First report of *Lactoria cornuta* from the west coast of India – Evidence of the role of tropical cyclone Ockhi

Muhammed Zafar Iqbal A.N.[1*], Gurudev Mali[1], Raghavendra Dollin[1]

1. Post Graduate Department of Zoology, Government First Grade College, Karwar, Karnataka, India.

Corresponding Author

Dr Muhammed Zafar Iqbal A.N.
Post Graduate Department of Zoology, Government First Grade College, Karwar, Karnataka, India.
Email: zafarin@gmail.com

Abstract

India is known for its rich biodiversity and is fortunate to have several endemic species from different classes of vertebrates. India is home to 7.5% of the global fish diversity, with 91 endemic species of ray finned fishes, the actinopterygians. Some fish species have never been reported until recently, and one such example is the long-horned Cowfish (Ostracidae), best known for inhabiting only certain areas of the Indo-Pacific oceans. However, it has been reported recently in the Bay of Bengal, but never on the west coast of India. This is the first time this fish has been found on the west coast of India. Given its morphology, the migration seems highly improbable since it can only endure lethargic swimming. In this article, we have explored the role of other external forces that could have contributed to its journey to the west coast of India. As such, we recognize the role of Super Cyclone Ockhi as a vital force in determining the expansion of its range. The fact that its first collection coincides with the passage of Cyclone Ockhi on the west coast of India greatly supports our hypothesis. A year later, another specimen was recovered from a location very close to the first, indicating the successful establishment of *Lacturia cornuta* in its new environment. Related morphometric and meristic studies of our specimens are consistent with previous studies reported in the Bay of Bengal.

Key Words: *Lacturia cornuta*, Cyclone, Ockhi, Venomous, Bay of Bengal.

Introduction

India has 7.5% of the world's fisheries diversity with 2,443 species from 927 genera (230 families of 40 orders). The Andaman Archipelago and the Nicobar Archipelago are the most numerous (1431 species), followed by the east coast of India (1121 species) and the west coast (1071 species) (Van der Elst, 1993; Chaudhuri, 2004; Berra, 2001; Leveque. et. al. 2008; Mishra and Gopi, 2015). The fishing industry makes an important contribution to the social and economic status of people living in coastal areas. In addition, India has 91 endemic fish species, the majority of which are found on the east coast of India. Unfortunately, an almost equal number of species have been introduced into the IUCN Near-Threatened category. The threat to fish diversity is primarily due to habitat degradation and non-scientific harvesting of fish resources.

Fish have a very large number of poisonous or venomous species, indeed more than 50% of venomous and venomous vertebrates are actually fish (Smith and Wheeler, 2006; John et al. 2014). Consequently, the number of venomous and poisonous fish are divided into several orders of ray-finned fish (Church and Hodgson, 2002; Halstead, 1970; 1988; Haddad et al. 2003; Haddad Jr V, Martins, 2006; Haddad Jr V et al. 2009; Vetrano et al 2002). Almost all tetradontiform fish, which constitute approximately 5% of total fish, are poisonous or toxic. Some of the familiar representatives found off the coast of India are Porcupinefishes (Diodontidae), Puffers (Tetradontidae), spikefishes (Triacanthodidae), triple spine fishes (Triacanthidae), triggerfishes (Balistadae), the boxfishes (Ostracionidae) and molas (Molidae). Many have powerful toxins in any of the organs such as the hepatopancreas, ovary or intestine, but certain species secrete toxins from their dermal glands. Tetrodotoxin is one of the most potent neurotoxins affecting predominantly neuromuscular transmission and sympathetic nervous system (Gopalakrishnakone and Malhotra, 2017; Smith and Wheeler, 2006). Beyond the associated risk, these fish are unpleasant, preventing them from being exploited commercially, whether for food or other commercial purposes.

