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Design and technical specifications of marine gill nets of Pulicat, Tamil Nadu, India

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Abstract
The documentation of marine gill nets was carried out from January 2016 to September 2016 at Pulicat fishing village of Thiruvallur district of Tamil Nadu (Lat:13°25'N;Long :80°21'E). Maximum fishermen were depending on gill net fishery in the coast of Pulicat. Around eight different types of gill nets with various mesh sizes were found to be in operation. Gill nets are mostly classified by target catch of species namely mackerel gill net, seer fish gill net, pomfret gill net, flying fish gill net, Indian whiting gill net, crab gill net, and sardine gill net. In this present study showed that two kinds of gill nets were used for sardines. Gill nets with 28 mm mesh size for *sardinella gibbosa* and gill net with 20 mm for *sardinella longiceps*. Gill nets of different mesh sizes ranging from 20 to 170 mm targeted at different groups of fishes are prevalent along the coast. Besides, trammel net known as *eppo valai* used for shrimps.

Keywords: Gill net, trammel net, mesh size, fishery

1. Introduction
Global total capture fishery production in 2014 was 93.4 million tonnes, of which 81.5 million tonnes from marine waters and 11.9 million tonnes from inland waters, China remained the major producer followed by Indonesia, the United States of America and the Russian Federation (FAO,2016) [3]. Total marine fish production in Tamil Nadu during 2015 was 7.09 lakh t. Mechanized trawlers contributed 67% of the total landing and the contribution by out-board motor operated gillnet was 14.8%. and other major contributors were outboard motor operated ring seine 8.7%, out-board motor operated hook and line 2.3% and mechanized ring seine 1.5% but the total effort expended in numbers showed that out-board operated gillnets was the most dominant one registering 68.8% whereas the contribution by mechanized trawlers was only around 12.6% (CMFRI,2015-16) [4]. In world fisheries, gill nets bottom set and drifting rank next to trawls and purse seines in terms of total catch. Worldwide, 20% of the fish catching methods are gill netting. Gill nets are among the simplest and oldest methods of fishing. The nets are operated by gilling or entangling fish in the meshes of a sheet of netting. The net is left to fish passively as fishes are being caught when they swim into it and the mesh of the net becomes caught behind its gills, hence the name ' gill nets'. Compared to other fishing gear, gill-nets can be highly size-selective (Gulland 1983) [5] and, for a given mesh size, catches decrease sharply for fish smaller and larger than the modal size class of those retained (Acosta 1994) [1]. The gill net fisheries of India are described as one of the mainstays of the artisanal as well as small-mechanized sectors of the fishing industry. Gill nets are the dominant type of gear at the all India level. Luther *et al.* (1997) reported that Kerala landed the bulk (21%) of the large mesh gill net catch of the country followed by Tamil Nadu (17%), Gujarat (16%), Maharashtra and West Bengal (13% each), Andhra Pradesh (ll%) and the rest (9%) contributed by Karnataka, Goa and Orissa. In the small mesh gill net sector, Tamil Nadu landed maximum (41%), followed by Andhra Pradesh (27%), Kerala (12%) and 20% contributed by Gujarat, Maharashtra, Karnataka, Orissa and West Bengal. Homell (1938) [7] described two typical gill nets of Malabar coast used for mackerel and sardine. A detailed account of the design and construction of gill nets for sardine and mackerel was given by Satyanarayana and Sadanandan (1962) [15]. Yohannan and Balasubramanian (1989) [17] studied drift gill net fishery of Calicut with special reference to scombroids. Jayaprakash (1989) [8] studied the trends in drift gill net fishery of Cochin with special reference to effort, inputs and returns during 1986-87 and compared the same with that of 1981 and 1982. Despite, Pulicat Lake is a second largest brackish water body in India after Chilka Lake but the fishing gears operating in Pulicat has less documented. This preliminary study provides insight into the

major fishing gears operated in Pulicat coast. The studies in simulating the process of fishing in a gill nets have rarely been done in spite of its importance in fishery.

