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A REVISION OF THE MUGILID FISHES FROM TAIWAN

CHEN-HSIANG LIU and SHIH-CHIEH SHEN

Department of Zoology, National Taiwan University, Taipei, Taiwan 10765, Republic of China

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Chen-Hsiang Liu and Shih-Chieh Shen (1991) A revision of the mugilid fishes from Taiwan. *Bull. Inst. Zool., Academia Sinica* **30**(4): 273-288. The mugilid fishes from Taiwan including five genera and ten species are revised. Among them, one genus, *Oedalechilus* and three species, *Oedalechilus labiosus*, *Liza alata* and *L. subviridis* are new records for Taiwan. Key, diagnostic charcteristics, synonyms and color photographs of each species are given.

Key words: Mugilidae, Fish taxonomy, Taiwan, Mullet.

Fishes of the family Mugilidae, usually called mullet, occur in tropical and temperate oceans. There are 13 genera (*Agonostomus, Cestraeus, Chaenomugil, Joturus, Liza, Mugil, Myxus, Rinomugil, Valamugil, Oedalechilus, Crenimugil, Aldrichetta* and *Trachystoma*) with about 95 species known in the world (Nelson, 1984).

The earliest reports on the collections of mullets in Taiwan are from 1919, 1922a and 1922b by Oshima who recorded 11 species: *Mugil cephalus, M. oeur, M. japonicus* (=*M. cephalus*), *M. carinatus* (=*Liza affinis*), *M. anpinensis* (=*L. dussumieri*), *M. kelaartii* (=*Valamugil cunnesius*), *Liza formosae, L. pescadorensis* (=*L. macrolepis*), *L. parva* (=*L. macrolepis*), *L. troscheli* (=*L. macrolepis*) and *Chelon crenilabis* (=*Crenimugil crenilabis*). Among them, *Mugil oeur* and *M. japonicus* were synonymized with *M. cephalus* by Thomson (1964), *Mugil carinata* of Oshima (1919) was misidentified as *L. affinis* (Senou *et al.*, 1987). Therefore, only 8 species listed by Oshima are recognized. Chen (1969) added 5 more species, *Mugil tade, Lita vaigiensis, L. melinoptera, L. macrolepis* (*M. troscheli*), and *Crenimugil crenilabis* to the Taiwan list. The former 3 species which are usually found in the Indo-Australian area, are usually not collected in Taiwan waters. Chen and Yu (1986) added another 4 species: *Liza subviridis, Valamugil cunnesius, V. speigleri* and *V. seheli*. Among them only *Liza subviridis* and *Valamugil cunnesius* were found in Taiwan, *Valamugil speigleri* and *V. seheli* were collected from the Indo-Australian area but this also remains doubtful. Mugilid fishes have been extensively and intensively collected in the Taiwan waters by some workers from 1982 to 1990. The collection reveals that there are 10 species belonging to five genera: *Mugil cephalus* (Linnaeus, 1758), *Liza macrolepis* (Smith, 1849) *L. affinis* (Günther, 1861), *L. dussumieri* (Cuvier and Valenciennes, 1836), *L. subviridis* (Valenciennes, 1836), *L. alata* (Steindachner, 1892), *Valamugil cunnesius* (Valenciennes, 1836), *V. formosae* (Oshima, 1921), *Crenimugil crenilabis* (Forsskal, 1775) and *Oedalechilus*

labiosus (Valenciennes, 1836). Among them, one genus, *Oedalechilus*, and three species: *L. alata*, *V. formosae* and *O. labiosus*, are new records for the adjacent waters around Taiwan. Only the species *Valamugil formosae* is endemic to southern Taiwan. The following four species listed by Chen and Yu (1986) are either synonyms or erroneous records: *Mugil kelaartii* Günther is a synonym of *Valamugil cunnesius*, *Liza parva* and *L. pescadorensis* are synonyms of *L. macrolepis*, *Mugil tade* (Forsskål) has not yet been found in this area.

MATERIALS AND METHODS

Specimens used were mostly collected by gill net and beach seine from Keelung, Kaohsiung and Penghu. Specimens were photographed when fresh and then preserved in 10% formalin for further observations. Measurements were made with needle-point dividers following the methods of Hubbs and Lagler (1958). The lateral scales (L.S.) were counted along the middle of the left side of the body; transverse scales (Tr. S.) were counted from the most anterior dorsal base to the ventral base; and the predorsal scales (P.S.) were counted from the mid anterior dorsal base to the frontal. Gill rakers (G.R.) were counted both on the outer and inner side of the first gill arch of the left side. The ratio of adipose eyelid length to eye diameter (Lae/ed) was calculated from measurements made as illustrated in Fig. 1. Dorsally, the adipose eyelid almost covered the eye; ventrally, the adipose eyelid was present only at the anterior and the posterior part of the eye. Blotches, spots and pigment patterns were also used as important key characteristics. All specimens are now deposited in the Museum of the Department of Zoology, National Taiwan University (NTUM).

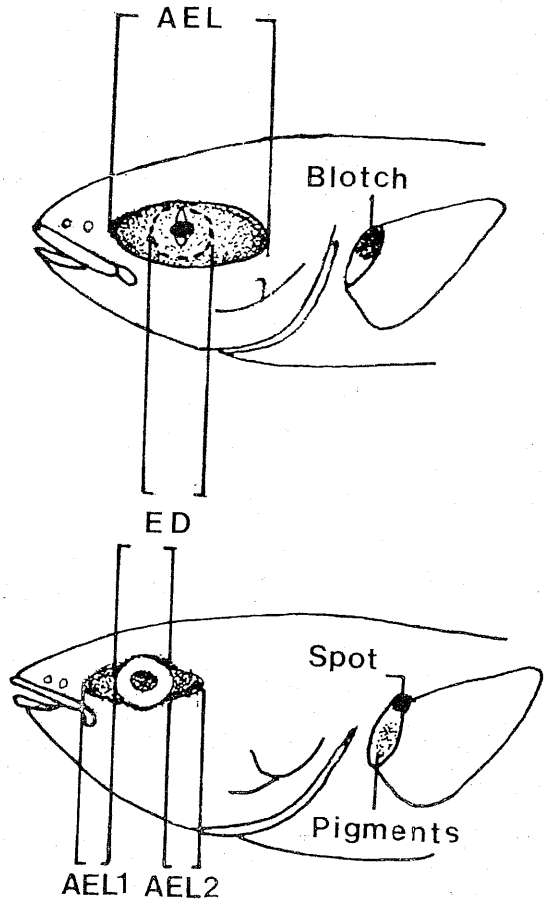

Fig. 1. The adipose eyelid and pectoral base of Mugilidae.
AEL: length of adipose eyelid
ED: eye-diameter
AEL1: length of adipose eyelid (anterior part of eye)
AEL2: length of adipose eyelid (posterior part of eye)