The Ostraciidae family is one of ten families of this order with 33 species (12 existing genera) in the world. The Ostraciidae fishes have a peculiar square, box-shaped body and are very similar

to pufferfishes and filefishes. The mucus contains a potent toxin, ostracitoxin (Pahutoxin), secreted from club cells in the skin epidermis (Halstead, 1970; 1988). Along the coastlines of India, nine species from four genera have been documented (Matsuura 1998; 2015). The Longhorn cowfish (*Lactoria cornuta cornuta*) is extensively distributed along the coasts of the Red Sea, Japan, South Korea and Australia at a depth of 1 to 50 meters.This species prefers habitats such as coral reefs, reef flats, and muddy or sandy coastlines (Lieske and Myers, 1994; Ambak et al.2010; Allen and Erdmann, 2012; Hutchins 1984). Porcupine and pufferfish of the Ostraciidae family continue to be reported on the east and west coasts of India. Nevertheless, until recently, cowfishes had not been documented before, either in the Bay of Bengal or in the Arabian Sea. The first record of Cowfishes emerged from Bangladesh in 2013, followed by Odisha and Pondicherry. (Both reports from the Bay of Bengal) (Khan, 2013; Behera, 2017). In this article, we report for the first time the collection of Longhorn Cowfishes from the west coast of India. This article also examines the factors, which might have played key role in the range extension for this species.

Materials and Method

Collection of first Specimen

The first specimen of Longhorn cowfish, *Lactoria cornuta cornuta* was caught (Fig. 2.0) alive from a small water puddle at Ravindranath Tagore beach, Karwar (14.809863 N and 74.125204 E) between 5 PM to 5:30 PM on 30 March 2018 during routine field studies. Collected specimen identified as longhorn cowfish, necessary photography and videography was done in the field itself to capture its activities. Live specimen was carefully collected and transported to the laboratory in plastic container with 15 liters of seawater for further studies. Notwithstanding to all our possible efforts, the specimen could be maintained alive for more than one hour in the laboratory condition. The specimen designated as **WCI18**, which stands for **W**est **C**oast of **I**ndia 20**18**.

Morphometric and Meristic studies

The specimen subjected to morphometric and meristic characterization by adopting the procedure given by Hutchins and Randall (1982). Necessary morphometric measurements

recorded by using digital caliper and meristic studies done by recording number of rays in the paired and median fins

Identification. Both morphometric and meristic data tabulated systematically.

Collection of second Specimen

After the collection of first specimen (WCI18), we were vigilant and continuously in search of more number of species. Fortunately, second dead but intact specimen was collected at around 7 AM on 18th February 2019 from Majali beach (14.88126 N & 74.10631 E) 10 km south of Karwar town. The specimen, transported to the laboratory and designated as **WCI19** (**W**est **C**oast of **I**ndia 20**19)** and necessary Photographs were taken. Morphometric and meristic studies carried out by following the Hutchins and Randall (1982) as described for WCI18 specimen and the data recorded and tabulated.

RESULTS

The specimens conclusively confirmed as longhorn cowfish *Lactoria cornuta* by using identification keys provided by various authors (Hutchins and Matsuura, 1984; Randall et al.,1990; Allen, 2012; Ambak 2010).

First specimen WCI18

The specimen WCI18 collected from Ravindranath Tagore beach, studied in detail and all morphometric and meristic characters measured and tabulated (Table 1.0.) Important morphometric measurements such as body length, body depth, eye diameter & inter-orbital length, fin lengths were recorded. During it was found that anterior dorso-lateral horns were unequal in length (Right measured 1.5 cm and left 0.6 cm) (Fig.11.) However, posterior dorso-lateral horns were equal both measuring 2.4 cm. (Fig. 12.) The right and left anterior horns spaced closely with gap of 2.3 cm while the posterior horns were slightly distantly spaced with 3.4 cm. gap in between.

All rays of median fins (Dorsal, anal and caudal) (Fig. 10) and paired (Pectoral fin Fig. 9.0) counted carefully and meristic characters depicted in table 2.0.

Second specimen WCI19

Second specimen of *Lactoria cornuta* collected from Majali beach as dead but in fresh and intact condition. All morphometric and meristic studies conducted on WCI18 repeated on this specimen as well (WCI19). The morphometric and meristic data depicted in Table 1.0. and Table 2.0 respectively. In this specimen, the length of right and left anterior as well as posterior dorso-lateral horn lengths found to be equal (Fig.19.0. & 20)

Longhorn Cowfish, *Lactoria cornuta* specimen collected on 30-03-2019 (WCI18)

Fig. 1.0. Sub terminal Mouth – Cowfish!!!