2. Material and methods

The present study was carried out from January 2016 to September 2016 at Pulicat fishing village of Thiruvallur district of Tamil Nadu (Lat:13°25'N;Long :80°21'E) for document the type of marine gill nets using along the coast of Pulicat (Fig.1). Around 15 fishing villages are engaged in fishing at sea, 16 fishing villages are involved in brackish water (Pulicat) and 5 fishing villages are permitted to fishing both in brackish water and sea. Brackish water fishermen's are prohibited to fishing in sea and fishermen's who involved fishing in sea are rigorously restricted to fishing in brackish water. Different criteria like local name of the fishing gear, material of fishing gear, mesh size, number of meshes in length and depth, duration of operation, depth of operation, number of person to operate gear have collected. Fishing materials are locally called as *Pannu nool* for nylon monofilament and *Pattu nool* for nylon multifilament according to their distribution. *Paadu* is a traditional system of fishing practiced in fishing village of Pulicat. This system is common to many coastal areas of Tamil Nadu. *Paadu* system is controlled by fishermen from three villages: Kottai Kuppam, Christian Kuppam and Andikuppam.

3. Results

In this present study nine different types of gill net (eight gill net and one trammel net) with varying mesh sizes from 20 to 170 mm were found to be operation in marine. The design and technical specification of each category of gill nets are given in Table 1.The gill nets are classified based on construction of gill nets, mesh size and target species. The gill nets were categorized into single walled and multi-walled nets according to construction of nets. Based on mesh size, the single walled gill nets were broadly classified into small mesh sized (less than 50mm) and large mesh sized gill nets (more than 50 mm). Small meshed gill nets operated in Pulicat coast are flying fish gill net, Indian whiting gill net, gold striped sardine gill net and oil sardine gill net followed by mackerel gill net, seer fish gill net, pomfret gill net and crab gill net are large meshed gill nets. Besides the gill nets were classified based on target species (sardine, mackerel, seer fish, pomfret, flying fish, and sardines). In multi walled nets, trammel nets only in operation. In this present study showed that most of the gill nets which operating in this region are drift gill nets. The small mesh sized gill net with total length of 1km mostly used for sardines, flying fish, Indian whiting and large sized gill nets for seer fish, mackerel, pomfret, seer fish and crab with total length of net has 2km.These gill nets were made up of two different type of materials *viz.* Poly Amide monofilament (mackerel gill net, pomfret gill net, flying fish gill net and Indian whiting gill net) and Poly Amide multifilament(seer fish gill net, sardine gill net) with different mesh size. All gill nets were mostly operated from motorized wooden/FRP of 12-15 m LOA fitted with 10 hp. The nets are operated through the whole year and the peak fishing season. Based on the reports from the fishermen various sizes of fishes were caught in gill nets. In mackerel gill net each fish is weighing 250 g, seer fish weighing range from 400-500g, pomfret weighing up to 350g, flying fish caught at 600g and each sardine weighing 150g and crab weighing range from 0.5kg-1 kg. Among the all gill nets sardine gill net has highest catch rate at 4 tonnes/trip followed by Flying fish gill net (200 kg/operation),Mackeral gill net 50kg/operation, Pomfret gill net (30kg/operation), Seer fish gill net (30kg/operation), Indian whiting gill net (30kg/operation) and crab gill net (10kg/operation). Besides puffer fish, scatophagus and marine cat fish were occasionally caught as incidental catch in these gill nets.

Trammel net (multi-walled net) is locally called as *eppo valai* operated mostly for shrimps. Design aspects of trammel nets are given in Table 2. Trammel net consist of three layers with different mesh sizes mostly made by PA multifilament. The two outer layers (armor) have mesh size of 250 mm with 1mm thick while inner layer (lint) has 42 mm mesh size with 0.75 mm thick. The number of meshes in length was same both in inner and outer layer of the net. It has 50000 meshes in length but number of meshes will vary in depth of net. The depth of net has 7 meshes in outer layer and 70 meshes in inner layer and 100 meshes in depth. The hanging coefficient ranged from 0.5 to 0.8. The depth of operation was carried out at 2m with fishing ground distance of 10km. During operational period fishes are passed out through the outer layer meshes and entangled in middle layer. The total catch obtained at 50kg per trip. For finding the nets position during the night, indicator flag lights were attached to both end of the net. Setting and hauling of the net was done by manually without any mechanical devices.

