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Some aspects on the bluespotted cornetfish, *Fistularia commersonii* Ruppell, Nagapattinam, Tamil Nadu, India

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Abstract
Cornetfishes are reported in tropical and temperate near shore marine waters in the Atlantic, Pacific, and Indian oceans. The present study was performed on the Blue spotted Cornetfish, *F. commersonii* from Nagapattinam (Tamil Nadu, India) concerning morphometrics and meristic characters, length-weight relationship and food and feeding nature. The morphometrics and meristic characters of the cornetfish had been presented. The results revealed that regression plot of the data for LWR indicated a linear relationship among the two variables. The r value for the cornetfish, *F. commersonii* was 0.90. In the present study, various food items were identified as 'fishes, crustaceans (shrimps, crabs etc.), molluscs (cephalopods, gastropods and so on) digested contents and others (unidentified)' and they had been segregated for calculating percentage occurrence of each food items. It may be assumed that this species has been a success like others as a result of aggressive superiority and pre-adaptation as noticed in the present study.

Keywords: Cornetfis, *Fistularia commersonii*, morphometric and meristic, LWR, food, India

Introduction
Cornetfishes (Sygnathiformes: Fistulariidae) or flutemouth are distributed in tropical and temperate nearshore marine waters in the Atlantic, Pacific, and Indian oceans. Fistularidae constitutes with four species namely *Fistularia commersonii, F. corneta, F. petimba and F. tabacaria* (Fritzsche, 1976) [51] and they can be identified mainly through their long tubular snout performing as a pipette, which is an excellent adaptation for feeding among reefs (Nelson *et al*., 2016) [31]. Reports on the distribution of benthopelagic species Blue-spotted cornetfish, *F. commersonii* is described in Garibaldi and Relini (2008) [14]; Froese and Pauly (2011) [13]; Ragheb (2022) [34]. They live either solitary or in schools (Fischer and Bianchi 1984, Nakamura *et al.* 2003, Karachle *et al.* 2004, Froese and Pauly 2007) [11, 30, 25, 12] and occur in diverse habitats such as rocky bottom, reef area, seagrass meadows, muddy and sandy regions (Bilecenoglu *et al.* 2002, Corsini *et al.* 2002, Azzurro *et al.* 2004, Pais *et al*. 2007, Garibaldi and Orsi-Relini 2008, Kara and Oudjane 2008) [4, 6, 2, 32, 14, 24]. Length-weight relationships (LWR) are helpful for the conversion of growth-in-length equations and assist in fisheries ecology and stock assessment (Ecoutin *et al*., 2005; Froese and Pauly, 2007) [8, 12]. Studies on LWR are available for the cornet fishes from Libya (Southern Mediterranean) (Elbaraasi, 2014) [9]; South of Sicily (Central Mediterranean) (Vitale *et al.*, 2016) [48] and Egyptian Mediterranean (Ragheb, 2022) [34]. Investigation on the diet helps in defining the trophic status and the pattern of growth rate of fish (Qasim, 1972) [33]. Cornetfish evolves with many techniques for capturing prey, such as ambushing, stalking and chasing (Keenleyside, 1979; Gerking 1994) [27, 15]. Feeding behavior of Cornetfishes is reported by Corsini *et al*., 2002; Nakamura *et al*., 2003 and Takeuchi, 2009 [6, 30, 44]. Fishing activity in Nagapattinam has been happening from time immemorial and it is noteworthy that its antiquity is chronicled in the Tamil ancient literature. Research on fisheries aspect are carried out from Nagapattinam on rayfish diversity (Ravi, 2006; Ravi and Veeramani, 2007) [38, 39], LWR of Parrotfish (Veeramani *et al*., 2010) [47], marine fish diversity (Ramu *et al*., 2015; Karthik *et al*., 2019) [35, 26], production of marine fishing (Sethubalan and Xavior Selvakumar, 2019) [40] and edible crustaceans (Gopalsamy *et al*., 2020) [20]. The present study was aimed at the Blue spotted

Cornetfish, *F. commersonii* from Nagapattinam (Tamil Nadu, India) concerning morphometrics and meristic characters, length-weight relationship and food and feeding nature.

