Chapter 5.

A new record of *Caesio cuning*
outside its known geographical array
5.1. 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 (Padate et al., 2010a). In the marine environment, physical factors such as temperature, salinity, dissolved oxygen and nutrient levels may tend to regulate the occurrence and distribution of a species through availability of adequate food and substratum, as well as regulation of biological processes such as recruitment, establishment and reproduction. 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 those occur seasonally or occasionally in very low numbers (Engel and Kvitek, 1998). Among these, species belonging to two orders, namely Perciformes (perch-like fishes) and Scorpaeniformes (scorpion fishes, rock fishes and sting fishes) dominate the fish assemblages (Froese and Pauly, 2008). Further among the perch-like fishes, the fusilier belonging to the family Caesionidae are particularly unique with regards to evolutionary trends those display transition from benthic carnivorous to semi-pelagic planktivorous habit (Carpenter, 1988).

5.2. Literature review

Published literature pertaining to the taxonomy of the Family Caesionidae reveals limited works by various taxonomists across the Indo-West Pacific region.
(Masuda et al., 1975; Schroeder, 1980; Shen, 1984; Gloerfelt – Tarp and Kailola, 1984). However, Carpenter (1987, 1988) provided exhaustive descriptions of twenty extant fusilier species along with phylogenetic classification. Further, among the species described in the above literature, Caesio cuning (Bloch, 1791) is known to be distributed from southern Japan to northern Australia and from Vanuatu to the Bay of Bengal (Carpenter, 1988).

In view of the above, this chapter describes the new record of occurrence of the rare fusilier species, C. cuning found outside its geographical locale in the coastal waters of Goa along the west coast of India (Padate et al., 2010a).

5.3. Taxonomy

5.3.1. Family Caesionidae

The diagnostic characters of Caesionidae are “body slender, fusiform, elongate (resembling pelagic fishes) and brightly coloured with stripes and patches; unique jaw morphology, wherein the ascending maxillary process is completely separated from the pre – maxilla; highly protrusible upper jaw; reduced dentition.”

The above morphological characters are an adaptation towards planktivorous feeding habit. Further, they exhibit synchronous schooling habit that facilitates their semi – pelagic mode of locomotion in the coastal waters. Contrastingly, in other related perciform fishes such as the benthic carnivores, particularly snappers (family Lutjanidae), the ascending maxillary process is confluent with the pre – maxilla (Carpenter, 1988), and the dentition consists of strong canines to facilitate grasping of prey.
5.3.2. Genus *Caesio* Lacépède, 1801 (Carpenter, 1988)

*Caesio* Lacépède, 1801, pp. 85 (type species: *Caesio caerulea* Lacepede, 1801, by subsequent designation (Bleeker, 1876))

Fin formula: D X, 13 – 16; A III, 10 – 13; P 17 – 23; V I, 5; C (procurrent) 9 – 10

“Body high to fusiform, elongate and moderately compressed. A single post-maxillary process; posterior end of maxilla blunt, its greatest depth posterior to end of pre-maxilla; small conical teeth on jaws, vomer and palatines; interorbital space convex; margin of opercle with a pronounced dorso-posterior flap.”

“Scales weakly ctenoid; scales present on dorsal and anal fins, those in lateral line 45 – 67; 9 – 13 scale rows on the upper portion of caudal peduncle, 12 – 17 on the lower one; 7 – 11 scale rows between lateral line and dorsal fin origin, 14 – 20 scale rows between lateral line and anal fin origin; supra-temporal band of scales distinct, confluent at dorsal midline or interrupted by a thin scaleless zone.”

“Predorsal configuration 0/0/0 + 2/1 + 1. 10 – 14 epipleural ribs, without flattened projections on first or second epipleural. Anterior profile of first anal pterygiophore strongly convex distally.”

“Colour: lateral sides may possess longitudinal stripes; caudal fin either devoid of markings, with a blackish blotch on tips of lobes, or with a longitudinal blackish streak in the middle of each lobe.”

5.3.3. *Caesio tuning* (Bloch, 1791)

5.3.3a. 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). 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).

Details of morphometric measurements of fish specimens along with their
mean and standard deviation are provided in Table 5.1. Reference voucher sample is
deposited at the Marine Biology laboratory, Department of Marine Sciences, Goa
University.

