First Record of Two Species of Engraulids, *Thrissina gautamiensis* Babu Rao, 1971 and *Stolephorus tamilensis* Gangan, Pavan-Kumar, Jahageerdar and Jaiswar, 2020 (Engraulidae: Clupeiformes) from the West Coast of India

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ABSTRACT

The coastal regions of India, encompassing the Bay of Bengal to the east and the Arabian Sea to the west within the northern Indian Ocean, host diverse marine ecosystems. This study focuses on fish specimens collected during a survey conducted in Goa, situated along the western coast of India. Morphological examination of the collected samples revealed the presence of two anchovy species, *Thrissina gautamiensis* Babu Rao, 1971 and *Stolephorus tamilensis* Gangan, Pavan-Kumar, Jahageerdar and Jaiswar, 2020, marking their inaugural documentation on the western coast of India. Distinguishing characteristics such as the termination of the maxilla before the base of the pectoral fin, a body depth comprising 23–28% of the standard length, presence of enlarged teeth in both upper and lower jaws, as well as the counts of gill rakers and anal fin rays, were utilized to differentiate *T. gautamiensis* from its congeners. Conversely, diagnostic traits including a concave pre-opercular margin, the absence of a pre-dorsal spine and a double-pigmented line posterior to the dorsal fin, as well as the lack of scattered melanophores between the dorsal fin and caudal peduncles, along with gill raker counts, were employed to confirm the identification of *S. tamilensis*. Comparative analysis of the morphological features of the examined specimens with those of the holotypes of both species further corroborated their taxonomic assignments. This discovery underscores the need for comprehensive investigations into the diversity, distribution, and ecological dynamics of small pelagic species inhabiting Indian waters.

Keywords: Anchovy, Arabian Sea, Goa, Northern Indian Ocean, Taxonomy

INTRODUCTION

Engraulids, commonly referred to as anchovies, represent a prevalent species of small pelagic fish abundantly distributed in tropical and temperate seas worldwide (Ganga, 2015). Presently, the taxonomic classification encompasses approximately 187 recognized species across 16 genera globally (Fricke *et al*., 2024). Anchovies play a significant role in fisheries, contributing substantially to the global fish production. In India, anchovy populations support artisanal fisheries, constituting a crucial source of income for traditional fisherfolk (Khan *et al*., 2004). Currently, five genera of engraulids are documented within Indian waters: *Encrasicholina*, *Stolephorus*, *Setipinna*, *Thrissina*, and *Coilia* (Ganga, 2015).

The genus *Thrissina* Jordan and Seale, 1925 comprises 29 globally recognized species (Fricke *et al*., 2024), with 18 species documented in India (Saren *et al*., 2019; Hata and Motomura, 2019). Recorded species within the Indian context include *Thrissina baelama* (Forsskal, 1775), *Thrissina cultella* (Hata and Motomura, 2019), *Thrissina dayi* Wongratana, 1983, *Thrissina dussumieri* (Valenciennes, 1848), *Thrissina encrasicholoides* (Bleeker, 1852), *Thrissina gautamiensis* Babu Rao, 1971, *Thrissina*

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hamiltoni (Gray, 1835), *Thrissina kammalensis* (Bleeker, 1849), *Thrissina kammalensoides* Wongratana, 1983, *Thrissina malabarica* (Bloch, 1795), *Thrissina mystax* (Bloch and Schneider, 1801), *Thrissina polybranchialis* Wongratana, 1983, *Thrissina purava* (Hamilton, 1822), *Thrissina serena* (Hata and Motomura, 2019), *Thrissina setirostris* (Broussonet, 1782), *Thrissina spinidens* (Jordan and Seale, 1925), *Thrissina stenosoma* Wongratana, 1983, and *Thrissina vitrirostris* (Gilchrist and Thompson, 1908). This genus represents a significant pelagic resource in India, contributing approximately 22–30% of the country's total engraulid landings annually (CMFRI, 2022; 2023). Previous investigations (Rao, 1966; Saren *et al*., 2019; Gangan *et al*., 2020; Gouda *et al*., 2023) have highlighted a higher abundance of *Thrissina* species along the east coast of India compared to the west coast (Table S1). Notably, species such as *T. vitrirostris, T. hamiltonii, T. dussumieri* and *T. mystax* exhibit widespread distribution in Indian waters, while T. *baelama, T. serena*, and *T. spinidens* are comparatively less prevalent.

