

A Revision of the Family Engraulidae (Pisces) from Taiwan

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Shuh-Sen Young, Tai-Sheng Chiu and Shih-Chieh Shen (1994) A revision of the family Engraulidae (Pisces) from Taiwan. *Zoological Studies* 33(3): 217-227. Twelve species, belonging to five genera, have been found in the coastal waters around Taiwan. They are: *Engraulis japonica*, *Encrasicholina punctifer*, *E. heteroloba*, *Stolephorus commersonii*, *S. indicus*, *S. insularis*, *S. waitei*, *Setipinna tenuifilis*, *Thryssa chefuensis*, *T. dussumieri*, *T. hamiltonii* and *T. setirostris*. This record of *Stolephorus waitei* is the first in Taiwan. Misidentifications of *Setipinna taty* and *Thryssa kammalensis* previously are corrected as *Setipinna tenuifilis* and *Thryssa chefuensis*, respectively. The identification key, diagnostic characteristics, synonyms, and detailed illustration of the engraulid species are presented.

Key words: Anchovies, Fish taxonomy, Herringlike fishes.

The members of Engraulidae, commonly known as anchovies or engraulid, are small to moderate-sized fishes in suborder Clupeoidei, characterized by having a common prominent snout overhanging the mouth. Sixteen genera and 139 species have been identified around the world (Nelson 1984). Engraulid fish ranges widely from 60°N to 50°S. Primarily, this family includes marine coastal species with schooling behavior. Some species penetrate into brackish water while most species dwell in seawater permanently (FAO 1988).

Twelve anchovies species in Taiwan were reported by Shen (1959), i.e., *Engraulis japonica*, *Setipinna taty*, *Stolephorus zollingeri* (= *Encrasicholina punctifer*), *S. pseudoheterolobus* (= *Encrasicholina heteroloba*), *S. tri*, *S. commersonii*, *S. indicus*, *Thryssa* (= *Thryssa*) *dussumieri*, *T. setirostris*, *T. kammalensis* and *T. hamiltonii*. Shen (1984) categorizes 15 species to the family Engraulidae and amended the following species: replaced *S. zollingeri* with *S. punctifer*, *S. pseudoheterolobus* with *S. heterolobus*, and *S. insularis* with *S. bataviensis*, substituted genus name *Thryssa* with *Thryssa* and subjoined *T. mystax*, *Coilia mystus* and *C. grayii*. These fifteen species of Shen (1984), were recognized by Chen and Yu (1986). However, *S. pseudoheterolobus* (not *S. heterolobus*,

treated as a separate species) and *Thryssa baelama* were listed as Engraulidae. Additionally *Thryssa* was replaced by *Thryssocles*.

Engraulidae are abundant along the Indo-Pacific coast. The most recent comprehensive Engraulidae classification was undertaken by Wongratana (1980). After examining specimens from around the world, Wongratana (1980) was able to clear up many nomenclatural questions and to correct documented misidentification which had previously been based on limited material. He described 11 new species of Engraulidae (Wongratana 1983) and provided keys to the species of *Engraulis*, *Encrasicholina*, and *Stolephorus* (Wongratana 1987). A survey of literature concludes that 14 engraulid species are potentially distributed to the waters around Taiwan: *Engraulis japonica*, *Encrasicholina punctifer*, *E. heteroloba*, *E. devise*, *Setipinna tenuifilis*, *Stolephorus commersonii*, *S. indicus*, *S. chensis*, *S. insularis*, *Thryssa chefuensis*, *T. adalae*, *T. dussumieri*, *T. hamiltonii*, and *T. setirostris* (Shen 1959 1984, Wongratana 1980, FAO 1988). In addition, three species of *Coilia* (*C. grayii*; *C. mystus* and *C. nasus*) are present in the coastal waters of China, in both brackish water and freshwater areas; but, these fishes have not been located in the waters of Taiwan.

Herring-like fishes, especially engraulid, are

heavily utilized in the waters around Taiwan. The general biology of three major species, *Engraulis japonica*, *Encrasicholina punctifer* and *Encrasicholina heteroloba*, are relevant realized (Shen 1969 1971, Chen 1979 1980 1984 1986 1987 1989, Chen and Jean 1982, Young et al. 1992). However, knowledge of classification and distribution of engraulid is relative limited. We conducted a general survey of engraulid specimens from the waters around Taiwan. The current status of engraulid classification stands revised as foundation for further taxonomic, fishery, and biological investigations.

MATERIALS AND METHODS

Most specimens, 284 examined and 166 measured, were collected fresh from the coastal water of Taiwan and currently are deposited in the Economic Fish Laboratory, Department of Zoology, National Taiwan University. The other 242 specimens catalogued in the Museum of Department of Zoology, National Taiwan University (NTUM) were also checked.

Pigmentation and external morphology were observed on fresh specimens. Formalin preserved specimens were used as reference. Counts and measurements were obtained in accordance with those proposed by Hubbs and Lagler (1964), Shen (1959), and Wongratana (1983 1987), with minor modification. Small specimens were examined under binocular microscope. Vertebrae and fin ray counts were performed on the cleared-and-stained specimens; the Potthoff (1984) clear and stain method was used. The abbreviations for meristic and morphometric characteristics are: SL — standard length, D — dorsal fin ray, A — Anal fin ray, P — pectoral fin ray, V — pelvic fin ray, VERT — vertebrae, PRS — Pre-pelvic keeled scute, PS — pelvic scute, POS — Post-pelvic keeled scute, GR — 1st gillraker, UGR — 1st upper gillraker, LGR — 1st lower gillraker, PDS — pre-dorsal spine, PCV — precaudal vertebrae, CV — caudal vertebrae, IH — inter-haemal spine, SD — length from snout to dorsal fin origin, DB — length of dorsal fin base, POD — length from dorsal fin posterior to last haemal vertebra, POA — length from anal fin posterior to last haemal vertebra, AB — length of anal fin base, PA — length from pectoral fin to anal fin origin, SV — length from snout to pelvic fin base, SP — length from snout to pectoral fin base, SA — length from snout to anal fin origin, BH — body height at the first dorsal

fin ray, and DA — length from origin of dorsal fin to origin of anal fin (Fig. 1).

