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Marine fishery at Vizhinjam - A decadal analysis

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Abstract

The average annual marine fish landing of Vizhinjam during 2004-2013 fluctuated from 13,119 to 23,798 t registering an average catch of 1,9462 t. Standard effort fluctuated over the years with minimum of 53,772 during 2011 and maximum of 1,21,524 during 2005 with an average of 91,491 units. Pelagic finfishes contributed 78.4% to the total catch, followed by demersal finfishes (10.5%), crustaceans (0.8%) and molluscs (10.5%). Boat seine contributed 39% to the total catch, followed by drift gillnet (31%) and mechanised hooks and line (20%). Landings of major pelagic resources registered marginal increase till 2009, after which the catch decreased drastically. Tunas contributed 33.8% of the total pelagic landings followed by clupeids which formed 27.5%. Mackerel landings showed a gradual increase from 465 t in 2004 to 2,869 t in 2008 and subsequently declined with fluctuations in between. Carangids, one of the major resources also showed fluctuations in their landings with maximum landings during 2009. Trichiurids showed wide fluctuation, with peak landings during the period 2004-2007. Among demersal finfishes, perches formed 26.6% followed by elasmobranchs (21%) and flatfishes (10.4%). Crustacean landings which is highly seasonal showed a declining trend over the years. Penaeid prawns on an average formed 59.56% of total crustacean landings, followed by *Acetes* which constituted 20.7% and the rest by crabs. Total cephalopod production increased from 836 t in 2004 to 2,891 t in 2012 and comprised mainly squids and cuttlefish. Disappearance of gears such as *Kolachivala*, *Achil* and reduction in the effort of non-motorised crafts which operate gears like *Chalavala, Netholivala* as well as hooks & line were noticed during the present study.

Keywords: *Catch and effort, Decadal analysis, Exploited fish stocks, Marine fishery*

Introduction

Vizhinjam (Lat. 8°22'30" N; Long. 76°59'15"E), is one of the most important artisanal fish landing centres (Fig. 1) of southern Kerala enclosed by two rocky promontories extending into the sea, providing a protected bay affording excellent opportunities for fishing operations even during heavy monsoon. There are two monsoon seasons prevailing in this area, the south-west and the north-east. The south-west monsoon begins in May or June and lasts till about the beginning of August. The north-east monsoon is of shorter duration and begins in October and ends by November. Greater part of the rainfall is derived from the south-west monsoon. Fishery of this centre also fluctuates according to the monsoon. Close proximity to the biodiversity-rich 'Wadge Bank', an ecologically sensitive area, makes this area more significant in fish diversity. Motorisation initiated during the middle of 1982 has resulted in the replacement of non-motorised crafts by motorised ones to a large extent. Consequently, a decline in the effort by non-motorised traditional crafts was noticeable from 1984 onwards. Fishing is carried out at Vizhinjam throughout the year and is confined mainly to the inshore waters having a depth of 10-20 m and extending upto 24 km from the coast. The breakwater facility at Vizhinjam is an added advantage for berthing and launching the crafts, even during the monsoon months. Hence during the peak monsoon months, many fishermen from Anchengo to Colachel migrate to Vizhinjam along with their craft and gear for fishing. But construction of fishing harbours at Perumathura in the north and Thengaipatnam in the south has resulted in a decline in their migration and also the failure of south-west monsoon added to decline in monsoon fishing activity in the recent years. The inshore areas of the south-west coast between Vizhinjam and Cape Comorin are rich in young ones of both pelagic and demersal fishes. Pelagic finfishes continue to be the dominant group, constituted chiefly by tunas, clupeids, mackerels, carangids

Fig. 1. Vizhinjam fish landing centre

and ribbonfishes. Targeted fishing for the coastal tuna species, *Auxis rochei*, is being actively carried out by traditional and motorised units. Several studies have been conducted on the biology and fishery of the important fishery resources of this unique area, most of which oriented towards major groups like mackerel, carangids, anchovies, tunas and perches (Radhakrishnan, 1973, 1974; Lazarus, 1976; Luther, 1979; Gopakumar, 1986; Gopakumar and Sarma, 1989; Gopakumar and Thomas, 1991; Gopakumar *et al.,* 1991; Lazarus and Sharma,1991; Nair, 1993; Lazarus and Thiagarajan, 1994; Thomas *et al.,* 1994). Apart from the studies by Nayar (1958) and Luther *et al.* (1972), no other comprehensive account is available on the general fishery scenario of this traditional fishing centre in the recent past. The present investigation attempted to fill the gap and to get a clear picture about the present status of marine fishery off Vizhinjam.