Fig. 2.0. Cowfish – Collection Site

Fig. 3.0. Lateral View

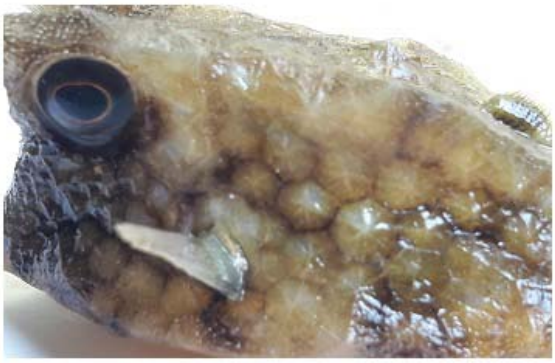


Fig. 4.0. Plate like Dermal Scales

Fig. 5.0. Dorsal View

Fig. 6.0. Lateral View

Longhorn Cowfish, *Lactoria cornuta* specimen collected on 30-03-2019 (WCI18)

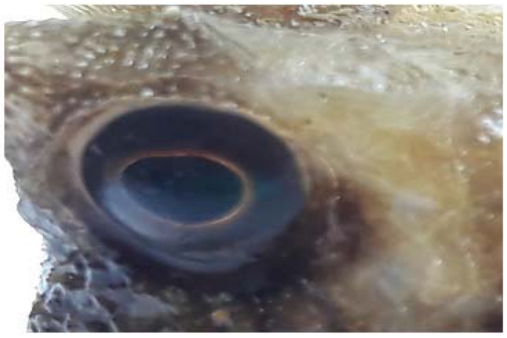


Fig.7 .0. Orbit

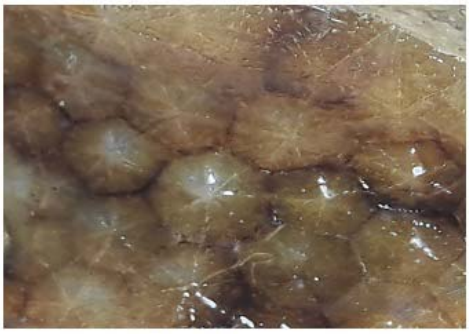


Fig.8 .0. Plate like Dermal Scales

Fig.9 .0. Pectoral Fin

Fig.10 .0. Dorsal Fin

Fig.11 .0. Anterior Horn

Fig.12 .0. Posterior Horn

Table 1. Morphometric characters of *Lactoria cornuta* specimens (WCI18 & WCI19)

Sl.No.	Character	Measurements in cm	
		WCI18	**WCI19**
1	Total length (TL)	12.6	19.2
2	Standard length (SL)	7.9	12.8
3	Head length (LC)	2	3.3
4	Pre Orbital Distance (PRO)	0.4	0.8
5	Maximum body depth (Hx)	3.8	3.8
6	Minimum body depth (Hm)	2.3	2.3
7	Caudal peduncle length (LPC)	2.8	2.8
8	Eye diameter (OH)	0.9	1.2
9	Inter-orbital Distance (IO)	1.1	3.1
10	Pre-dorsal Distance (PD)	5.3	7.6
11	Pre-anal length (PA)	5.8	9.2
12	Pre-pectoral Distance (PPEC)	2.3	3.6
13	Depth of Dorsal fin (DDF)	1.5	2.2
14	Depth of Anal fin (DAF)	1.3	2
15	Length of Pectoral fin (LPF)	1.6	2.7
16	Length of Caudal fin (LCF)	6.5	7.1
17	Pectoral fin base length 1	-	1
18	Pectoral fin base length 2	-	1
19	Caudal fin base length	-	1.4
20	Width of caudal fin	-	7.7
21	Dorsal fin base length	-	1.2
22	Dorsolateral Anterior Horn	1.5 R & 0.6 L	2.0 L/R
23	Ventrolateral Posterior Horn	2.4 R/L	2.0 L/R
25	Distance between two horns at head region	2.3	2.7
26	Distance between two horns at anal region	3.4	3.6

Longhorn Cowfish, *Lactoria cornuta* specimen collected on 18-02-2019 (WCI19)

Fig. 13.0. Front View – Cowfish!!

