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**A note on the occurrence of reef inhabiting, red-bellied yellow tail fusilier, *Caesio cuning* from outside known geographical array**

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*The reef inhabiting fusilier, Caesio cuning (Bloch, 1791) characterized by pinkish abdomen and yellow caudal fin exhibits shoaling behaviour and is known to be geographically distributed from the Gulf of Mannar to Vanuatu Islands in the South Pacific. The present observation is an evidence for the first record of this species off Goa, West coast of India outside the known geographical array. The bay-estuarine and coastal region of Goa influenced by southwest monsoon receives nutrient-rich water during upwelling. Hence, the region is highly productive and supports diverse marine assemblages. Moreover, the present observation reveals very low numbers (n = 4) of this species in the light of the trawl hauls (n = 92) with a core sampling effort of 146 hours, wherein it was found to occur only in two hauls. The paper also provides detailed insight into the description of C. cuning from this region with orthodox taxonomic methods including morphometry and meristic counts.*

**Keywords:** Reef inhabiting, *Caesio cuning*, first record, geographical array, Goa, West coast of India

## INTRODUCTION

The zoo-geographical range of a species refers to the distribution of a species, either horizontal or vertical, largely determined by the pervasiveness of certain environmental anomalies and biotic components those favour establishment of the species, and whose boundaries are defined by gradual dilution or abrupt termination of these components. Coastal ecosystems being dynamic are rich in diverse assemblages with estimates of about 80 % of marine fauna inhabiting these areas (Anon., 1989; Ray, 1988, 1991) with highly overlapping boundaries those are influenced by complex relationships among varying niches in the marine environment. These coastal areas also support rare fish species (Engel & Kvitek, 1998; Froese & Pauly, 2008) predominantly belonging to two finfish orders, namely Perciformes (perch-like fishes) and Scorpaeniformes (scorpion fishes, rock fishes and sting fishes) (Froese & Pauly, 2008). Among the perch-like fishes, the fusiliers belonging to the family Caesionidae are particularly unique with regards to evolutionary trends those display transition from benthic carnivorous to semi-pelagic planktivorous behaviour (Carpenter, 1988).

The inshore shelf waters of Goa, Central West coast of India up to 20 m depth are subjected to anthropogenic inputs such as commercial trawling (Ansari *et al.*, 1995, 2003) and maritime activities (Anil *et al.*, 2002) those pose a potential threat to coastal ecosystems and the resident biota. The present paper describes the new record of occurrence of rare fusilier species, *Caesio cuning* (Bloch, 1791) found outside its geographical locale in the coastal waters of Goa along the West coast of India.

## MATERIALS AND METHODS

The present study area encompasses the Mandovi – Zuari estuarine complex (Figure 1) and the adjacent fishing grounds up to 20 m depth those subjected to increased level of exploitation by commercial trawl operations. The potential fishing grounds located between 15°29'N and 15°34'N latitudes and between 73°40'E and 73°51'E longitudes were selected for intensive sampling. During the present study period (May, 2005 to May, 2008), intensive sampling comprising 92 trawling operations with a total effort of 146 hours was undertaken in the estuarine and offshore areas of Goa, Central West coast of India to assess the diversity and total community structure of demersal fish fauna. Trawl nets with mesh sizes of 15 mm (mouth end) and 9 mm (cod end) were towed approximately at a speed of 2 knots (4 km.h<sup>-1</sup>). The catch obtained was sorted into five sub-samples. Uncommon (or rare) specimens were picked out, put on ice and sent to the laboratory for detailed examination. In addition, samples were obtained by operating beach seine along Betim (15°30'18"N, 73°49'52"E) during December, 2005 and twice in the

vicinity of Mormugao Port Trust (15°24'16''N, 73°48'56''E) during December, 2005 and September, 2006 to assess the occurrence of demersal species in the estuarine embayment as these were inaccessible to demersal trawlers.

At the laboratory, a detailed morphological study of the biological specimens was carried out using identification keys (Fischer & Whitehead, 1974; Talwar & Kacker, 1984; Froese & Pauly, 2008).

