

## First record of *Thrissina splendida* (Clupeiformes, Engraulidae) from Taiwan and a key to all Taiwanese species of *Thrissina*

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### Abstract

A single specimen of *Thrissina splendida* Hata, 2022, collected from Yun-Lin County, Western Taiwan, was recently found in the fish collection of the University of Michigan Museum of Zoology, representing the first record of this species from Taiwan. It had previously been recorded only from the Korean Peninsula and the Chinese coast. The Taiwanese specimen has been described in detail herein, and a key to all Taiwanese *Thrissina* spp. has additionally been provided.

**Keywords:** anchovies, biodiversity, ichthyofauna, new record, taxonomy, *Thrissina adela*

### Introduction

*Thrissina* Jordan & Seale, 1925, an Indo-Pacific genus of marine and/or brackish water anchovies (Engraulidae), presently includes 34 valid species (Roberts, 1978; Wongratana, 1983, 1987; Whitehead et al., 1988; Wongratana et al., 1999; Gill et al., 2018; Hata & Motomura, 2019; Hata & Nakae, 2019; Hata & Koeda, 2020; Hata, 2020, 2022; Hata et al., 2020, 2021, 2022a, 2023a-b). Some species of the genus are caught abundantly and important for fisheries in Taiwan (Yang, 2013; Chiang et al., 2014; Hata, 2019).

Although Northwestern Pacific species of *Thrissina*, which are characterized by possessing a long maxilla posteriorly (just reaching the pectoral fin insertion), had long been regarded as a single species, *Thrissina adela* (Rutter, 1897) (Whitehead et al., 1988), Hata (2022) showed that “*T. adela*” included true *T. adela* (distributed off Fujian Province, China to Northern Vietnam) and a new species *Thrissina splendida* Hata, 2022 (Southeastern coast of the Korean Peninsula and Bohai Sea to Fujian Province). Although both species occur

sympatrically off Fujian Province, the identity of individuals in Taiwanese waters, namely the Taiwan Strait located east of Fujian Province, has not been confirmed to date. During a revisionary study of the genus, a specimen collected off the west coast of Taiwan that had been deposited in the University of Michigan Museum of Zoology was identified as *T. splendida*. Because the specimen represents the first record of this species from Taiwan, it is described in detail below, and a key for the six Taiwanese species of *Thrissina* has also been provided.

## Materials and methods

Methods for counts and proportional measurements (Tables 1-2) followed Hata and Motomura (2019), all being made with digital calipers to the nearest 0.01 mm. Abbreviations are as follows—SL=standard length; UGR, LGR, and TGR= upper limb, lower limb, and total gill rakers, respectively (with associated numbers indicating the specific gill arch); distance from dorsal fin origin to pectoral fin insertion=D-P1; distance from dorsal fin origin to pelvic fin insertion=D-P2; distance between dorsal and anal fin origins=D-A; distance between pectoral and pelvic fin insertions=P1-P2; distance from pelvic fin insertion to anal fin origin=P2-A. Institutions are abbreviated as follows: Field Museum of Natural

History, Chicago, USA (FMNH); National Museum of Marine Biology and Aquarium, Checheng, Taiwan (NMMB); University of Michigan Museum of Zoology, Ann Arbor, USA (UMMZ); and Smithsonian Institution, National Museum of Natural History, Washington, DC, USA (USNM). Nomenclature and authorship of the genus *Thrissina* Jordan & Seale, 1925 followed Kottelat (2013).

