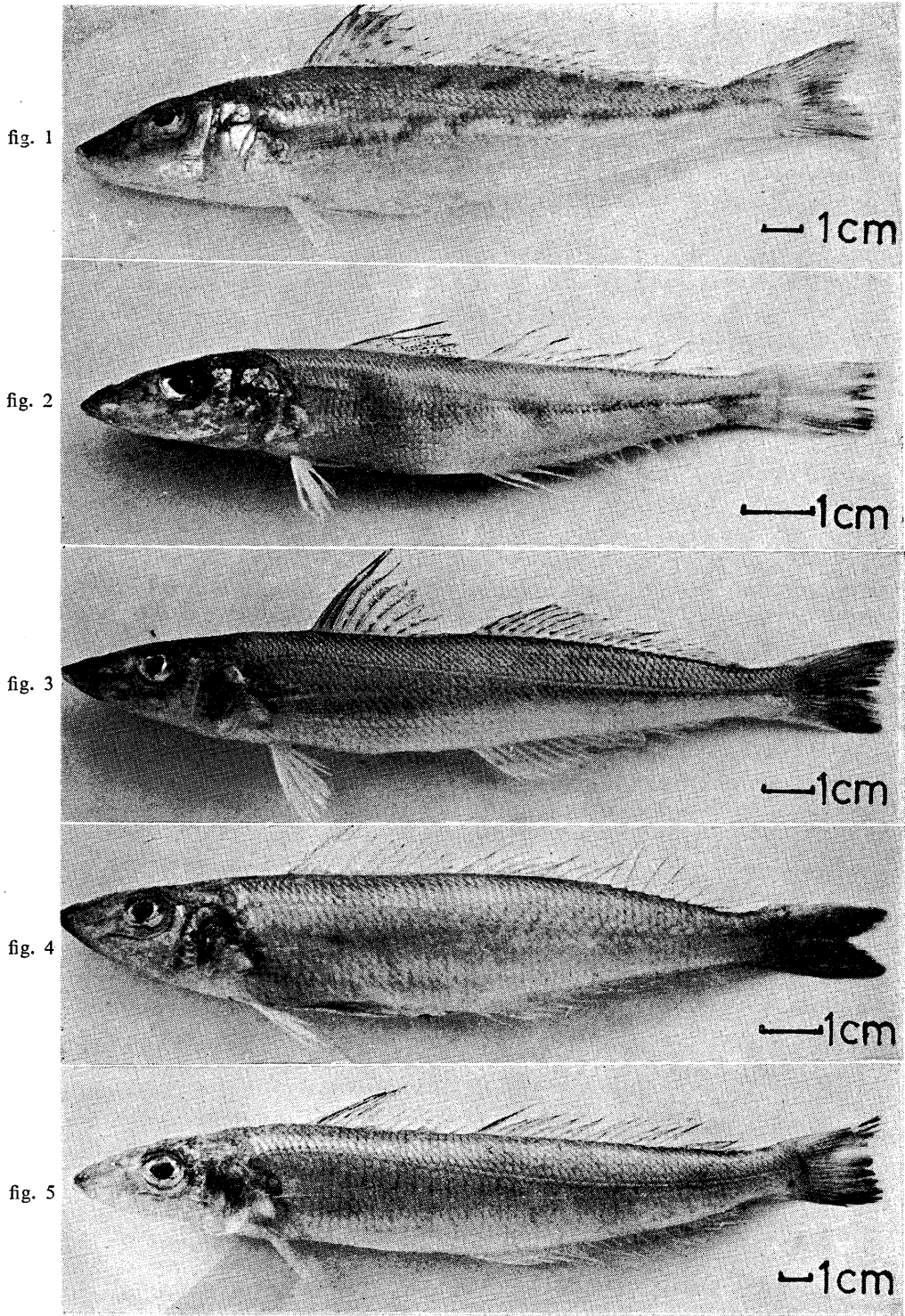


Plate I. Photographs of 5 fresh species of *Sillago*, fig. 1 to fig. 5 are *S. maculata*, *S. parvisquamis*, *S. sihama*, *S. argentifaciata*, and *S. japonica*.

