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NOTES ON GEOGRAPHIC DISTRIBUTION

First records of *Hilsa kelee* (Cuvier, 1829), Kelee Shad (Clupeiformes, Dorosomatidae), from the main island of Taiwan, South China Sea

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Abstract. *Hilsa kelee* (Cuvier, 1829) is widely distributed in the Indo-West Pacific, but so far it has been recorded only from insular areas (Matsu, Kinmen, and Penghu Islands) in Taiwanese waters. Here we report on 18 specimens collected from off Ke-tzu-liao, Kaohsiung City, southwestern main island of Taiwan. Morphometric and meristic data and an anatomical description of those specimens are presented, together with remarks on the distribution of the species and its occurrence in Taiwanese and adjacent waters.

Key words. Biodiversity, Clupeomorpha, *Macrura*, taxonomy, *Tenualosa*

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INTRODUCTION

Hilsa kelee (Cuvier, 1829), Kelee Shad, is a medium-sized (~27 cm maximum standard length) species belonging to the herring family Dorosomatidae and the only member of the monotypic genus *Hilsa* Regan, 1917 (Whitehead 1985; Munroe et al. 1999; Anderson 2022). Although adults of *H. kelee* mainly inhabit pelagic waters, the species is also known to be anadromous, with some individuals reported living in freshwaters (Vu et al. 2022). *Hilsa kelee* is widely distributed in the Indo-west Pacific, from the eastern coast of Africa to Papua New Guinea, with its northern limit in the Pacific regarded as being in Zhejiang Province, China (Whitehead 1985; Munroe et al. 1999; Zhang 2001). However, while Taiwan lies within this range, *H. kelee* has only been recorded from insular areas—i.e., Matsu, Kinmen, and Penghu Islands—off the west coast of Taiwan, and no records from the main island have ever been reported (Shen 1984; Chen and Yu 1986). In recent years (since 2023), the third author has observed several individuals from off Ke-tzu-liao, southwestern main island of Taiwan, and 18 specimens were collected during the ichthyofaunal survey out of a much larger catch by local fisheries. Since these specimens represent the first records of *H. kelee* from the main island of Taiwan, they are presented and discussed here.

METHODS

Counts and measurements, expressed as percentages of standard length (SL), followed Hata and Motomura (2017), and are shown in Tables 1 and 2. All measurements were made with digital calipers to the nearest 0.01 mm. The map (Figure 4) was constructed with QGIS (2025). Abbreviations are: SL (standard length), NMMB-P (Pisces Collection, National Museum of Marine Biology and Aquarium, Pingtung, Taiwan), OISTICH (Ichthyological Collection under OIST Natural History Collection, Okinawa Institute of Science and Technology Graduate University, Okinawa, Japan).

RESULTS

Order Clupeiformes
Family Dorosomatidae
Genus *Hilsa* Regan, 1917

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***Hilsa kelee* (Cuvier, 1829)**
Common name in English: Kelee Shad
Common name in Chinese: 花點鰣
Figures 1–3; Tables 1, 2

Material examined. TAIWAN — Kaohsiung • Ke-Tzu-Liao Fishing Port; 18 Sept. 2023; H.-C. Ho leg.; 161.9–176.6 mm SL; 3 specimens, NMMB-P39604 • ibid.; 21 Mar. 2025, H. Hata, A. Bandai, and H.-C. Ho leg.; 160.4 mm SL, 1 specimen, OISTICH 690; 160.7 mm SL, 1 specimen, OISTICH 691; 156.1 mm SL, 1 specimen, OISTICH 692; 150.5 mm SL, 1 specimen, OISTICH 693; 145.4 mm SL, 1 specimen, OISTICH 694; 156.8 mm SL, 1 specimen, OISTICH 695; 149.8 mm SL, 1 specimen, OISTICH 696; 156.4 mm SL, 1 specimen, OISTICH 697; 156.7 mm SL, 1 specimen, OISTICH 698; 183.5 mm SL, 1 specimen, OISTICH 699; 159.9 mm SL, 1 specimen, OISTICH 700; 158.9 mm SL, 1 specimen, OISTICH 1338 • ibid.; 7 Apr. 2025, H. Hata and H.-C. Ho leg.; 163.8 mm SL, 1 specimen, OISTICH 920; 159.2 mm SL, 1 specimen, OISTICH 921; 171.7 mm SL, 1 specimen, OISTICH 922.