The genus *Stolephorus* Lacepede, 1803 comprises 38 species globally, with a notable abundance in the Indo-Pacific region (Gouda *et al*., 2023). Among these, 11 species have been identified in India, including *Stolephorus andhraensis* Babu Rao, 1966, *Stolephorus baweanensis* Hardenberg, 1933, *Stolephorus tamilensis* Gangan, Pavan-Kumar, Jahageerdar and Jaiswar, 2020, *Stolephorus mercurius* Hata, Lavoué and Motomura, 2021, *Stolephorus rex* Jordan and Seale, 1926, *Stolephorus bengalensis* (Dutt and Babu Rao, 1959), *Stolephorus indicus* (van Hasselt, 1823), *Stolephorus tri* (Bleeker, 1852), *Stolephorus hindustanensis* Hata and Motomura, 2022, *Stolephorus taurus* Hata, Lavoue and Motomura, 2022 and *Stolephorus dubiosus* Wongratana, 1983 (Nair and Kumar, 2018; Gangan *et al*., 2020; Hata and Motomura, 2022a; Hata and Motomura, 2022b; Hata *et al*., 2022a; Hata *et al*., 2022b). *Stolephorus* constitutes a significant genus, contributing substantially (43-56%) to the total engraulid landings in India (CMFRI, 2022; 2023). Previous investigations (Krishnan and Mishra, 1993; 1994; Mishra and Srinivasan, 1999; Barman *et al*., 2000; Mishra and Krishnan, 2003; Kottelat, 2013; Suresh *et al*., 2018; Hata and Motomura, 2019; Gangan *et al*., 2020; Gouda *et al*., 2023) have indicated a higher species richness of *Stolephorus* along the west coast of India compared to the east coast (Table S2). Species such as *S. baweanensis, S. bengalensis,* and *S. indicus* are reported to be more abundant in Indian waters, while occurrences of *S. dubiosus, S. hindustanensis, S. mercurius,* and *S. rex* are comparatively limited.

In this study, several engraulid samples were collected from the western coastline of India. Morphological assessments revealed the absence of two species classified under the genera *Thrissina* and *Stolephorus*, hitherto unrecorded from the region. Consequently, this study documents the first occurrences of the engraulid species *Thrissina gautamiensis* and *Stolephorus tamilensis* on the western coast of India.

MATERIALS AND METHODS

Fish specimens used in this study were sourced from a recent survey conducted in Goa, a state situated along the western coast of India, as part of an internal research initiative of the Zoological Survey of India (ZSI), headquartered in Kolkata. A total of twenty specimens of *Thrissina* and three specimens of *Stolephorus* were collected from the local fish landing area at Siridao beach (15.43883°N, 73.861597°E), Goa (Figure 1). Upon collection, the specimens were promptly cleaned and preserved in 10% formalin. Subsequently, in the laboratory setting, detailed morphometric and meristic analyses were conducted (Shafi *et al*., 2021), with each specimen being identified at the species level using established references and keys (Talwar and Kacker, 1984; Gangan *et al*., 2020; Froese and Pauly, 2024). Furthermore, a comparative assessment of the collected specimens with the respective holotypes (available in the National Zoological Collections of ZSI; *T. gautamiensis*: Holotype Reg. No ZSI F4600/2, *S. tamilensis*: Holotype Reg. No ZSI F12077/2) was undertaken (Figure 2). All specimens were duly registered and archived within the National Zoological Collections of ZSI, Kolkata.