RESULTS AND DISCUSSION

Twelve engraulid species from the coastal waters of Taiwan have been assigned to five genera. Those genera include *Engraulis*, *Stolephorus*, *Setipinna* and *Thryssa* (Shen 1984); and the addition of *Encrasicholina*. Two species, assigned to *Stolephorus* previously, now constitute the genus of *Encrasicholina* (Nelson 1983), i.e. *S. punctifer*=*E. punctifer* and *S. heterolobus*=*E. heteroloba*. Nelson (1983) made this proposal based on the morphology of the sensory canal system and urohyal structure. Given no further phylogenetic analysis, the proposed genus name *Encrasicholina* is adopted in this study. *Setipinna taty* mentioned by Shen (1959 1984) and Chen and Yu (1986) is considered to be misidentified from *Setipinna tenuifilis*. *Thryssa kammalensis* also noted by Shen (1959 1984) should be identified as *Thryssa chefuensis*. Three species described by Shen in 1984 but not in his 1959 work; *Thryssa mystax*, *Coilia mystus*, and *Coilia grayii*, are no longer considered indigenous to Taiwan. The change of the genus name *Thryssa* to *Thrissocles* by Chen and Yu (1986) should be regarded as invalid. The distribution charts worked out by Wongratana (1983) should be revised so that *Stolephorus commeronii* and *Stolephorus waitei* extend to the Taiwan coast. *Encrasicholina devise*, possibly indigenous to Taiwan, is not found in this study.

Key to genera and species

- 1a. Anal fin ray less than or equal to 22, postpelvic scutes absent 2
- 1b. Anal fin ray more than 22, postpelvic scutes present 8
- 2a. Prepelvic scutes absent, anal fin originates well behind last dorsal fin ray (*Engraulis*) *Engraulis japonica*

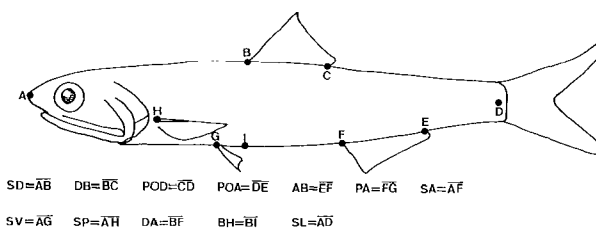


Fig. 1. Diagram for morphometric measurements.

- 2b. Prepelvic scutes present, anal fin originates vertically before or slightly behind base of last dorsal fin ray 3
- 3a. Anal fin usually originates vertically behind the base of 11th dorsal fin ray, muscular portion of isthmus terminates a short distance behind border of branchiostegal membrane, urohyal partially exposed, pyloric caeca usually darkish—(*Encrasicholina*) 4
- 3b. Anal fin usually originates before base of 12th dorsal fin ray, isthmus entirely formed by muscle, urohyal unexposed, pyloric caeca pale—(*Stolephorus*) 5
- 4a. Maxilla pointed posteriorly, clearly projects beyond the 2nd supramaxilla, reaching the margin of preoperculum, bony urohyal plate, anal fin rays 18-20 the origin commences below the base of 12th dorsal fin ray slightly behind the base of the dorsal fin; posterior frontal frontanelles more or less sigmoid or triangular in shape, vertebrae 20-23 + 19-20 *Encrasicholina heteroloba*
- 4b. Maxilla blunt rounded posteriorly, scarcely project beyond the 2nd supramaxilla, but not to anterior border of preoperculum, urohyal plate fleshy knob, anal fin rays 14-16, with origin clearly behind dorsal fin base, posterior frontal frontanelles more or less oval in shape; vertebrae 24-25 + 17-18 *Encrasicholina punctifer*
- 5a. Posteroventral edge of preoperculum concave, roof of mouth dotted darkish, a small patch of dark spots just behind occipital, double pigmented line along dorsal midline posterior to dorsal fin *Stolephorus insularis*
- 5b. Posteroventral edge of preoperculum convex, roof of mouth plain, a large patch of dense dark spots just behind the occipital, no pigmented line along dorsal midline 6
- 6a. Maxillary tip reaches a short distance before or slightly behind anterior margin of preoperculum *Stolephorus indicus*
- 6b. Maxillary tip reaches well beyond anterior margin of preoperculum 7
- 7a. Pelvic fin tip terminates below base of 1st to 4th dorsal fin ray, palatine and pterygoid teeth weakly developed, epibranchial gill raker no tooth knob, tip of lower jaw and upper jaw below eye not heavily pigmented *Stolephorus commersonii*
- 7b. Pelvic fin tip terminates a quarter of eye diameter vertically before dorsal fin origin, palatine and pterygoid teeth fairly well developed, epibranchial gill raker with tooth knob, tip of lower jaw and upper jaw below eye heavily pigmented *Stolephorus waitei*
- 8a. Upper pectoral fin ray with filament extend to anal fin base, supramaxilla present *Setipinna tenuifilis*
- 8b. Upper pectoral fin ray not extended as filament, supramaxilla absent 9
- 9a. Maxilla short not reaching posterior margin of preoperculum *Thryssa chefuensis*
- 9b. Maxilla long, extend over gill opening 10
- 10a. Maxilla over gill opening, do not reach pectoral fin base *Thryssa hamiltonii*
- 10b. Maxilla reach pectoral fin base 11
- 11a. Maxilla reach pectoral fin, not beyond pectoral fin, lower gill rakers 16-19, abdominal scute 21-24 *Thryssa dussumieri*
- 11b. Maxilla reach pectoral fin, sometimes over anal fin, lower gill rakers 10-12, abdominal scute 25-26 *Thryssa setirostris*

Identification of engraulid species from Taiwan is feasible based on meristic and morphometric characteristics (Tables 1, 2). In short, monotypic genera of *Engraulis* and *Setipinna* are readily separated by PRS and CV characteristics. Further separation of *Thryssa* is possible based on higher PRS counts. More care is needed to discriminate *Encrasicholina* and *Stolephorus*; however, other qualifiable key characteristics are reading available (see Key to genera and species).

Engraulis japonica Temminck and Schlegel (Fig. 2)

Engraulis japonica Temminck and Schlegel, 1846: 239 (Japan).
Stolephorus celebicus: Hardenberg, 1933: 262.
Engraulis japonica: Fowler, 1941: 649, Hayashi, 1961: 145, Hayashi and Tadokoro, 1962: 30, Hayashi, 1967: 44, Shen, 1959: 21 and 1984: 97.

