

Traditional knowledge of fisher folk of Kollam district, Kerala on coastal and marine biodiversity and conservation

Biju Kumar, A.^{1*} and Anitha, R.^{1,2}

¹Department of Aquatic Biology & Fisheries, University of Kerala, Kariavattom,
Thiruvananthapuram-695581, Kerala

² Department of Zoology, SN College, Kollam, Kerala

* bijupuzhayoram@gmail.com

Received: 27 Nov 2017

Accepted: 15 Dec 2017

Abstract

The fisheries sector in Kerala state of India is particularly rich in custom, tradition and local knowledge, reflecting this in its communities, their established beliefs and practices. The proximity to the natural resource base has a dominating influence on the culture and thinking of the fishing community. This paper documents the traditional knowledge of traditional fishermen in Kollam district of Kerala on marine biodiversity and conservation, based on a questionnaire survey conducted in 17 fishing villages. The paper records traditional knowledge of fisher folk on algal blooms, jellyfish blooms, coastal vegetation, sea snakes, sea turtles, whales, dolphins, sea birds, reefs in the sea, seasonal availability and medicinal importance of fishes, identification of fish in the sea, threats to marine biodiversity, and their perceptions on conservation and management. For the conservation and sustainability of bioresources, traditional fishers demand increase in the number of monsoon trawl ban days and implementation of the ban in two times a year based on the breeding time of fishes. Further, for ensuring sustainability they suggested limits to exploitation and preventing destructive fishing practices. This knowledge can be further fine-tuned for implementing biodiversity conservation and fisheries management programmes.

Keywords: Ocean, Traditional Ecological Knowledge, Fisher Folk, Conservation, Sustainability

Introduction

The knowledge system of mega biodiversity countries such as India would be much stronger and sound as is primarily founded on traditional knowledge, which often showcases the skills, experiences and observations of people living in close contact with nature besides earning their livelihood from biodiversity. The Local Ecological Knowledge (LEK) or Traditional Ecological Knowledge (TEK) of the fisher folk could be used effectively for documenting information on biology and behaviour of marine organisms, collecting ecosystem knowledge, and managing the marine natural resources (Drew, 2005; Fischer *et al.*, 2015; Stephenson *et al.*, 2016). Further, perceptions of local fishers

may also enable us to tide over the limitations in data availability and to recover historical changes in marine ecosystems (Saenz-Arroyo *et al.*, 2006; Boudreau and Worm, 2010).

Few studies done in India have addressed the TEK related to fisheries and ocean (Swathi Lekshmi and Dinesh Babu, 2009; Rathakrishnan *et al.*, 2008, 2009; Sethi *et al.*, 2011; Salim and Antony, 2013; Swathi Lekshmi *et al.*, 2013; Vipinkumar *et al.*, 2013; Panipilla and Manirajan 2014; Geetha *et al.*, 2015). Biju Kumar and Robert (2014) compiled the information on the traditional knowledge of marine fisherfolk of Kerala. Andrews (2008) a fishermen from Kollam wrote a Malayalam book 'Kadalmuthu' narrating his experience in

fishing and his relationship with sea and marine biodiversity. The information documenting the biodiversity knowledge of fisher folk of Kerala coast is scanty. This paper documents traditional knowledge of marine fish folk of Kollam district of Kerala on biodiversity and conservation.

Materials and Methods

Traditional knowledge of marine fishing folk of Kollam district of Kerala (8°45' and 9°07' N; 76°29' and 77°17' E) on biodiversity and conservation was collected based on a structured questionnaire and through focused group discussions (Schönhuth and Kievelitz, 1994) involving their relationship with coastal and marine species, exploitation levels, status of species, traditional knowledge related to fisheries, and suggestions on conservation. In addition to this, information on fishers' perceptions regarding biodiversity changes with time and ecological changes of marine ecosystems were also documented. All the interviews were recorded using a voice recorder. Detailed notes were also prepared during each interview to make sure that the information collected was complete and accurate. Once the interviews were complete, the transcript information was labelled and

sorted out by area. The interviews were carried out in the local language Malayalam. The species identity of the specimens described by the fishers were confirmed with the help of colour photographs of species available in the field guide on marine animals of Kerala coast (Biju Kumar, 2012). Wherever possible additional specimens were collected from the field with the help of traditional fishermen for verification, photo documented and identified.