Comparative materials. NMMB-P42777, 101.7 mm SL, NMMB-P42778, 95.8 mm SL, Matsu Islands, near Fujian Province.

Identification. The specimens were identified as *Hilsa kelee*, the only species of the genus, on the basis of the following combination of characters, which closely matched the diagnostic features of the species presented by Whitehead (1965a, 1985) and Munroe et al. (1999): numerous bony striae present on frontoparietal region (Figure 2); gill rakers on inner part of first gill arch distinctly curved outwardly; 39 or 40 scale rows in longitudinal series; numerous perforations on posterior part of body scales (Figure 3); a distinct median notch on maxilla; and abdomen entirely covered with 39 or 40 hard scutes from isthmus to anus. Species of the genus *Tenualosa* were previously included in the genus *Hilsa* (e.g. Whitehead 1967, 1972; Kuronuma and Abe 1972; Talwar and Kacker 1984; Sirimontaporn 1984) and are generally morphologically similar to *H. kelee*. However, species of the genus *Tenusalosa* Fowler, 1934 are distinguishable from *H. kelee* by lacking bony striae on the frontoparietal region and perforations of the posterior part of body scales (Whithead 1965a, 1985; Munroe et al. 1999). Also, according to Whitehead (1985) and Munroe et al. (1999), another diagnostic feature of *H. kelee* is the presence of up to 10 lateral black spots along flank in line with a large spot on the cleithrum behind the opercle. However, only one black spot is present in the preserved specimens (145.4–183.5 mm SL) on which we base this report. Specimens of the species collected on a survey by the Nagao Natural Environment Foundation (2021: 65) suggest that the lateral series of black spots may be difficult to detect in large specimens, since these may disappear with age. This was inferred based on comparisons photos of a juveniles with the series of black spots; [the same photo is shown as "small young" in Tran et al. (2013)] and adults with just one black blotch at the regium of the cleithrum. In addition, the specimens of *H. kelee* shown in Matsunuma (2011: 15.0 cm SL; 2013: 13.2 cm; 2015 14.8–15.2 cm), White et al. (2013: 254 mm SL), Hata (2018: 15.8 cm SL), Gloerfelt-Tarp and Kailola (2022: 123 mm SL) have only one spot. We therefore believe that the series of black spots on the lateral body of *H. kelee* disappear or become almost indistinct in specimens larger than 12 cm SL, with only the spot on the cleithrum remaining in specimens about this size or larger than this.

Description. Counts and measurements, expressed as percentages of SL, are given in Tables 1 and 2. Body oblong, strongly compressed, deepest at dorsal-fin origin. Dorsal contour rising from snout tip to dorsal-fin origin, subsequently lowering to upper margin of caudal-fin base. Ventral margin from lower-jaw tip to lower margin of caudal-fin base broad convex in a parabolic curve with pelvic-fin insertion at midpoint. Abdomen covered with 39 or 40 prominently keeled scutes from isthmus to anus.

Pectoral-fin insertion anterior to posterior margin of opercle, below level of lower margin of maxilla. Upper, lower, and posterior margins of pectoral fin nearly straight. Posterior tip of pectoral fin pointed, reaching vertical through 1st to 6th dorsal-fin ray origin or anterior to vertical through dorsal-fin origin; posterior tip of pectoral fin also not reaching pelvic-fin insertion. Uppermost ray of pectoral fin unbranched, all other rays branched. Dorsal-fin origin anterior to mid-point of body. Dorsal fin triangular, its contour elevated from fin origin to fifth fin-ray tip, thereafter lowering to last-fin ray tip. Dorsal-fin first ray minute, located closely to second ray; anterior four rays unbranched (only one specimen with three unbranched rays), remaining branched; posteriormost ray not filamentous. Pelvic-fin insertion below origin of 4th to 10th dorsal-fin ray. Pelvic-fin triangular, its outer margin lowering from fin insertion to first fin-ray tip, subsequently rising to last fin-ray tip. Anterior and posterior margins of pelvic fin nearly straight. Posterior tip of depressed pelvic fin pointed, not reaching anus. Anteriormost ray of pelvic fin unbranched, other rays branched. Anal-fin origin just behind anus, posterior to end of dorsal-fin base. Anterior, ventral, and posterior margins of anal fin nearly straight. Anterior three rays of anal fin unbranched, other rays branched. Caudal fin forked, upper and lower margins straight. Inner margins of both lobes rounded. Posterior tips of both lobes of caudal fin rounded. Anus oval, horizontal axis longest.

