

RESEARCH ARTICLE

Ethnoecology of *Gerres filamentosus* (Cuvier, 1829) along the south Konkan coast of Maharashtra, India

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ABSTRACT

Ethnoecology can be understood as the ways in which people: “experience ecology, of ways in which they engage with, and build upon, the ecological relationships of which they are a part”. Investigations were carried out to collect and document the local ecological knowledge on *Gerres filamentosus* and compare the local knowledge on biology with biological studies and published literature. A total of 100 fishers from Ratnagiri and Sindhudurg districts constituted the sample size of the study. The ethnoecological knowledge on local name and identification of *Gerres*, its habitat and fishery season, size at first maturity, food and feeding and spawning season was collected. Similarly the local knowledge on effect of lunar cycle, wind direction, water colour and temperature on availability of *G. filamentosus* has been documented. The views of fishers on feeding habit, size at first maturity and spawning season of *G. filamentosus* were compared with biological studies and published literature. Mann-Whitney U-test showed agreement between local ecological knowledge, biological studies and published literature.

INTRODUCTION

Tropical, small scale fisheries, which feed and provide income to millions of people around the world [5,12,31,37] are especially difficult to manage in proper scientific manner based on optimum yield. The fishers by virtue of living in close proximity of the nature to harness natural resources possess strong indigenous knowledge system. The corpus of this knowledge combined with involvement of local institutions is used in management of most of the small scale coastal fisheries. The definition of Indigenous knowledge has been variously construed by different authors. The main ones being the local knowledge, indigenous knowledge, traditional ecological knowledge, indigenous skill and ethnoscience [42]. Ethnobiology is the study of the knowledge and of the concepts developed by any society with respect to biology [39]. The study of traditional ecological knowledge begins with the study of species identifications and classification (ethnobiology) and proceeds to considerations of peoples' understandings of ecological processes and their relationships with the environment [11]. Depending on the scope of the study the term ethnoecology is used in the present study. Ethnoecology is the cross-cultural study of how people perceive and manipulate their environments and begins with the study of species identification and classification (ethnobiology) and proceeds to consideration of peoples' understanding of ecological processes and their relationship with the environment [11]. The knowledge of the marine area used by fishers, i.e., location of fishing spots for each species, the knowledge fishers have of the biology and ecology of species and their LEK is based on studies of the ethnobiology, ethnoecology, and

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ethnotaxonomy of fish [8]. The study of ethnoecology has got the potential to generate important knowledge database especially in case of small scale tropical fisheries. Previous studies have analyzed relevant topics related to fishers LEK in the Brazilian and Mexico coast, such as fish reproduction [44], migration [43], ecology of endangered reef fish [22] and nature & resource [14,15,48]. Some of these surveys addressed both fishers LEK and biological studies of coastal fishes [9,45]. South Konkan coast of Maharashtra is dotted by a number of estuaries supporting brackish water fisheries. The fisheries are constituted by commercially important species targeted by artisanal fishers with the help of multiple gears. The fisheries are data deficient and no organized data on the landings are currently available. The distribution and landings of Gerreidae in the Red Sea were given by [7]. Gerreids are abundant and occupy an important habitats common in sandy bottom and muddy areas [26]. *Gerres filamentosus* belonging to the family Gerridae is one of the important commonly landed brackishwater fishes in coastal region of Maharashtra. There are no published reports on the present status of exploitation of *Gerres filamentosus* along the south Konkan coast of Maharashtra. Ethnoecological knowledge on *Gerres filamentosus* and its validation will be helpful in management and conservation of the species in the region.

MATERIALS AND METHODS

The study was carried out in south Konkan coast of Maharashtra (Fig. 1). South Konkan coast of Maharashtra is comprised of Ratnagiri and Sindhudurg districts with a coastline of 288 km. Major portion of the total fish landings of the district is contributed by the marine sector. The total fisher population of Ratnagiri and Sindhudurg district is 99863 while rural estuarine fisher population is about 18286 [5]. Twenty six fishing villages viz., Bhatye,