A sample size of 40 fishermen aged between 48 and 80 years was interviewed during the period of survey. The survey carried out the period October 2015 to August 2016. All the respondents were males. It included active fishermen and retired fishermen having an experience over years. Most of the interviews were done in the home of fishers and were in a participatory manner. The duration of the discussion varied depending upon the informant's knowledge, approach, interest and availability.

RESULTS

The list of species identified based on the information provided by the fishermen, and field collection by the fishermen are provided in Table 1.

Table 1. List of species from Kerala coast identified based on the information provided by the fishermen in Kollam district of Kerala

Sl. No.	Classification	Scientific name	Local name	Remarks
ALGAL BLOOMS				
1	Domain: Eukaryota Phylum: Dinoflagellata Class: Dinophyceae Order: Noctilucales Family: Noctilucaeae	<i>Noctiluca scintillans</i>	Kadal kara	Irregular bloom in Kollam coast

2	Domain: Bacteria Kingdom: Eubacteria Phylum: Cyanobacteria Class: Cyanophyceae Order: Oscillatoriales Family: Microcoleaceae	<i>Trichodesmium</i> sp.		Very rare occurrence
JELLYFISH BLOOMS				
3	Phylum: Cnidaria Class: Scyphozoa Order: Semaestomeae Family: Cyaneidae	<i>Cyanea</i> sp.	Aana chori	Rare
4	Order: Semaestomeae Family: Pelagiidae	<i>Chrysaora caliparea</i>	Theechori, Kandarichori	Rare
5	Order: Rhizostomeae Family: Cepheidae	<i>Netrostoma coerulescens</i>	Neela chori, Krishna chori	Common
6	Family: Thysanostomatidae	<i>Crambionella orsini</i>	Parayanthala chori/ Karippotti chori	Form blooms after southwest monsoon
SEA SNAKES				
7	Phylum: Chordata Class: Reptilia Order: Squamata Suborder: Serpentes Family: Hydrophiidae	<i>Pelamis platura</i>	Manjavayaran paambu	
8	Family: Elapidae	<i>Enhydrina schistosa</i>	Valakadiyan paambu	
9		<i>Hydrophis fasciatus</i>	Kodali pambu	

Algal Blooms

According to the fishers algal bloom is a natural phenomenon occurring in the months of Chingam and Kanni (mid-September to October). It causes mass mortality of fishes and also skin irritation to the fisher folks and they observe red colour of water during tides. According to the fisher folks rise in water temperature causes algal blooms. Based on the description of colouration and nature of distribution the species were identified tentatively as the dinoflagellate *Noctiluca scintillans* (Fig. 1) and the Cyanobacterium *Trichodesmium* sp.



Fig. 1. Blooms of *Noctiluca scintillans* in Kollam coast (blooms seen in red colour)

Jellyfish blooms

Commonly called as “kadal chori” among fishers, the fishers in Kollam district could distinguish many species of jellyfish by their colour and structure. Many of the fishers believe that they form food to sharks and shelter to some juvenile fishes. Jellyfishes cause disturbance to the fishing as they clog the nets and also some of them cause body pain and skin irritation while they try to remove them from the nets. The fisher’s taxonomic knowledge distinguished the following types of jellyfish in the coastal waters of Kollam district:

(i) Aana chori: This name in Malayalam is the combination of two words, ‘ana’ (elephant) and ‘chory’ (common name for all jellyfish, something that causes itching). This type of jelly fishes are of large size with long tentacles. This could be various species of *Cyanea* (Fig. 2)



Fig. 2. Jellyfish *Cyanea* sp.

(ii) Neela chori: This type of jelly fish is blue (‘neela’ in Malayalam means blue) in colour and small in size. Hindu fishermen call this species as ‘*Krishna chori*’, as this species possess colour of Lord Krishan. According to the fishers it is considered as most dangerous, often causing death to human beings. This could be *Netrostoma coerulescens* (Fig. 3) available in the locality and confirmed by the fishermen.



Fig. 3. Jellyfish *Netrostoma coerulescens*

(iii) Parayanthala chori/Karippotti chori: This jellyfish is brown in colour and round (hence

the name 'karippotti chori'. This species did not cause much skin irritation and are found largely when the wind blows from east. This may represent the species *Crambionella orsini* (Fig. 4).