SYSTEMATIC ACCOUNTS

Key to genera and species of Mugilidae

1. Anal fin III, 8; adipose eyelid prominent, Lae/ed 3.2–4.1, a blue blotch on upper pectoral base (*Mugil*)..... .....*Mugil cephalus*

Anal fin III, 9; adipose eyelid developed, Lae/ed 0.3–2.5, dark blue spot on upper end of pectoral base present or absent.....2

2. With a dark blue spot on upper end of pectoral base 3
   Without a dark blue spot on upper end of pectoral base (*Liza*).....4
3. Lips with papillae.....5
   Lips without papillae (*Valamugil*) 6
4. Adipose eyelid developed (Lae/ed 1.2-2.2) 7
   Adipose eyelid obsolescent (Lae/ed 0.6-1.0) 8
5. Pectoral without axillary scale; upper lip very thick; with a low double symphysial knob (*Oedalechilus*).....
   .....*Oedalechilus labiosus*
   Pectoral with axillary scale; upper lip thin; with a high symphysial knob (*Crenimugil*).....*Crenimugil crenilabis*
6. Upper and lower lips with teeth.....
   .....*Valamugil cunnesius*
   Upper and lower lips toothless.....
   .....*Valamugil formosae*
7. Without keel on the back; lower lip teeth present; pectoral without axillary scale.....*Liza subviridis*
   With keel on the back; lower lip teeth absent; pectoral with axillary scale
   .....*Liza affinis*
8. Pectoral base golden ...*Liza macrolepis*
   Pectoral base pale 9
9. Lateral scales 28-29; pectoral base without pigment .....*Liza dussumieri*
   Lateral scale 32; pectoral base with black pigment.....*Liza alata*

Mugil cephalus Linnaeus, 1758

(Figs. 2-3)

Mugil cephalus Linnaeus, 1758: 316 (Type locality: European seas).
Mugil dobula Günther, 1861: 420.
Mugil perusii Hutton, 1872a: 36, 113.
Mugil occidentalis Castelonau, 1873: 135.
Mugil grandis Castelnau, 1875: 32.
Mugil gelatinosus Klunzinger, 1879: 395.
Mugil mulleri Klunzinger, 1879: 395.
Mugil marginatis Saville-Kent, 1893: 294.
Mugil hypselosoma Ogilby, 1897b: 74.
Mugil oeur Ogilby, 1897: 74.

Diagnosis: D. IV+I, 8; A. III, 8; P. 16-17; V. I, 5; L.S. 37-41; Tr. S. 12-15; P.S. 20-21; G.R.: 83-160 (outer) and 90-171 (inner). Head length, 24-28%, head width, 16-18% of standard length. Adipose eyelid prominent, Lae/ed 3.2-4.1. No keel on back. Scales cycloid in young, becoming finely ctenoid with growth.

Scale ctenii cone shaped, in many rows. Pectoral axillary scale long. Lips thin, with a high symphysial knob, and 1-4 rows of labial teeth on lower lip and 1-6 rows of labial teeth on upper lip. These teeth are unicuspid on outer rows and bicuspid on inner rows. Preorbital bone slender, unnotched, filling only half the space between lip and eye. Color in fresh specimens, olive-green on back, silvery on sides, shading to white ventrally. Lateral side of body with 6 or 7 rows of obscure brownish running with the scale series. Fins are minutely dotted with black, forming a dusky appearance, except for the ventrals which are in pale yellowish color. Upper 1/2 of pectoral base with a blue blotch (Fig. 3). A golden ring around iris.

Liza affinis (Günther, 1861)

(Figs. 4 and 12)

Mugil affinis Günther, 1861: 433 (Type locality: Amoy, China).
Mugil carinatus (nec Valenciennes) Oshima 1919: 247.
Myxus profugus Mohr, 1927: 186. (Type locality: Japan and Formosa).
Liza haematocheilus (nec Temminck & Schlegel) Kamohara, 1957: 12.
Liza carinatus (nec Valenciennes) Chu *et al.*, 1963: 198; Kamohara and Yamakawa, 1967: 2.
Liza affinis Thomson, 1964: 3.
Liza carinatus carinatus (nec Valenciennes) Yoshino and Senou, 1984: 119.

Diagnosis: D. IV+I, 8; A. III, 9; P. 16-17; V. I, 5; L.S. 40-41; Tr. S. 11; P.S. 21-22; G.R.: 68-84 (outer) and 72-85 (inner). Head length, 25-27%, head width, 16-17% of standard length. Adipose eyelid well

developed. Lae/ed 1.7-2.2. With a keel on back. Scales ctenoid.

Scale ctenii cone shaped, in many rows. Pectoral axillary scale long. Lip thin, with a high symphysial knob and toothless on lower lip, and a row of primary teeth on upper lip. Preorbital bone, unnotched, filling the space between lip and eye. Color in fresh dark brown dorsally, white on sides and belly. Fins olive-green except for the ventrals which are in white color. Pectoral base colorless (Fig. 12).

Liza dussumieri (Cuvier & Valenciennes, 1836)

(Figs. 5 and 12)

Mugil dussumieri Cuvier & Valenciennes, 1836: 147 (Type locality: Bombay: Coramandel).
Mugil sundanensis Bleeler, 1853: 245.
Liza compressa Jordan and Seale, 1908: 17.
Mugil stevensi Ogilby, 1908: 17.
Mugil tadopsis Ogilby, 1908: 27.
Liza dussumieri, Thomson, 1964: 97.

Diagnosis: D. IV+I, 8; A. III, 9; P. 15; L.S. 28-29; Tr. S. 9; P.S. 17-19; G.R.: 90-97 (outer) and 92-101 (inner). Head length, 24-26%, head width, 15-19% of standard length. Adipose eyelid obsolescent, Lae/ed 0.9-1.0. No keel on back. Scales ctenoid.