4. Discussion

Saly N. Thomas and C. Hridayanathan (2006) [14] reported that 'chooda vala' and 'veloori vala' the gill nets for white sardine (Kovala koval) is concentrated along the northern Kerala coast with mesh sizes ranging from 16 to 26 mm. In this present study showed that *kavalai valai* and *maththi valai* gill net with mesh sizes ranging from 20-28 mm used for sardine fishery. *S. gibbosa* is a commercially important species and is captured along Thoothukudi coast largely by gillnets with the mesh size ranging from 26 to 30 mm (Neethiselvan *et al*., 2001) [12]. In line with the present study, *sardinella gibbosa* and *sardinella longiceps*. were mostly caught by gill net with mesh size of 28mm and 20mm. Luther *et al.,* (1997) [10] grouped gill nets of India into small mesh and large mesh keeping 45 mm as the cut off mesh size. From this present study it was observed that gill nets were grouped into small mesh gill net below 50 mm and large mesh gill net above 50 mm. Panikkar *et al.,* (1978) [13] worked out 126.0 mm as the optimum mesh size for the capture of *Pampus argenteus*. However, in this present study optimum mesh size for pomfret is 170 mm. Harsha. K (2016) [6] reported that the large meshed (*Paru valai*, *Thirukka valai* and *Nandu valai*) and small meshed (*Murral valai*, *Parava valai*, *Kanava valai* and *Katta Murral valai* - monofilament) gillnets are being used in Tharuvaikulam for catching high value large pelagic fishes, crabs, cuttle fishes and smaller fishes respectively. In this current study it was found that large meshed gill net (*Ayilai valai*, *Vanjiram valai*, *Woval valai*, *Nandu valai*) and small meshed gill net (*Cola valai*, *Kilangan valai, Kavalai valai*, *Mathi valai*) are used for catching high value fishes in Pulicat. Satyanarayana and Sadanandan (1962) [15] reported almost uniform mesh size of 50.8 mm and Vijayan *et al*., (1993) [16] reported 50 mm in 1958 and 50 to 52 mm in I991 for mackerel. Mathai *et al*., (1993) [11] conducted mesh selectivity studies in mackerel gill nets operated off Goa and found that a mesh size of 50 mm was optimum for the exploitation of mackerel of commercially

accepted size having a total length of 190-200 mm. In this present study also mackerel gill net with mesh size of 58mm found to be in operation. Joel and Ebenezer (1985) [9] introduced the trammel nets known as *disco valai* into the state during mid-eighties are popular only in Thiruvananthapuram and Kollam. In this present study we found that trammel net known as *eppo valai* used for shrimps. Anirudhkumar (2011) [2] reported that 25 species of fishes, molluscan shells, seaweeds etc. from the catches of trammel nets operated along the Thoothukudi coast. In Pulicat coast trammel net is mostly intended for catch only shrimps.

Table 1: Design and technical specifications of marine gill nets

Parameters	**Mackerel gill net**	**Seer fish gill net**	**Pomfret gill net**	**Crab gill net**	**Flying fish gill net**	**Indian Whiting gill net**	**Gold striped sardine gill net**	**Oil sardine gill net**
Local name	*Ayilai valai*	*Vanjiram valai*	*Woval vala*	*Nandu valai*	*cola valai*	*Kilangan valai*	*Kavala valai*	*Mathi valai*
Webbing material	PA Monofilament	PA Multifilament	PA Monofilament	PA Monofilament	PA Monofilament	PA Monofilament	PA Monofilament	PA Multifilament
Twine specification	0.28 mm diam.	0.25 and 0.5 mm diam. 210D/2/3	0.32 mm diam.	0.28 mm diam.	0.20 mm diam.	0.16 mm diam.	0.16 mm diam.	0.5 and 0.75 mm diam. 210D/2/3
No. of meshes in length	30000	30000	16000	10000	4000	5000	50000	20000
No. of meshes in height	125	250	85	60	60	75	500	2800
Mesh size (mm)	58	60	170	120	46	34	28	20
Horizontal hanging co-efficient	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vertical hanging co-efficient	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
No. of floats	300	300	400	500	200	-	500	200
Specifications of float	Thermocol (Styrofoam)-40 x 30 mm diam.	Thermocol (Styrofoam)-40 x 30 mm diam.	Thermocol 200 x 40 mm diam.	Thermocol (Styrofoam) 40 x 30 mm diam.	Thermocol (Styrofoam) 40 x 30 mm diam.	-	Thermocol (Styrofoam) 40 x 30 mm diam.	Thermocol (Styrofoam) 40 x 30 mm diam.
No. of sinkers	300	300	100	250	200	70	2000	50
Specifications of sinker	cement-250g	cement-250g	cement-0.5kg	Lead-10g	Lead -25g	Lead -20g	Lead -20g	Lead -20g
Specifications of Selvedge	1 mesh of 50 mm Nylon	1 mesh of 50 mm Nylon	1 mesh of 50 mm Nylon	1 mesh of 120 mm Nylon	1 mesh of 50 mm Nylon	1 mesh of 50 mm Nylon	1 mesh of 40 mm Nylon	1 mesh of 30 mm Nylon