## Results

### Family Engraulidae Gill, 1861

### *Thrissina* Jordan & Seale, 1925

### *Thrissina splendida* Hata, 2022

Taiwanese species name: 多稜長頷稜鯷  
(Fig. 1)

**Specimen examined.** UMMZ 194341, 102.3 mm SL, 122.1 mm total length, Mailiao, Yun-Lin County, Taiwan.

### Description of the Taiwanese specimen.

Body compressed laterally, with greatest depth at dorsal fin origin. Dorsal profile gradually elevated from snout tip to dorsal fin origin, thereafter lowering to uppermost point of caudal fin base. Ventral contour lowering from snout tip to lower margin of mandibular articulation, parallel to body axis thereafter to anal fin origin, and subsequently rising to lowermost point of caudal fin base. Abdomen covered with 17 and 9 sharp, needle-like scutes from

**Tab. 1.** Counts of *Thrissina splendida*.

	Hata (2022)		This study		Mode
	Holotype	Paratypes	North Korea	Taiwan	
	CAS-SU 26536	<i>n</i> = 18	<i>n</i> = 4	UMMZ 194341	
Standard length (mm)	129.8	62.9–142.7	102.5–145.4	102.3	
Dorsal fin rays (unbranched)	3	3	3	3	3
Dorsal fin rays (branched)	11	10–11	10	10	10
Anal fin rays (unbranched)	4	3–4	4	4	4
Anal fin rays (branched)	40	37–43	40–42	41	41
Pectoral fin rays (unbranched)	1	1	1	1	1
Pectoral fin rays (branched)	12	11–12	11	10	11
Pelvic fin rays (unbranched)	1	1	1	1	1
Pelvic fin rays (branched)	6	6	6	6	6
Caudal fin rays	19	19	19	19	19
Gill rakers on 1st gill arch (upper)	12	11–13	11–12	13	12
Gill rakers on 1st gill arch (lower)	18	16–18	17–18	18	18
Gill rakers on 1st gill arch (total)	30	27–31	28–30	31	30
Gill rakers on 2nd gill arch (upper)	10	9–11	9–10	11	10
Gill rakers on 2nd gill arch (lower)	17	16–18	16–18	18	17
Gill rakers on 2nd gill arch (total)	27	25–29	26–27	29	27
Gill rakers on 3rd gill arch (upper)	7	7–9	7–8	7	7
Gill rakers on 3rd gill arch (lower)	10	9–10	9–10	10	10
Gill rakers on 3rd gill arch (total)	17	16–19	16–17	17	17
Gill rakers on 4th gill arch (upper)	5	5–7	6–7	6	6
Gill rakers on 4th gill arch (lower)	9	8–9	8	9	8
Gill rakers on 4th gill arch (total)	14	13–16	14–15	15	14
Gill rakers on posterior face of 3rd gill arch	5	4–6	4–5	5	5
Pre-pelvic scutes	19	16–20	17	17	17
Post-pelvic scutes	10	9–11	10–11	9	10
Total pelvic scutes	29	26–30	27	26	26
Scale rows in longitudinal series	46	44–46	44–46	44	45
Transverse scales	12	11–12	11–12	11	11
Vertebrae	46	46–49	47	45	47