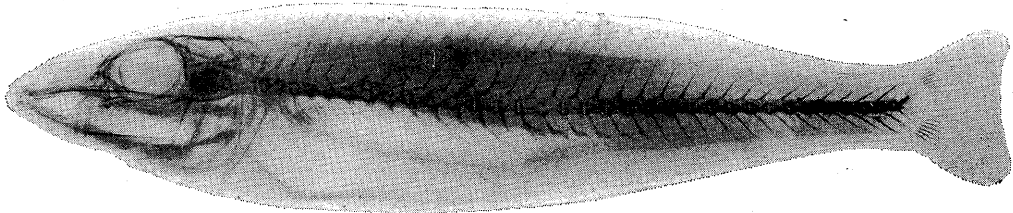
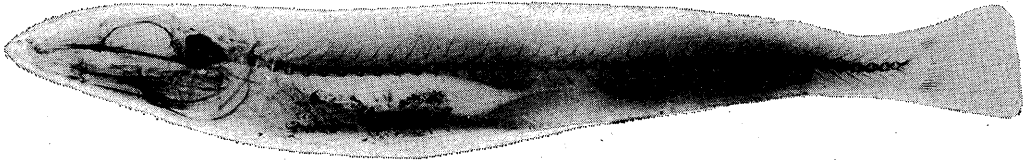
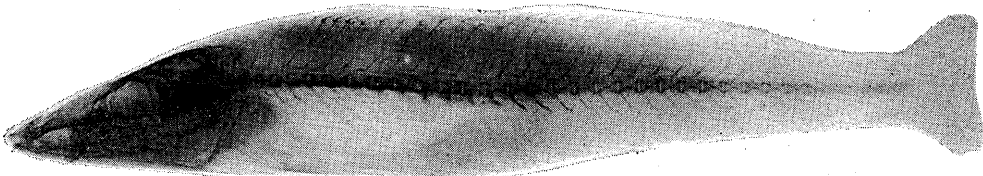
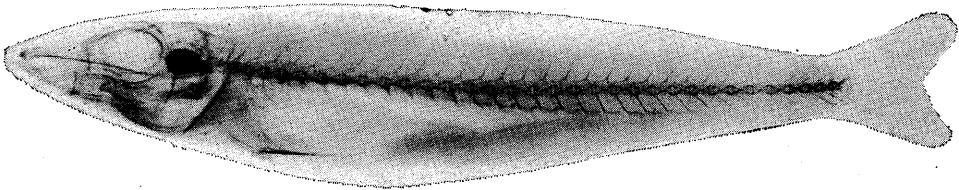
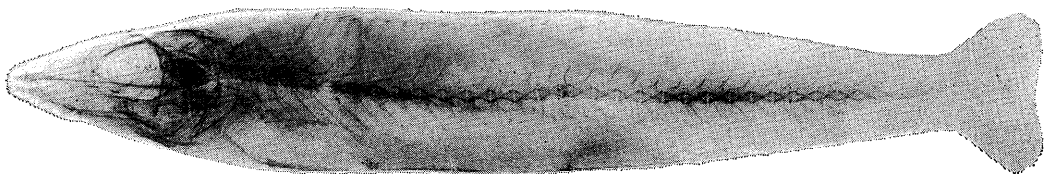
fig. 1. *Sillago maculata*fig. 2. *Sillago parvisquamis*fig. 3. *Sillago sihama*fig. 4. *Sillago argentifaciata*fig. 5. *Sillago japonica*

Plate II. Radiographs of *Sillago* found in Taiwan (all in real size).

3. *Sillago sihama* (Forsk.)

(pl. 1, fig. 3; pl. 2, fig. 3)

Atherina sihama Forskal, 1775: 70 (type locality: Lohaja, Red Sea), not seen by the authors.

Sillago sihama Weber & de Beaufort⁽¹⁸⁾, 1931: 172, fig. 33; Fowler⁽⁹⁾, 1967: 235; Fowler⁽⁷⁾, 1933: 417; Martin & Montalban⁽¹³⁾, 1934: 222, pl. 1, fig. 1; Chen⁽⁸⁾, 1952: 331; Chen⁽⁴⁾, 1969: 372; Cheng⁽⁵⁾, 1962: 350; Matsubara⁽¹⁴⁾, 1963: 646; Chu⁽⁶⁾, 1963: 239; Lindberg⁽¹²⁾, 1969: 147.