Materials: NTUM06443, 91-105 mm SL, Apr. 8, 1978, Tachi, NTUM01849, 60-82 mm SL, Dec. 27, 1972, Penghu, NTUM08300, 90-97 mm SL, Mar. 9, 1992, Ilan, NTUM08301, 34-45 mm SL, May. 12, 1991, Ilan.

Diagnosis: D iii + 12-14, A iii + 15-18, P 15-17, V 7, GR. 21-24 + 36-42, VERT 25-27 + 18-20. Body slender, rather round belly. Snout very prominent and pointed. Mouth large. Maxillary tip rounded ending slightly behind the mandibular, does not reach preoperculum. Dorsal fin origin behind origin of pelvic fin. Anal fin short, origin far behind dorsal end. Scales thin, deciduous. No abdominal scute.

Coloration: In fresh specimens, brown dorsally, head to tip of snout. Abdominal silvery white. Young stage has silver banding lateral.

Distribution: Most of Taiwan strait and north of Hualien in the east.

Remark: Two forms of *E. japonica* are found. Normal form: slender, black body with deeper color on dorsal, located in the northern coast of Taiwan from February to May. Local form: hatched during spring, growth in coastal waters of Taiwan is characterized by round body shape, pale color dorsally and silver stripe laterally.

Encrasicholina heteroloba (Rüppell) (Fig. 3)

Engraulis heteroloba Rüppell, 1837: 79 (Massawa, Red Sea).
Encrasicholina heteroloba: Nelson, 1983: 53.
Stolephorus pseudoheterolobus: Hardenberg, 1933: 261, Shen, 1959: 30, Chen and Yu, 1986: 274.
Anchoviella heteroloba: Fowler, 1941: 698.
Stolephorus heterolobus: Whitehead, 1965: 266, 1969: 294, Tiews, Ronquillo and Santos, 1975: 95, Wongratana, 1980: 226, Shen 1984: 97, Chen and Yu 1986: 273.

Table 1. Meristic characteristics for engraulid species

Species	N	SL	D	A	P	V	PRS	PS
<i>Engraulis japonica</i>	48	34-100.3	3,12-14(13)	3,15-18(16)	15-17(16)	7	0	0
<i>Encrasicholina heteroloba</i>	34	31.8-68.2	3,11-13(12)	3,15-17(16)	13-15(14)	7	4-6(5)	0
<i>E. punctifer</i>	22	39.3-66.6	2,11-12(11)	2,12-14(13)	14-16(16)	7	4-6(4)	0
<i>Stolephorus commersonii</i>	6	83.9-90.9	3,12-13(13)	3,17-19(18)	13-14(13)	7	3-4(4)	0
<i>S. indicus</i>	18	36.2-116.2	3,13(13)	3,16-17(17)	14(14)	7	3-6(4)	0
<i>S. insularis</i>	53	26.1-46.3	3,11-14(13)	3,16-19(18)	12-13(12)	7	5-7(6)	0
<i>S. waitei</i>	14	68.1-75.4	3,12-14(13)	3,16-19(19)	13-14(14)	7	5-7(6)	0
<i>S. tenuifilis</i>	4	108.4-144.1	3,10-12(11)	4,48-51(48)	12-13(12)	7	17-19(19)	1
<i>Thryssa chefuensis</i>	46	37.7-56.0	3,11-13(11)	4,25-29(27)	12-14(13)	7	14-16(15)	1
<i>T. dussumieri</i>	21	61.4-98.6	3,9-12(11)	4,30-37(34)	11-12(11)	7	13-16(14)	1
<i>T. hamiltonii</i>	14	34.5-100.5	3,11-12(11)	4,33-40(36)	12-13(13)	7	15-18(17)	1
<i>T. setirostris</i>	4	79.5-121.4	3,11-12(11)	4,32-37(35)	13-14(13)	7	17	1

Species	POS	UGR	LGR	PDS	PCV	CV	IH
<i>E. japonica</i>	0	21-24(32)	36-42(38)	0	25-27(26)	18-20(19)	11-13(12)
<i>E. heteroloba</i>	0	20-23(21)	23-27(24)	0	20-23(22)	19-20(20)	8-9(8)
<i>E. punctifer</i>	0	15-18(17)	23-27(24)	0	24-25(24)	17-18(18)	9-10(9)
<i>S. commersonii</i>	0	21-23(21)	26-28(27)	0	20	19	8
<i>S. indicus</i>	0	16-20(18)	22-25(23)	0	20-21(20)	20-21(21)	8-9(9)
<i>S. insularis</i>	0	16-19(18)	22-26(24)	1	19-21(20)	19-21(20)	8-9(8)
<i>S. waitei</i>	0	15-18(16)	21-24(22)	0	19-20(20)	19-20(19)	8-9(8)
<i>S. tenuifilis</i>	7	10-11(11)	16-17(16)	1	15	31	11
<i>T. chefuensis</i>	8-10(9)	21-24(23)	26-30(28)	1	16-18(17)	23-25(24)	7-8(7)
<i>T. dussumieri</i>	6-9(7)	13-15(14)	16-19(18)	1	17-19(18)	23-24(23)	7
<i>T. hamiltonii</i>	10-12(11)	9-10(9)	14	1	19-21(20)	25-27(26)	7
<i>T. setirostris</i>	7-8(8)	5-6(6)	10-12(11)	1	20	25	8-10(9)

SL — Standard length, D — Dorsal fin ray(unbranched, branched) by formula of lower counts-upper counts, A — Anal fin ray(u,b), P — Pectoral fin ray, V — Pelvic fin ray, PRS — Pre-pelvic keeled scute, PS — pelvic scute, POS — Post-pelvic keeled scute, UGR — 1st upper gillraker, LGR — 1st lower gillraker, PDS — pre-dorsal spine, PCV — precaudal vertebra, CV — caudal vertebra, IH — inter-haemal spine.