**Tab. 2.** Measurements of *Thrissina splendida*

	Hata (2022)		This study		Mean
	Holotype	Paratypes	North Korea	Taiwan	
	CAS-SU 26536	<i>n</i> = 18	<i>n</i> = 4	UMMZ 194341	
Standard length (mm; SL)	129.8	62.9–142.7	102.5–145.4	102.3	
As % of SL					
Head length	20.9	19.6–24.7	20.3–22.1	24.1	22.6
Body depth	25.7	20.5–25.1	23.2–25.2	22.7	22.7
Pre-dorsal fin length	52.3	49.1–52.3	52.1–53.8	52	51.4
Snout tip to pectoral fin insertion	23.3	21.9–27.0	22.8–24.6	26.4	25
Snout tip to pelvic fin insertion	38.5	38.2–43.1	38.3–42.7	40.7	40.5
Snout tip to anal fin origin	56.4	57.1–60.6	57.6–61.4	60	59.1
Dorsal fin base length	8.8	7.6–9.4	7.9–8.8	8.9	8.5
Anal fin base length	34.7	33.5–39.4	34.2–37.8	37.6	36.4
Caudal peduncle length	8.7	6.7–9.8	7.0–7.9	7.1	8.1
Caudal peduncle depth	broken	7.4–9.0	7.7–9.1	8.4	8.2
D–P1	37.7	32.7–38.2	34.9–37.9	33.9	35.1
D–P2	27.5	22.6–29.2	26.5–29.0	26.1	25.7
D–A	26.4	20.3–24.9	23.1–24.6	23.6	22.6
P1–P2	16.7	14.6–18.4	16.0–18.8	14.9	16.4
P2–A	19.7	16.7–22.7	19.3–22.3	18.6	19.3
Pectoral fin length	broken	17.7–20.4	18.0–19.9	20.2	19.1
Pelvic fin length	7.7	6.9–8.7	7.2–8.4	7.8	7.9
Maxilla length	24.5	24.6–28.1	23.4–25.5	27.1	26
Mandibular length	15.9	14.3–18.1	15.3–16.5	18	16.7
Supramaxilla end to maxilla end	10.7	9.3–12.0	9.1–10.7	10.2	10.8
4th anal fin ray length	broken	11.7–13.3	11.3–12.5	13.3	12.7
5th anal fin ray length	broken	11.2–13.1	10.1–12.3	13	12.2
Orbit diameter	5.8	5.1–7.0	5.6–6.6	6.5	6.1
Eye diameter	4.9	4.3–6.2	5.0–5.7	5.3	5.3
Snout length	3.1	3.1–4.0	3.4–3.7	3.8	3.6
Interorbital width	5.1	4.5–5.6	4.8–5.3	5.5	5.2
Postorbital length	12.5	11.7–13.8	12.1–12.5	13.9	12.9



**Fig. 1.** (A) Lateral, (B) dorsal, and (C) ventral views of a preserved specimen of *Thrissina splendida* collected from Mailiao, Yun-Lin County, Western Taiwan: UMMZ 194341, 102.3 mm SL, 122.1 mm total length.

isthmus to pelvic scute, and pelvic scute to anus, respectively. Anus just anterior to anal fin origin. Caudal peduncle compressed; its depth greater than orbit diameter. Head compressed. Snout length much shorter than orbit diameter. Snout tip pointed, slightly above horizontal through center of eye but lower than its upper rim. Eyes round, covered with thin, adipose eyelids, lateral on head, dorsal to horizontal through pectoral fin insertion, and visible in dorsal and ventral views. Pupil round and orbit elliptical. Nostrils close to each other, anterior to anterior margin of orbit and above horizontal through midline of body. Interorbital space flat. Mouth large, inferior, below body axis, and extending backwards well beyond posterior margin of eye. Mandible slender and much shorter than maxilla. Anterior tip of mandible slightly dorsal to lower margin of eye. Maxilla (broken on left side) long, its posterior tip pointed and beyond posterior-most point of pectoral fin insertion. First supramaxilla small and oval. Second supramaxilla elongated and cylindrical anteriorly, posteriorly round, and symmetrical. Small uniserial, conical teeth on both jaws. Single row of fine teeth on palatine. Several conical teeth on vomer. Fine teeth patch on pterygoids. Small dense conical teeth on upper edges of basihyal and basibranchial. No teeth on dorsal surface of hyoid.