Fig. 4. Jellyfish *Crambionella orsini* in bloom
(iv) Theechori, Kandarichori: This species with bright orange colouration is *Chrysaora caliparea* (Fig. 5).



Fig. 5. Jellyfish *Chrysaora caliparea*.

The other types of jellyfish they could distinguish in the coastal waters of Kollam include Pottas chori (hydrozoans), Valli chori, Kannadi chori (hydrozoans and cubozoans), Vattar chori (*Aequorea* sp.), etc.

The fishermen apply coconut oil when they come in contact with jellyfish and for warding off irritation of skin they jump to seawater for some time to escape from itching sensation and pain.

Coastal vegetation

The fishers generally agree with the fact that the mangrove vegetation along the coastal belt of Kollam district has declined consistently over the last few decades. There is a practice of planting mangroves in the Tsunami prone area by the government in order to prevent the risk of Tsunami. The fisher folk opine that mangroves grow well only along the river mouths and adjacent areas and natural vegetation such as *Calotropis gigantea* (Crown flower or 'erukku'), *Tamarindus indica* (Tamarind or 'puli maram') and *Calophyllum inophyllum* (Indian laurel or 'punna maram'), etc. would be ideal for coastal protection.

Sea snakes

Sea snakes are usually found in offshore waters. They are poisonous and the nature of toxicity varies between species as some are highly poisonous. A general observation on sea snakes compared to the land snakes is that in the former head portion is very narrow and tail region is broad. Accidentally the snakes were caught in fishing nets and the fishers remove them by holding in the tail region; the sea snakes caught are not killed but thrown back into the sea. The fisher folks also record a few incidences of human mortalities caused by sea snake bite. The three varieties of sea snakes narrated by the fishers are the following:

(i) Manjavayaran paambu (*Pelamis platura*): Belly portion is yellow and upper portion in black colour; poisonous.

(ii) Kodali paambu: Head narrow and pointed, body with stripes; poisonous. This could be the species of *Hydrophis fasciatus* (Fig. 6).



Fig. 6. Striped sea snake, *Hydrophis fasciatus*

(iii) Valakadiyan paambu (*Enhydrina schistosa*) (Fig. 7): Highly poisonous and the Malayalam name is due to its characteristic behaviour of biting and tearing the net. It rarely bites.



Fig. 7. Valakadiyan sea snake, *Enhydrina schistosa*

The fishermen belonging to Hindu community believes that the presence of snakes in the nets is a bad omen, indicating the anger of naga raja (serpent god). The fishers offer “pulluvan paattu” (holy songs in front of naga raja temple) to get rid off the anger by the serpent god.

Sea turtles

Sea turtles live in reefs and they come to the shore for laying eggs. The meat and egg of sea turtles has high demand in the market. So the fishermen catch the sea turtles for earning money and also it has some medicinal properties which make the sea turtle important among fishermen. The sea turtles recognized by the fisher folk are ‘Thoduvetti aama’ (largest among sea turtles;

leatherback turtle, *Dermochelys coriacea*) and other sea turtles. Though three are other turtles such as ...recorded from Kerala coast, there are no separate names exist for these species in Kollam region; the other species of sea turtles in the region include green turtle (*Chelonia mydas*), olive ridley turtle (*Lepidochelys olivacea*) and hawksbill turtle (*Eretmochelys imbricata*). They also recognize freshwater turtles and land forms thorough names such as ‘Vellama’, ‘Alungaama’

and 'Karayaama' (land tortoise). The fishers also aware of the fact that sea turtles are protected under Wildlife (Protection) Act of India and their capture and trade are illegal. The Hindu fishers do not catch and eat sea turtle, because they consider these animals as one of the incarnations of Lord Vishnu.

Whales

The whales are considered as the elephants of the sea by the fishers and hence the name 'kadalaana' ('kadal' = sea; 'aana' = elephant in Malayalam). All religious groups of fishers believe that whale is the king of oceans. Some elderly fishers in Kollam district call whale as 'Kadalachan' or father of the sea. Fishers believe that they do not harm them and therefore they will never try to catch them. While seeing whales they salute them with devotion. There will be plenty of fish when whales are present in sea and some fishers believe that decline in the quantity of sardines in recent years is related with the disappearance of whales. However, the fishermen could not distinguish the various species of whales in Kerala coast.