Materials and Methods

A. Study area and sample collection

Nagappttinam (Lat.10°46 N., Long. 79°51E) is one among the important fishing harbours in Tamil Nadu, situated at the mouth of the river Kaduvayar in the Bay of Bengal. Exports of high value fishing products like shrimp, crabs, lobster, cuttlefish, octopus, molluscs and edible fishes are important sources for foreign exchange here. This landing centre will be active soon after when fishes are landed freshly in the very early morning hours. In the present study, a total of 51 specimens of the cornetfish (*F. commersonii*) were collected using a modified gill net, cast net and dip net with the help of local fishermen during the study period (August 2017 to January 2018) and they are locally called as in Tamil 'Oosikoala Meen or Kokku Meen'. The fish samples of the cornetfishes were preserved in 10% buffered formalin for further analysis of morphometric parameters (Jayaram, 2002) [18] and all such characters were measured to the nearest millimeter using digital calipers and weighed to nearest milligram (mg) by a digital balance. In the present study, mean and standard deviation were worked out for the morphometric characters.

B. Length-weight relationship

A total of 51 *F. commersonii* were measured and weighed from the study area (Nagapattinam) during the study period. The length of the cornetfish was measured from the tip of snout to the extended tip of caudal fin (35cm to150cm TL) and the weight of individual fish was gauged to the nearest gram with an electronic balance.

The length-weight relationship (LWR) was estimated by using the equation.

$$W = aL^b$$

Where W= weight in mg, L= total length in mm, 'a' is a scaling constant and b the allometric growth parameter. Logarithmic transformation was used to understand the linear relationship:

$$\log W = \log a + \log b\ L$$

Regression was used to estimate the intercept (log a) and the regression coefficient or slope (b), using Microsoft Excel spread sheet.

C. Food and feeding habits

The samples of Cornetfish, *F. commersonii* were collected (51) with the range of 32cm to 75cm TL respectively for the present study from the landing centre of Nagapattinam, Tamil Nadu, and southeast coast of India. The fish samples were transported to the laboratory and washed under running fresh tap water. After recording the length (cm) and weights (g), the individual fishes were dissected by cutting open the belly area, the stomach removed and the contents examined. The degree of fullness of the stomach was recorded in relation to total length of the fish and season (months). Stomachs were designated based on the degrees of fullness as "full" when it was filled with food completely, with its wall very thin and transparent. Stomachs were designated as "3/4 full" when the wall stomach was in a partly collapsed condition. Similarly, stomachs were classified as "1/2 full", 1/4 and "trace" based on the relative fullness and the space occupied by the ingested food contents. Stomachs containing practically nothing within were termed as "empty". Fishes with stomachs gorged, full, ¾ full were considered as active feeders, ½ as moderate feeders and ¼ full and trace stomachs as poor feeders (Rao and Rao, 2002) [37]. The quantitative analysis was done by the points method described by many workers (Swynnerton and Worthington, 1940; Hynes 1950; Bapat and Bal, 1952) [43, 17, 3]. Points were allotted to estimate the average feeding intensities in different months and various length groups based on the degree of fullness of stomach. The points allotted according to the degree of fullness of stomach are as empty (0%), trace (10%), 1/4 full (25%), 1/2 full (50%), 3/4 full (75%) and full (100%). The total number of different food items and its occurrence were noted on a monthly basis. The percentage occurrence of different food items in different months and also in different length groups were determined by summing the total number of occurrences of each item. Similarly, the percentage of total number of each food item in different months was determined by summing the total number of different food items.

Results

1. Morphmetric and meristic characters of *F. commersonii*

The morphometric and meristic characters of *F. commersonii* are given in Tables (1&2). Totally 15 morphometric and 6 meristic characters were carried out. Among morphometric characters, the total length, standard length, fork length, predorsal fin distance, prepectoral fin distance, pre pelvic fin distance, head length and tubular snout length were found to have higher values than that of the other parameters like upper jaw length, lower jaw length, eye diameter, etc. The special character of tubular snout length and caudal fin ray length were unique measurements to this cornet fish (Table 1). The meristic characters (dorsal fin ray, anal fin ray, pectoral fin ray, pelvic fin ray, caudal fin forked with a medial filament and Vertebrae) were counted and are given in Table 2. In order to understand the skeletal structure of *F. commersonii*, X-Ray images were taken from Vaishnavi Clinical Laboratory, Kumbakonam (Tamil Nadu, India) (Fig. 1).