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Shirgaon, Sakhartar, Mirya, Kalbadevi, Natye, Jaitapur, Ambolgad, Gavkhadi, Unavre, Pangari, Dabhil, Shiravne, Kelshi, Anjarla, Vijaydurg, Devgad, Achara, Malvan, Sarjekot, Vengurla, Sagawe, Shirse, Tarkarli, Devbag and Nivati situated along the estuaries of the south Konkan coast were selected randomly for the purpose of collecting data for the study. A total of 100 fishers were interviewed for the study with the help of semi-structured interview schedule designed by incorporating all the items on which the information was required. The respondents were selected using the snow ball method in which people from the community and the interviewees themselves indicate the people to be interviewed [6]. Snowball method is non-probability sampling technique where existing study subjects recruit future subjects from among their acquaintances. It is a useful tool for building network and increasing the number of participants [23]. Information gathered from the fishers was quantified as percentage of interviewees who mentioned a given answer to asked questions. The majority of respondents' often mentioned answers to a particular question were considered as reflecting aspects of indigenous knowledge. The findings of the study were also supported by non-participant observation and documentary evidences. Similarly ethnobiological studies were corroborated by biological studies carried

out in the laboratory.

For biological studies the specimens of *Gerres filamentosus* were collected from Harnai, Ratnagiri, Purngad, Vijaydurg, Malvan and Vengurla at monthly intervals from October 2017 to September 2018. These places are the prominent landing centers situated along the study area and where catch from the adjacent coastal/estuarine villages is brought for disposal. Gut content was done by using point method [25]. Reproductive biology was carried out with respect to gonado somatic index and maturity studies. For calculating the gonado somatic index, the weight of the individual fish was noted. The gonads were removed carefully and weighed on an electronic balance after removing the excess moisture using a blotting paper. Maturity stages of *Gerres filamentosus* were classified as per [36]. The stages are I) Immature, II) Early developing, III) Developing, IV) Late developing, V) Ripe, VI) Running type and VII) Spent. Ethnoecological knowledge on feeding habit and spawning season of *Gerres filamentosus* was compared with biological studies and published literature. Mann-Whitney U test was done to be carried out to check the agreement between ethnoecology, biological studies and published literature.

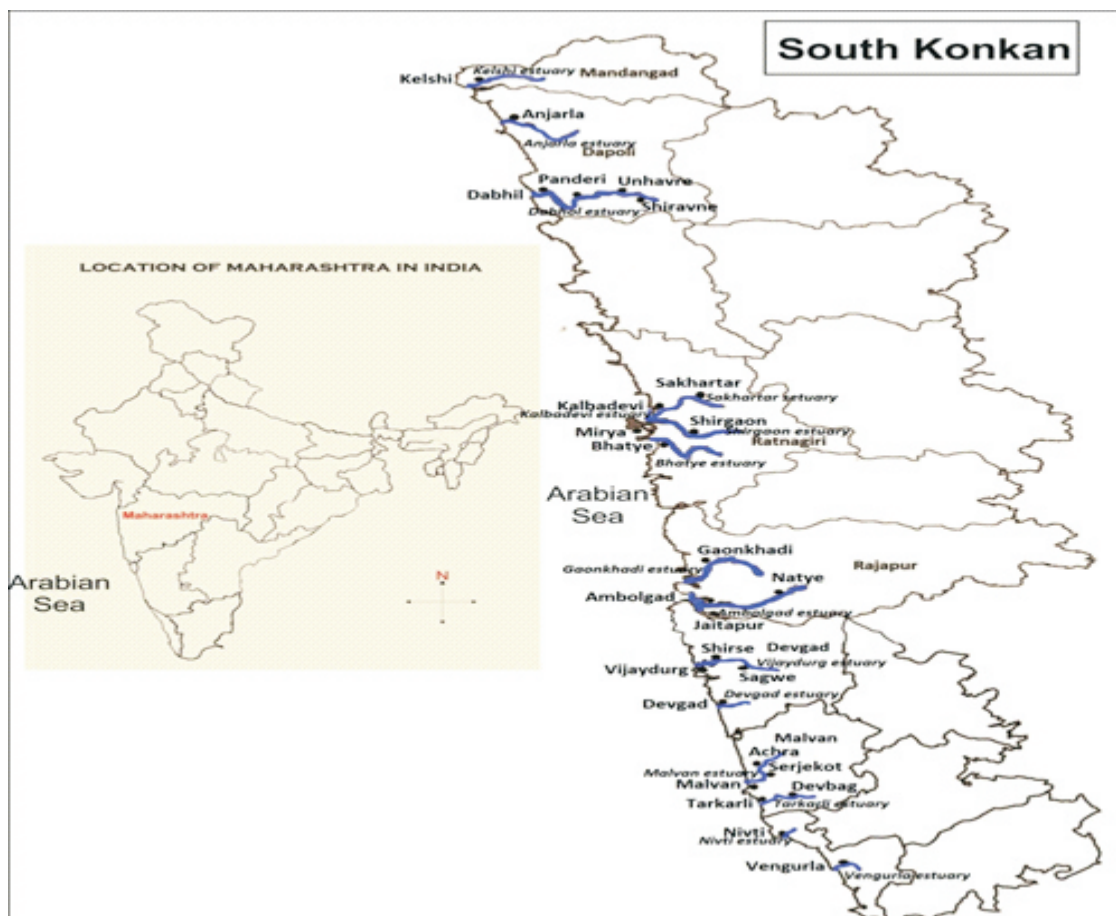


Fig 1 : Study area.