## RESULTS

### **Material examined**

Two unsexed specimens; RP-1, 6.08 cm SL and RP-2, 5.21 cm SL (Co-ordinates: 15°30'43.1''N, 73°45'40.1''E to 15°32'28.1''N, 73°45'9.4''E; water depth: 11-14 m). Collected by V. P. Padate, 11 March 2007.

Two unsexed specimens; RP-3, 6.89 cm SL and RP-4, 6.11 cm SL (Co-ordinates: 15°29'43.2''N, 73°44'39.7''E to 15°33'15.2''N, 73°42'41.6''E; water depth: 6-7 m). Collected by V. P. Padate, 25 March 2007.

Details of morphometric measurements of fish specimens along with their mean and standard deviation are provided in Table 1. Reference voucher sample is deposited at the Marine Biology laboratory, Department of Marine Sciences, Goa University.

### **Family Caesionidae**

Ascending maxillary process is completely separated from the pre-maxilla (Carpenter, 1988). In other related perciform fishes, particularly snappers (family Lutjanidae), the ascending maxillary process is confluent with the pre-maxilla (Carpenter, 1988). The above morphological character is an adaptation towards planktivorous feeding habit.

The taxonomic identification of these specimens up to the species level was carried out using identification keys provided by Carpenter (1988) and Froese & Pauly (2008).

### **Genus *Caesio* Lacepède, 1801**

A single post-maxillary process; posterior end of maxilla blunt, its greatest depth posterior to end of pre-maxilla (Carpenter, 1988).

### ***Caesio cuning* (Bloch, 1791)**

(Figures 2-7)

Dorsal region of body from tip of snout to anterior spinous portion of dorsal fin greyish yellow, mid-lateral portion of body pale-white (Figure 2); caudal fin yellow, lacking prominent blackish markings (Figure 3); ventral region of body from cheeks to lower portion of caudal peduncle, pectoral, pelvic and anal fins light pink (Figure 4). Supra-temporal band of scales of either side confluent at dorsal midline (Figure 5); dorsal fin with 10 spines and 15 soft rays, its spinous portion covered with scales up to  $\frac{1}{2}$  its greatest height (Figure 6); anal fin with 3 spines and 11 rays, covered with scales (Figure 7); about 4-5 scale rows on cheek; 48-51 scales in lateral line.

The data on morphometry of present specimens was compared with existing literature. Fishbase, the world-wide geographical information system on finned fishes (Froese & Pauly, 2008) reveals that *C. cuning* grows upto a size of 60 cm Total Length (TL). However, the present specimens (n=4) ranged between 7.49 cm and 10.05 cm TL, thus confirming the capture of juvenile / young individuals of this species.

### DISCUSSION

The existing data on the geographical distribution of *Caesio cuning* (Figure 8) suggests that this species inhabits the Indo-Pacific region from Gulf of Mannar to Vanuatu Islands in the South Pacific (Carpenter, 1988; Froese & Pauly, 2008). Carpenter (1988) attributed the geographical distribution of this species to availability of appropriate habitat and adequate ecological parameters those favour the occurrence of this species. Published literature on the commercial finned fishes of Indian coast (Talwar & Kacker, 1984) indicates that *C. cuning* occurs along Andaman coast which falls within known zoo-geographical range of this species. However, Fishbase (Froese & Pauly, 2008) indicates the possible expansion of occurrence of this species to the adjacent waters. Published literature along Goa coast (Prabhu & Dhawan, 1974; Ansari *et al.*, 1995, 2003) provides information on the total demersal fish community structure with major emphasis on commercial finfish species. However, this species does not find mention in available literature from the present study area.