Materials and methods

The marine fish landings data collected during 2004-2013 from Vizhinjam fish landing centre were used for this study. Observations were made twice a week for estimating the catch and effort. Daily fishing trip was taken as a unit of fishing effort and standard effort was calculated by taking boat seine as the standard gear. Monthly and annual estimates of catches were made following the Stratified Multi-stage Random Sampling method (Srinath *et al*., 2005). The resources were studied based on gear-wise catch and effort and the quantitative estimates of the exploited stocks in different seasons.

Annual production

Table 1 gives the gear-wise annual effort (E) in terms of number in each type of gear employed in fishing, catch (C) in t, and catch per effort (C/E) in kg. The annual average catch and the efficiency factor (RE, relative efficiency) of each gear were estimated in relation to the catch per effort (C/E) of boat seine which is taken as the standard gear. The table also furnishes the annual total catch landed by all gears, the standard effort, SE (which is obtained by totalling the values obtained by multiplying the effort of each type of gear by its relative efficiency, RE with reference to boat seine) as well as the annual catch per standard effort (C/SE) during the period from 2004 to 2013.

The annual marine fish landings at Vizhinjam ranged from 13,119 t in the year 2004 to 26,343 t in 2009 with annual average being 19,462 t. As a result of motorisation, the area of fishing extended to 20-25 km off Vizhinjam coast at a depth range of 60-80 m, whereas the traditional crafts confined to the 10 km range from the shore at a depth of 40-50 m. Due to the rocky bottom, trawl fishing is not undertaken, but a variety of traditional gears are operated in this centre to exploit the fishery

Table 1. Gear-wise annual effort, catch (t), catch per effort (kg), annual average catch (t) and the efficiency factor in relation to boat seine along with annual total catch (t), standard effort and catch per standard effort (kg) for the period 2004-2013 at Vizhinjam

Gear		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Annual average	RE
Boat seine	Catch (C)	3641.283	9209.1	7400.2	11073.3	11287.2	14485.2	3540.195	3706.7	3873.27	6736.18	7495.2	
	Effort (E)	23846	46659	33042	42264	51570	45998	15851	21556	27261	34235	33787	
	C/E	152.7	197.3	223.9	262	218.8	315	223	172	142	196.76	210.3	1
Hook & Line (M)	Catch (C)	2678.873	1765.7	2598.5	1643.38	1996.75	2766.57	7437.303	6843.71	7940.51	3753.3	3942.46	
	Effort (E)	57626	42066	49555	36444	46385	51418	81702	66491	98253	76180	60612	
	C/E	46.5	42	52.44	45	43	53.8	91	102.9	80.8	49.27	60.67	0.29
Drift gill net	Catch (C)	4015.636	5652.6	8633.9	7452.71	7806.45	7563.29	5527.876	4514.78	3492.58	5458.8	6011.86	
	Effort (E)	75129	89432	72392	72914	73932	84140	41186	22224	26823	54043	61222	
	C/E	53.45	63.2	119.26	102.2	105.6	90	134.2	203	130.2	101	110.2	0.52
Chalavala	Catch (C)	2013.629	3771	3454.3	2036.4	2633.29	1358.75	4.475	42.069	85.22	6.056	1504.5	
	Effort (E)	29735	40055	29693	33122	46385	20992	533	761	2004	521	20380	
	C/E	67.72	94.12	116.3	61.5	56.8	64.73	8.4	55.28	42.52	11.62	63	0.3
Konchuvala	Catch (C)	657.023	729.25	1437.6	394.5	29.384	55.162	66.121	7.819	5.212	121.22	350.3	
	Effort (E)	11619	19391	15514	12892	1947	1960	2627	310	407	2850	6951	
	C/E	56.55	37.6	92.7	30.6	15	28.14	25.17	25.2	12.8	42.5	36.62	0.17
Hooks & line (NM)	Catch (C)	63.827	67.753	27.156	85.065	36.12	44.934	88.177	57.433	72.805	32.148	57.542	
	Effort (E)	3740	3399	2240	3779	2083	2726	5131	3512	7201	5281	3909	
	C/E	17	19.9	12.12	22.5	17.34	16.48	17.2	16.35	10.11	6.08	15.5	0.074
Rollvala	Catch (C)	0.233			47.214		62.423		9.183	37.653	137.084	48.97	
	Effort (E)	10			1439		2260		418	2069	8493	2448	
	C/E	23.3			32.81		27.62		21.97	18.2	16.14	23.34	0.11