Material examined: 359 fish were random selected from over thousand fish, 3.7–10.5 cm FL (not including the juveniles for squamation studies), tidal pools of beach, Hsinchu, ichthyocide, 0.2–1.5 m deep, monthly collected from Aug. 1974 to Oct. 1975. 154 fish, 7.3–18.1 cm FL, fish market of Tanshui, from Feb. to Nov. 1975; 47 fish, 8.9–10.0 cm FL, beach seine, Tainan, 1–4 m deep, Mar. 20, 1975.

Diagnosis: Body rather slender, its rostrum-frontal line gently convex. Lateral line complete, almost straight. Scales on body and operculum ctenoid; those in prenasal canal, lower parts of preoperculum and operculum cycloid; interorbital, cheek and preoperculum coexistence with both ctenoid and cycloid. Dorsal rays higher than those in the rest of species. Vertebrae 33 but caudal vertebrae mostly 20. Caudal nearly truncate or slightly emarginate.

Body colour when alive have geographical variations such as silvery-olive in Tanshui and Hsinchu specimens or light brown in Tainan specimens, the former with an indistinct silvery longitudinal strip which is turned black instead in larger specimens; the latter with the stripe of silvery-yellow. Ventral part of body whitish. Dorsal and anal fins pale with dusky edge; pectoral, ventral and caudal pale except the whitish pelvic spines.

Meristics and morphometrics: see Table 2.

Distribution: It distributes widely from the Red Sea through Indian Ocean to the Malay Archipelago, southward to Australia and eastward to Samoa, northward to China, Japan and Korea.

4. *Sillago argentifaciata* Martin & Montalban

Sillago argentifaciata Martin & Montalban⁽¹³⁾, 1934: 226, pl. 1, fig. 3 (type locality: Lumbucan Isl., Palawan).

Material examined: 75 fish, 8.0–15.8 cm FL, offshore waters of Penghu, trawl net, depth unknown, Jul. 18, Sept. 8, 10, 1975. 3 fish, 10.2–12.5 cm FL, fish market of Tanshui, Jul. 18, 1974.

Diagnosis: The deepest portion of body maybe at origin of second dorsal and anal, its rostrum-frontal line slightly inclined. Teeth villiform in both jaw and those in outer row enlarged and bent more forward than the rest of species. Lateral line complete, slight arched anteriorly. Body covered with ctenoid scales except few cycloid scales on prenasal canal and lower part of preoperculum. Caudal deeply forked. The number of vertebrae least only $13+19=32$, but the hemal arch most, 9–11 (mostly 10).

Colour when alive dull silvery, with a brilliant, longitudinal stripe running from upper pectoral base to caudal base; dorsal edged with sparsely blackish dots; other fin hyaline.

Meristics and morphometrics: see Table 2.

Distribution: It was only reported from Philippine and Formosa.

5. *Sillago japonica* Temminck & Schlegel

(pl. 1, fig. 5; pl. 2, fig. 5)

Sillago japonica Temminck & Schlegel, 1842: 23, tab. 10, fig. 1 (type locality: Japan), not seen by the authors; Weber & de Beaufort⁽¹⁸⁾, 1931: 173; Fowler⁽⁷⁾, 1933: 425; Chen⁽⁸⁾, 1952: 331; Chen⁽⁴⁾, 1969: 372; Tanaka⁽¹⁶⁾, 1958: 1171, pl. 229; Cheng⁽⁵⁾, 1962: 351; Chu⁽⁶⁾, 1963: 240; Matsubara⁽¹⁴⁾, 1963: 646; Lindberg⁽¹²⁾, 1969: 147.

Material examined: 55 fish, 13.4–21.2 cm FL, offshore waters of Penghu, trawl net, depth unknown, Jul. 18, Sept. 9, 1975; 4 fish, 12.5–14.2 cm FL, fish market of Tanshui, Jul. 18, 1974.

Diagnosis: Rostro-frontal line nearly straight. Lateral line complete, slightly arched anteriorly. Scales almost ctenoid, except few patches of cycloids present on prenasal canal and lower parts of preoperculum and operculum. Scales of the present species are relatively larger than other co-genus, with 3 scales between lateral line and original of first dorsal. Caudal nearly truncate or slightly emarginate. The number of vertebrae, $13+21=34$ (rarely 35), hemal arch 8-10 (mostly 9) only less than *S. argentifaciata* 10; second dorsal fin ray 20-22 (mostly 21) more than *S. argentifaciata* 15-17 (mostly 16).