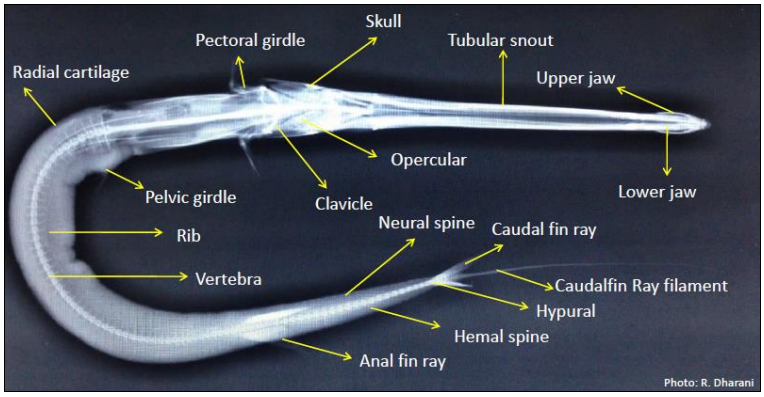

Fig 1: X-Ray image of the cornetfsih, *F. commersonii*

Table 1: Morphometric parameters of *F. commersonii* and their range, mean and standard deviation (SD±)

Sl. No.	Morphometric Parameters (cm)	Min (cm)	Max (cm)	Mean (cm)	SD ±
1.	Total length (TL)	59	75	66.9	5.6
2.	Standard length (SL)	54	71	62.5	4.8
3.	Fork length (FL)	51	73	62	4.2
4.	Tubular snout length (Tu Sn L)	14.5	19.5	17	3.5
5.	Upper jaw length (UJL)	0.5	2.5	1.5	0.5
6.	Lower jaw length (LJL)	1	2.7	1.8	0.2
7.	Head length (HL)	18	24	21	4.2
8.	Inter orbit length (IOL)	1	2.5	1.75	0.6
9.	Eye diameter (ED)	1.7	2.2	1.95	0.3
10.	Body depth (BD)	1.5	4	2.75	1.7
11.	Pre-dorsal fin distance	48	63	55.5	10.6
12.	Pre-pectoral fin distance	20.5	27	23.75	4.5
13.	Pre-pelvic fin distance	28.6	37	32.8	5.9
14.	Caudal fin length (CFL)	2	4	3	0.4
15.	Caudal fin ray length (CF Ray L)	10	23	16.5	4.8

Table 2: Meristic data of *F. commersonii*

Sl. No.	Meristic characters	Count (n)
1.	Dorsal fin ray	16
2.	Anal fin ray	15
3.	Pectoral fin ray	14
4.	Pelvic fin ray	6
5.	Caudal fin forked with a medial filament	1
6.	Vertebrae (Fig.1)	83

2. Length-weight relationships for *F. commersonii*

The length-weight relationship of the cornetfish, *F. commersonii* representing pooled (both sexes) are presented in Fig. 2. The regression plot of the data indicated a linear relationship between the two variables. It can be assumed from the figures that points are very close to the line indicating a linear relationship between body length and body weight. The regression line attained from the linear relationship between the two variables *viz*., length and weight. The points lied more or less close to the line and possessed a close relationship between the two variables. Additionally the correlation analysis was closely related to regression analysis and so the correlation coefficient (r) value was also estimated. The r value for the cornetfish, *F. commersonii* was 0.90. The equations thus derived in respect of length-weight relationship are as follows:

$$W = -14.4 + 2.842L$$

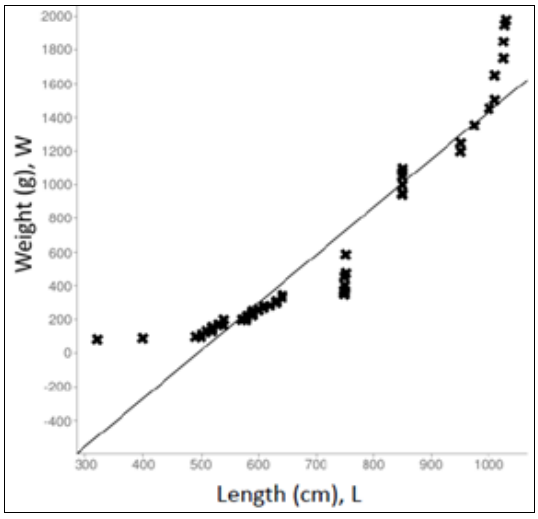

Fig 2: Length-weight relationship of *F. commersonii*

3. Gut content analysis of *F. commersonii*

3.1 Percentage (%) occurrence of gut contents of *F. commersonii*

Results of the percentage occurrence of food items of Cornetfish, *F. commersonii* are shown in Fig. 3. In the present study, various food items were identified as 'fishes, crustaceans (shrimps, crabs etc.), molluscs (cephalopods, gastropods, etc.) digested contents and others (unidentified)' and they were segregated for calculating percentage occurrence of each food items. Among the food items, the cornetfish was found to prefer fishes with higher occurrence (79%), followed by crustaceans (5%), mollusc (1%), digested contents (7%) and others (8%). Based on the above results, it could be highly carnivorous in nature.