Fig.14 .0. Lateral View

Fig.15 .0. Dorsal View

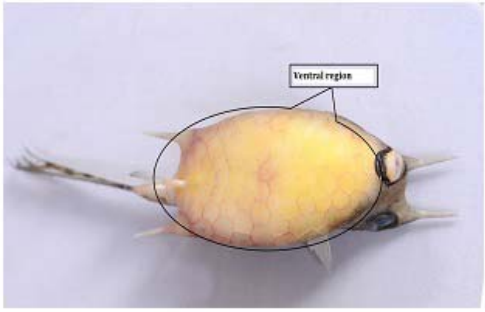


Fig.16 .0. Ventral View

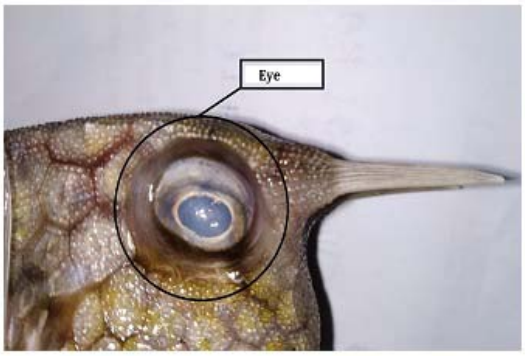


Fig. 17 .0. Orbit

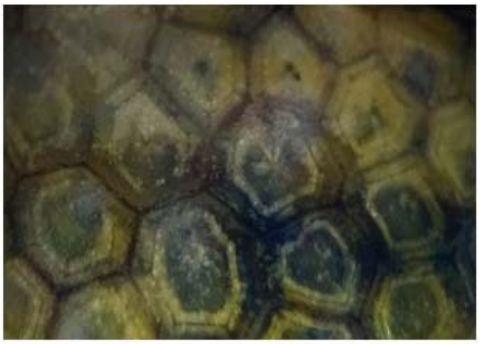


Fig.18 .0. Plate like Hexagonal Scales

Longhorn Cowfish, *Lactoria cornuta* specimen collected on 18-02-2019 (WCI19)

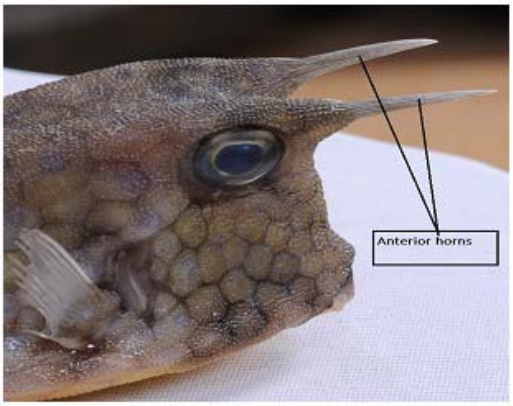


Fig.19 .0. Anterior Horn

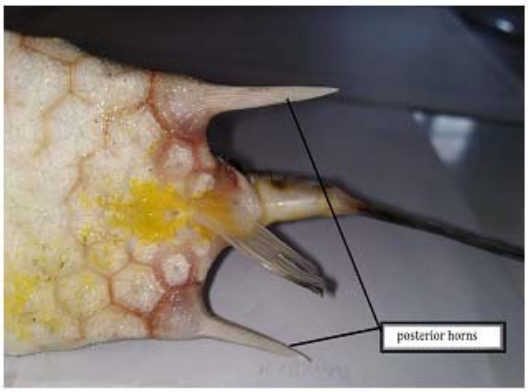


Fig.20 .0. Posterior Horn

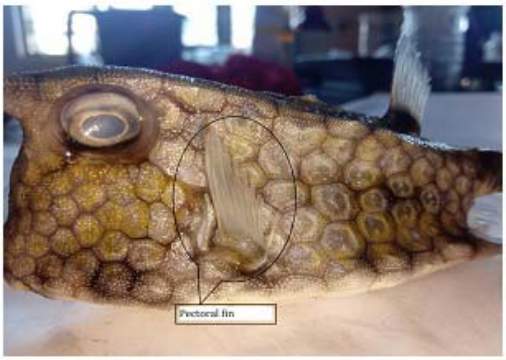


Fig.21 .0. Pectoral Fin

Fig. 22.0. Dorsal Fin

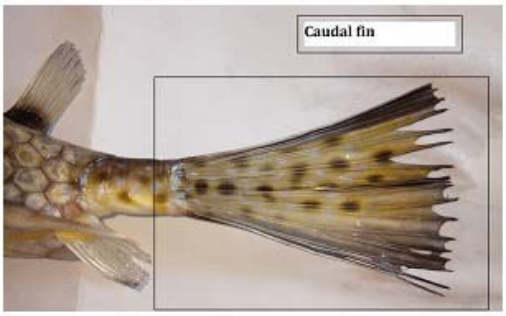


Fig.23 .0. Caudal Fin

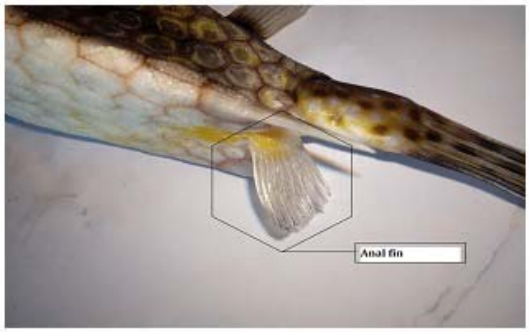


Fig.24 .0. Anal Fin

Table 2. Meristic characters of *Lactoria cornuta* specimens (WCI18 & WCI19)