RESULTS

Local names and identification of species of *Gerres filamentosus*

Gerres filamentosus is identified by the fishers with the help of shape, type of dentition, size and colour. The details are given in the **Table 1**.

Ethnoecology on habitat of identified fishes

Almost all fishers opined that *G. filamentosus* inhabit estuaries having mostly muddy to sandy substrates.

Ethnoecology on fishery season

Almost all fishers reported that the fishing for *G. filamentosus* is carried out using different gears throughout the year.

Ethnoecology on food and feeding

All fishers reported that the *Gerres filamentosus* to be carnivores species and feed on chote kide (small insects) and alya (polychaetes).

Ethnoecology on spawning season of brackishwater fishes

Fishers opined that the spawning season of *G. filamentosus* is during July to November.

Ethnoecology on size at first maturity

Accordingly as per fishers view the size at first maturity (minimum average size of the fish observed with bulgy abdomen) of *G. filamentosus* was reported to vary between 100-150 gm.

Ethnoecology on effect of lunar cycle on availability/abundance of brackish water fishes

Multiple views on effect of lunar cycle on availability of *G. filamentosus* were expressed by fishers. According to fishers more catch of *G. filamentosus* is obtained during amavasya and pournima in hook and line and gill net fishery respectively.

Ethnoecology on effect of wind direction on availability/abundance of brackish water fishes

Most of the fishers held the view that winds blowing from different directions certainly had bearing on availability of fishes. Accordingly fishers stated that winds blowing from northerly direction (matlavar) during August to November fetch more catch of *G. filamentosus* to gill net.

BIOLOGICAL STUDIES

Food and feeding habits

In the present study the major food items for *G. filamentosus* were found to be molluscs, polychaetes, fish parts, sand, semi-digested and digested matter during most of the months.

REPRODUCTIVE BIOLOGY

Gonado-somatic index

The gonado-somatic index (GSI) was calculated for each individual and averaged for each month. The averaged gonado-somatic index of males and females was plotted against month to show monthly variations. GSI was highest during the months of October, December, January, November and February showing occurrence of more ripe individuals. Higher GSI in males was seen during March, February, November and December.

Length at sexual maturity (Lm)

The length at sexual maturity was estimated using the distribution of proportion of mature individuals. For this purpose, proportion of mature individuals was plotted against size groups. The length at sexual maturity for female was estimated to be 144 mm.

Statistical analysis

The statistical analysis was done by Mann-Whitney U test by SAS version 9.3 and revealed that the ethnoecological knowledge (F), biological studies (L) and published literature (P) profiles were statistically volatile ($p > 0.05$)

Ethnobiology vs biological studies vs published literature

Most popular views held by fishers on the biology of *Gerres filamentosus* was chosen for comparison with biological studies and published data given in the below tables.

DISCUSSION

Local knowledge

Local names and identification of *Gerres filamentosus*

Gerres filamentosus is locally known by shetuk and charbit. *Gerres filamentosus* cited by the fishers is at generic taxonomic level. According to [10] the generic taxonomy may be arranged in two ways; generic monotypic, when the generic does not possess a lower category, and generic polytypic, when it is divided in a specific way. The local names given to *G. filamentosus* by fishers indicates generic monotypic arrangement. Further over-differentiation type of correspondence as proposed by [10] is noted as shetuk and charbit refer to a single scientific species. Fishers identify *Gerres filamentosus* based upon criteria such as coloration, shape and type of dentition emphasizing utilitarian dimension of taxonomy. Many of these criteria are also

found in guides and in taxonomic identification keys [17,29,32]. However for collecting ethnoecology, coloured photographs of *Gerres filamentosus* was downloaded from Fish Base [18] and shown to fishers to confirm the selected species.

Table 1 : Local names and identification of *G. filamentosus*.

Species	Local name	Identification by fishers	Frequency
<i>Gerres filamentosus</i>	shetuk, charbit	Body laterally compressed (chapta). Mouth having small sharp teeth. (lahaan tokdar daat) Colour – Whitish (paandhara) and shiny (chamkdar)	100

Table 2 : Food and feeding.