Scale ctenii cone shaped, in many rows. Pectoral axillary scale absent. Lips thin, with a high symphysial knob and toothless on lower lip, and a row of labial teeth on upper lip. Teeth on the pterygoids and tongue but not on the vomer or palatines. Preorbital bone broad and strongly serrated, very slightly notched. Color of fresh specimens, greyish green postero-dorsally, brownish over head, silvery laterally shading to white ventrally, about 5-6 faint stripes along upper rows of scales. Dorsal fins greyish, ventrals white. Caudal dark bluish, black marginally. Pectorals yellowish, base colorless (Fig. 12), and without pigment. A slight golden segment on the upper part of the iris.

Liza macrolepis (Smith, 1846)

(Figs. 6-9)

Mugil macrolepsis Smith, 1846: 28 (Type locality: South Africa).
Mugil smithi Günther, 1861: 477.
Liza macrolepis, Smith and Heemstra, 1986: 716.

Diagnosis: D. IV+I, 8; A. III, 9; P. 16; V. I, 5; L.S. 30-34; Tr. S. 10; P.S. 19-21; G.R.: 97-117 (outer) and 190-117 (inner). Head length, 25-27%, head width, 17-19% of standard length. Adipose eyelid slight, Lae/ed 0.61-0.91. No keel on back. Scales finely ctenoid.

Scale ctenii cone shaped, in many rows. Without pectoral axillary scale. Lips thin, with a high symphysial knob and toothless on lower lip, and a row of peg-like labial teeth on upper lip. Teeth on vomer, pterygoid and tongue, none on palatines. Preorbital bone moderately wide, filling the space between lip and eye, notched anteriorly. Color in fresh specimens greenish grey dorsally, silvery on sides and belly. Dorsal fins greyish, ventrals off-white. Caudal dark bluish, black marginally. Pectoral yellowish, base golden colored (Fig. 8) and with special pigments (Fig. 9) aggregated together under epidermis. A golden ring around the iris.

Liza subviridis (Cuvier and Valenciennes, 1836)

(Figs. 10-12)

Mugil subviridis Cuvier and Valenciennes, 1836: 115 (Type locailty: Ganges, Northern India.
Mugil subviridis, Günther, 1859-1861: 423, 1867: 64.
Mugil subviridis, Day, 1865: 138.
Mugil alcocki Ogilby, 1908: 21.
Mugil subviridis, Max Weber, 1913: 138.
Liza subviridis, Thomson, 1983: FAO Liza 14.

Diagnosis: D. IV+I, 8; A. III, 9; P. 16; V. I, 5; L.S. 30-32; Tr. S. 10; P.S. 18-21;

G.R.: 90-99 (outer) and 103-120 (inner). Head length, 22-25%, head width, 16-17% of standard length. Adipose eyelid developed, Lae/ed 1.2-1.9. No keel on back. Scales ctenoid.

Scale ctenii with rows and cone shaped. Pectoral axillary scale rudimentary or absent. Lips thin, with a high symphysial knob and a row of villiform labial teeth on lower lip, and several rows of fine teeth on upper lip. Preorbital bone narrow, filling only 3/4 between lip and eye, anteriorly notched. Color in fresh, dark greenish on dorsally and white below, caudal fin edged with black. Pectoral base pale colored, with few pigment spots (about 50). A slight golden ring around the iris.

Liza alata (Steinderchner, 1892)

(Fig. 13)

Mugil alata Steindachner, 1892: 133 (Type locality: Madagascar).
Mugil diadema Gilchrist and Thompson, 1911: 42.
Pteromugil diadema Smith and Heemstra, 1986: 716.
Liza alata, Smith, 1975: 64.

Diagnosis: D. IV+I, 8; A. III, 9; P. 16; V. I, 5; L.S. 32-33; Tr. S. 10; P.S. 21; G.R.: 80 (outer) and 82 (inner). Head length, 24%, head width, 16% of standard length. Adipose eyelid obsolescent, Lae/ed 0.6-0.75. No keel on back. Scales ctenoid.

Scale ctenii with rows and cone shaped. Pectoral axillary scale absent. Lips thin, with a high symphysial knob and tooth-less on lower lip, and 3-5 rows of unicuspid labial teeth on the upper lip. Pterygoids and tongue with villiform teeth, vomers and palatines edentate. Preorbital bone wide, filling the space between lip and eye, slightly notched anteriorly. Color in fresh, dark greenish dorsally, silvery on sides and ventrally. Scale margins dark, especially dorsally, giving the dull grey body the characteristic reticulate ("diamond") appearance. Light brown dorsally, silvery laterally. Pectoral base with many pigment spots (more than 300). Fins greyish.

Oedalechilus labiosus (Valenciennes, 1836)

(Fig. 14)

Mugil labiosus Valenciennes, 1836: 7 (Type locality: Red Sea).
Oedalechilus labeo Fowler, 1904: 748.
Oedalechilus labiosus, Thomson, 1983: FAO Oedal. 1.

Diagnosis: D. IV+I, 8; A. III, 9; P. 17-18; V. I, 5; L.S. 33-36; Tr. S. 12; P.S. 18-20; G.S.; 62-71 (outer) and 66-74 (inner). Head length, 24-26%, head width, 18-19% of standard length. Adipose eyelid obsolescent, Lae/ed 0.3-0.36. No keel on back. Scales ctenoid.

Scale ctenii with rows and cone shaped. Without pectoral axillary scale. Lips toothless, with a low double symphysial knob and a single row of papillae on lower lip, and upper lip very thick, with 3-4 rows of papillae. No teeth on palatines, a few teeth on tongue. Preorbital bone wide, filling the space between lip and eye, deeply notched anteriorly. Color in fresh, olive-brown dorsally, silvery on sides and ventrally. Pectoral base colorless but with a dark spot on upper end (Fig. 16).

Valamugil cunnesius (Valenciennes, 1836)

(Figs. 15-16)

Mugil cunnesius Valenciennes, 1836: 114 (Type locality: Moluccas, Malabar, Bombay); Cantor, 1850: 1082; Günther, 1859-1861: 434; Klunzinger, 1884: 132; Ogilby, 1908: 26.
Valamugil cunnesius, Smith, 1975: 64.

Diagnosis: D. IV+I, 8; A. III, 9; P. 15-16; V. I, 5; L.S. 31-34; Tr. S. 11-12; P.S. 18-19; G.R.: 55-78 (outer) and 55-86 (inner). Head length, 25-28%, head width, 16-18% of standard length. Adipose eyelid developed, Lae/ed 1.8-2.2. No keel on back. Scales with weak ctenoid.