Table 2. Morphometric characteristics for engraulid species

Species	N	SL	SD	DB	POD	POA	AB	PA	SV	SP	SA	BH	DA
<i>Engraulis japonica</i>	28	41.5-100.3	53.9	12.1	35.1	12.9	15.1	21.1	52.0	30.7	72.9	15.4	23.7
<i>Encrasicholina heteroloba</i>	20	54.8-69.7	54.1	11.4	36.4	18.5	16.8	19.1	47.5	28.6	66.2	17.7	21.8
<i>E. punctifer</i>	17	43.8-66.7	53.3	11.5	36.7	18.2	14.2	22.0	47.0	25.2	68.7	16.2	22.0
<i>Stolephorus commersonii</i>	6	83.9-90.9	55.0	15.8	33.1	18.7	19.1	19.2	46.4	26.4	64.7	21.2	22.7
<i>S. indicus</i>	14	39.9-156.7	57.4	14.5	30.3	19.2	16.6	19.3	46.2	26.8	64.8	19.0	20.2
<i>S. insularis</i>	17	39.3-44.8	56.6	15.2	30.4	17.5	20.0	19.0	45.4	26.0	64.3	20.6	21.4
<i>S. waitei</i>	10	68.1-75.4	57.2	15.2	30.1	17.2	19.3	18.9	45.6	27.3	64.2	20.8	22.1
<i>S. tenuifilis</i>	4	15.2-129.3	53.6	10.1	46.6	5.9	46.9	16.9	37.7	23.5	51.3	31.4	31.4
<i>Thryssa chefuensis</i>	17	39.8-89.5	53.7	11.1	37.2	7.7	25.1	21.5	50.1	32.2	70.7	23.8	28.0
<i>T. dussumieri</i>	16	74.5-98.6	52.1	12.3	41.0	7.2	31.5	19.5	46.0	28.9	64.7	28.7	29.7
<i>T. hamiltonii</i>	14	35.3-100.9	54.5	9.1	38.6	7.6	33.5	20.4	43.7	27.9	63.0	25.3	25.5
<i>T. setirostris</i>	3	79.5-112.6	53.7	13.4	38.4	7.7	34.4	21.1	44.6	26.0	64.0	27.1	27.6

N — sample size, SL — standard length, SD — length from snout to dorsal fin origin, DB — length of dorsal fin base, POD — length from dorsal fin posterior to last haemal vertebra, POA — length from anal fin posterior to last haemal vertebra, AB — length of anal fin base, PA — length from pectoral fin to anal fin origin, SV — length from snout to pelvic fin base, SP — length from snout to pectoral fin base, SA — length from snout to anal fin origin, BH — body high at the first dorsal fin ray, DA — length from origin of dorsal fin to origin of anal fin.

Materials: NTUM02144, 66-71 mm SL, Oct. 27, 1962, Chinshan, NTUM03566 and 03567, 61-85 mm SL, Jul. 24, 1979, Tongkang, NTUM03568, 55 mm SL, Apr. 24, 1979, Tachi, NTUM01885, 65-81 mm SL, Oct. 26, 1972, Tongkang, NTUM01886, 68-80 mm SL, Sep. 8, 1971, Tachi, NTUM01844, 45-66 mm SL, Aug. 17, 1971, Chinchuan, NTUM01887, 45-78 mm SL, Oct. 20, 1971, Tongkang, NTUM01920, 66 mm SL, Oct. 13, 1972, Tongkang, NTUM08302, 59-64 mm SL, Aug. 4, 1991, Suao, NTUM08303, 32-38 mm SL, Dec. 30, 1990, Wangkun.

Diagnosis: D iii + 11-13, A iii + 15-17, P 13-15, V 7, GR 20-23 + 23-27, VERT 20-23 + 19-20. Body slender. Snout pointed prominently. Mouth large. Maxillary tip pointed, projecting beyond second supra-maxilla, reaches the sub-operculum. No enlarged and curved serration on ventral edge of maxillary tip. Dorsal fin origin behind origin of pelvic fin. Anal fin short, origin right after end of dorsal fin. Scales thin, deciduous. Pre-pelvic abdominal scute 4-6.

Coloration: In fresh specimens, body color

yellowish below, a little grayish on back, a light silvery later band on sides.

Distribution: Waters around Taiwan.

Remark: *E. heteroloba* (= *S. pseudoheteroloba*, Shen (1959), *S. heterolobus*, Shen (1984), and *S. heterolobus*, Chen and Yu (1986)). This species is characterized by having 3 first unbranched dorsal and anal rays. The first tiny ray may not be seen in un-treated specimens. It might be confused with *E. devisi* which also has three unbranched rays on dorsal and anal fins. Other characteristics are basically similar to the congeneric species of *E. heteroloba*.

Encrasicholina punctifer Fowler

(Fig. 4)

Encrasicholina punctifer Fowler, 1938: 158 (Fare Bay, Society Island).

Stolephorus zollingeri: Weber and de Beaufort, 1913: 44, Hardenberg, 1933: 326, Shen, 1959: 29, Hayashi and Tadokoro, 1962: 26.

Stolephorus buccaneeri: Strasburg, 1960: 396, Whitehead, 1965: 268, 1968: 17, Ozawa and Tsukuhara, 1973: 151, Tiews, Ronquillo and Santos, 1970: 97, Wongratana, 1980: 224, Chen and Yu 1986: 275.

Stolephorus punctifer: Lewis, Smith and Ellway, 1983: 16, Shen, 1984: 97.

Materials: NTUM01910, 65-82 mm SL, Dec. 17, 1972, Chinshan, NTUM01889, 35-48 mm SL, Sep. 20, 1972, Tachi, NTUM03582, 55-81 mm SL, Jul. 24, 1979, Tongkang, NTUM08304, 52-66 mm SL, Jul. 17, 1991, Suao, NTUM08309, 40-51 mm SL, Sep. 9, 1991, Fangliao.

Diagnosis: D ii + 11-12, A ii + 13-14, P 14-16, V 7, GR 15-18 + 23-27, V 24-25 + 17-18. Body slender, rather round-belly. Snout a little prominent, shorter than eye. Maxillary tip posteriorly dilated, rounded, reach mandibular joint, scarcely project beyond second supra-maxilla, and anterior margin of pre-operculum. No enlarged and curved serration on ventral edge of maxillary tip. Dorsal fin origin behind origin of pelvic fin. Anal fin short, origin a little behind dorsal fin base. Scales thin, deciduous. Pre-pelvic abdominal scute 4-6.