In view of the above, our observations primarily focus on the occurrence of rare species along Goa coast. Subsequently, the efforts of the three-year study led to the reporting of *C. cuning* for the first time off Goa and along the entire West coast of India. It has been well documented earlier (Carpenter, 1988) that this species and its congeners occur in coastal reef areas. The present specimens were

obtained from bottom trawl catch in the vicinity of the grounded ore-carrier, *MV River Princess* off the Candolim-Sinquerim shore. The grounded *MV River Princess* off Goa coast in 2000 (Ingole *et al.*, 2006) might have created an artificial reef-like habitat, thereby attracting several reef inhabitants from adjacent reefs (Qasim & Wafar, 1979) and further facilitated recruitment of their larval and juvenile forms (Arena *et al.*, 2007). Fishbase (Froese & Pauly, 2008) reveals that *C. cuning* grows upto a size of 60 cm TL. However, the present specimens (n=4) ranged between 7.49 cm and 10.05 cm TL, thus confirming capture of young stages. Secondly, existing literature indicates the presence of partially submerged rocky reefs off the Aguada Hill, those inaccessible for trawl net operations (Qasim & Wafar, 1979), thus suggesting suitability of habitat in this area. Moreover, the above region is nutrient-rich turbid waters due to transport of suspended material from the adjacent Mandovi estuary and Aguada Bay (Ansari *et al.*, 1995). Kessarkar *et al.* (2009) reported two seasonal peaks in suspended particulate matter (SPM) concentration (20 mg.l<sup>-1</sup> and 19 mg.l<sup>-1</sup> during June-September and February-April, respectively) from the Mandovi estuary and attributed these to interactions between strong seasonal winds, wind-induced waves and tidal currents in the estuary. It is probable that wind-induced waves, tidal currents along with the resultant turbidity in the water column might have induced the migration of *C. cuning* juveniles towards the bay-estuarine waters. Carpenter (1988) suggested that *C. cuning* prefers turbid waters, thus corroborating the present observations. Further, Leis and Carson-Ewart (2003) suggest the orientation of pelagic larvae of certain reef-fish in response to solar or reef-based cues. The present observations reveal that the prevalence of similar ecological conditions might have enabled the younger population of *C. cuning* to migrate to coastal-estuarine embayment.

*Caesio cuning* inhabits the eastern Indian Ocean and Western Pacific Ocean regions (Carpenter, 1988) those influenced by hydrographic parameters (temperature, salinity, dissolved oxygen) characteristic of tropical oceans (Moore, 1972) Hydrographic parameters measured during the present study were observed to be similar and indicated clear seasonal variations at 10 m depth (Figure 9), however the value were found to be comparatively higher at the time of collection of *C. cuning*. The study area experiences seasonal upwelling phenomenon (Ansari *et al.*, 1995) rendering the region highly fertile in terms of primary productivity (13.12 to 14.21 mg C.m<sup>-3</sup>.h<sup>-1</sup>; Krishna Kumari *et al.*, 2002). Such high productivity sustains high zooplankton biomass (Qasim & Sen Gupta, 1981). As *C. cuning* is a zooplankton feeder (Carpenter, 1988), it is possible that schools of this species might have migrated to the above region to forage upon the abundant zooplankton.

Further, the intensive sampling effort covering wider coastal region through use of modern fishing vessels and gear those provided access to submerged rocky patches in coastal inshore embayment may have enabled entrapping this species. However, it must be noted that in the present study, only four specimens were obtained in the light of the intensive sampling (n = 92) with a core fishing effort of 146 hours over a period of three years excluding monsoonal periods (June – August), wherein it was found to occur only in two hauls. The present observations contradict earlier observations (Carpenter, 1988) those suggest a shoaling behaviour, indicating either these individuals might have strayed away from the larger shoal and got trapped in the trawl net over the soft substratum or might have not been able to establish as a large shoal largely due to habitat complexity.

Moreover, the study area is a potential fishing ground and has been intensively exploited by demersal trawlers perennially (with the exception of 75-day monsoon ban) ever since the initiation of mechanized fishing in 1963 and its further expansion during the subsequent decades. Such long-term intensive trawling activity may lead to changes in the structure and composition of the resident demersal communities and benefit other species groups as reported earlier from the Gulf of Thailand (Longhurst & Pauly, 1987).