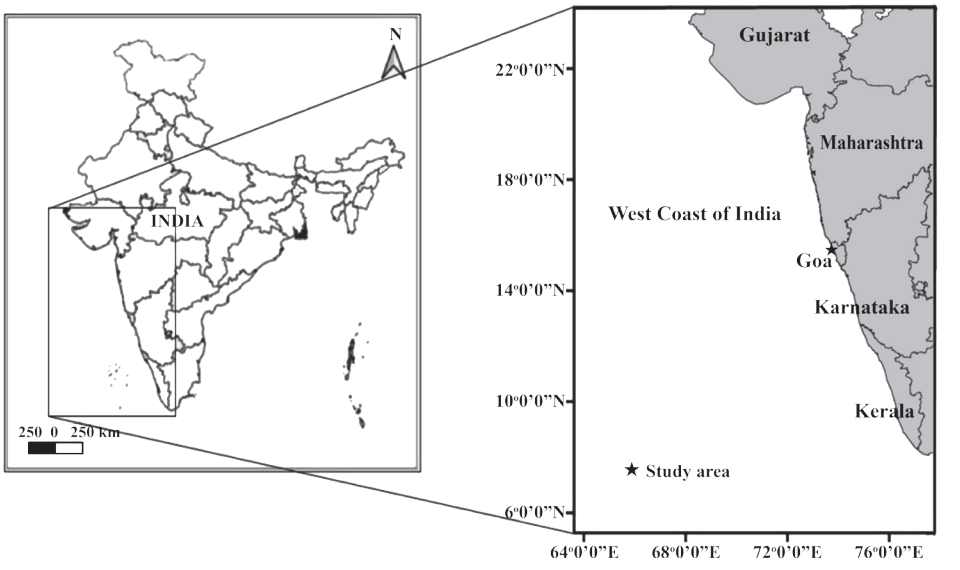

Figure 1. Map of the study area showing Goa along the west coast of India

Figure 2. (a) Type specimen of *Thrissina gautamiensis* (standard length: 103.3 mm) (Reg. No. ZSI F4600/2); (b) Collected specimen of *Thrissina gautamiensis* (standard length- 91 mm) (Reg No. ZSI F15448/2); (c) Type specimen of *Stolephorus tamilensis* (Reg No. ZSI F12077/2) (standard length- 50 mm); (d) Collected specimen of *Stolephorus tamilensis* (standard length- 90.6 mm) (ZSI F15544/2).

RESULTS

Thrissina gautamiensis Babu Rao, 1971

Material examined

Twenty specimens (standard length- 70–119.4 mm) of *T. gautamiensis* were identified and maintained under National Zoological collections (specimens 1 and 2: Registration No. ZSI F15541/2 [standard length: 73.7–75 mm], specimens 3–15: Registration No. ZSI F15448/2 [standard length: 70–97.4 mm], specimens 16–20: Registration No. ZSI F15436/2 [standard length: 76.3–119.4 mm]).

Diagnostic characters

The tip of the snout at the same level as the upper rim of the eye. Moderate maxilla with posterior tip extending a little beyond the edge of the gill cover. First supra maxilla is minute and oval. The teeth is slightly enlarged. A dark blotch present behind the upper part of the opening of the gill; two dark lines present on the back.

General description

Standard length ranges from 70 to 119.4 mm with the average value being 84.46 mm ±11.7. The percentage of average value in standard length: body depth 27.3%; head length 25.20% (average of body depth: 23.4±3.68; head length: 21.28± 2.80). Percentage of average value in head length: snout length 22.2% (average of snout length: 4.35±0.71). The total number of scutes 24–25; the pre-pelvic scutes: 14 or 15; and the post-pelvic scutes: 10 in number. Pectoral-fin rays 13; pelvic-fin rays 7; dorsal-fin rays 12; and anal-fin rays 36 or 37. The gill rakers of the first-gill arch on the lower limb 17–20 and the upper limb 11–14.

Remarks

The morphological characteristics of the examined specimens were compared with those of the holotype of *Thrissina gautamiensis*. It was observed that the studied specimens exhibited congruent traits with both the holotype and the general species descriptions (Table 1).