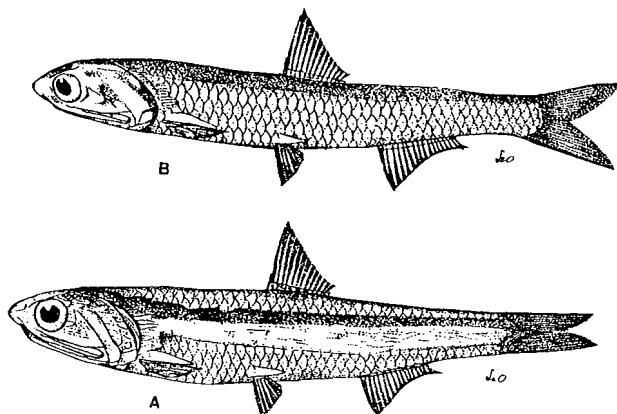


Fig. 2. *Engraulis japonica* Temminck and Schlegel. A: local form, SL = 75 mm; B: normal form, SL = 120 mm.

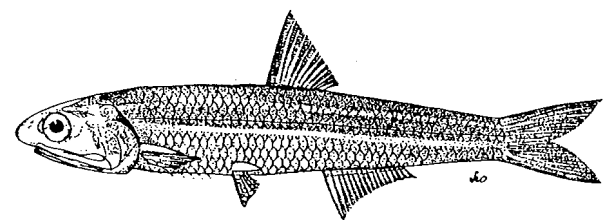


Fig. 3. *Encrasicholina heteroloba* (Rüppell). SL = 74 mm.

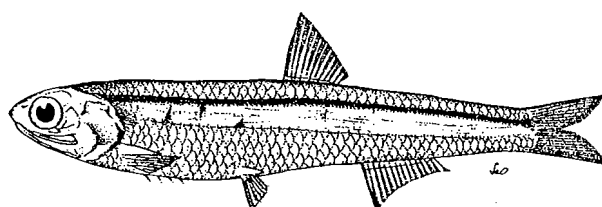


Fig. 4. *Encrasicholina punctifer* Fowler. SL = 67 mm.

Coloration: In fresh specimens, dorsally brown, ventrally pale yellow, a light silvery lateral band.

Distribution: Waters around Taiwan.

***Stolephorus commersonii* Lacepede**

(Fig. 5)

Stolephorus commersonii Lacepede, 1803: 381 (Mautitius).

Stolephorus commersonianus: Bleeker, 1872: 128.

Stolephorus rex: Jordan and Seale, 1926: 380.

Anchoviella commersonii: Fowler 1941: 703, Chu, Tchang and Chen, 1963: 107.

Stolephorus commersonii: Shen, 1959: 32, Whitehead, 1968: 18, Tiews, Ronquillo and Santos, 1975: 24, Wongratana, 1980: 236.

Materials: NTUM083022, 85-91 mm SL, Nov., 1992, Kaohsiung.

Diagnosis: D iii + 12-13, A iii + 17-19, P 13-14, V 7, GR 21-23 + 26-28, VERT 24-25 + 17-18. Body somewhat compressed, belly a little rounded. Snout bluntly rounded, shorter than eye. Maxillary tip pointed, reaches to or a little beyond posterior margin of pre-operculum. Dorsal fin origin behind origin of pelvic fin. Tip of pelvic ray reaches to anterior dorsal fin base. Anal fin short, origin below second half of dorsal fin base. Scales thin, deciduous. Pre-pelvic abdominal scute 3-4.

Coloration: Body translucent, flesh brown, silver lateral stripe when fresh. A black spot on occipital. A pair of dark patches behind occipital, followed by a pair of dark lines extending to dorsal fin origin in preserved specimens.

Distribution: Waters south-west of Taiwan.

***Stolephorus indicus* (van Hasselt)**

(Fig. 6)

Engraulis indica van Hasselt, 1823: 329 (Java).

Stolephorus indicus nanus: Hardenberg, 1933: 236.

Stolephorus extensus: Jordan and Seale, 1926: 382.

Stolephorus insularum: Jordan and Seale, 1926: 381.

Stolephorus indicus: Shen 1959: 31, Whitehead, 1965: 270, Wongratana, 1980: 231.

Materials: NTUM03577, 83-110 mm SL, Jul. 24, 1977, Tongkang, NTUM03636 105 mm SL, Sep. 22, 1978, Kaohsiung, NTUM08307, 36-38 mm SL, Dec. 30, 1990, Wangkun, NTUM08315, 74 mm SL, Aug. 14, 1992, Suao, NTUM08319, 105-115 mm SL, Dec. 19, 1984, Nainwain.

Diagnosis: D iii + 13, A iii + 16-17, P 14, V 7, GR 16-20 + 22-25, VERT 20-21 + 20-21. Body somewhat slender, rather round in cross section, belly round. Snout bluntly round, prominent, shorter than eye. Maxilla broaden above mandibular joint, tip pointed, reach to or just beyond front border of pre-operculum. Hind border of pre-operculum convex. Dorsal fin origin behind origin of pelvic fin. Tip of pelvic ray does not reach dorsal fin origin. Anal fin short, origin below half of dorsal fin base. Scales thin, deciduous. Pre-pelvic abdominal scute 3-6.

Coloration: Body translucent, flesh brown; silver lateral stripe when fresh. A black spot on occipital. No dark pigment lines on back (compare to *S. commersonii*) when preserved.

Distribution: Waters south-west of Taiwan.

Remark: *S. indicus* (= *S. insularis* of Shen 1959), is characterized by a truncated maxilla, reaching anterior margin of preoperculum in contrast to other *Stolephorus* species. The maxilla of *Stolephorus*, other than *S. indicus*, extends to gill opening.

***Stolephorus insularis* Hardenberg**

(Fig. 7)

Stolephorus insularis Hardenberg, 1933: 260 (Java).

Stolephorus baweansis: Hardenberg, 1933: 261.

Stolephorus insularis oceanicus: Hardenberg 1933: 261.

Anchoviella batawensis: Fowler, 1941: 708.

Stolephorus tri: Shen, 1959: 31.

Stolephorus bataviensis: Whitehead, 1969: 261, Shen, 1984: 100, Chen and Yu, 1986: 275.

Stolephorus insularis: Wongratana, 1980: 250.