## CONCLUSION

Our observations suggest the first new record of *Caesio cuning* off Goa along the entire West coast of India that lies outside its known geographical array. The present study through intensive sampling effort of 146 hours for three-year duration attempted to highlight the occurrence of rare species, *C. cuning*. The occurrence of this species in low numbers could primarily be due to sampling gear and local bathymetry in the vicinity of the grounded ship that probably reduced the chances of entrapment of this species in the trawl net. Furthermore, it appears that the selection of gear with increased efficiency in such reef dominated habitats might yield more individuals from such areas. It is suggested that further detailed ecological studies on this species might provide more detailed information and explain its occurrence and various biological processes in such habitats. Moreover, molecular studies of this species using genomic DNA would further enhance the understanding of its population stock structure and connectivity with existing populations (Carmen & Ablan, 2006).

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## FIGURE LEGENDS

**Fig.1.** Map of study area indicating sampling sites and location of collection of *Caesio cuning*

**Fig.2.** Distinguishing characters and colour of fresh specimen of *Caesio cuning*

**Fig.3.** Caudal fin of *Caesio cuning* indicating characteristic yellow colouration

**Fig.4.** Ventral portion of *Caesio cuning* indicating characteristic pink colouration

**Fig.5.** Supra-temporal band of scales in *Caesio cuning* –

(a) Present specimen (b) Diagrammatic representation of supra-temporal scales of *C. cuning* provided by Carpenter (1988)