Mouth terminal, large, posterior tip of maxilla extending beyond vertical through middle of eye, but not to posterior margin of iris. Snout tip rounded, projecting slightly beyond lower-jaw tip. Teeth absent on jaws, palatal region, and tongue. Two supramaxillae, first elongated longitudinally; second oval, com-

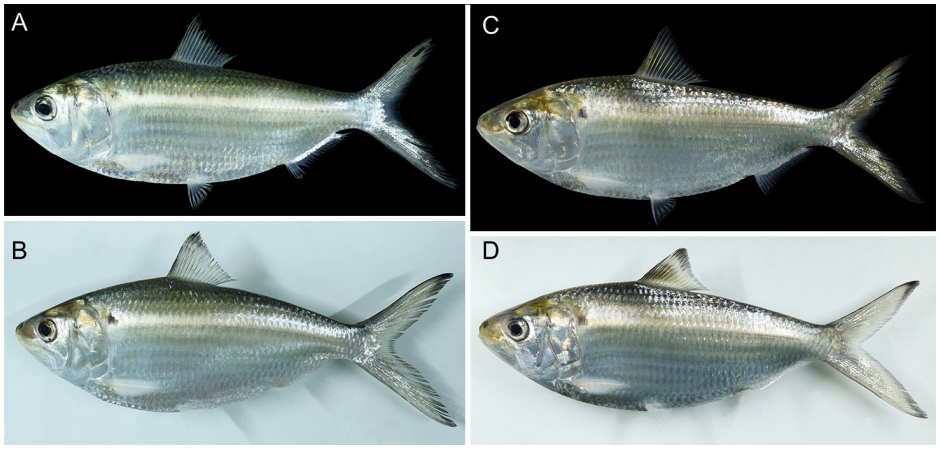

Figure 1. Fresh specimens of *Hilsa kelee* collected from southwestern Taiwan. **A.** OISTICH 691, 160.7 mm SL; **B.** OISTICH 699, 183.5 mm SL; **C.** OISTICH 921, 159.2 mm SL; **D.** OISTICH 922, 171.7 mm SL.

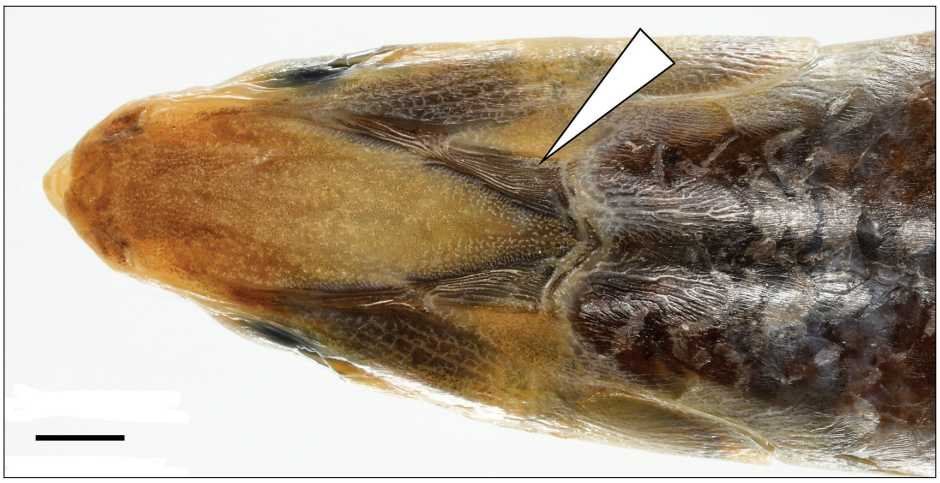

Figure 2. Dorsal view of head of *Hilsa kelee* collected from southwestern Taiwan (NMMB-P36904, 166.7 mm SL). Arrow indicate bony striae on frontoparietal region. Scale bar indicates 5 mm.