Dolphins

The traditional fishermen using cast net in the Ashtamudi estuary, Kollam district of Kerala, take advantage of the behavioural patterns of dolphins ('*kadal panni*') for getting good catches. They possess good knowledge about the entry of dolphins into the estuary based on tides and their behaviour patterns. As an organism engaged in group hunting, dolphins chase the fish shoals to

the shallow areas of the estuary and the fishermen cast their net during this time to get good catches. In Ashtamudi, the process of chasing of fish by the dolphins is called 'panniyadi' ('panni' is the local name for dolphins) and this is considered by the fishermen as the best time for casting the net for getting good catch. This traditional knowledge is best employed by the fishermen during the migration time of mullets, a preferred food of humpback dolphin (*Sousa plumbea*) (Fig. 8).



Fig. 8. Fishermen in Kollam casting net in front of advancing dolphins

Sea birds

Fishermen use seabirds as an indicator of fish shoal, and the behavioural changes of some species of sea birds provide warning signals towards natural disasters. The fishers believe that while some species occur round the year, some are visitors in certain seasons of the year. They use the names such as *Kadal kaakka* (*Larus* spp.), *Kadal aala* (*Sterna* spp., *Chlidonias* sp., *Gelochelidon* sp., *Hydroprogne* sp.), *Neerkaakka* and *Eranda* (*Dendrocygna*, *Anas*), *Pongachi kaakka*, *Parunthu* and *Kokku* (egrets and herons) to distinguish aquatic birds.

Reefs in the sea

The traditional fishermen, using their long experience, have earned the expertise in locating underwater rocky reefs and named them precisely as these areas are the fish aggregation sites. Rocky reef ('paaru' in Malayalam) areas have been used by the fishers for fishing.

Edavapaaru: Situated off the east of Edava, between 4 fathoms and 10.5 fathoms, extending over a large area, this area is used by the fishers to fish for seer fish, ribbon fish, *peruvatha*, *motha*, *vela para*, *oola*, *arippan*, *kalava*, etc. Gears operating in this area are gill net and hook and line.

Pozhikkarapaaru: Located near Paravur pozhi ('pozhi' in Malayalam means seasonal estuary with a sand bar) very close to the coastal area, this reef extends from 2 to 7 fathoms depth. In the month of January (Malayalam months *Dhanu* and *Makaram*), 'Narayakanava' (pencil squids of the family *Loliginidae* travelling in the vaadaneeru rest in these areas. For eating this various types of big fishes visit this area.

Kallukattapaaru: This reef is located to the west of Pozhikkarapaaru near Mukkam about 4 fathoms to 8 fathoms deep. All the fishes which can be caught by hook and line are found abundantly in this reef.

Thendapaaru: Towards the southwest of Kallukattapaaru at about 11.5 fathoms lies scattered the Thendapaaru. According to the local fishers this is like a man-made cave.

Kakkakallu: Literally translated as 'crow stone', this reef is located to the west of Kallukattapaaru near Thanni between 2 and 8 fathoms; it is a solitary rock.

Arnnukallu: This reef is located to the west of Kakkakallu at Eravipuram coast at 2 to 8 fathoms and it is highly uneven.

Kozhikodupaaru: This reef is found to the west of Arnnukallu near Kakkathoppu at 4 to 8 fathoms, where fishes like mullets and catfishes are abundant.

Mundakallu: This is a very important fishing site for local fishers using catamaran and fishes such as big eye, snappers, and perches are abundant in this area.

Ainakallu: It lies to the west of Mundakallu, near the park, between 2 to 4 fathoms. Fishes like *Azhuka*, *Karithada*, *Madanam*, *Kuruvala* and *Anchalaare* were abundant in this area.

Thundampaaru: This reef is found between 5 to 7 fathoms off Terminus coast.

Vattakallu: It is a solitary rock located straight to the Kollamthoppu church, located at 5 fathoms.

Palakarakallu: This reef is situated to the north side of Vattakallu.

Thattacherikallu: It lies to the west of Vattakallu and the local fishers opt out of this reef as continuous trawling made this area almost barren.