Scale ctenii plate shape, in a single row. Pectoral axillary scale long. Lips

thin, with a high symphysial knob and labial teeth on lower lip, and labial teeth on upper lip. These teeth are short and scattered on upper lip, long, ciliate and spaced on lower lip. No teeth on palatines but vomer, pterygoids and tongue dentate. Preorbital bone wide, filling the space between lip and eye, notched anteriorly but filling with age. Color in fresh, yellow-brown to dark grey dorsally, silvery ventrally. Pectoral fin yellow, with a dark blue spot on the upper end of the base (Fig. 16).

Valamugil formosae (Oshima, 1922)

(Figs. 16-17)

Mugil suppositus (nec Günther) Day, 1865: 143 (Type locality: Sea of Malabar and Malaysia).
Liza formosae Oshima 1922: 251 (Type locality: Anpin of Taiwan).
Valamugil formosae, Liu and Shen, 1990.

Diagnosis: D. IV+I, 8; A. III, 9; P. 16; V. I, 5; L. S. 34; Tr. S. 10; P. S. 20; G. R.: 104 (outer) and 95 (inner). Head length, 27%, head width, 17% of standard length. Adipose eyelid developed, Lae/ed 1.9. No keel on back. Scales with weak ctenoid.

Scale ctenii plate shape, in a single row. Pectoral axillary scale long. Lips thin and toothless, a high symphysial knob on lower lip. Preorbital bone slender, filling the space between the lip and eye, notched anteriorly. Color in fresh, dusky grey dorsally, silvery on sides and ventral. A dark blue spot on the upper end of the pectoral base (Fig. 16). First and second dorsal, caudal, anal and pectoral fins yellowish, ventral whitish.

Remarks: This species is endemic to southern Taiwan. In the year 1865 Francis Day described a small mullet *Mugil suppositus*. It is quite different from Günther's *M. suppositus* (1861). However, the characteristics of *Liza formosae* (Oshima, 1922) were identical to the description of Day's *Mugil suppositus*. This species has no generic characteristics of *Liza*, but shares many chacteristics of the genus *Valamugil*, for example, a dark blue spot on the upper end of the pectoral base, pectoral axillary scale long and scales with only one row ctenoid membrane, etc. Because of these shared characteristics we placed this species in the genus of *Valamugil*.

Crenimugil crenilabis (Forsskål 1775)

(Figs. 16 and 18)

Mugil crenilabis Forsskål, 1775: 14,73 (Type locality: Red Sea).
Mugil lauvergnii Eydoux and Souleyet, 1842: 174.
Mugil heterocheilos Bleeker, 1873: 143.
Mugil heterochilus Weber and de Beaufort, 1922: 258.
Mugil ruppellii Günther, 1861: 458.
Mugil crenilabris, Kner, 1865: 229.
Mugil neocaledonicus Castelnau, 1873: 116.
Querimana crenilabis Jordan and Scale, 1906: 218.
Liza crenilabis Kendall and Goldsborough, 1911: 258.
Chelon crenilabis Oshima, 1922: 257.
Oedalechilus cirrhostomus Whitley, 1941: 19.
Crenimugil crenilabis, Schultz, 1946: 387.

Diagnosis: D. IV+I, 8; A. III, 9; P. 16; V. I, 5; L. S. 38-39; Tr. S. 12; P. S. 21-24; G. R.: 81-90 (outer) and 88-120 (inner). Head length, 25-29% of standard length. Adipose eyelid developed, Lae/ed 1.4-2.5. No keel on back. Scales with weak ctenoid.

Scale ctenii plate shape, in a single row. Pectoral axillary scale long; Lips thick and toothless, with a high symphysial knob and 1-10 rows of papillae (the first appearing at about 7 cm S. L.) on lower lip. Teeth on palatines and small patches on the tongue, but none on the vomers or pterygoids. Preorbital bone narrow, filling the space between the lip and eye, slightly notched anteriorly in young, unnotched in adults. Fresh specimens olive-green dorsally, white on sides and belly. Pectoral fin yellowish, with a dark blue spot on the upper end

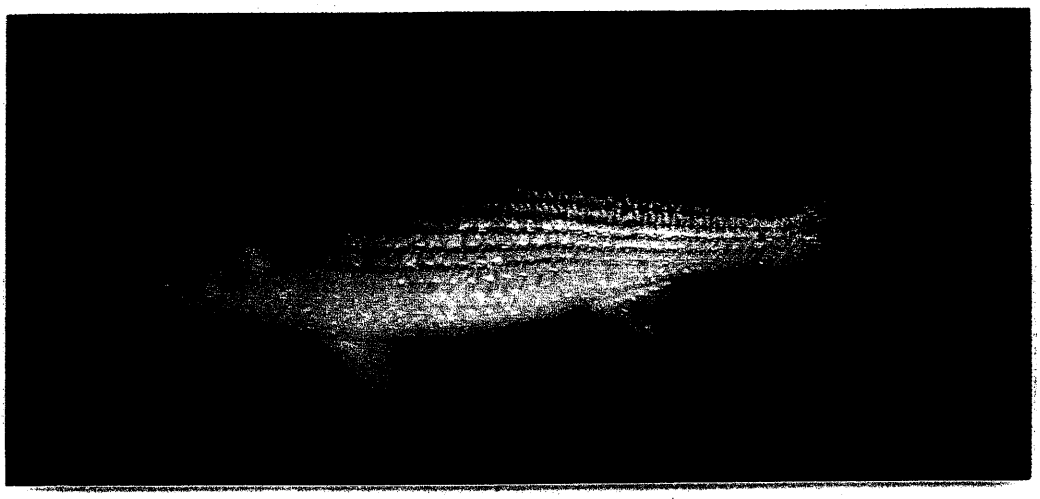

Fig. 2. *Mugil cephalus* S. L. 427 mm).

Fig. 3. *Mugil cephalus*, its upper 1/2 pectoral base with a blue blotch.