**Fig.6.** Dorsal fin of *Caesio cuning* indicating scaled portion and characteristic fin count

**Fig.7.** Anal fin of *Caesio cuning* indicating characteristic fin count

**Fig.8.** Map of the world indicating geographical distribution of *Caesio cuning*

**Fig.9.** Monthly variations in physico-chemical parameters measured during the study

■ – Known zoo-geographical range of *Caesio cuning*

■ – Possibility of occurrence of *Caesio cuning*

**GOA** – Site of present collection

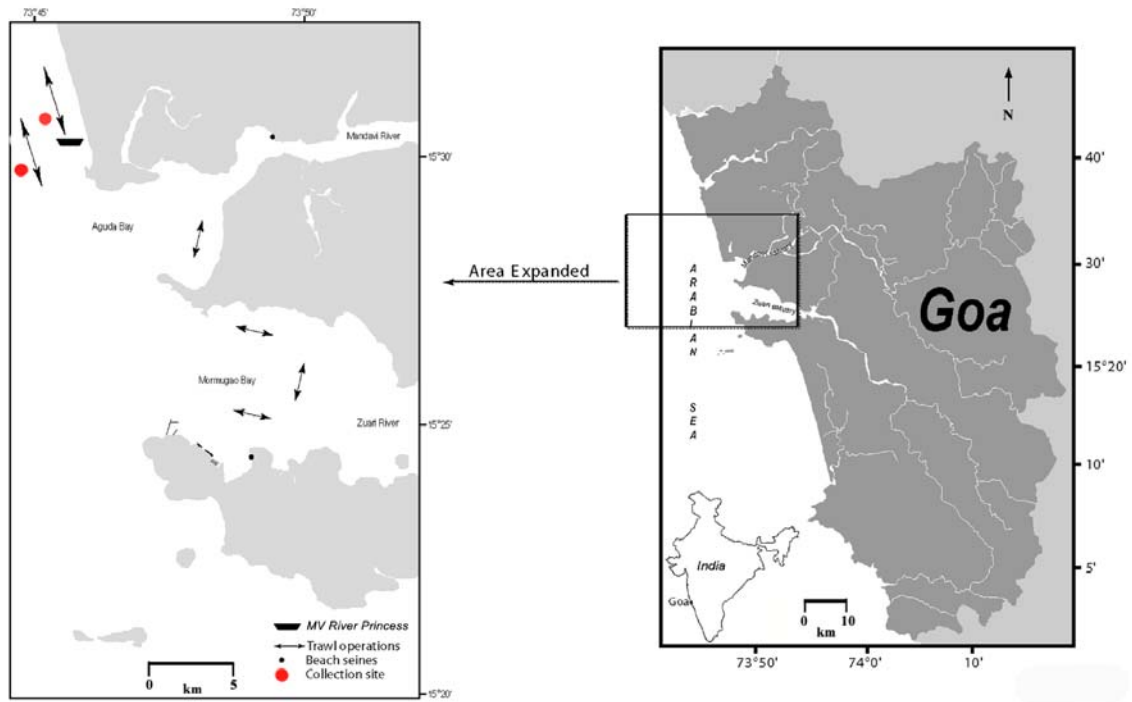
TABLE

**Table1.** Details of morphometric measurements (in cm) of *Caesio cuning* specimens (n = 4) collected along Goa coast

Sr. No.	Morphological parameter	Specimen				Mean±S.D.
		RP-1	RP-2	RP-3	RP-4	
1.	Total Length	8.48	7.49	10.05	8.56	8.65±1.06
2.	Fork Length	6.99	6.57	8.38	7.42	7.34±0.78
3.	Standard Length	6.08	5.21	6.89	6.11	6.07±0.69
4.	Body Depth	2.34	1.91	2.64	2.27	2.29±0.30
5.	Pre-dorsal Length	2.28	2.07	2.53	2.32	2.30±0.19
6.	Pre-anal Length	4.18	NA	4.84	4.33	4.45±0.35
7.	Head Length	2.02	NA	2.36	2.13	2.17±0.17
8.	Snout Length	0.39	0.42	0.44	0.38	0.41±0.03
9.	Eye Diameter	0.74	0.61	0.88	0.87	0.78±0.13

RP, site of sample collection in the vicinity of the marine vessel River Princess grounded off Goa coast.

