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PHYLOGENETIC ANALYSIS AND REDESCRIPTION OF THRYSSA STENOSOMA (TELEOSTEI: CLUPEIFORMES: ENGRAULIDAE) COLLECTED FROM PURI, ODISHA, BAY OF BENGAL

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ABSTRACT

The genus *Thryssa*, part of the Engraulidae family, is crucial to fisheries resources along the Indian coast. An accurate identification is essential for effective management and fishing practices. This study aims to resolve the overlapping characteristics and uncertainties between *T. stenosoma* and other closely related species within the genus. *Thryssa stenosoma* is distinguished by 40-45 anal fin rays 17-19 gill raker on the first lower gill arch, and 25-27 pre- and post-pelvic scutes. Key identification features include its long maxilla, which reaches the pectoral fin base or slightly beyond. This work provides the first barcode sequence of the least investigated *T. stenosoma*, an endemic species in this region, detailing its distribution, redescription, and phylogenetic placement.

KEYWORDS: Anchovy, Barcode, COI, Indian waters, Taxonomy

INTRODUCTION

The Genus *Thryssa* consists of small, slender, and elongated anchovies that form large schools and hold significant ecological and commercial value across many regions globally. Of the 37 species identified worldwide, 18 are recorded in India [1]. In 2021, *Thryssa* species accounted for 1.3% of the total marine landings in India [2]. Gill nets and mini purse seines are the major fishing gear employed in their fishery. These fish are caught unintentionally along with other target species. These anchovies are typically found at depths of less than 50 meters. Beyond human consumption, *Thryssa* species are also utilized in the production of fishmeal and fish oil. These species are characterized by having medium-compressed or strongly-compressed bodies with 21 to 32-keeled scutes on the abdomen, extending from before the pectoral fin base to the anus [3]. The length of their maxilla can vary from short to very long, with 25-45 branched anal-fin rays [3]. Numerous authors have hinted at the taxonomic analysis of various *Thryssa* species [4-8]. Recently, Hata redescribed two nominal species previously regarded as junior synonyms of *Thryssa mystax* [1]. Studies on the taxonomy of *T. stenosoma* are limited. The present study aims to reveal valuable information about the phylogeny, redescription, and distributional status of *T. stenosoma* from north-south landing centers of Puri, Odisha, East coast of India.

MATERIALS AND METHODS

Twenty specimens of *T. stenosoma* were collected from small landing centers of Puri, Odisha, India (19° 44' 24'' N, 85° 12' 37'' E) from January 2020 to December 2023. Caught using gill nets at a depth of 15-20 meters, the samples were ice-packed immediately and transported to the lab. Morphometric measurements were taken using a vernier caliper (accuracy 0.1 cm), while total weight (TW) was recorded using an electronic balance (accuracy 0.01 g). Meristic traits were counted, with key taxonomic features like gill raker counts analyzed under a stereo zoom microscope. Species identification followed by Whitehead et al., (1988) For genetic analysis, approximately 100 mg of white muscle tissue from each specimen was preserved in 95% ethanol.

DNA Extraction And Pcr Condition

Genomic DNA extraction used the Phenol Chloroform method [9], and PCR was conducted for mitochondrial COI sequences using LCO1490/HCO2198 primers [10]. Amplifications were performed on a PTC 200 gradient thermal cycler, in 25 µL reaction volumes with necessary reagents. PCR products were purified with a Qiagen kit and sequenced at Eurofins Scientific, Bangalore. Chromatograms were analyzed using ABI Sequence Editor 3.3.

DNA Sequencing And Analysis

Sequencing used forward and reverse primers to confirm nucleotide bases. Edited sequences were aligned in MEGA version 11 [11], and the study sequence was deposited in GenBank (Accession: PP413701). Phylogenetic analysis, incorporating seven NCBI GenBank sequences and an outgroup (*Encrasicholina punctifer*, HQ564397), was conducted using the Maximum Likelihood (ML) method.

RESULTS AND DISCUSSION

Taxonomy

Class: Actinopterygii
Order: Clupeiformes
Family: Engraulidae
Genus: *Thryssa*, Cuvier 1829.
Species name: *Thryssa stenosoma* (Fig.1), Wongratana, 1983

Fig. 1 Species *T. stenosoma* collected from Puri, Odisha, India

Distribution:
Thryssa stenosoma is known only from the northern part of the Bay of Bengal, the east coast of India, Andhra Pradesh, Odisha, and West Bengal.