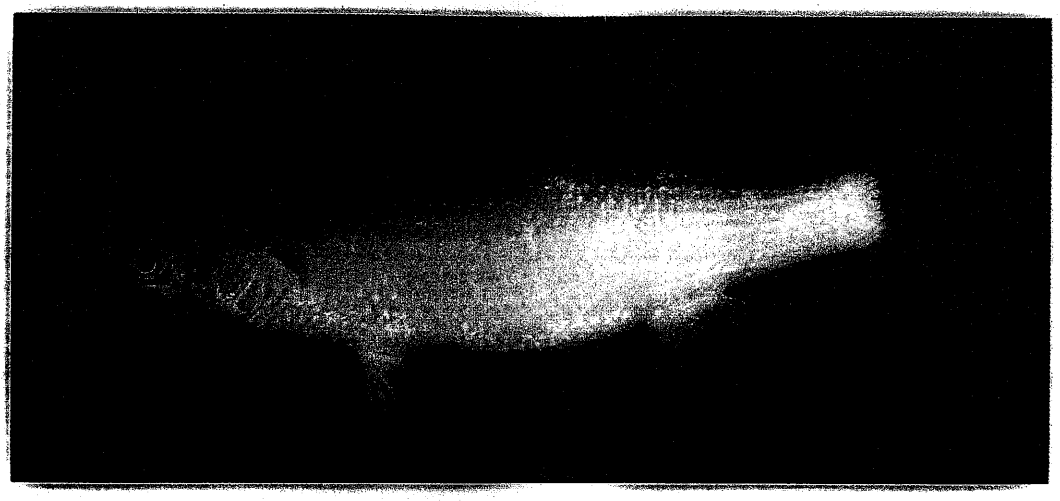

Fig. 4. *Liza affinis* (S. L. 170 mm).

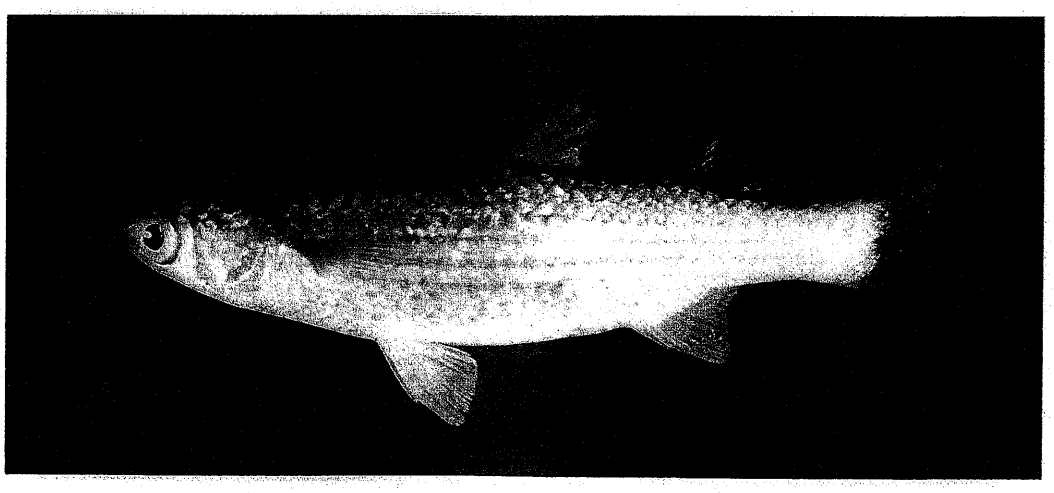

Fig. 5. *Liza dussumieri* (S. L. 181 mm).

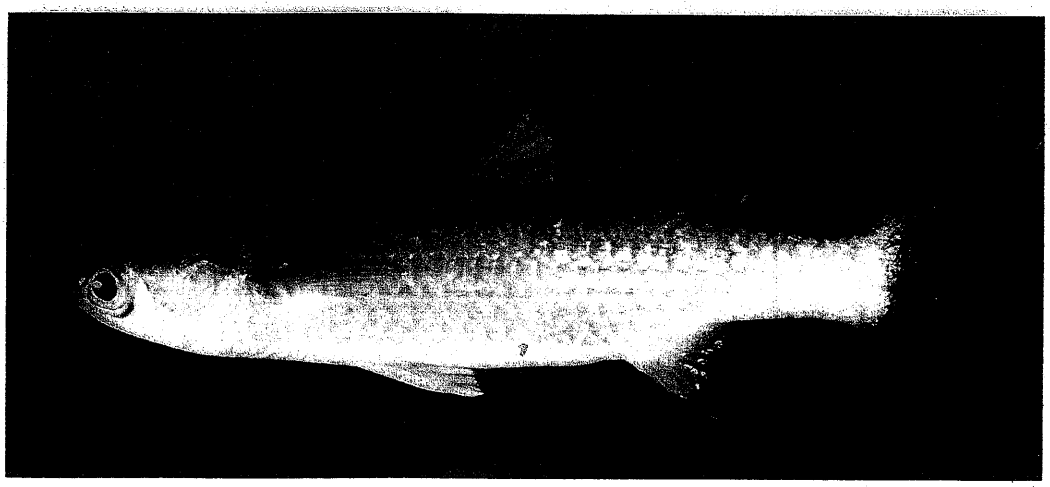

Fig. 6. *Liza macrolepis* (S. L. 176 mm).

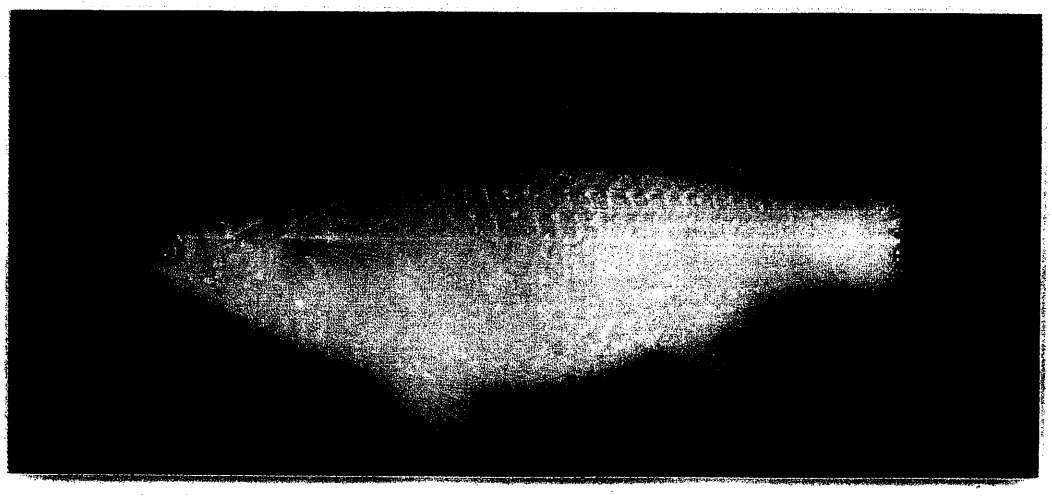

Fig. 7. *Liza macrolepis* (S.L. 190 mm female).