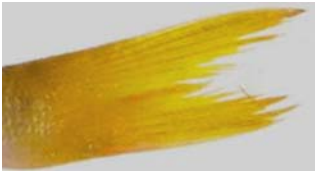
**Fig.1**



**Fig.2.**



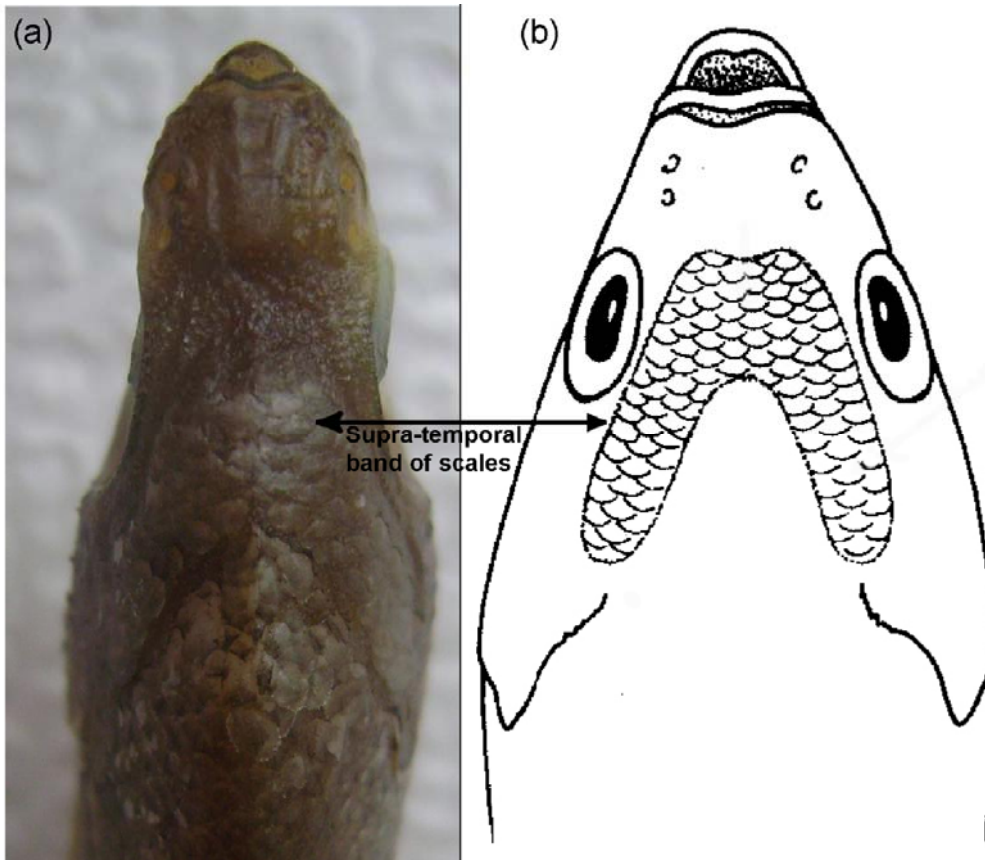
**Fig.3**



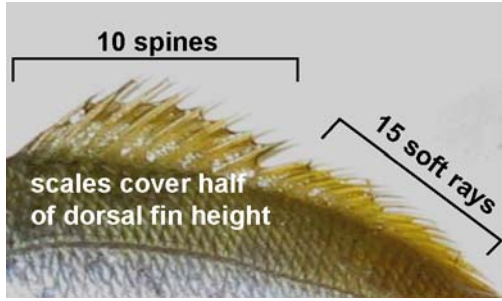
**Fig.4**



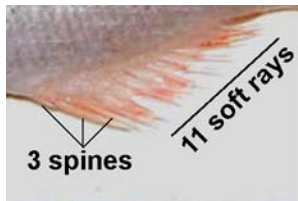
**Fig.5**



**Fig.6**



**Fig.7.**



**Fig.8**

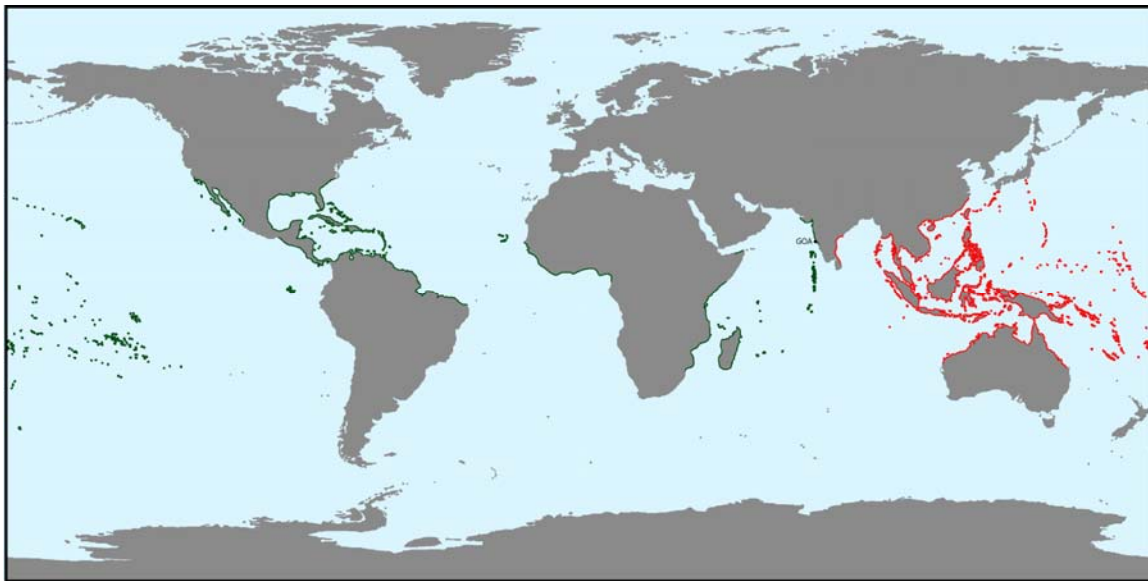


Fig 9