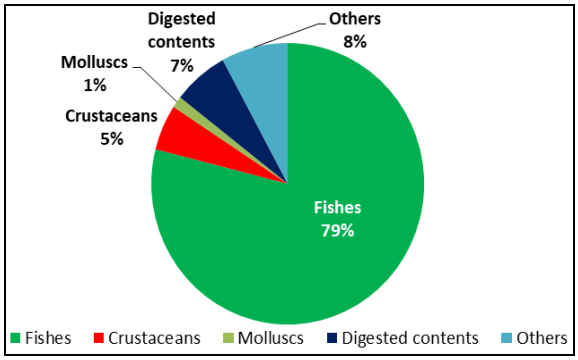

Fig 3: Percentage (%) occurrence of gut contents of *F. commersonii*

3.2 Feeding intensity (%) by month-wise in *F. commersonii*

The feeding intensity (%) observed in different months for *F. commersonii* are shown in Table 3. They are followed as: empty stomach-8 to 37% (average 21.3%); trace 10-15.2% (average 11.6%); ¼ full-11.32-17.15% (average 14.5%); ½ full-10.14-20.32% (average 15.75%) ¾ full-9.48-18.1% (average 13.3) and full-5.49-21% (average 14.2%).

Table 3: Feeding intensity (%) in different months for *F. commersonii*

Month-wise	Empty	Trace	1/4 full	1/2 full	3/4 full	Full
August	28.64	13.25	15.23	16.40	10.48	8.42
September	37.46	15.28	17.15	10.14	9.48	5.49
October	21.00	10.00	13.56	20.32	12.00	12.89
November	10.00	11.30	14.70	15.00	16.70	21.00
December	8.00	10.00	15.30	22.50	18.10	18.60
January	23.00	10.34	11.32	10.21	13.48	18.84
Average	21.3	11.6	14.5	15.7	13.3	14.2

3.3 Feeding intensity (%) by size-wise in *F. commersonii*

The feeding intensity (%) observed in different size groups for *F. commersonii* are shown in Table 4. They are followed as: empty stomach-11.66 to 36.89% (average 17.8%); trace 9.87-12.9% (average 10.9%); ¼ full-10.66-23.27% (average14.6%); ½ full-12.25-23.56% (average 18.3%) ¾ full-8.34-26.47% (average 19.7%) and full-5.33-14.31% (average 10.7%).

Table 4: Feeding intensity (%) in various size groups of *S. guttatus*

Size groups (mm)	Empty	Trace	1/4 full	1/2 full	3/4 full	Full
30-40	12.12	11.11	12.41	14.89	26.47	14.31
40-50	11.66	12.90	11.77	18.98	25.75	9.14
50-60	36.89	10.34	23.27	12.25	8.34	5.33
60-70	16.27	10.43	14.97	23.56	12.55	13.14
70-80	12.35	9.87	10.66	22.31	25.78	12.00
Average	17.8	10.9	14.6	18.3	19.7	10.7

Discussion

The cornet fish *F. commersonii* reaches up to 150 cm total length, widely distributed in the Indo-Pacific Oceans. In recent times, this species was reported in the Eastern Mediterranean Sea, off the Israel coast (Golani, 2000) [19]; later, further findings were recorded in the Aegean Sea (Rhodes Island) (Corsini *et al*., 2002) [6] and off the Anatolian coast (Bilecenoglu *et al*., 2002) [4]. Records of Indo-Pacific species (*F. commersonii*) from the Nagapattinam coast increase continuously in the present study, following the biodiversity change and enrichment of the basin fish fauna. Sluka (2013) [41] described the coastal marine fish biodiversity along the western coast of India and mentioned the *F. commersonii* and *F. petimba*. Jeyasanta and Jamila Patterson (2017) [22] made a survey on the trash fishes in the major fish landing centers of Tuticorin, Southeast coast of India and noticed the presence of *F. commersonii, F. petimba* and *F. villosa* in the trashes while Jeyasanta *et al*., (2014) [23] revealed the quality characteristics of sun dried fish (*F. commersonii*) for poultry feed in Tuticorin, South East Coast of India.