Sl.No.	Meristic Characters	Specimen	
		WCI18	WCI19
1	Dorsal spines	0	0
2	Dorsal fin rays	9	9
3	Anal spines	0	0
4	Anal fin rays	9	9
5	Caudal fin rays	10	10
6	Pectoral fin rays	10	10
7	Weight	Not recorded	81.89 gm

Comparative study with the specimens collected from Bay of Bengal

As many as 10 standard morphometric rations calculated not only for our specimens (WCI18 & WCI19) but also for the specimens collected from the Bay of Bengal by other workers. Our aim was to carry out some comparative studies among the specimens collected from the east and west coast of India, it became inevitable for us to calculate the ratios even for their morphometries, as those authors haven't provided ratios in their publications (Khan, 2013; Behera, 2017). The comparative data of ten important rations given in Table 3.0.

In comparative studies, majority of the growth parameters do not show any significant deviations from the specimens collected from the east coast of India (Khan, 2013; Behera, 2017). However, some parameters such as ratios of LC/PRO, SL/PPEC and OH/IO conspicuously differ among the species, the details are provided in Table 3.0.

Table 3. Comparison of Standard Morphometric Ratios of present study with the specimen collected from Bay of Bengal

	Standard Morphometric Ratios				
Sl.No.	**Measurements**	**Khan *et.al.* 2013**	**Behera *et. al.* 2017**	**Present Study**	
				WCI2018	**WCI2019**
1	Total Length (TL) :Standard Length (SL)	0.93	1.16	1.59	1.5
2	Total Length (TL) :Head Length (LC)	6.09	5.01	6.3	5.18
3	Standard Length (SL) :Head Length (LC)	3.95	4.38	3.95	3.87
4	Head Length (LC) : Pre Orbital Distance (PRO)	4.2	1.31	5	4.1
5	Maximum Body Depth (Hx) : Minimum Body Depth (Hm)	1.34	1.03	1.65	1.65
6	Eye Diameter (OH) :Inter Orbital Distance (IO)	0.9	0.7	0.81	0.38
7	Total Length (TL) :Pre Dorsal Distance (PD)	2.56	2.64	2.37	1.68
8	Standard Length (SL) :Pre pectoral Distance (PPEC)	3.6	4.51	1.49	3.55
9	Total Length (TL) : Pre Anal Distance (PA)	2.13	2.28	2.17	2.08
10	Standard Length (SL) :Pre Anal Distance (PA)	1.38	1.95	1.36	1.39

DISCUSSION

The longhorn cowfish, *Lactoria cornuta*, is widely distributed in certain pockets of the Indo-Pacific oceans Viz. Red sea, east Africa, Marquesas and Tuamotu Islands, South Korea, Ryukyu Islands (southern Japan), south of Australia and Lord Howe Islands (Goren and Dor, 1994; Van der Elst 1993; Lieske and Myers 1994). Preferred habitats of cowfishes include coral reefs, reef plain habitat, but occasionally they have also been reported from sandy beaches.The species was

never recorded before 2013, whether in the Bay of Bengal or in the Arabian Sea. However, this fish was first reported on Saint Martins Island (south-east Bangladesh) and later in 2017 it was further documented in Gopalpur (Odisha, India) and Pondicherry (Khan, 2013; Behera, 2017) These are the only reports of cowfish from the Bay of Bengal.