Posterior margin of preopercle convex and smooth. Subopercle with rounded posterior margin. Opercular membrane without serrations. Pseudobranchial filaments present and covered with a fleshy membrane. Gill rakers long, slender, and with serrae similarly sized. Gill membrane on each side joined distally, with most of the isthmus muscle exposed and not covered by gill membrane. Branches of cephalic lateralis sensory canal exposed at upper part of gill opening. Pectoral fin insertion slightly posterior to opercle's posterior tip. Uppermost ray of pectoral fin unbranched; other rays branched. Posterior tip of pectoral fin pointed, slightly beyond pelvic fin insertion. Pectoral fin triangular, with upper, lower, and posterior margins nearly straight. Pelvic fin insertion anterior to dorsal fin origin. Posterior tip of depressed pelvic fin not reaching vertical through dorsal fin origin. Pelvic fin triangular, with upper, lower, and posterior margins nearly straight. Anteriormost ray of pelvic fin unbranched; other rays branched. Dorsal fin origin anterior to anus. Anterior-most three rays of dorsal fin unbranched; other rays branched. Single spine-like scute located just anterior to dorsal fin origin. Dorsal fin triangular; dorsal contour rising sharply from fin origin to third fin ray tip, thereafter lowering to tip of posterior-most fin ray. Anal fin origin just below origin of

8th dorsal fin ray. Lower contour of anal fin dropping from fin origin to 4th fin ray tip, subsequently almost parallel to ventral profile of body. Caudal fin forked. Body scales completely lost, except for ventral scutes.

*Coloration of the preserved specimen.* Body uniformly pale ivory. Melanophores densely scattered on upper part of lateral body surface. Numerous melanophores densely scattered on dorsum, forming indistinct double lines from occipital area to dorsal fin origin and end of dorsal fin base to caudal fin base. Branches of cephalic lateralis sensory canal on upper part of gill opening black, forming a distinct black blotch. All fins pale and semi-transparent. Melanophores scattered along fin rays of dorsal and caudal fins. No melanophores on pectoral, pelvic, or anal fins, nor on jaws, gill rakers, isthmus, mouth roof, or inner surface of opercle. Melanophores scattered on upper branch of gill arch, gill filaments on upper part of first gill arch, and dorsal surfaces of the hyoid and bathyhyal.

**Distribution.** *Thrissina splendida* is distributed in the 1) Northwestern Pacific along the Chinese coast from the Bohai Sea to Fujian Province, 2) northwestern and southeastern coasts of the Korean Peninsula, and 3) west coast of Taiwan (Hata, 2022; this study).

**Remarks.** The specimen from Taiwan was assigned to the genus *Thrissina*, defined by Whitehead et al. (1988) and Wongratana et al. (1999; as *Thryssa*) as having 17 and 9 strongly keeled pre-pelvic and post-pelvic scutes, respectively, on the ventral edge, a spine-like scute at the dorsal fin origin, dorsal and anal fins with 13 and 44 rays, respectively, its uppermost pectoral fin ray not extended as a filament, and small conical teeth on both jaws. Moreover, the specimen was identified by the following combination of characters, which closely matched the diagnostic features of *T. splendida* (Hata, 2022): long maxilla posterior to posterior end of pectoral fin base; small first supramaxilla; paired dark lines on dorsum; distinct black blotch on upper part of gill opening; 11 transverse scales; 44 longitudinal series of scale rows; snout 3.8% of standard length (SL); lower jaw 18.1% of SL; D–A 23.6% of SL; 4th anal fin ray length 13.3% of SL; and 5th anal fin ray length 13.0% of SL. Other meristic and morphometric characters, including gill-raker counts on each gill arch, of the specimen generally matched those of *T. splendida* from Hata (2022), except for slight differences in branched pectoral fin ray (10 in the Taiwanese specimen vs. 11–12; **Table 1**) and vertebral (45 vs. 46–49) counts. Detailed comparisons of *T. splendida* with similar

congeners were given in Hata (2022), who described the former from 19 specimens. The present specimen, together with the North Korean ones also discussed herein, are the only examples of *T. splendida* reported since the original description. The former represents the first record of the species from Taiwan. Additionally, four comparative specimens (FMNH 55401, 102.5–145.4 mm SL) represent the first records from North Korea and the east coast of the Yellow Sea.