Table 2: Design aspects of trammel net

Parameters	**Specifications**
Local name	*Eppo valai*
Mesh size	Outer layer-210 Inner layer-48
Material type	PA multifilament
Twine type	Inner layer-0.75mm dia. Outer layer – 1 mm dia.
No.of meshes in length	25000
No.of meshes in depth	Outer layer-7 meshes Inner layer-60 meshes
Hanging co-efficient	0.5
Head rope	PP with 4mm dia.
Foot rope	PP with 4mm dia.
Float type	Thermocol (Styrofoam) (4cmx5cm)
No.of floats	1400
No.of sinkers	2800
Sinkers type	Lead with 10 g
Crafts used	FRP motorized with 10 hp
Selvedge	1 mesh of 50 mm PA multifilament
Target catch	shrimps

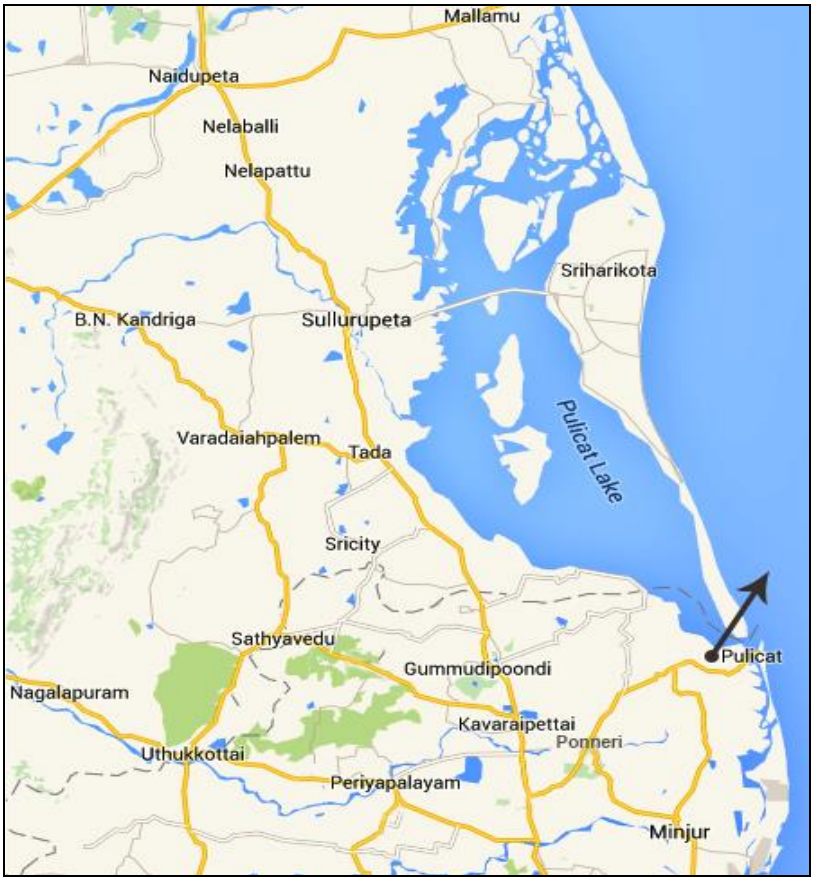

Fig 1: Description of the study area

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