5.3.3b. Description

Fin formula: D X, 15; A III, 11; P 17; V I, 5; C (procurrent) 9 – 10

Dorsal region of body from tip of snout to the anterior spinous portion of
dorsal fin greyish yellow, soft dorsal fin bright yellow, mid – lateral portion of body
pale white, a black blotch on pectoral fin axil (Fig. 5.1a); caudal fin yellow, lacking
prominent blackish markings (Fig. 5.1b); ventral region of body including the cheeks,
pectoral, pelvic, anal fins and the lower portion of caudal peduncle, light pink (Fig.
5.1c). Body fairly deep (body depth approximately three times in standard length,
almost equal to head length) and compressed. A single post – maxillary process; small
conical teeth in jaws, vomer and palatines. Supra – temporal rows of scales on either
side of head confluent at midline (Fig. 5.2); four to five scale rows on cheek; 48 – 51
scales in lateral line; eight scale rows between lateral line and the origin of dorsal fin;
fifteen scale rows between lateral line and the origin of anal fin. Dorsal fin
continuous, with ten spines and fifteen soft rays, scales cover approximately half the
greatest height of dorsal fin (Fig. 5.3); anal fin with three spines and eleven soft rays
(Fig. 5.4); spines on both the dorsal and anal fins interconnected by thin membrane;
pectoral fins with seventeen soft rays; pelvic fins with one spine and five soft rays;
caudal fin strongly forked, with nine to ten procurrent rays.
Table 5.1. Details of morphometric measurements (in cm) of *Caesio cuning* specimens (N = 04) collected off Goa during the present study

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Morphological parameter</th>
<th>Specimen</th>
<th>μ ± S.D.</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>RP – 1</td>
<td>RP – 2</td>
</tr>
<tr>
<td>1.</td>
<td>Total length</td>
<td>8.48</td>
<td>7.49</td>
</tr>
<tr>
<td>2.</td>
<td>Fork length</td>
<td>6.99</td>
<td>6.57</td>
</tr>
<tr>
<td>3.</td>
<td>Standard length</td>
<td>6.08</td>
<td>5.21</td>
</tr>
<tr>
<td>4.</td>
<td>Body depth</td>
<td>2.34</td>
<td>1.91</td>
</tr>
<tr>
<td>5.</td>
<td>Pre – dorsal Length</td>
<td>2.28</td>
<td>2.07</td>
</tr>
<tr>
<td>6.</td>
<td>Pre – anal Length</td>
<td>4.18</td>
<td>NA</td>
</tr>
<tr>
<td>7.</td>
<td>Head length</td>
<td>2.02</td>
<td>NA</td>
</tr>
<tr>
<td>8.</td>
<td>Snout length</td>
<td>0.39</td>
<td>0.42</td>
</tr>
<tr>
<td>9.</td>
<td>Eye diameter</td>
<td>0.74</td>
<td>0.61</td>
</tr>
</tbody>
</table>

RP – site of sample collection in the vicinity of the marine vessel River Princess grounded off Goa coast
Fig. 5.1a. Distinguishing characters and colour of fresh specimen of *Caesio cuning* (Photograph)

Fig. 5.1b. Caudal fin of *Caesio cuning* indicating characteristic yellow colouration (Photograph)

Fig. 5.1c. Ventral portion of *Caesio cuning* indicating characteristic pink colouration (Photograph)
Fig. 5.2. Supra-temporal band of scales in *Caesio cuning* (a) Photograph, (b) Diagrammatic representation (Carpenter, 1988)
Fig. 5.3. Dorsal fin of *Caesio cuning* indicating scaled portion and characteristic fin count (Photograph)

Fig. 5.4. Anal fin of *Caesio cuning* indicating characteristic fin count (photograph)
Morphometric data of the present specimens (Table 5.1) was compared with the existing literature. Fishbase (Froese and Pauly, 2008) revealed that *C. cuning* grows up to a size of 60 cm Total length (TL). However, the present specimens (N = 04) ranged between 7.49 and 10.05 cm TL ($\mu = 8.65 \pm 1.06$ cm), thus confirming the capture of juvenile / young individuals of this species.

5.4. Discussion

The existing data on the geographical distribution of *Caesio cuning* (Fig. 5.5) suggests that this species inhabits the Indo – Pacific region from Gulf of Mannar to Vanuatu Islands in the South Pacific (Carpenter, 1988; Froese and Pauly, 2008). The above regions fall within the tropical zone and are characterized by warm, saline, and nutrient – rich waters. Further, these regions harbour diverse habitats such as coral reefs, mudflats, sea – grass beds, thereby augment to the high productivity of these waters. Carpenter (1988) attributed the geographical distribution of *C. cuning* to the availability of appropriate habitat and adequate ecological parameters those favour the occurrence of this species.