Description
The specimens showed the following characteristics: 11-12 dorsal fin rays; 40-45 anal fin rays; 10-12 pectoral fin rays; 17-19 gill rakers on first lower gill arch. Belly with 15-17 pre-pelvic and 9-11 post-pelvic scutes, totaling 25-27 scutes overall (Table 1). These fish had elongated and relatively slender bodies, with the tip of snout positioned slightly above center of eye. Long maxilla reached pectoral fin base or extended slightly beyond. First supra-maxilla notably small and oval, with slightly enlarged teeth on lower jaw. Serrae on gill raker not clumped. Faintly discernible dark blotch either absent or present behind upper part of gill opening, while pair of dark pigmented lines adorned dorsal side. Flanks and belly displayed a silvery, with noticeable pre-dorsal spine.

Species name	***T. stenosoma***	
No. of specimens examined	n=20	
Standard length (SL mm)	86-134	
Morphometric characters		
in % of SL	Range	Mean ± standard deviation
Eye diameter	4.1-7.1	5.1±0.8
Snout length	3.6.2-5.2	3.8±0.5
Inter orbital length	11.1-13.9	12.4±1
Maxilla length	20.4-24.8	22.5±1.4
Head length without maxilla extension	18.3-24.4	20.6±1.9
Head Height	20.4-25.5	22.5±1.6
Snout to inter-orbital	5.4-7.2	6±0.6
Snout to dorsal fin origin	47.8-52.3	49.5±1.5
Snout to anal fin origin	47.3-65	56.1±5.6
Snout to pectoral fin origin	21.5-26.6	22.8±1.6
Snout to pelvic fin origin	32.3-41.3	36.5±3.2
Distance between pelvic to anal	19.2-25.2	22.1±1.6
Dorsal fin base length	6.2-9.5	7.4±1.1
Anal fin base length	25.6-38.7	34.8±3.9
Pectoral fin base length	3.7-5.5	4.6±0.7
Pelvic fin base length	1.4-2.1	1.8±0.2
Caudal peduncle length	7.7-12.9	10±1.9
Caudal peduncle depth	9.2-11.1	9.9±0.6
Caudal peduncle width	0.4-1.3	1±0.4
Caudal length	15.5-26.3	21.1±3
Dorsal fin length	15.1-18.9	17.5±1.5
Anal fin length	12.3-15.8	14±0.9
Pectoral fin length	14.2-19.5	16.8±3
Pelvic fin length	8.9-14.4	10.9±2.9
Upper jaw length	11.8-17.7	13.9±1.6
Post orbital length	8.5-10.9	9.3±0.7
Head width	5.6-9.2	7±1
Body depth at dorsal	25.8-29.5	27.4±1.2
Body depth at anal	21.5-25.5	23.7±1.4
Meristic counts	Range	Mode
Dorsal fin rays (unbranched)	3	3
Dorsal fin rays (branched)	11-12	11
Anal fin rays (unbranched)	3-4	3
Anal fin rays (branched)	40-45	43
pectoral fin rays (unbranched)	1	1
pectoral fin rays (branched)	10-12	12
First gill raker count (lower)	17-19	18
Pre pelvic scutes	15-17	15
Post pelvic scutes	9-11	11
Total scutes	25-27	26

Table 1 The ratio of parameters of T. stenosoma to standard length

Key to the genus *Thryssa* recorded from the east coast of India:
The major distinguishing characteristics of all the *Thryssa* species are as follows:

I. Maxilla very long, reaching at least halfway along the pectoral fin and to the pelvic fin base, lower gillraker 17-19; the serrae on the inner edge in distinct clumps…….. *T. dussumieri* Valenciennes, 1848.
II. Maxilla tip is not beyond the pectoral fin tip.
   A. Maxilla is short, not reaching the pectoral fin base.
      1. Anal fin rays 32-39; lower gillraker 11-13; pigmented lines along back, body depth 28.5-32.0% of SL…… …..……*T. malabarica* Bloch, 1795.
      2. A 30-33; lower gillraker 26-32; A diffuse dark saddle on nape…….…… ……..…..*T. kammalensis* Bleeker, 1849.
      3. A 34-38; lower gillraker 17-19; small spots on the cheek, gill cover, maxilla, and paired fins, body depth 33.8 to 38.8% of SL…… ….……*T. cuvierii* Swainson, 1839.

   B. Maxilla long, reaching to pectoral fin base.
      1. Maxilla long, reaching almost the base of first pectoral fin ray, lower gill rakers 14-16; Anal fin rays 29-37, pre-dorsal length ≤53.3% of SL, second supra-maxilla length ≤6.3% of SL

…… *T. mystax* (Schneider, 1801).

2. Teeth in lower jaw slightly enlarged, A 40-45… ……*T. stenosoma* (Wongratana, 1983).
3. Maxilla long, reaching beyond base of first pectoral fin ray. Gill rakers on first lower gill arch 21-23, Anal fin 31-34, long pelvic fin length 8.6-10.1% of SL, body depth 24.7-25.41% of SL, 9-10 transverse scale…… *T. cultella* Hata and Motomura, 2019.