Figure 3. Stained scale removed from right side of midbody (above anal fin) of *Hilsa kelee* collected from southwestern Taiwan (OISTICH 696, 149.8 mm SL; left-right inverted). Scale bar indicates 1 mm.

pressed laterally, deep. Orbit elliptical, horizontal axis longest. Eye rounded, positioned laterally on head, visible in dorsal view. Pupil round. Dorsal margin of eye above horizontal level of snout tip. Well-developed adipose eyelid entirely covering eye; anterior tip reaching to anterior margin of orbit; posterior tip reaching to vertical through posterior margin of preopercle. Interorbital space flat. Nostrils close to each other, positioned on lateral surface of head, anterior to orbit. Numerous bony striae on frontoparietal region (Figure 2).

Opercle smooth, without bony striae. Posterior margins of preopercle, subopercle and opercle convex and rounded, without serrations. Pseudobranchial filaments present on inner surface of opercle, exposed; pseudobranch shorter than eye diameter. Hind margin of gill opening evenly rounded, without freshy outgrowths; single large papilla on ventral margin.

Gill rakers present on first to fourth gill arches and posterior surface of third gill arch; gill rakers long,

Table 1. Meristic data of specimens of *Hilsa kelee* collected off southwestern Taiwan.

	***n* = 18**
Standard length (mm)	145.4–183.5
Dorsal-fin rays (unbranched)	3–4
Dorsal-fin rays (branched)	13–15
Dorsal-fin rays (total)	17–19
Anal-fin rays (unbranched)	3
Anal-fin rays (branched)	16–20
Anal-fin rays (total)	29–23
Pectoral-fin rays (unbranched)	1
Pectoral-fin rays (branched)	13–15
Pectoral-fin rays (total)	14–16
Pelvic-fin rays (unbranched)	1
Pelvic-fin rays (branched)	7
Lower gill rakers on 1st gill arch	143–157
Prepelvic scutes	16–18
Postpelvic scutes	11–13
Total scutes	28–31
Scale rows in longitudinal series	39–40
Pseudobranchial filaments	26–34

Table 2. Morphometric data of specimens of *Hilsa kelee* collected from off southwestern Taiwan.

	***n* = 18**
Standard length (mm; SL)	145.4–183.5
As % SL	
Head length	29.8–31.8
Body depth	34.0–39.9
Pre-dorsal-fin length	44.6–46.8
Snout tip to pectoral-fin insertion	29.5–31.4
Snout tip to pelvic-fin insertion	51.5–54.5
Snout tip to anal-fin origin	76.4–80.4
Dorsal-fin base length	14.5–15.6
Anal-fin base length	15.6–17.5
Caudal-peduncle length	8.6–10.9
Caudal-peduncle depth	9.5–11.0
D–P1*	32.6–36.5
D–P2*	32.9–38.5
D–A*	42.9–45.3
P1–P2*	22.1–24.5
P2–A*	26.6–30.5
Pectoral-fin length	18.1–19.4
Pelvic-fin length	10.3–11.6
Maxilla length	13.4–14.6
Lower-jaw length	16.8–18.2

*Abbreviations: D–P1 = distance from dorsal-fin origin to pectoral-fin insertion; D–P2 = distance from dorsal-fin origin to pelvic-fin insertion; D–A = distance between origins of dorsal and anal fins); P1–P2 = distance between insertions of pectoral and pelvic fins); P2–A = distance from pelvic-fin insertion to anal-fin origin.

slender, with single rows of numerous tiny spines on anterior and posterior faces. Gill rakers on second, third, and fourth arches curled outwards. Gill filaments longer than corresponding gill rakers.

Scales cycloid, thin, not deciduous; most body scales remain on preserved specimens; body scales with several centrally continuous vertical striae and numerous perforations and pores (Figure 3). Predorsal scales paired. No elongate wing-like scales present beneath normal paired scales. Longitudinally elongated sheath-like scales on bases of dorsal and anal fins. Scales absent on head and fins, except fine scales on central parts of both lobes of caudal fin.

Coloration. Body uniformly silver, dorsum blueish or greenish black. Upper part of lateral surface of body brownish silver. Upper part of head yellowish. Dorsal fin yellowish, anterior and dorsal margins black; central part of fin black. Pectoral, pelvic, and anal fins whitish, without melanophores. Caudal fin yellow, outer margin of fin black. Fine scales on caudal fin blight silver. Black blotch on cleithral region smaller than pupil.