Length has an important function for the weight of fish (Weatherley and Gill, 1987) [49]. The specific gravity of the flesh is known to undergo changes, while Le Cren, (1951) [29] stated that the density of fish might be maintained in the surrounding water by means of swim bladder and consequently change in weight is due to change in form but not in specific gravity. Cube law is not confirmed for all fishes because growth causes the change of their shape (Ali, 1999) [1]. Wootton (1990) [50] also described that a value less than 3.0 indicated that fish becomes lighter (negative allometric) and greater than 3.0 as heavier (positive allometric) for a particular length as it increases in size. It is clear from the regression equations obtained in the present study that the 'b' values calculated as 2.842 were less than 3, showing slight negative growth. According to Wootton (1990) [50], 'b' values differ because of season, habitat, gonad maturity, sex and stomach fullness. A similar result was also reported by Torres (1991) [46] in certain marine fishes of South Africa and also King (1996) [28] noticed a similar growth pattern in several Gobiids of Nigeria. Hile (1936) proposed that the 'b' value for an ideal fish may range between 2.5 to 4.0. The 'b' value also ranged between 2.5 and 4.0 in the present study. Swennen *et al.* (1995) [42] reported allometric growth with 'b' value of 2.4-2.8 in the five sympatric mudskippers of Pattani area, Southern Thailand. The parameters of length-weight relationship for fish species are used for fisheries management and fish biology, however in this study we compare the LWR of bluespotted cornetfish during the year to find out the growth performance in the population. Values of exponent b provide information on fish growth indicating the type of growth; isometric (b=3.0), positive allometric (b>3.0) or negative allometric (b<3.0). In general, the value of b of the length-weight relationship was within the expected range of 2.5-3.5 (Dulcic and Glamuzina, 2006) [7] except in September which was n=3. In the present study, the equations thus derived in respect of length-weight relationship of *F. commersonii* are as follows: Log W= -14.4 + 2.842L.

Food and Feeding

The food items of the bluespotted cornetfish *F. commersonii* was found to contain almost fishes (79%) based on the stomach contents analysis of specimens collected during the study period. Marine ecosystems are, however, open, complex and commonly subject to a multitude of anthropogenic stressors making it hard to link changes in ecosystem structure to the appearance of a specific species. Grosholz *et al.* (2003) [16] described that the biological invasions have the potential to change an ecosystem dramatically, by effecting its processes, composition and food-web interactions. Takeuchi *et al*. (2002) [45] recognized ten fish families in the diet of a conspecific population of cornetfish in shallow reef waters of South Japan whereas eleven teleost families were found in trawl catches in the area (Corsini and Economidis 1999 [5]; Corsini *et al*. 2002) [6]. Four prey-fish families (Gobiidae, Labridae, Mullidae and Scaridae) are also present among the prey reef fish of *F. commersonii* in Japanese reef habitats (Takeuchi *et al*. 2002) [45], confirming that many colonizers of Mediterranean coastal waters retain their basic feeding habits (Golani 1993b) [52]. *F. commersonii* is primarily piscivorous in its original distribution range, mainly feeding on bottom-dwelling fishes, but supplementing its diet with squids and shrimps (Randall *et al.* 1997; Golani 2000; Takeuchi *et al.* 2002) [36, 19, 45]. Thus, diversification in foraging behavior in piscivores will be more remarkable than in fish of other tropic levels (Hixon, 1991, Gerking, 1994), [21, 18]. Corsini *et al*. (2002) [6] also considered the cornetfish as carnivorous, seeking food over reefs and seagrass beds, as well as benthic fish and occasionally shrimps. In the present study, the cornetfish was found to prefer fishes with higher occurrence (79%), followed by crustaceans (5%), mollusc (1%), digested contents (7%) and others (8%) among the food items. Based on the above results, it could be inferred that the cornetfish is highly piscivorous in nature. Likewise, Kalogirou *et al.*, (2006) [53] studied the diet of the fish *F. commersonii* in a recently colonized area of the eastern Mediterranean, who noticed the diet of the blue cornetfish consists of 96% by number and 99.95% by weight of fish.

Conclusion

F. commersonii is the fastest and furthest spreading alien fish species; it feeds on numerous commercial native populations. It may be presumed that this species like others has been a success due to aggressive superiority and pre-adaptation of the tropical Indo-Pacific fish.

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