One of the elderly fisherman in Kollam district Andrews has depicted the position of rocky reefs in Kollam coast with line drawings, which is so precise in locating the reefs (Fig. 9).

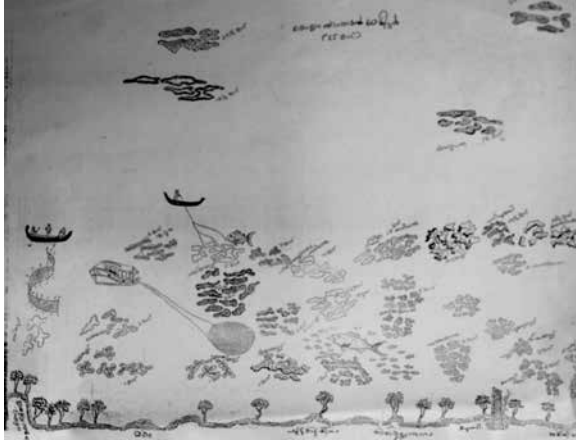


Fig. 9. Line drawings of rocky reefs drawn by Andrews

Seasonal availability of fishes

The information provided by the fishers can be summarized as follows: (i) December-January: Shrimps, anchovies and squids; (ii) February-May: Mackerel, sardine, shrimps, etc; (iii) June-August: Ribbon fishes, shrimps, etc. and due to rough weather catch will be poor; (iv) August-September: Silver belly, anchovies, shrimps; (v) October-November: Mackerel, sardines, squids, pomfrets, anchovies, king fish, seer fish, tuna, silver belly and shrimps.

Identification of fish in the sea

Most of the surface swimming fishes move in shoal, which are referred to as ‘*Meenpaadam*’ by the fisher folk. Some of the observations towards identification of fish shoals by colour are the following:

Red colour: Indicates the presence of either sardine or shrimps. In the case of shoals of sardine small bubbles are seen on the surface of water (Fig. 10), while shrimps jump above the surface.



Fig. 10. Shoals of sardine indicated by bubbles on sea surface

White colour: Indicates shoal of pomfrets and the proverb used by the fishers says “*Avoli paadam vellayam vithachathu pole*”, which can be roughly translated as “shoal of pomfrets is like the one sown with white”. Black colour: Indicates sardine shoal (Fig. 11).



Fig. 11. Shoals of sardine indicated by black colour on sea surface

Black and white colour with big Bubbles: Indicates the presence of mackerel shoal.

Blue colour: Indicates the shoal of fringe-scale sardine, *Sardinella fimbriata*.

The other indications of the presence of fish or signs of good catch are the following: (i) Red snapper jumps on the surface of water; (ii) Presence of dolphins is a sign of good catch, and (iii) Presence of sea birds is an indication of fish shoal.

Medicinal properties of fishes

The fishes and other aquatic animals are used

as medicine and the following is the list prepared based on the information provided by the fishers and the details are given in Table 2.

Table 2. Medicinal properties of fishes of Kollam district, Kerala

Sl. No.	Species	Use
1	Thedu' (marine catfish), especially <i>poriyan thedu</i> (<i>Tachysurus</i> spp.)	To improve health and stamina
2	Shark meat	Good for people suffering from asthma and bronchitis and for treating piles and arthritis
3	Crab meat	Good to treat body pain
4	<i>Madanam</i> , <i>Arippan</i> and <i>Chemballi</i> (<i>Lutjanus argentimaculatus</i>)	Good for improving eyesight and memory power of children
5	<i>Parava</i> (<i>Lactarius</i>), <i>Pallikora</i> and <i>Ezhuthan kora</i> (croakers)	Good for healthy body
6	Anchovies and ribbonfishes	Good for lactating women
7	Shark and ray meat	Should be included in the diet of women after delivery for their health
8	Sardine oil	Medicine for treating boils formed during burning
9	Dried and powdered seahorse mixed with honey	Good for preventing whooping cough in infants
10	Letherjackets (Family Carangidae)	Good for treating whooping cough
11	Fish, <i>Kidannumulli</i>	Given to given to children having the habit of bed wetting

Threats to marine biodiversity

The forces identified by the fishers that damage the ecosystems include over harvesting for export, destructive fishing methods (use of small mesh sized fishing nets), catching of juveniles of fishes, over harvesting of sea weeds for preparation of medicines and agar and pollution caused by the waste waters of Indian Rare Earth Limited at Chavara, near Kollam.