Distribution. *Hilsa kelee* is widely distributed in the Indo-West Pacific from the eastern coast of Africa to Papua New Guinea in the east, and north to Zhejiang Province (Kanmen), China (Whitehead 1985; Munroe et al. 1999; Zhang 2001; Anderson 2022). Although Anderson (2022) stated that this species is not found in the Red Sea, Persian Gulf or Arabian Sea, it is known to be distributed in the waters of various countries on the Arabian Sea such as Pakistan and Oman (Psomadakis et al. 2015; Sarker et al. 2020). Biological research has been regularly conducted on the populations off the Pakistani coast (Panhwar et al. 2012, 2013; Khan et al. 2024). The species has also been recorded in the Persian Gulf (Al-Jufaili et al. 2010; Ali et al. 2018; Eagderi et al. 2019). Although distributional records of *H. kelee* from the Red Sea were not confirmed in this study, reports of the species from adjacent waters such as the Gulf of Aden and Djibouti are likely accurate (Whitehead 1965a, 1965b). In Taiwanese waters, *H. kelee* was previously reported from Penghu, Matsu, and Kinmen Islands (Shen 1984; Chen and Yu 1986) and is now recorded from the southwestern part of the main island of Taiwan (Ke-tzu-liao, Kaohsiung City; Figure 4).

DISCUSSION

Hilsa kelee was described by Cuvier (1829) based on an illustration in Russell (1803: pl. 195) of a specimen collected from Vizagapatam (currently Visakhapatnam), Andhra Pradesh, India. *Hilsa kelee* is now regarded as the only species of the genus, with seven junior synonyms recognized: *Clupeonia blochii* Valenciennes, 1847, *Alosa brevis* Bleeker, 1848, *Alausa kanagurta* Bleeker, 1852, *Alausa brachysoma* Bleeker, 1854, *Alosa malayana* Bleeker, 1865, *Clupea platygaster* Günther, 1868, *Clupea durbanensis* Regan, 1906 (Whitehead 1985; Kottelat 2013; Fricke et al. 2025). Whitehead (1985), in a major review of clupeoids of the world, indicated the northern limit of the distribution of *H. kelee* in the Pacific as Hong Kong, China. Subsequently, Zhang (2001) found that *H. kelee* also occurs along the Chinese coast from Kanmen, Zhejiang Province to Hainan Island, but the species is not common in Chinese waters.