Materials: NTUM08308, 27-46 mm SL, Dec. 30, 1990, Wangkun, NTUM08317, 35-45 mm SL, Dec. 12, 1991, Fangliao.

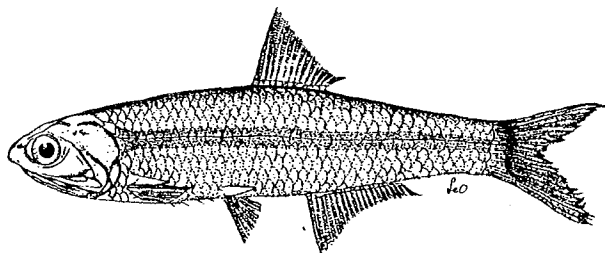


Fig. 5. *Stolephorus commersonii* Lacepede. SL = 87 mm.

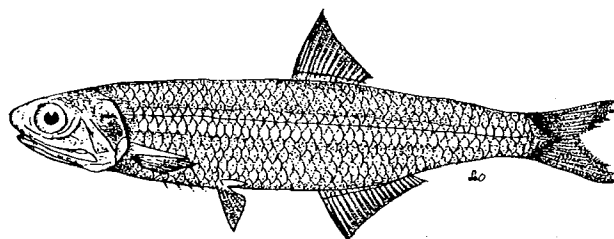


Fig. 6. *Stolephorus indicus* (van Hasselt). SL = 128 mm.

Diagnosis: D iii + 11-14, A iii + 16-19, P 12-13, V 7, GR 16-19 + 22-26, VERT 19-21 + 19-21. Body compressed, a small pre-dorsal spine in some specimens. Snout bluntly round, prominent, shorter than eye. Maxillary tip pointed, reaches to or beyond posterior margin of pre-operculum. Pre-operculum posterior margin concave, indented near the maxillary tip. Dorsal fin origin behind origin of pectoral fin. Tip of pectoral ray does not reach dorsal fin origin. Anal fin short, origin below half of dorsal fin base. Scales thin, deciduous. Pre-pelvic abdominal scute 5-7.

Coloration: Body translucent, pale white, silver lateral stripe, tail is deeply yellow when fresh. A double dark pigment line on back, behind dorsal fin to caudal fin when preserved.

Distribution: Western Taiwan coastal waters.

Remark: *S. insularis* was misidentified as *S. tri* in Taiwan coastal waters (Shen 1959). Currently, we have not located any specimen of *S. tri*, which is characterized by having a pelvic scute and a double dorsal pigment line.

***Stolephorus waitei* Jordan and Seale**

(Fig. 8)

Stolephorus waitei Jordan and Seale, 1926: 380 (Queensland).

Stolephorus insularis bataviensis: Hardenberg, 1933: 261.

Stolephorus bataviensis: Whitehead, 1968: 19.

Anchoviella waitei: Fowler, 1941: 702.

Stolephorus waitei: Wongratana, 1980: 242.

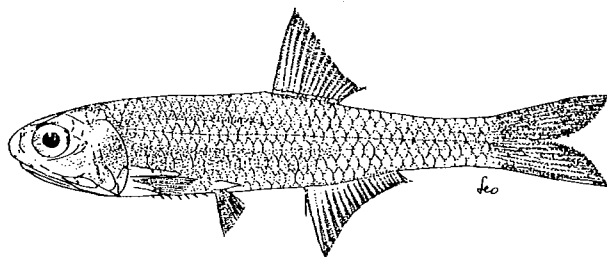


Fig. 7. *Stolephorus insularis* Hardenberg. SL = 52 mm.

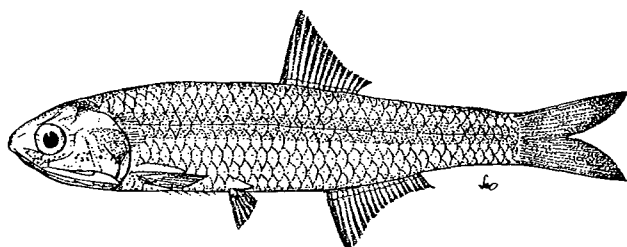


Fig. 8. *Stolephorus waitei* Jordan and Seale. SL = 80 mm.

Materials: NTUM08311, 68-72 mm SL, Oct. 26, 1991, Suao.

Diagnosis: D iii + 12-14, A iii + 16-19, P 13-14, V 7, GR 15-18 + 21-24, VERT 19-20 + 19-20. Body a little compressed. Snout bluntly round, prominent, shorter than eye. Maxillary tip pointed, reaches posterior margin of pre-operculum. Pre-operculum posterior margin convex. Dorsal fin origin behind origin of pelvic fin. Tip of pelvic ray almost reaches to dorsal fin origin. Anal fin short, origin below half of dorsal fin base. Scales thin, deciduous. Pre-pelvic abdominal scute 5-7.

Coloration: Several black spots below eye level, situated behind eye and lower jaw; both distinctive to other engraulid species. When fresh, body translucent, pale yellow, silver stripe lateral, tail yellow.

Distribution: Only collected from Suao (eastern Taiwan coastal waters).

***Setipinna tenuifilis* (Valenciennes)**

(Fig. 9)

Engraulis tenuifilis Valenciennes, in Cuvier and Valenciennes, 1848: 62 (Rangoon).

Setipinna gilbert: Jordan and Starks, 1905: 194.

Setipinna lighti: Wu, 1926: 26.

Setipinna taty: Fowler, 1941: 689; Shen, 1959: 26.

Setipinna tenuifilis: Wongratana, 1980: 242.

Materials: NTUM03563, 130 mm SL, Apr. 21, 1974, Quemoy, NTUM03564, 125 mm SL, Oct. 17, 1978, Kaohsiung, NTUM08320, 120-145 mm SL, Jul. 18, 1978, Tainan.

Diagnosis: D iii + 10-12, A iv + 48-51, P 12-13, V 7, GR 10-11 + 16-17, V15 + 31. Body very compressed ventrally. Keel scute 17-19 pre-pelvic, 1 pelvic scute, 7 post-pelvic. Dorsal fin 1 strong spine. Dorsal fin origin behind origin of pelvic fin. Tip of pelvic ray does not reach dorsal fin origin. Anal fin long, origin below dorsal fin origin, reaches caudal fin base. Pectoral fin filament long, reaches anal fin base at 15th fin ray.