Species	Local name	Food and Feeding		Frequency	NR*
		Feeding habit	Food items		
<i>Gerres filamentosus</i>	<i>Shetuk</i> <i>Charbit</i>	<i>maunsahar</i> (Carnivore)	<i>chote kide, alya ani</i> <i>choti kolambi</i>	75 (75.00)	25 (25.00)

Table 3 : Size at first maturity.

Species	Local name	Size at first maturity			
		30-60 gm	50-100 gm	100-150 gm	NR*
<i>Gerres filamentosus</i>	<i>Shetuk/Charbit</i>	-	23 (23.00)	38 (38.00)	39 (39.00)

Table 4 : Percentage composition of food items in the stomach of *G. filamentosus* from October 2017 to September 2018.

Food Items	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun	Jul.	Aug.	Sep.
Molluscan shells	57.12	25.14	45.34	22.15	25.39	19.52	17.25	16.45	18.06	24.18	13.98	12.17
Polychaetes	9.78	16.39	12.96	15.86	16.20	18.45	11.47	11.55	12.18	10.12	18.79	13.42
Fish parts	5.15	14.10	8.32	14.77	14.83	21.39	12.19	10.47	20.34	19.12	29.87	18.28
Sand	9.54	12.58	7.37	9.10	12.25	18.12	20.66	19.77	12.39	12.31	20.89	25.40
Semi-digested matter	9.44	12.85	15.46	17.08	16.21	15.40	16.97	13.02	22.56	14.17	16.47	18.48
Digested matter	8.97	18.94	10.55	21.04	15.12	7.12	21.46	28.74	14.47	20.10	0.00	12.25

Table 5 : Monthly GSI values for males and females of *G. filamentosus* along Ratnagiri and Sindhudurg coast during October 2017 to September 2018.

Sex	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun	Jul.	Aug.	Sep.	Average
Male	0.99	1.13	1.04	1.13	1.45	1.71	0.44	0.60	0.80	0.56	0.94	0.79	0.97
Female	2.98	2.44	2.59	2.53	2.03	1.75	0.92	0.60	0.75	0.77	0.81	0.89	1.59

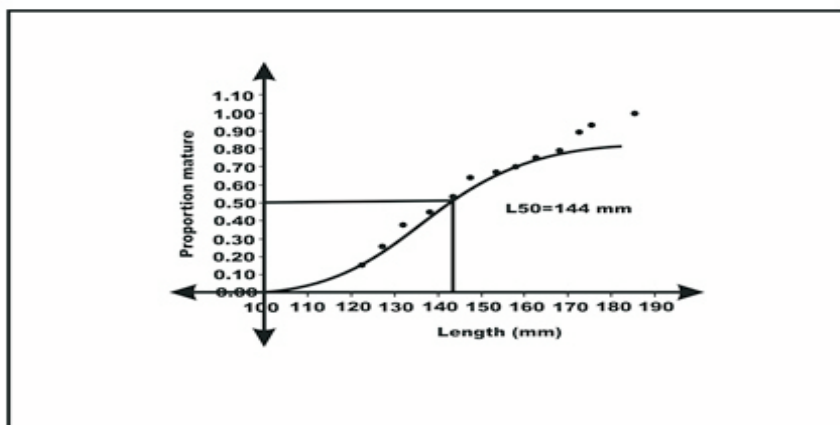


Fig 2 : Length at sexual maturity of *G. filamentosus*.

Sr. no.	Domain	Fishers view	Laboratory observations	Published literature
1.	Identification of species			
	a) Colour- reddish-1, Silver-2, b) Shape- Elongated- 3, moderately compressed-4			
	b) Teeth- small/sharp teeth-5			
	Colour	2	2	2
	Shape	4	4	4
	Teeth	5	5	5
2.	Fishery season			
	a) Throughout the year-1	1	1	1
3.	Size at first maturity			
	a) 100-150gm-1, b) 150-200gm-2	1	1	1
4.	Spawning season			
	a) Feb. to May-1, b) Jun. to Sept.-2, c) Oct. to Jan.-3	3	3	3
5.	Feeding habit			
	a) Carnivore-1, b) Omnivore-2	1	2	2
6.	Food items			
	a) Crabs/fishes/shrimps and oysters-1	2	2	2
	b) Polycheates/fish parts/sand-2			

Mann-Whitney U-test

Profile	P value
F:L	0.7944
F:P	0.4896
L:P	0.4028

Ethnoecology on habitat of identified fishes

As per fishers *G. filamentosus* inhabit estuaries having mostly muddy to sandy substrates. *G. filamentosus* is known to inhabit sandy substrate in coastal waters including estuaries [1,2]. The observation of fishers agrees with published literature. Fishers have integral knowledge on availability of particular species on specific habitat [20]. This knowledge helps them to fish in particular habitat using suitable gear.