Table 1. Morphometric and meristic characters of the type and studied specimens of *Thrissina gautamiensis* from the National Zoological Collections

Morphological characters	***Thrissina gautamiensis* (holotype: Reg. No.F4600/2)**	***Thrissina gautamiensis* studied specimens**
Standard length	103.3 mm	70–119.4 mm
Body depth	27 mm	18.2–33.6 mm
Body depth in % standard length	26.1	26–28
Head length	25 mm	16.5–30 mm
Head length in % standard length	24.2	23.5–25.1
Snout length	4.5 mm	2.8–5.8mm
Snout length in % head length	18	17–19
Pre pelvic scutes	15	14–15
Post pelvic scutes	10	10
Total number of scutes	25	24–25
Dorsal fin rays	12	12
Anal fin rays	36	36–37
Pectoral fin rays	13	13
Pelvic fin rays	7	7
Number of gill rakers on lower limb of first gill arch	20	17–20

Stolephorus tamilensis Gangan, Pavan-Kumar, Jahageerdar and Jaiswar, 2020

Material examined

Three specimens (standard length: 88.4–90.6 mm) of *S. tamilensis* were identified and maintained under National Zoological collections (specimens 1 and 2: Registration No. ZSI F15464/2 [standard length: 88.4–89.4 mm], specimen 3: Registration No. ZSI F15544/2 [standard length: 90.6 mm]).

Diagnostic characters

The body cylindrical and slightly compressed. The dorsal and ventral profiles of the head slightly convex. The posterior margin of preopercle concave and indented. A single row of slender and pointed teeth present on premaxilla, maxilla and the lower jaw. The region of the dorsum and the suborbital region containing many melanophores. Two dark-pigmented lines are found to be present on the dorsum region just before the dorsal fin. The pelvic fin lacking any spine and scute absent in the pre-dorsal and post-pelvic region. The snout long and rounded with length less than the diameter of the eye. The mouth sub-terminal, its corner extending beyond the posterior margin of the eye. Eyes large and round and eyelids containing adipose tissue.

General description

The standard length ranges from 88.4 to 90.6 mm with the average value as 89.47 mm ± 0.90. Percentage of average value in standard length: body depth 20.6%; head length 23.9% (average value of body depth: 18.46±1.43; head length: 21.36±0.66). Percentage of average value in head length: snout length 21.67% (average value of snout length: 4.63 ±0.68). The pre-pelvic scutes are 5–6. pectoral-fin rays 13; pelvic-fin rays 7; anal-fin rays 19; and dorsal-fin rays 14 or 15. The gill rakers on the first gill- arch lower limb 25 to 27 and the upper limb 15 and 16.

Remarks

The morphological characters of the studied specimens were compared with the characters of holotype of *Thrissina gautamiensis*, and it is observed that the studied specimens possess matching characteristics with holotype and species general descriptions (Table 2).

Table 2. Morphometric and meristic characters of the type and studied specimens of *Stolephorus tamilensis* from the National Zoological Collections.

Morphological characters	***Stolephorus tamilensis* (holotype: Reg. No.F12077/2)**	***Stolephorus tamilensis* studied**
Standard length	50 mm	88.4–90.6 mm
Body depth	9 mm	15.5–20.5
Body depth in % standard length	18	-22.6
Head length	11.4 mm	19.8–22.3
Head length in % standard length	22.8	22.3–24.6
Snout length	2.4 mm	4.1–5
Snout length in % head length	21.1	20.7–22.4
Pelvic scutes	6	5–6
Total number of scutes	6	5–6
Dorsal fin rays	14	14–15
Anal fin rays	19	19
Pectoral fin rays	13	13
Pelvic fin rays	7	7
Number of gill rakers on lower limb of first gill arch	26	25–26

DISCUSSION

The species *Thrissina gautamiensis* is historically documented along the northern reaches of the Indian Ocean, with its initial report in India originating from the Gautami branch of the Godavari estuary in Andhra Pradesh by Rao (1971). Subsequent sightings extended to various states along the East Coast of India, including West Bengal, Andhra Pradesh, and Odisha. Conversely, *Stolephorus tamilensis*, a relatively recent taxonomic species, was firstly described in 2020 from the Tamil Nadu state along the East Coast of India, with no further reported occurrences.