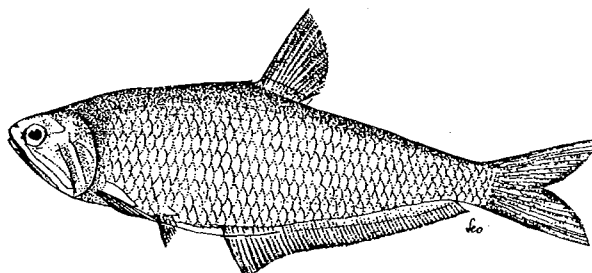


Fig. 9. *Setipinna tenuifilis* (Valenciennes). SL = 111 mm.

Distribution: Southern coastal waters of Taiwan.

Remark: *Setipinna tenuifilis* was previously misidentified as *S. taty* (Shen, 1959). *S. taty* is distinct from *S. tenuifilis* in the number of scutes and gill rakers.

Thryssa chefuensis (Gunther)

(Fig. 10)

Engraulis chefuensis Gunther, 1874: 158 (Chefu, China).

Scutengraulis kammalensis: Tchang et al, 1955: 54.

Thryssa kammalensis: Shen, 1959: 26; Chu et al, 1962: 130, Chu, Tchang and Chen 1963: 109.

Thryssa kammalensis: Shen, 1984: 101.

Thryssa chefuensis: Wongratana, 1980: 262.

Thrissocles kammalensis Chen and Yu, 1986: 276.

Materials: NTUM06415, 40-58 mm SL, 1974, Tanshui, NTUM00183, 78-105 mm SL, Oct. 1957, Lukang, NTUM03569, 101-110 mm SL, Oct. 17, 1978, Kaohsiung, NTUM03570, 102 mm SL, Apr. 8, 1978, Tachi, NTUM03571, 89 mm SL Apr. 22, 1979, Tachi, NTUM08305, 37-49 mm SL, Dec. 30, 1990, Wangkun, NTUM08310, 46-52 mm SL, Nov. 14, 1991, Taichung.

Diagnosis: D iii + 11-13, A iv + 25-29, P 12-14, V 7, GR 21-24 + 26-30, VERT 16-18 + 23-25. Body compressed ventrally. Prepelvic scute 14-16, pelvic scute 1, post-pelvic scutes 8-10. Maxilla short, reach far beyond posterior margin of pre-operculum. First supramaxilla long, at least half the length of the second supramaxilla. Anal fin long, origin below posterior part of dorsal fin base.

Coloration: A dark blotch behind upper part of gill opening when fresh, in preserved specimens the dark blotch pales.

Distribution: Western and north-eastern coastal waters of Taiwan.

Remark: *Thryssa chefuensis* was misidentified as *T. kammalensis* (Shen 1959). *T. kammalensis* is distinct from *T. chefuensis* in having a longer maxilla (reaching to or beyond the gill opening) and more anal fin ray (3/31-3/32) (Bleeker 1849, Fowler

1941, Whitehead et al. 1969, Wongratana 1980).

Thryssa dussumieri (Valenciennes)

(Fig. 11)

Engraulis dussumieri Valenciennes, in Cuvier and Valenciennes, 1848: 69 (no locality).

Engraulis auratus: Day, 1865: 312.

Engraulis dussumieri: Weber and de Beaufort, 1913: 41.

Thrissocles dussumieri: Fowler, 1941: 681, Chen and Yu, 1986: 276.

Thryssa dussumieri: Shen, 1959: 26, Chu, Tchang and Chen, 1963: 112.

Thryssa dussumieri: Shen, 1984: 100, Wongratana, 1980: 273.

Materials: NTUM06972, 95 mm SL, Jul. 15, 1986, Sinda, NTUM03579, 90 mm SL, Oct. 17, 1978, Kaohsiung, NTUM03580, 70-90mm SL, Sept. 23, 1978, Tainan, NTUM03635, 85 mm SL, Mar. 16, 1979, Sinda, NTUM03781, 105-115 mm SL, Dec. 31, 1978, Tainan, NTUM08312, 70-91 mm SL, Jun. 26, 1992, Taichung, NTUM08313, 78-85 mm SL, Aug. 13, 1991, Tongkang.

Diagnosis: D iii + 9-12, A iv + 30-37, P 11-12, V 7, GR 13-15 + 16-19, VERT 17-19 + 23-24. Body compressed ventrally. Pre-pelvic keel scute 13-16, pelvic scute 1, post-pelvic scute 6-9. Maxilla very long, reach far beyond gill opening, at least half-way between pectoral fin base and pelvic fin base. First supramaxilla absent. Anal fin long, origin below posterior part of dorsal fin base.

Coloration: In fresh specimens, a dark blotch behind the upper part of the gill opening is sometimes joined to a dark saddle on head.

Distribution: Coastal waters of western Taiwan.

Thryssa hamiltonii (Gray)

(Fig. 12)

Thryssa hamiltonii Gray, 1835: pl.92 (India).

Engraulis oravi: Bleeker, 1851: 492, Weber and Beaufort, 1913: 37.

Thrissocles hamiltonii: Fowler, 1941: 673, Chen and Yu, 1986: 276.

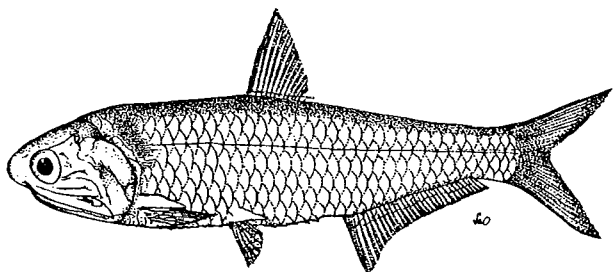


Fig. 10. *Thryssa chefuensis* (Gunther). SL = 94 mm.

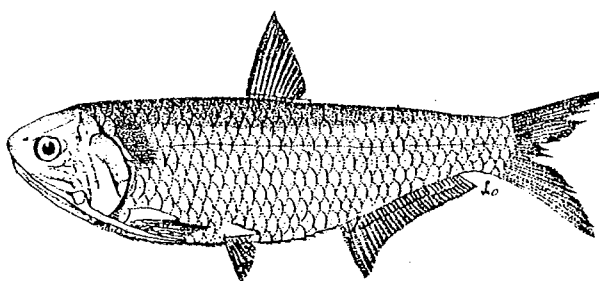


Fig. 11. *Thryssa dussumieri* (Valenciennes). SL = 110 mm.