Further, increase in jelly fish blooms in the recent past affect their fishing operations, especially after the southwest monsoon. Plastics has become another menace in sea bottom and the quantity of plastic wastes are increasing considerably as reflected in their increased presence in shore seines. The fishers are of the opinion that whales and dolphins were disappeared in the sea due to heavy trawling.

Conservation and management

Traditional fishers feel that increasing the duration of trawl ban and limiting trawling for day time would help increasing the availability of fish from the sea, besides ensuring sustainability. Further, recent climate variations characterized by increase in temperature and changes in water currents is one of the reasons for the decrease in the quantity of fish landing. Further, unregulated fishing, destructive fishing, and over fishing are the reasons of the disappearance of fishes and the fishers suggest the need for strict rules to prevent this, including frequent monitoring. Some of the fishers opined that the current timing of monsoon trawl ban is unscientific as it is not the breeding time for many fish species. They also suggest that many fishes lay eggs during November-January and therefore ban during this period would be much useful than ban during monsoon (June-July) which is currently practiced. Some fishers also suggested trawl ban during two seasons during a year.

Discussion

Documentation and preservation of traditional knowledge, especially Traditional Ecological Knowledge (TEK) is highly relevant in the modern times not only for socio-cultural and conservation needs, but also for ethical reasons in conserving for preserving cultural diversity. According to the International Union for Conservation of Nature and Natural Resources (IUCN) Program on Traditional Knowledge for Conservation (IUCN, 1986), the benefits of such documentation include, (i) provision for new biological and ecological insights; (ii)

resource management in tropical fisheries, (iii) values and examples for conservation education; (iv) provisions for more realistic evaluations of environment, natural resources, and production systems for development planning, and (v) usefulness for environmental assessment.

Kerala has a long tradition of utilising marine fisheries resources and the coastal population of Kerala including the fisherfolk, with a long historical continuity of resource use and management, has acquired a plethora of traditional knowledge about the ecosystem and biodiversity, which was then perfected by learning-by-doing and transferred through generations through oral traditions of songs, stories, and proverbs. The traditional knowledge in this sector is largely qualitative, resource-specific and local specific (Biju Kumar and Robert, 2014). The results of the study on the traditional knowledge of marine fisherfolk of Kollam district of Kerala on marine biodiversity and conservation showed rich knowledge of fishermen about the bioresources of sea and marine ecosystem.

The TEK of fishers corroborate with the modern scientific observations in most of the cases. Similar documentations of TED were done in earlier reports of Swathi Lekshmi and Dinesh Babu (2009). Vipinkumar *et al.* (2013) and Biju Kumar and Robert (2014). The traditional fishermen using cast net in the Ashtamudi estuary of Kollam district of Kerala take advantage of the behavioural patterns of dolphins for getting good catches. As an organism engaged in group hunting, dolphins chase the fish shoals to the shallow areas of the

estuary and the fishermen cast their net during this time to get good catches. Biju Kumar *et al.* (2012) documented this process along Kera about resource use and availability and for sustainable management of coastal resources. Further, considering the absence of any marine protected area in Kerala, the traditional knowledge of the communities, coupled with scientific data base so far generated, could be used for the selection and co-management of marine resources of the coast.

Acknowledgements: The authors thank the support of University of Kerala for the project to document the fish diversity and traditional knowledge of Kerala. We thank the traditional fishermen of Kollam district for their support in providing data. We are grateful to Mr Andrews for sharing the line drawings for use in this article.