Fig. 8. Golden colored pectoral base of *Liza macrolepis*.

Fig. 9. Pectoral base with special pigments (under microscope 40 * 5), *Liza macrolepis.*

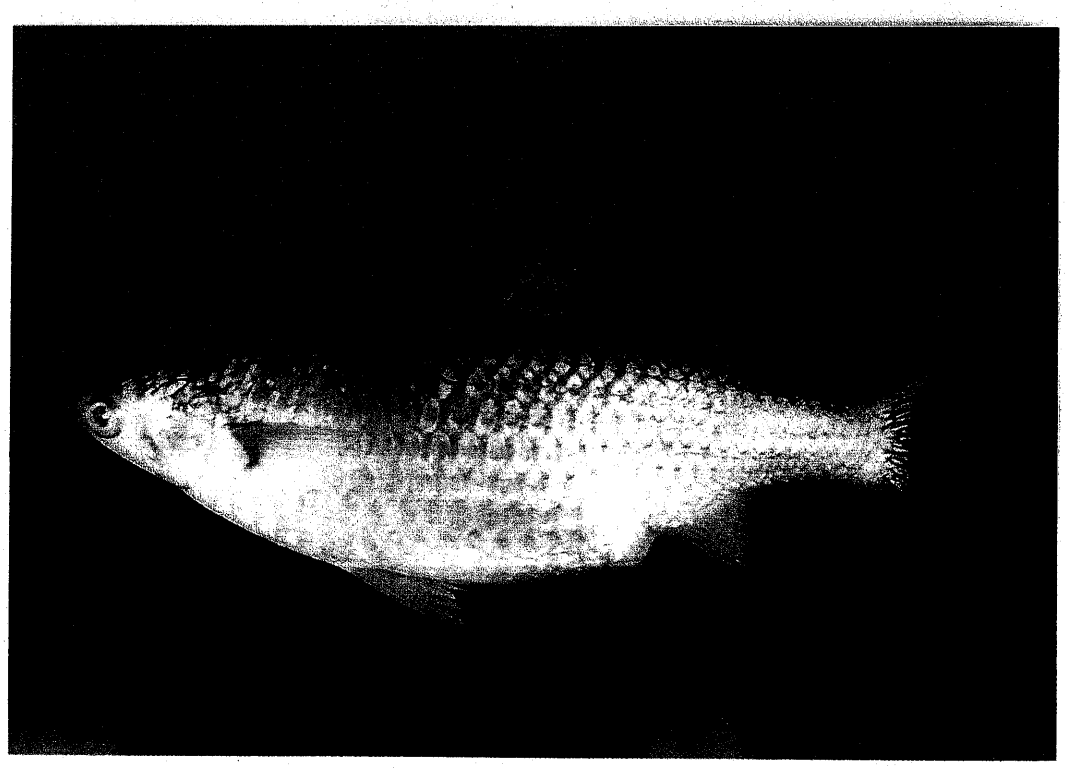

Fig. 10. *Liza subviridis* (S. L. 226 mm female).

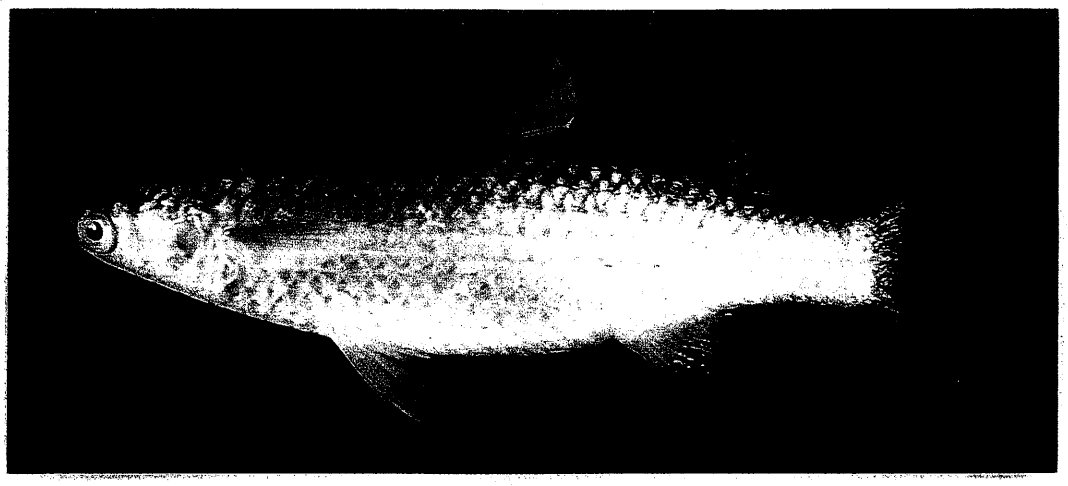

Fig. 11. *Liza subviridis* (S. L. 220 mm).

Fig. 12. Pale colored pectoral base, *Liza subviridis*.