Published literature (Talwar and Kacker, 1984) pertaining to the rare fishes of Indian coast provide a short description of *C. cuning* along with short note on its occurrence and distribution. In Indian territory, this species is known to occur only along the Andaman coast which incidentally falls within known zoo – geographical range of this species (Talwar and Kacker, 1984). Although rare in occurrence and distribution, this species finds mention in the above work due to its commercial importance.

However, Fishbase (Froese and Pauly, 2008) indicates the possible expansion of occurrence of this species to the adjacent waters due to changes in climate or land
Known zoo – geographical range of *Caesio cuning*

Possibility of occurrence of *Caesio cuning*

GOA – Site of present collection

Fig. 5.5. Map indicating the worldwide distribution of *Caesio cuning*
use patterns those were responsible for the development of ambient conditions, thereby favouring the occurrence of this species. Published literature along Goa coast (Prabhu and Dhawan, 1974; Ansari et al., 1995, 2003) provides information on the demersal fish community structure as well as the fishery potential of this region. However, efforts to obtain information pertaining to the entire demersal faunal community have resulted in scanty information as evident from the reporting of the most dominant or common species. *C. cuning* being a rare 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 present investigation 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 and Wafar, 1979; Rodrigues et al., 1998) and further facilitated recruitment of their larvae and juvenile forms (Arena et al., 2007). The observations made on size of collected individuals ($\mu = 8.65 \pm 1.06$ cm) suggested capture of young stages. Published literature (Qasim and Wafar, 1979; Rodrigues et al., 1998) indicates the presence of partially submerged rocky reefs off the Aguada Hill, suggesting suitability of habitat. Moreover, the above region contains 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 seasonal peaks in suspended particulate matter (SPM)
concentration, 20 and 19 mg.l\(^{-1}\) 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 with the present observations. Further, Leis and Carson – Ewart (2003) suggest that pelagic larvae of certain reef fish orient their movement in response to solar or reef – based cues. *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 such as temperature (27.5 – 28.7 °C), salinity (35.1 psu) and DO (180 – 190 µM) were observed to be in similar range and indicated clear seasonal variations at 10 m depth (Fig. 5.6), however the values were found to be comparatively higher at the time of collection of *C. cuning*. Similar studies on *C. cuning* ecology from the Seribu Island, Indonesia (Tati *et al*., 1998) reported marginally different values for temperature (28.7 – 29.5 °C), salinity (32.55 – 32.73 psu) and DO (3.85 – 4.25 mg.l\(^{-1}\)). Further, the study area experiences seasonal upwelling (Ansari *et al*., 1995) that brings the cold, nutrient – rich, sub – surface water to the surface. The above phenomenon sustains luxurious phytoplankton growth and renders the region highly fertile in terms of primary productivity (13.12 – 14.21 mg C.m\(^{-3}\).h\(^{-1}\); Krishna Kumari *et al*., 2002). Such high productivity sustains high zooplankton biomass (Qasim and Sen Gupta, 1981). *C. cuning* preferably feeds on mid – water zooplankton (Carpenter, 1988), and it is possible that schools of this
Fig. 5.6. Seasonal variations in hydrographic parameters measured at surface and 10 m depth during 2007
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 trawl hauls (N = 95) with a core fishing effort of one hundred and fifty six hours over a period of three years excluding monsoonal periods (June - August). Moreover, only two individuals each were obtained from two hauls with a highly diverse faunal composition. Carpenter (1988) suggested a shoaling behaviour among the caesionids, similar to those in other planktivorous fishes. However, no large shoals were observed during the present study. This probably could be due to segregation of these individuals from the larger shoal to be trapped in the trawl net or might have not been able to establish as a large shoal. Fishbase (Froese and Pauly, 2008) revealed that this species inhabits rocky substrates in coastal waters up to 60 m depth and forms large shoals in mid-water. It is apparent from the above that the low depth (≈ 10 m) along with the habitat complexity i.e. silt - clayey substratum interspersed with submerged rock outcrops and patch reefs might have probably obstructed the formation of a large shoal. Moreover, the study area is a potential fishing ground and has been intensively exploited by demersal trawlers perennially with the exception of the seventy five - day monsoon ban ever since the initiation of mechanized fishing 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 and Pauly, 1987).

5.5. Conclusion

Our observations suggest the first new record of *Caesio cuning* off Goa along the entire west coast of India outside its known geographical array (Padate et al., 2010a). 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 need to be taken up to provide better insight into its occurrence and distribution. 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 and Ablan, 2006).