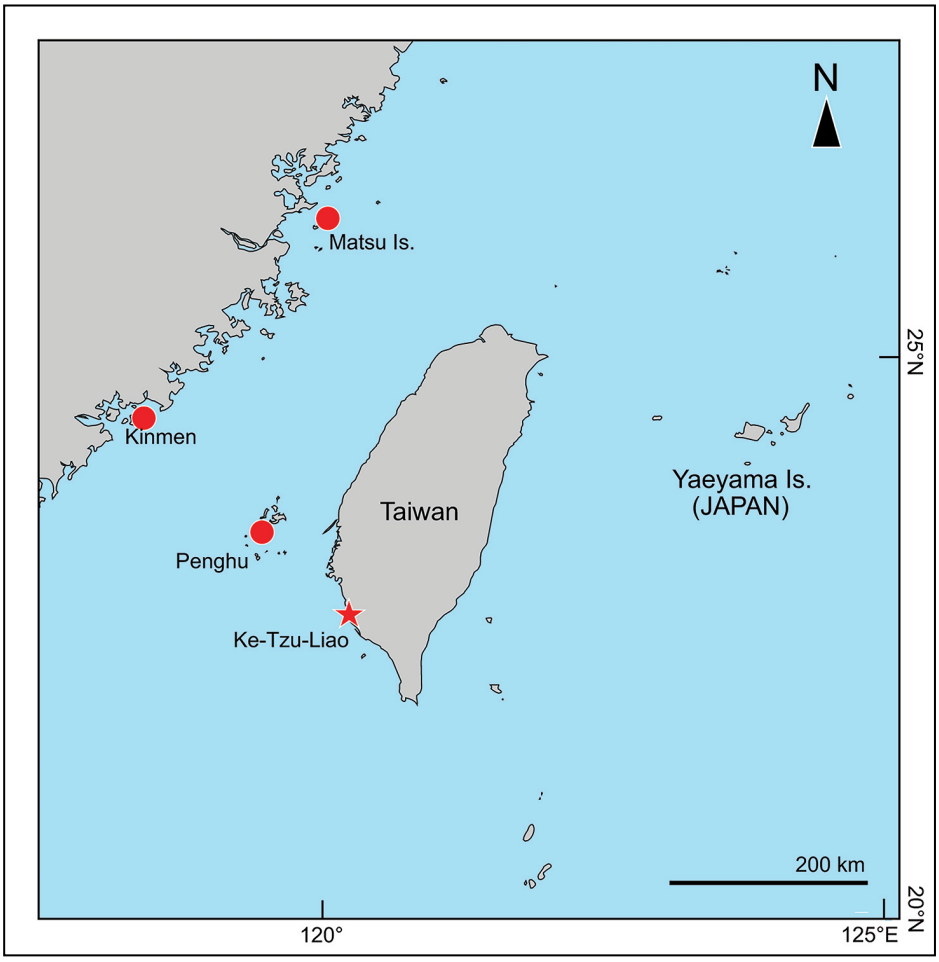

Figure 4. Records of *Hilsa kelee* in Taiwanese waters. Star and circles represent the localities of the specimens examined in this study, and previously published records, respectively.

A few studies reported on the occurrence of *H. kelee* in Taiwanese waters. Shen (1984) stated that *H. kelee* is a species native to the coastal waters of mainland China, being extremely rare in Taiwanese waters, with just occasional records in Penghu, Kinmen, and Matsu Islands. Subsequently Chen and Yu (1986) reported that *H. kelee* (as *Macrura kelee*) is occasionally recorded in Penghu Islands, referring to Shen (1984). Shen and Wu (2011) showed an illustration of *H. kelee* and included the species in the list of fishes of Taiwan. However, they did not indicate the specimens on which their records were based, nor did they provide information on the distributional range of the species. Therefore, our new records of the species represent the first confirmed from the main island of Taiwan. In addition, voucher specimens for the records of *H. kelee* from other islands of Taiwan made by Shen (1984) were not provided, and specimens of the species were not located in any Taiwanese collections or other collections checked. Therefore, this is also the first specimen-based record of the species from Taiwan in general. In addition, specimens of *H. kelee* collected from Matsu Islands are also deposited in the NMMB-P fish collection (see comparative materials).

The ichthyofauna in southwestern Taiwan, including Ke-tzu-liao Fishing Port, has been intensively surveyed for a long time. A comprehensive survey of clupeiform fishes in the region was conducted in the late 2010s, but specimens of *H. kelee* were not observed at that time (Hata 2019, 2020). On 21 March and 7 April 2025, when the specimens described here were collected from the catches of local fishers, large quantities of *H. kelee* were landed. In addition, since 2023, the species has also been frequently observed in large quantities at Ke-tzu-liao Fishing Port, indicating that population sizes in southwestern Taiwan may have increased in recent years. Ovarian eggs (ca. 0.4–0.5 mm in diameter) were also found in one of the specimens collected (OISTICH 920, 163.8 mm SL) suggesting that *H. kelee* may reproduce in Taiwanese waters.

In addition to *H. kelee*, *Scomberoides tala* (Cuvier, 1832), a carangid fish mainly distributed in the tropical Indo-west Pacific south of Philippines, has been newly recorded in recent years in the coastal waters of southwestern Taiwan. It has been suggested that the record of *S. tala* in Taiwan is related to rising sea temperatures (Su et al. 2025). It remains unclear, however, whether this also contributes to the apparent increase in the abundance of *H. kelee* in Taiwan. The ichthyofauna in southwestern Taiwan is thought to be undergoing significant changes based on fisheries surveys, and continued observation is necessary. Although *H. kelee* has been reported as not forming large schools (Whitehead 1985; Krishna Pillai and Kasinathan 1995; Munroe et al. 1999), several hundreds or even >1,000 individuals were landed at Ke-Tzu-Liao Fishing Port in a single occasion on 21 March and 7 April 2025, suggesting that large schools of the species are now present in southwestern Taiwan.

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ADDITIONAL INFORMATION

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

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Author contributions

Conceptualization: HH. Data curation: HH, HCH. Investigation: HH, HCH. Methodology: HH, HCH. Resources: HCH, LS. Supervision: HCH, LS. Writing – original draft: HH, HCH. Writing – review and editing: HH, HCH, LS.

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Data availability

All data that support the findings of this study are available in the main text.

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