Ethnoecology on fishery season

Almost all fishers reported that the fishing for *G. filamentosus* is carried out using different gears throughout the year. However the abundance may vary as per the season. *G. filamentosus* is available throughout the year in the estuaries of Karnataka [13]. The availability of *G. filamentosus* is also reported in estuaries of Ratnagiri to stake net is reported throughout the year [39].

Ethnoecology on food and feeding

Fishers have claimed *G. filamentosus* to be a carnivore feeding mostly on chote kide (small insects), alya (polychaetes) and choti kolambi (small shrimps). The observation of fishers on food items of *G. filamentosus* corroborates with published reports [40,41,50]. The view of fishers claiming *G. filamentosus* to be a carnivore species however contradicts with earlier reports. The food composition of *G. filamentosus* from Pulicat Lake is dominantly represented by amphipods, polychaetes, bivalves and decapod crustaceans [40]. Similar findings were reported [50]. The worms and insects larvae formed the food items of *G. filamentosus* [40]. It is clear from the results obtained that fishers do have considerable knowledge on the food of the fish species they report.

Ethnoecology on spawning season of brackishwater fishes

Fishers opined that the spawning season of *G. filamentosus* is during July to November. No reports of spawning season of *G. filamentosus* from Indian waters are available. The spawning season of *G. filamentosus* from Harghada Red Sea, Egypt was reported to be during July to October [3].

Ethnoecology on size at first maturity

Fishers reported the maturity size of the fishes mostly in relation to the average minimum weight of the fishes seen with bulgy abdomen and with carrying eggs. Accordingly as per fishers the size at first maturity of *G. filamentosus* was reported to vary between 100-150gm. Different works have reported maturity size varying from 136 to 198 mm mm [3,24,27,46] for *G. filamentosus* respectively. As the maturity size in terms of weight was not quoted by anyone the views of fishers could not be directly compared with published data.

Ethnoecology on effect of lunar cycle on availability/abundance of brackish water fishes

Multiple views on effect of lunar cycle on availability of brackishwater fishes were expressed by fishers. Only popular views are discussed. According to fishers more catch of *G. filamentosus* is obtained during amavasya and pournima in hook and line and gill net fishery respectively. The catchability of gill nets during the night is related to the lunar calendar, the largest catches usually made during the new moon [28]. The higher activity towards bait in whiting (*Merlangius merlangius*) during periods of currents than non-current [16]. The effect of lunar cycle on availability of brackishwater fishes is basically related to vulnerability of particular fish to the specific gear/gears and operation of gear with respect to lunar cycle. The effect of lunar cycle on catch has been earlier reported for dol net fishery, bivalve fishery and stake net fishery by various workers wherein lunar cycle yields similar kind of influence [20,21,33,34,35,49].

Ethnoecology on effect of wind direction on availability/abundance of brackish water fishes

Most of the fishers held the view that winds blowing from different directions certainly had bearing on availability of fishes. Accordingly fishers stated that winds blowing from northerly direction (matlaivara) during August to November fetch more catch of *G. filamentosus* to gill net. This observation agrees with the findings of [34]. The author has also noted the similar view of fishers of Mumbai and Sindhudurg districts in Maharashtra wherein winds blowing from northerly direction fetch more catch and those blowing from southerly direction fetch less catch.

BIOLOGICAL STUDIES

Food and feeding habits

In the present study the major food items for *G. filamentosus* were found to be molluscs, polychaetes, fish parts, sand, semi-digested and digested matter during most of the months [Table 4]. The food composition of *G. filamentosus* from Pulicatlake is dominantly represented by amphipods, polychaetes, bivalves and decapod crustaceans [41]. Similar findings were reported by [50]. The worms and insects larvae formed the food items of *G. filamentosus* [40]. The *G. filamentosus* is an omnivore fish due to the mouth lacking pharyngeal teeth as well as canines indicating a structure suitable for mixed diet [3]. The inclusion of sand grains as well as benthic organisms reveals that this fish is omnivorous and bottom feeder. The results of food items observed in the present study agree with published literature.