Our study clearly identified the occurrence of *T. gautamiensis* and *S. tamilensis* in the west coast of India, with the study on different morphological characteristics. *T. gautamiensis* has a long maxilla crossing gill cover, but not reaching the pectoral fin base (Rao, 1971), closely similar to *T. hamiltoni, T. kammalensis, T. kammalensoides, T. malabarica, T. purava, T. spinidens* and *T. polybranchialis*. The number of gill rakers in *T. gautamiensis* (17–20) is clearly different from *T. hamiltoni* (11–15), *T. kammalensis* (26–32), *T. kammalensoides* (24–25), *T. polybranchialis* (25–27), 1983 and *T. spinidens* (13–15), and is overlapping with species such as *T. malabarica* (17–19), *T. purava* (17–21) and *T. cultella* (20–23). For further identification another important character, the number of anal fin rays, is considered and it is 36–43 in *T. gautamiensis*, which is clearly different from *T. cultella* (31–34). The standard length to the body depth ratio of *T. malabarica* has a marked difference from *T. gautamiensis* (23–28% in *T. gautamiensis* vs. 34–37% in *T. malabarica*). Also, *T. purava* differs from *T. gautamiensis* by having enlarged teeth only in lower jaws vs enlarged teeth both in upper and lower jaws in *T. gautamiensis* (Talwar and Kacker, 1984).

For the identification of *Stolephorus tamilensis*, the shape of the pre-opercular margin acts as a main characteristic feature; it is concave in *S. tamilensis, S. dubiosus, S. bengalensis, S. taurus* and *S. andhraensis*, it is convex in *S. tri, S. mercurius, S. rex, S. baweanensis* and *S. indicus* (Gangan *et al*., 2020), whereas it is indented in *S. hindistanensis*. A small predorsal spine and the double-pigmented line behind the dorsal fin are present in *S. dubiosus, S. bengalensis* and *S. taurus*, but are absent in *S. tamilensis* (Gangan *et al*., 2020; Gouda *et al*., 2023). *S. andhraensis* is distinguished from *S. tamilensis* by the number of gill rakers (25–28 in *S. tamilensis* vs. < 22 in *S. andhraensis*). In addition, presence of scattered melanophores between dorsal fin and caudal peduncle recorded in *S. andhraensis* is absent in *S. tamilensis*, whereas a paired pigmented line after dorsal fin is present in *S. tamilensis*, which is not recorded in *S. andhraensis* (Gangan *et al*., 2020).

Thus, the examined specimens were unequivocally identified as *T. gautamiensis* and *S. tamilensis* based on their distinctive morphological features. *Thrissina gautamiensis* was characterized by the presence of a maxilla that extends beyond the gill cover but does not reach the pectoral fin base, a body depth ranging from 23–28% of the standard length, enlarged teeth present in both upper and lower jaws, a gill raker count of 17–20, and an anal fin ray count of 36–43. On the other hand, *S. tamilensis* was distinguished by a concave pre-opercular margin, absence of a pre-dorsal spine and double-pigmented line behind the dorsal fin, lack of scattered melanophores between the dorsal fin and caudal peduncles, and a gill raker count of 26–28. Furthermore, comparison with the morphological characteristics of the holotypes of both species revealed consistent traits, confirming their accurate identification.

CONCLUSION

Anchovies, members of the Engraulidae family, are renowned as small pelagic fishes and represent a vital component of global pelagic resources. Their significance extends to the artisanal fishery sector and significantly contributes to annual fish landings in India. In this context, the present study unveils a noteworthy occurrence, marking the first documentation of two engraulid species, *Thrissina gautamiensis* and *Stolephorus tamilensis*, on the west coast of India. This revelation adds to our understanding of the distribution and ecological dynamics of these species within Indian waters, shedding light on their broader geographical range and underscoring the need for further research and conservation efforts in the region.

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