References

1. Andrews A 2008. Kadalmuthu. DC Books, Kerala, India, 111pp.
2. BijuKumar, A. 2012. '*Kerala Theerathe Kadal Jeevikal*' (Marine Animals of Kerala coast- A Field Guide). Kerala State Biodiversity Board, Thiruvananthapuram, Kerala, 304 pp. (In Malayalam).
3. Biju Kumar A and Robert P 2014. Traditional knowledge in marine fisheries sector of Kerala. In: Pillai, V.N.R. (Ed.). *Traditional Knowledge* (Compendium of Invited Papers, 26th Kerala Science Congress, Kerala State Council for Science, Technology and Environment, Thiruvananthapuram, Kerala, pp. 213-137.
4. Biju Kumar A, Smrithy R and Sathasivam K A 2012. Dolphin-assisted cast net fishery in the Ashtamudi Estuary, south-west coast of India. *Ind J Fish* 59: 143-148.
5. Boudreau S A and Worm B 2010. Top-down control of lobster in the Gulf of Maine: insights from local ecological knowledge and research surveys. *Marine Ecology Progress Series*, 403: 181–191.
6. Drew J A2005. Use of traditional ecological knowledge in marine conservation. *Conservation Biology*19: 1286-1293.
7. Fischer J, Jorgensen J, Josupeit H, Kalikoski D and Lucas C M 2015. Fishers' knowledge and the ecosystem approach to fisheries: applications, experiences and lessons in Latin America. *FAO Fisheries and Aquaculture Technical Paper No. 591*. Rome, FAO. 278 pp.
8. Geetha, R., Vivekanandan, E., Kizhakudan, J. K., Kizhakudan, S.J., Chandrasekar, S., Raja, S. and Gupta, K.S. 2015. Indigenous Technical Knowledge (ITK) of coastal fisherfolk on climate change - a case study in Chennai, south-east coast of India. *Indian Journal of Fisheries*, 62 (1): 144-148.
9. Panipilla R and Marirajan T 2014. A Participatory Study of the Traditional Knowledge of Fishing Communities in the Gulf of Mannar, India. International Collective in Support of Fishworkers Publication, Chennai, India, 117pp.
10. Rathakrishnan T, Anandaraja N, Ramasubramanyan M and Kalai Selvan S 1998. Traditional products and practices of indigenous people inhabiting Ramanathapuram district of Tamil Nadu. *Indian Journal of Traditional Knowledge* 7: 23-26.

11. Rathakrishnan, T., Anandaraja, N., Ramasubramanyan, M., Suganthi and Anitha, S. 2009. Traditional fishing practices followed by fisherfolk of Tamil Nadu. *Indian Journal of Traditional Knowledge*, 8(4): 543-547.
12. Saenz-Arroyo A, Roberts C M, Torre J and Carino-Olvera M 2006. The value of evidence about past abundance: marine fauna of the Gulf of California through the eyes of 16th to 19th century travellers. *Fish and Fisheries* 7: 128–146.
13. Salim S S and Antony P 2013. Indigenous Technical Knowledge (ITK) in capture fisheries: A case study in Vypeen island of Ernakulam district. *Discovery Nature* 4: 7-10.
14. Santha S D, Gahana P and Aswin V S. 2014. Exploring risk, resistance and the power of myths among coastal fishing communities in Kerala, India. *Natural Resources Forum* 38: 118–128.
15. Schönhuth, M. and Kievelitz, U. 1994. Participatory Learning Approaches: Rapid Rural Appraisal, Participatory Appraisal: an Introductory Guide. TZ-Verlagsgesellschaft, 183 pp.
16. Sethi S N, Sundaray J K, Panigrahi A and Chand S 2011. Prediction and management of natural disasters through indigenous Technical Knowledge, with special reference to fisheries. *Indian Journal of Traditional Knowledge* 10: 167-172.
17. Stephenson R L, Paul S, Pastoors M A, Kraan M, Holm P, Wiber M, Mackinson S, Dankel D J, Brooks K and Benson A 2016. Integrating fishers' knowledge research in science and management. *ICES J Mar Sci* 73: 1459–1465.
18. Swathi Lekshmi P S and Dinesh Babu A P 2009. Indigenous technical knowledge and ancient proverbs of the coastal fisher folk of Kerala and their implications. *Indian Journal of Traditional Knowledge* 8: 296-297.
19. Swathi Lekshmi P S, Dinesh Babu A P, Purushottama G B, Sjiitha T, Geetha S, Prathibha R, Vivekanandan E and Zacharia P U 2013. Indigenous technical knowledge of Indian marine fishermen with special reference to climate change. Central Marine Fisheries Research Institute, Kochi, 124pp.
20. Vipinkumar V P, Swathi Lekshmi P S, Salini K P, Ambrose T V, Sunil P V and Dhanya G A 2013. Compilation of indigenous technical knowledge in marine fisheries sector of Karnataka. *Discovery Agriculture* 1: 43-50.