REPRODUCTIVE BIOLOGY

Gonado-somatic index

GSI was noted to be highest during the months of October, November, December, January and February

showing occurrence of more ripe females. A higher GSI male was seen during March, February, November and December. High values of both males and females were observed in *G. filamentosus* pointing to synchronous maturation. High GSI values of both sexes of *G. filamentosus* were noted during July to October in the Hurghada Red Sea, Egypt [3]. These peaks coincided with the spawning period. Higher GSI values in males and females in the present study during the period October to March did not agree with the findings of [3]. This may possibly be due to presence of distinct stocks in both regions. Similarly higher GSI values in males and females in present study correspond to spawning period of *G. filamentosus* along the Ratnagiri and Sindhudurg coast.

Length at sexual maturity (Lm)

The length at sexual maturity in *G. filamentosus* is estimated to be 144 mm in the present study. The size at first maturity of *G. filamentosus* to be 163 mm from Hurghada Red Sea, Egypt [3] and the size at first maturity for males and females of *G. filamentosus* to be 198 mm and 191 mm respectively from western Arabian Gulf [24]. The males of *G. filamentosus* attain length at first sexual maturity at size of 143 mm and female at 136 mm [46]. Length at sexual maturity reported by different workers for *G. filamentosus* ranged between 136 mm to 198 mm from different regions. The estimated length at sexual maturity in present study conforms to the earlier reported findings [3,24,27].

Comparisons of local knowledge on biology with biological studies and published literature Identification of species

In the present study it was found that fishers identify the fish species based upon its morphological characters particularly coloration, shape and type of dentition. The fishes are locally known by different names and some unique scientific species are also known by one or more local names. Many of these criteria are also found in guides and in taxonomic identification keys [17,29,32]. The categories used by fishers to identify and classify fish are based on standards related to their morphology, habitat, importance in commerce and the kind of fishery [38]. However for collecting ethnoecology, after scientific identification of the species, coloured photographs of selected common brackishwater fish species were downloaded from Fish Base [19] and pictures were presented illustrating each species so that fishers could confirm their identification of species. The fisher's views on identification of species were verified [4,10,30] with the laboratory observations and published literature [18,47].

Fishery season

The fishers opined that the fishery of brackishwater fishes is practiced throughout the year. The specimens of these species were available throughout the year and were collected for biological studies. The most of fishes are available throughout the year in the estuaries of

Karnataka [13]. The *G. filamentosus* stake net fishery in more or less quantity throughout the year [49]. The fisher's views on fishery season were verified with the laboratory observation and published literature.

Food and feeding habit

Fishers reported that *G. filamentosus* is a carnivores fish feeding on chotekide (small insects), alya (polychaetes) and choti kolambi (small shrimps). Gut content analysis revealed that the fishes mostly feed on the molluscs, polychaetes apart from the presence of sand particles. The views of fishers on feeding habit of *G. filamentosus* are validated by the biological studies as well as published literature [40,41,50]. The results of [40,41,50] on presence of food item i. e. polychaetes matches with the view of fishers and laboratory studies. While reports of presence of insects larvae agrees with fishers view. However the presence of small insects/insects larvae was not noted in the laboratory observation.

Spawning season

Fishers stated that the spawning season of *G. filamentosus* is during July to November. No published reports of spawning season of *G. filamentosus* from Indian waters are presently available. In the present investigation the spawning season of *G. filamentosus* was concluded to be during October to March based on GSI and maturity studies. October to March based on GSI and maturity studies in laboratory observation. The views of fishers on spawning season of *G. filamentosus* are validated by laboratory estimation while also matches with published literature [3] from Egyptian waters.

Size at first maturity

Most of the fishers reported the size at first maturity of *G. filamentosus* to be approximately between 100-150 gm. In the present study the length at sexual maturity for females was found to be 144 mm corresponding to about 106 gm weight. The views of fishers on maturity of *G. filamentosus* are validated by laboratory estimation of maturity size. Similarly the findings of [46] also almost agree the results.

CONCLUSION

The study of ethnoecology thus generated important knowledge database in case of data deficient small scale *Gerres filamentosus* fishery. The knowledge pertaining to the identification of *Gerres filamentosus*, its feeding habit, fishery season, size at 1st maturity, effect of lunar cycle, wind direction, etc. will be helpful in designing appropriate management intervention. Particularly ethnoecology on the size at first maturity and spawning season and validation may prove vital in deciding legal size and fishing ban for *G. filamentosus* in south Konkan region.

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