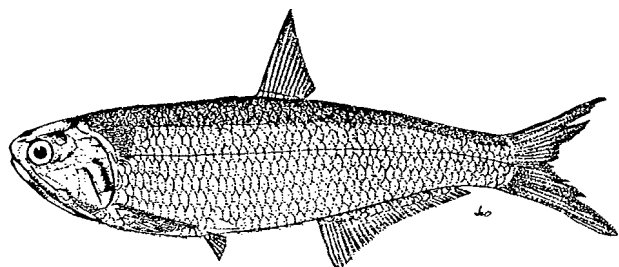


Fig. 12. *Thryssa hamiltonii* (Gray). SL = 196 mm.

Thryssa hamiltonii: Shen, 1959, Chu, Tchang and Chen, 1963: 110.

Thryssa hamiltonii: Whitehead, 1965: 273, Wongratana, 1980: 282, Shen, 1984: 100.

Materials: NTUM03586, 163 mm SL, Oct. 17, 1978, Kaohsiung, NTUM03585, 125 mm SL, Jul. 15, 1978, Chungchou, NTUM07092, 130 mm SL, Jul. 15, 1986, Sinda, NTUM08306, 41-63 mm SL, Feb. 1990, Wangkun, NTUM08314, 40-66 mm SL, Sep. 17, 1992, Wangkun, NTUM08316, 57-60 mm SL, Jan. 18, 1990, Wangkun, NTUM08318, 97-100 mm SL, Sep. 23, 1984, Sinda.

Diagnosis: D iii + 11-12, A iv + 33-40, P 12-13, V 7, GR 9-10 + 14, VERT 19-21 + 23-24. Body ventrally compressed. Pre-pelvic keel scute 15-18, pelvic 1, post-pelvic 7. Snout tip level with eye center, usually at level of upper eye rim. Maxilla short or moderate, reaches to the gill opening margin, or projects slightly beyond. First supra-maxilla long, oval. Anal fin long, origin below posterior of dorsal fin.

Coloration: Fresh specimens have a dark blotch behind the upper part of the gill opening. The anal fin and caudal fin are deep yellow when fresh.

Distribution: Taiwan strait.

Remark: *Thryssa mystax* was subjoined to the Enengraulidae list of Taiwan (Shen 1984). Two specimens named with *T. mystax* was cataloged with NTUM01798 collected from Quemoy (near to Amoy). These specimens (or rather this species) very similar to *T. hamiltonii*. Based on the data of Wongratana (1980), *Thryssa mystax* (Shen 1984) should be assigned to *T. adelae*. Since no further specimens are available and Wongratana (1980) have examined limited sources from Amoy, this conclusion is tentative. The taxonomic status of *T. adelae* needs further investigation.

Thryssa setirostris (Broussonet)

(Fig. 13)

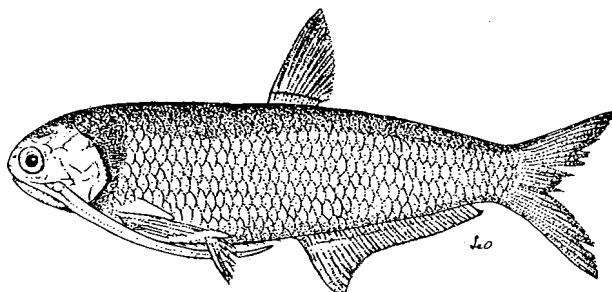


Fig. 13. *Thryssa setirostris* (Broussonet). SL = 105 mm.

Clupea setirostris Broussonet, 1782: pl. 2 (New Hebrides).

Clupea mystacina: Bloch and Schneider, 1801: 428.

Thrissocles setirostris: Fowler 1941: 679, Chen and Yu: 1986: 276.

Thryssa setirostris: Shen, 1959: 26, Chu, et al. 1962: 112.

Thryssa setirostris: Whitehead, 1965: 275, Wongratana, 1980: 293, Shen 1984: 100.

Materials: NTUM06154, 107 mm SL, Oct. 1, 1980, Fanliao, NTUM00007, 38-79 mm SL, Sept. 14, 1976, Tanshui, NTUM03578, 85 mm SL, Oct. 29, 1977, Tachi, NTUM08321, 98-113 mm SL, Jun. 24, 1992, Wangkun.

Diagnosis: D iii + 11-12, A iv + 33-40, P 13-14, V 7, GR 5-6 + 10-12, VERT 20 + 25. Body compressed. Pre-pelvic keel scute 17, pelvic 1, post-pelvic 7-8. Maxilla very long (the longest in Engraulidae), reaching least to the tip of the pectoral ray, usually at the pelvic fin base, or to the anal fin origin. Anal fin long, origin below the posterior part of dorsal fin base.

Coloration: Fresh specimens, gold tinted head. Anal fin and caudal fin deep yellow.

Distribution: Coastal waters of Taiwan.

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台灣鯷科魚類分類之修訂

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鯷科魚類為台灣沿海重要的經濟魚類，根據過去的報告及目前所採集的標本，經整理後，共計分為5屬12種：日本鯷魚 (*Engraulis japonica*)、刺公鯷 (*Encrasicholina punctifer*)、異葉公鯷 (*E. heteroloba*)、孔氏小公魚 (*Stolephorus commersonii*)、印度小公魚 (*S. indicus*)、島嶼小公魚 (*S. insularis*)、魏氏小公魚 (*S. waitei*)、黃鯷 (*Setipinna tenuifilis*)、芝燕綾鯷 (*Thryssa chefuensis*)、杜氏綾鯷 (*T. dussumieri*)、漢氏綾鯷 (*T. hamiltonii*)、長頰綾鯷 (*T. setirostris*)，其中魏氏小公魚為台灣的新記錄種，以往鑑定錯誤的干麥爾綾鯷 (*T. kammalensis*)及絲翅鯷 (*S. taty*)已修正為芝燕綾鯷及黃鯷。檢索表、主要判別特徵、異名及種的圖繪亦在本報告中呈現。

關鍵詞：鯷魚，魚類分類，魚勿鱧魚。

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