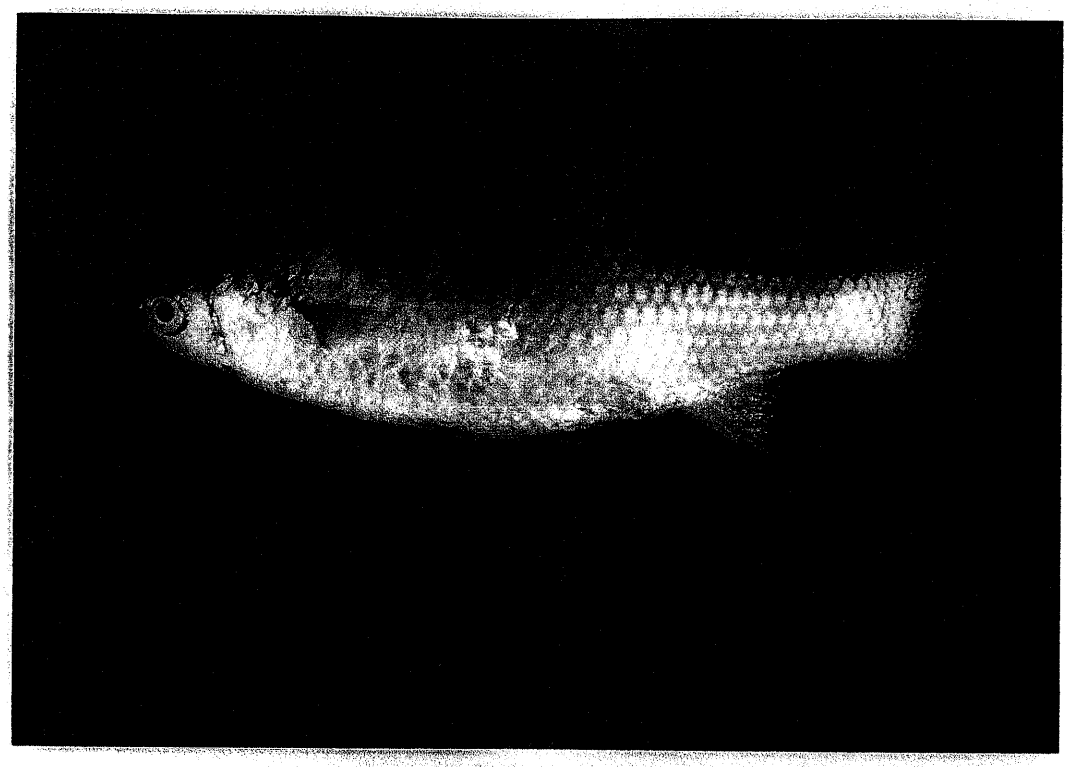

Fig. 13. *Liza alata* (S. L. 196 mm).

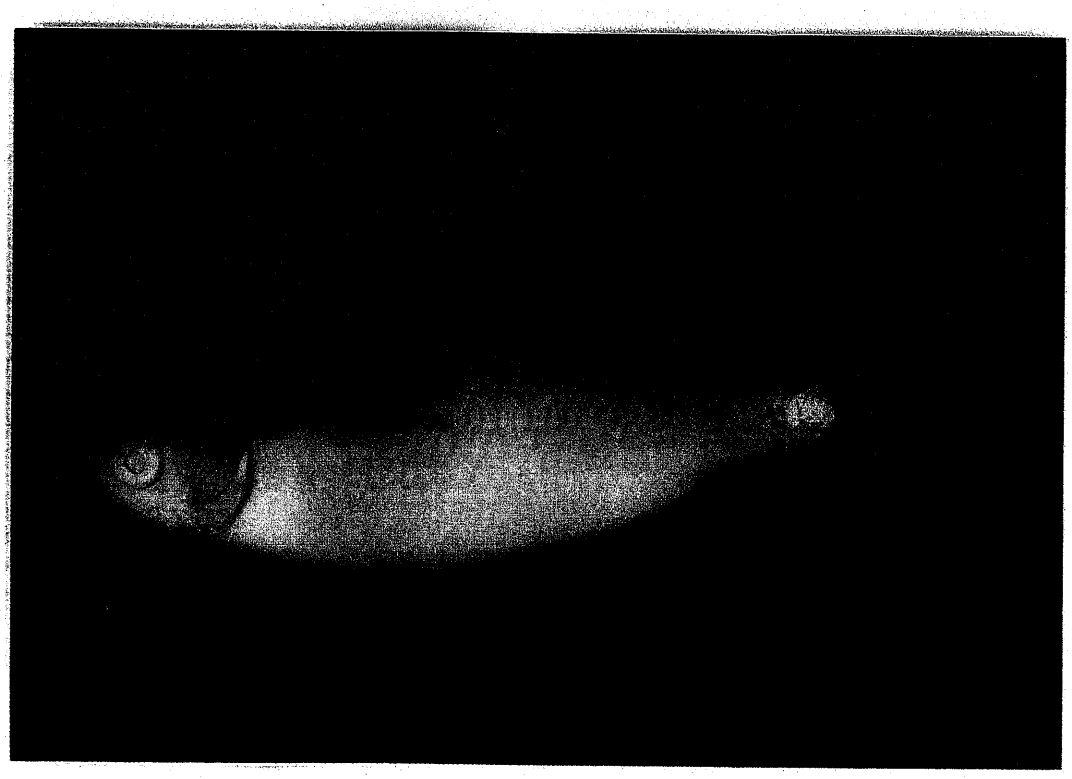

Fig. 14. *Oedalechilus labiosus* (S. L. 153 mm).

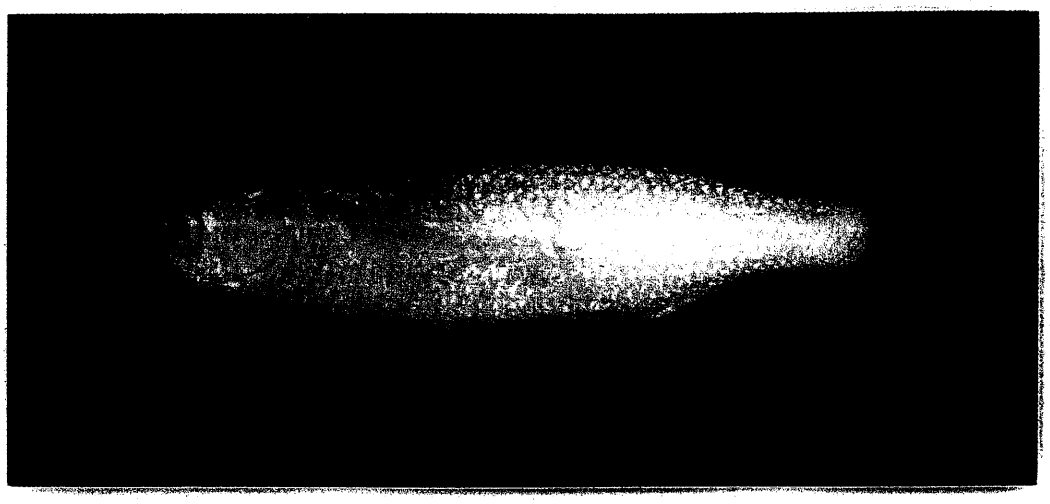

Fig. 15. *Valamugil cunnesius* (S.L. 154 mm).

Fig. 16. Upper end of pectoral base with a dark blue spot, *Valamugil cunnesius*.