We compared the morphometric data of every species with earlier studies [12-13]. The identification of the genus *Thryssa* is usually based on the combination of distinctive characteristics, such as the length of the maxilla which may be short (reaching the preopercular), medium (to the gill slits), long (to the base of pectoral fin), or very long, (reaching pelvic fin base or beyond) [3]. Wongratana [12] was the first to document the presence of *T. stenosoma* in the Godavari estuary, we compared our findings with their work and noted a resemblance in the count of anal fin rays and the number of the gill rakers. Psomadakis [13] observed the taxonomy of nine species from the Godavari estuary, including *T. stenosoma*. We contrasted our results with their contributions and found that our findings concur with their conclusion.

According to our findings, *T. stenosoma* shares close similarities with eight other species, *T. dayi*, *T. mystax*, *T. vitrirostris*, *T. cultella, T. serena, T. dussumieri,* and *T. setirostris*. Two of these species *T. setirostris* and *T. dussumieri* stand out for having a long maxilla that reaches to the pelvic fin or halfway to the pectoral fin. The maxilla length of the remaining six species extends to the base of the pectoral fin ray. Among the Indian water species, *T. stenosoma* resembles *T. mystax* and *T. dayi*. Species *T. mystax* differs from *T. stenosoma* in its gill raker count, which ranges from 14-16, whereas in *T. stenosoma* it was found to be 17-19. Species *T. vitrirostris* and *T. dayi*, are characterized by deeper bodies and are absent in the Bay of Bengal. The body depth with the standard length of *T. dayi* was around 26% of SL [3], whereas in *T. stensoma*, it ranges from 25.8-29.5% of SL. In *T. mystax* and *T. vitrirostris* the anal fin rays are often fewer than 40, while in *T. stenosoma* they have been observed to range between 40-45. In these species, a dark blotch was found behind the gill opening, while in *T. stensoma* it was indistinct or absent. According to Whitehead [3], *T. stenosoma* was previously misidentified as T. purava.

The phylogenetic reconstruction of *Thryssa* indicates that individuals of the same species form distinct clusters (Fig.2). This study marks the first attempt to reveal the phylogeny of *T. stenosoma* from Indian waters and shows its closest connection with *T. dussumieri* and *T. cuvierii*. They clustered together with a common ancestor. The morphological traits of *T. dussumieri* do not entirely match those of *T. stenosoma*. This study emphasizes the need for further research to explore the evolutionary relationship within this genus.

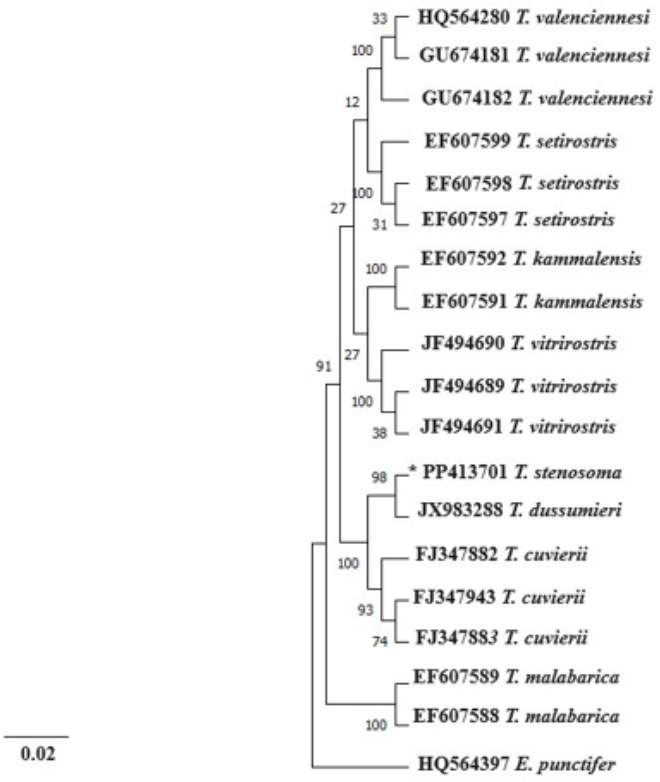

Fig. 2 Represents the maximum-likelihood (ML) phylogenetic tree of the genus *Thryssa* based on MEGA 11. Number of nodes indicates the bootstrap value. HQ564397 (*E. punctifer*) from GenBank was included as an out-group species. The Asterix indicates the accession number of species generated in this study.

CONCLUSION

The present report reveals a note on the occurrence, redescription, and phylogenetic analysis of *T. stenosoma* from Puri, Odisha, Bay of Bengal, India. Each specimen was accurately identified, and their characters were compared. A phylogenetic tree of the genus *Thryssa* was reconstructed and an endemic species, *T. stenosoma* was highlighted to register the COI sequence for the first time in GenBank. This study will be useful as baseline information for evolutionary biologists for future studies.

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Conflict of Interest: The authors have no competing interests.

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