Colour agree with that in *S. argentifaciata*.

Meristics and morphometrics: see Table 2.

Distribution: From Japan through the coast of China to Indonesia.

ACKNOWLEDGEMENT

The authors wish to thank Dr. Sin-Che Lee for his invaluable advice and criticism on the report, Mr. Chang-Po Chen for the supply of references and assistance in collecting the samples.

REFERENCES

1. CHANG, K. H. and C. P. CHEN, (1974). The newly recorded sandborers, *Sillago parvisquamis* Gill of Taiwan. *Bull. Inst. Zool., Academia Sinica* 13: 35-36.
2. CHEN, J. T. F. (1952). Check list of the species of fishes known from Taiwan (Formosa). *Quart. Jour. Taiwan Mus.* V: 331-334.
3. CHEN, J. T. F. (1969). A Synopsis of the Vertebrates of Taiwan. Shangwu Book Co., Taipei, 2: 1-548 (Chinese).
4. CHENG, C. T. (1962). A synopsis of fishes of South China Sea. pp. 349-351.
5. CHU, Y. D., C. L. CHANG and C. T. CHENG, (1963). A synopsis of fishes of East China Sea. pp. 238-240.
6. FOWLER, H. W. (1933). Fish of the Philippine and adjacent seas. *Bull. U. S. Nat. Mus.* 100: 465, 32 figs.
7. FOWLER, H. W. (1967). The Fish of Oceanic. Bernice P. Bishop museum-memoir Vol. X. Johnson Reprint Corp., N. Y. p. 235-236+337.
8. GILL, T. (1861). Synopsis of the Sillaginoids. *Proc. Acad. Nat. Sci. Philadelphia.* pp. 501-507.
9. GUNTHER A. (1860). Catalogue of the fishes in the British Museum, Vol 2. pp. 243-246.
10. HORITA, H. (1961). Comparative studies of axial skeleton of teleosts in Japan. *NE Fish. Res. Inst Rep.*, 164.
11. LINDBERG, G. U. and Z. V. KRASYUKOVA, (1969). Fishes of the sea of Japan and the adjacent areas of the Sea of Japan and the Yellow Sea. Part 3, Teleostomic XXIV Perciformies, Opre. Faune SSSR, No. 99: 1-479 (Israel program for scientific translations Jerusalem).
12. MARTIN, C. and H. R. MONTABON, (1934). Philippine Sillaginidae. *Philippine J. of Sci.*, 55: 221-229.
13. MATSUBARA, K. (1963). Fish Morphology and Hierarchy. (2nd ed.) pt. I, pp. XX+789, 289 figs. Ishizaki-shoten, Tokyo (in Japanese).
14. SHAO, K. T. (1976). Systematic studies of sandborers (Genus *Sillago*) from the waters around Taiwan. M.S. thesis, 131 pp. Inst. of Oceanogr. National Taiwan University.
15. TANAKA, S. (1958). Figures and descriptions of the Fishes of Japan. Vol. 57, pp. 11 1-1177* pl. 229.
16. TOMIYAMA, I., T. ABE and T. TOKIOKA, (1958). Encyclopaedia Zoological illustrated in colour. 2, Fishes, Tokyo: 10306, fig. 912, (in Japanese).
17. WEBER, M. and L. F. DE BEAUFORT, (1931). The Fishes of the Indo-Australian Archipelago. 6: 168-178.

臺灣海域產沙鮫屬魚類之分類研究

邵廣昭 張崑雄

本文係利用大樣品材料，比較研究臺灣海域產五種沙鮫屬魚類之外部形態，頭部鱗片，L-型血道弓門等特徵，並配合體節與非體節形質之研究結果，將沙鮫屬魚類予以重新分類。文中並附檢索表。這五種沙鮫分別為星沙鮫 *S. maculata*，野沙鮫 *S. parvisquamis*，沙鮫 *S. sihama*，青沙鮫 *S. japonica* 及銀沙鮫（擬稱）*S. argentifaciata*。