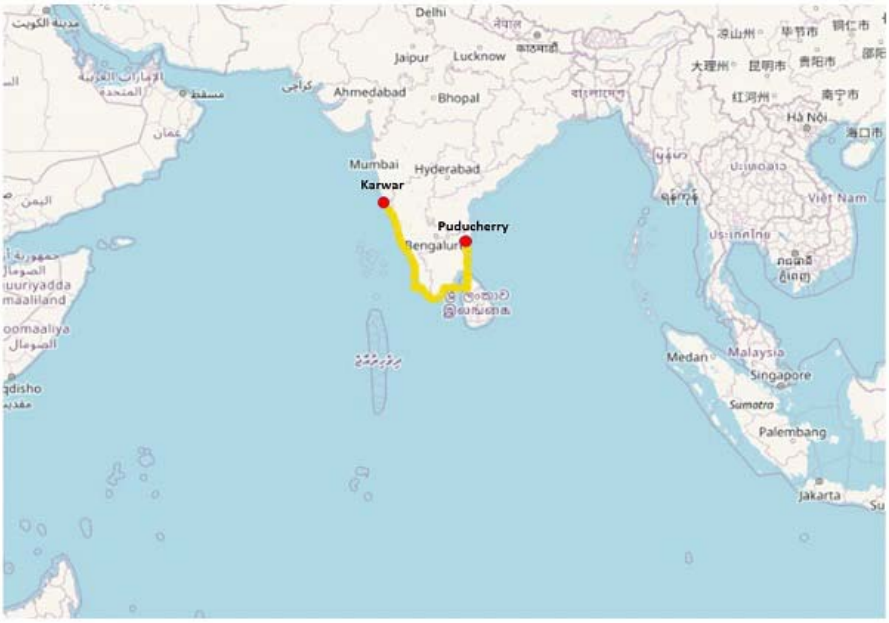
Until recently Longhorn cowfish was not been reported from the west coast of India. Here comes the very first - report on the collection of this fish from the west coast of India. We collected two specimens in two consecutive years, the first one in 2018 in Karwar and the second one in 2019 in Majali beach (10 Km away from Karwar).

Longhorn cowfish was never been reported untill recently from the west coast of India. This is first-ever report on the collection of this fish from the coast of Karwar, west coast of India. We have collected two specimens in two consecutive years, first specimen in 2018 from Karwar and second specimen was collected in 2019 from Majali beach (10 Km away from Karwar). Both specimens were thoroughly examined and the required morphological measurements were compiled using previously described methods (Hutchins 1984: Randall et al., 1990; Allen and Erdmann, 2012). Furthermore, no significant differences were found between the specimens we collected and those in the Bay of Bengal. The west coast specimen's morphometric and meristic traits closely resembled those described elsewhere (Khan et al. 2013; Behera et al. 2017).

The diagnostic characteristics of the specimens collected are consistent with those of the Ostraciid family. The specimen has a typical conical shaped body and is covered with a hexagonal plaque like scales, which are fused into box like carapace. Two pairs of anterior and posterior dorsal horns offer enormous survival advantages to escape from enemies, additionally predators find it difficult to swallow due to the presence of horns.(Fig.11 & 19). Other peculiarities included the sub-terminal mouth bound by prominent lips (Fig.1 and 13), gills without operculum. Along with the prominent caudal fin (Fig. 23), these fish also have pectoral, dorsal and anal fins. Collection of this fish from the west coast of India may be justified either on account of migration or because of physical forces such as cyclones and tornados. Given its morphology, migration appears highly unlikely to explain for the range extension because such a body design only sustains the lethargic swimming. The possible role of natural forces cannot be excluded, given the various natural perturbations created in the northern Indian Ocean.

Fig. 25. Track map of very severe Cyclone Ockhi (December 2017)
(Courtesy: Meow, Public domain, via Commons)

Fig. 26. Possible path of drifting of Longhorn Cowfish
(Track created by using http://ports.com)



This theory is reinforced by the fact that the Super Cyclone Ockhi on the western coast coincides perfectly with the collection of the first specimen. Therefore, we suggest the role of this super cyclone in the extension of the range of longhorn cowfish from the Bay of Bengal to the west coast of India. Our proposal is supported by numerous reports, which suggest the importance of cyclones in determining the richness, distribution and behaviour of species. (Harmelin-Vivien and Mireille, 1994: Gong et al. 2010; Fiedler, et al. 2013; Fandel et al. 2020; Booth and Thomas, 2021; Harley et al. 2006; Easterling et al. 2000; Easterling, 2000). Thus, we would like to conclude that the cyclone, Ockhi (Track of the cyclone, Figure 25), coming from the Sri Lanka west of Kanyakumari and reaching the coast of Karwar in December 2017, dragged this species along.

A year later, another specimen was recovered from a site very close to the first, indicating the successful establishment of *Lacturia cornuta* in its new environment. Relative morphometric and meristic studies of our specimens are consistent with previous studies reported in the Bay of Bengal.

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Conflict of Interest

No conflict exists either financial or personal among the authors

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