**Species of the genus *Thrissina* in Taiwan.**

According to Young et al. (1994), Hata (2019), and Hata & Koeda (2020), voucher specimens of five species of the genus *Thrissina* viz.- *Thrissina chefuensis* (Günther, 1874), *Thrissina dussumieri* (Valenciennes, 1848), *Thrissina encrasicoloides* (Bleeker, 1852), *Thrissina hamiltonii* (Grey, 1835), and *Thrissina setirostris* (Broussonet, 1782)- have been recorded from Taiwan. However, the species previously called “*T. hamiltonii*” in the Northwestern Pacific, including Taiwan, was described as a separate new species: *Thrissina katana* Hata, Lavoué & Motomura, 2022. In addition, *Thrissina kammalensis* (Bleeker, 1849), which has sometimes been reported in Taiwanese waters (e.g., Shen, 1984; Shen & Wu, 2011; Shao, 2023), is actually limited to the Gulf of Thailand and Indonesia (Whitehead et al., 1988; Wongratana et al., 1999).

Because *T. kammalensis* had been mistakenly regarded as a senior synonym of *T. chefuensis* in the past, Taiwanese records of *T. kammalensis* are in fact misidentifications of *T. chefuensis*, the former now being recognized as differing from *T. chefuensis* in having a longer maxilla that posteriorly reaches the posterior margin of the opercle (vs. not reaching the posterior margin of the preopercle in *T. chefuensis*; Hata et al., 2020). Differences between the two species were detailed by Whitehead et al. (1988), Wongratana et al. (1999), and Hata and Nakae (2019). Although Shen and Wu (2011) showed a color photograph of an individual named “*Thryssa baelama*” in their Taiwanese fish list, the individual is probably *T. encrasicoloides* due to the absence of an orange spot on the cleithrum (Hata et al., 2023b). Consequently, the six species included in the following key have been confirmed from Taiwanese waters. In addition, Taiwanese specimens in fresh condition (except for *T. splendida*) are shown in Hata (2019), with *T. katana* having being labelled as *T. hamiltonii*.

**Key to species of *Thrissina* recorded from Taiwan**

- 1a. Maxilla short, posteriorly not beyond posterior margin of preopercle ..... 2
- 1b. Maxilla long, posteriorly beyond opercular margin ..... 3



2a. 1LGR > 26; keeled ventral scutes  
> 23 ..... *T. chefuensis*<sup>a</sup>  
2b. 1LGR ≤ 26; keeled ventral scutes  
< 18 ..... *T. encrasicholoides*<sup>b</sup>

3a. Posterior tip of maxilla just reaching  
or slightly extending beyond posterior  
margin of opercle, not reaching pectoral  
fin insertion ..... *T. katana*<sup>c</sup>

3b. Posterior tip of maxilla at least  
reaching pectoral fin insertion ..... 4

4a. 1LGR < 13; maxilla very long, its  
posterior tip beyond pelvic fin insertion in  
adults ..... *T. setirostris*<sup>b</sup>

4b. 1LGR > 15; maxilla moderately long,  
its posterior tip not reaching pelvic fin  
insertion ..... 5

5a. ventral scutes < 25; posterior tip of  
maxilla reaching at least halfway along  
pectoral fin and to the pelvic fin  
base ..... *T. dussumieri*<sup>b</sup>

5b. ventral scutes > 25; posterior tip of  
maxilla slightly beyond or slightly short  
of posterior-most point of pectoral fin  
base ..... *T. splendida*<sup>d</sup>

<sup>a</sup> Data based on Hata et al. (2020); <sup>b</sup>  
Whitehead et al. (1988) and Wongratana  
et al. (1999); <sup>c</sup> Hata et al. (2022); <sup>d</sup>  
Hata (2022) and this study.

#### Comparative material examined.

*Thrissina splendida*, 23 specimens, listed  
in Hata et al. (2022) and 4 additional  
specimens: FMNH 55401, 4 specimens,

102.5–145.4 mm SL, Namp'o-hang,  
North Korea (Yellow Sea; 38°42'14.9"N  
125°23'59.1"E).

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