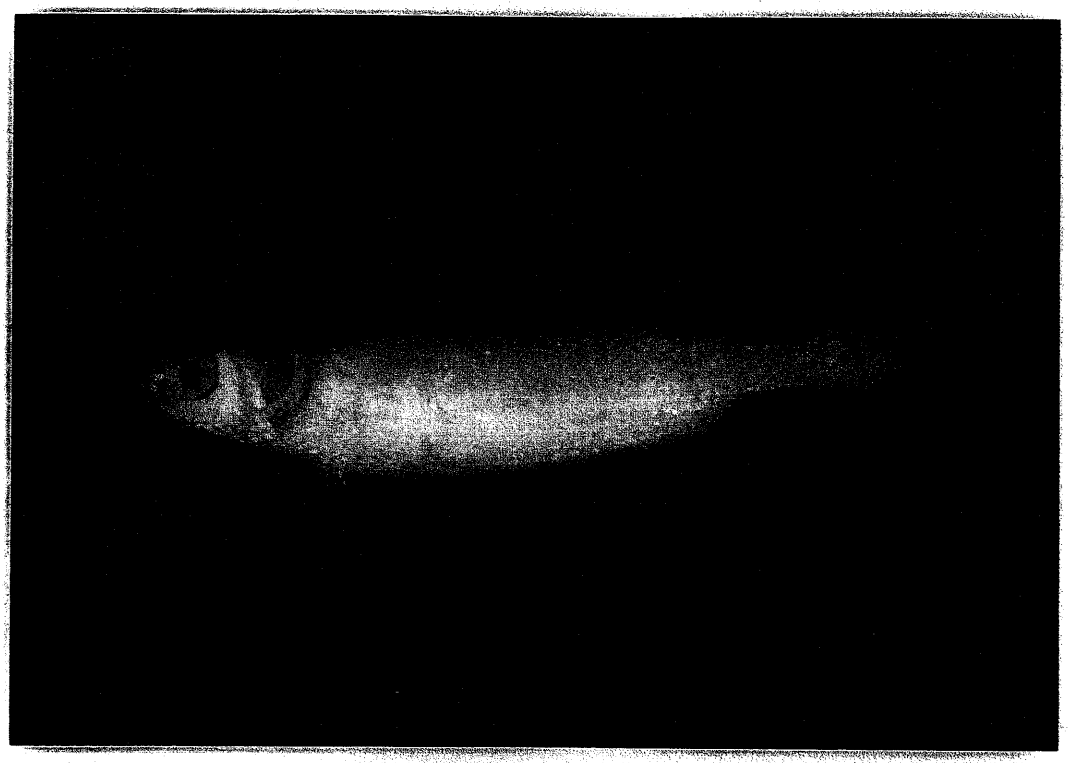

Fig. 17. *Valamugil formosae* (S. L. 142 mm).

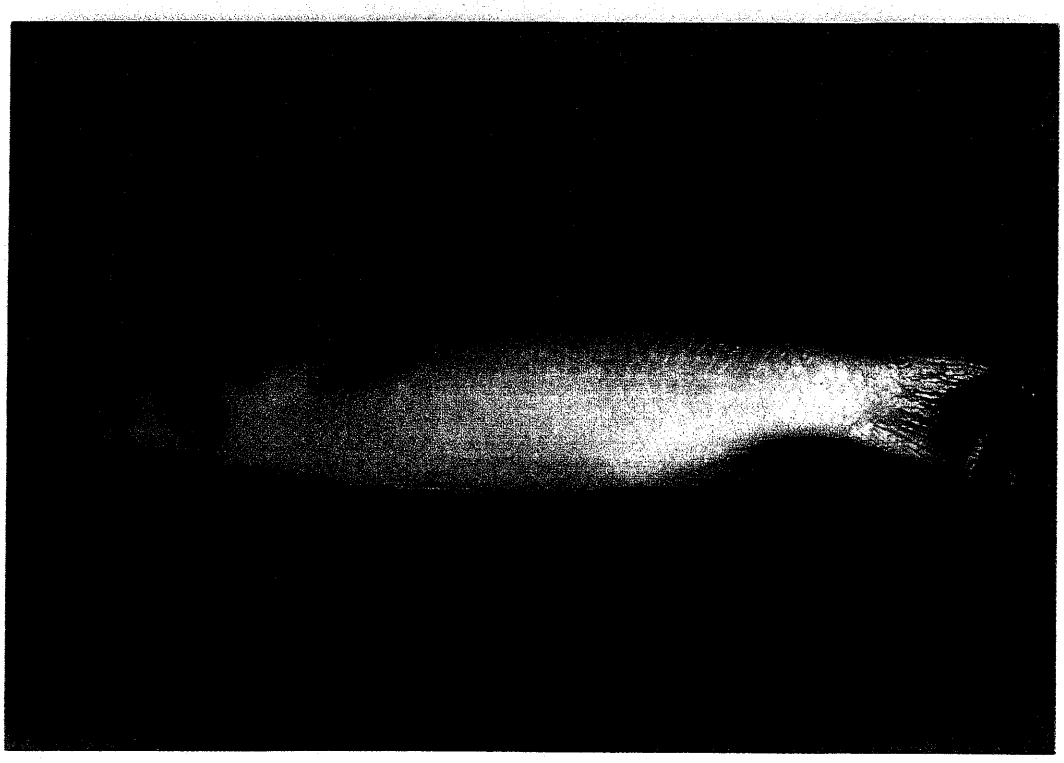

Fig. 18. *Crenimugil crenilabis* (S. L. 131 mm).

of the base (Fig. 16), other fins pale yellow.

Remarks: This species mostly inhabits the shallow coastal waters, and seems to not enter rivers like other mullet species reported in the present paper.

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臺灣的鯔科魚類

劉振鄉　沈世傑

臺灣之鯔科魚類最早的報告是大島正滿 (1919–1922)，共記錄 11 種；其中除去日本鯔是鯔的同種異名，澎湖鯧、少鯧是大鱗鯧的同種異名，合計爲 8 種，後來陳 (1969) 的記錄爲 13 種，隨後于 (1986) 記錄增爲 16 種，由於缺乏採集記錄，而無從查證，因此本研究自 1982 年起至 1990 年，重新採集標本，經整理結果共計 5 屬 10 種：鯔 (*Mugil cephalus*)、前鱗鯧 (*Liza affinis*)、粗鱗鯧 (*L. dussumieri*)、大鱗鯧 (*L. macrolepis*)、白鯧 (*L. subviridis*)、竹筒鯧 (*Liza alata*)、瘤唇鯔 (*Oedalechilus labiosus*)、粒唇鯔 (*Crenimugil crenilabis*)、臺灣凡鯔 (*Valamugil formosae*)、長鰭凡鯔 (*Valamugil cunnesius*) 等，比大島正滿的記錄多出三種，其中的白鯧、瘤唇鯔及竹筒鯧爲新記錄種，而臺灣凡鯔爲臺灣南部之特有種。