Gear		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Annual average	RE
Netholivala	Catch (C)	0.54	27.342	95.93	1.616	7.196	5.963					23.1	
	Effort (E)	80	1679	2060	51	95	129					682	
	C/E	6.75	16.28	46.57	31.69	75.75	46.22					37.21	0.18
Multiday	Catch (C)									14.017	48.076	31.05	
	Effort (E)									51	100	75	
	C/E									274.84	480.26	377.6	1.8
Kachal	Catch (C)	3.251	1.055									2.153	
	Effort (E)	290	207									248	
	C/E	11.21	5.09									8.15	0.04
Shoreseine	Catch (C)	17.435	12.989									15.212	
	Effort (E)	134	104									119	
	C/E	130.11	124.89									127.7	0.6
Nanduvala	Catch (C)	26.133	11.834	27.035	13.43	2.165	1.012	7.637	8.417	9.629	2.578	11	
	Effort (E)	294	567	448	641	64	116	1190	1295	1401	136	615	
	C/E	88	21	60	21	33.83	8.72	6.42	6.5	6.87	18.51	28.9	0.13
Kolachivala	Catch (C)	0.97	0.29									0.63	
	Effort (E)	39	21									30	
	C/E	24.87	13.81									21	0.1
Annual total catch, TC (t)		13118.83	21249	23675	22747.6	23798.6	26343.2	16671.78	15190.1	15530.9	16295.4	1946.2	
Standard Effort (SE)		91143	121524	97197	103407	117892	107375	63044	53772	73631	85928	91491	
TC/SE		143.9	174.8	243.5	220	201.8	245	264.4	282	210.9	189.6	217.6	

resources, both pelagic and demersal, in different seasons depending on the types of fish available and the seasonal climatic changes. These included drift nets, other gill nets, hooks and lines, shore seines and boat seines. Major gears such as boat seine, drift net, hooks and lines, *roll vala* and some minor gears such as *chalavala*, *netholivala* and *konchuvala* are seasonal in their operation. Each unit of hooks and lines consists of 25-50 hooks, the size of which depends on the size of the target species. In drift nets, generally large sized fishes like tuna, seer fish, mackerel and bill fishes were caught. *Kolachivala*, described by Luther *et al.* (1982) was not operated during the study period and a decline was noticed in the operation of traditional gears such as *katchal*, shore seine and *nanduvala* (bottom-set gill net, BSGN). Reduction in the traditional crafts used for these gears and exploitation of new high value fishes can be attributed to this decline. The boat seine (*thattumadi*) contributes to the bulk (39%) of the total fish landings, followed by drift gill net (31%) and mechanised hook and line (20%) (Fig. 2). The *chalavala* (gill net for sardines) contributed 8% and *konchuvala* (trammel net for prawns) 2%. All other gears such as *netholivala* (gill net for anchovies), *katchal* (scoop net using bait), shore seine locally known as *kambavala* and *nanduvala* (BSGN) contributed a very negligible quantity towards the total landings (Table 1). Reduction in the effort of non-motorised crafts which operate gears like *chalavala* and *netholivala* together with the climatic changes can be a reason for the decline in the catch of resources like sardines, *Thryssa* and silverbellies. Construction of fishing harbours at Perumathura in the north region and Thengaipatnam in the south resulted in a decline in the migration of fishermen towards the region. Fluctuations in the monsoon also added to decline in monsoon fishing activity in the recent years.

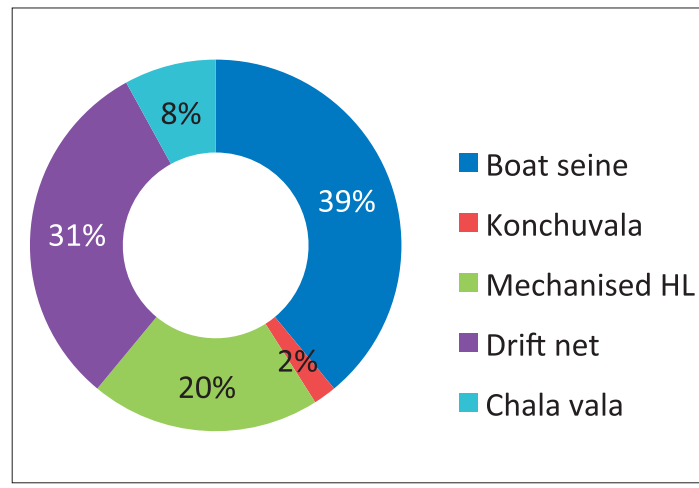

Fig. 2. Gear-wise contribution to marine fish landings at Vizhinjam during 2004-2013

Major gears contributing to the fishery

Along Vizhinjam coast, fishing is carried out only by traditional crafts and gears. Boat seine, hook and line and drift net are the principal gears in regular use (Table 2). Gill net for anchovies (*netholivala*), half beaks (*kolachvala*) and bottom set gill nets are used very rarely due to low catch. Nayar (1958) reported on details of the craft and gear employed at Vizhinjam and their modes of operation; Luther *et al.* (1982) on seasonal trend of operation of various gears and Gopakumar *et al.* (1986) gave an account on the motorisation along the coast. A brief mention is given here about the light fishing practices employed along this coast.

Light fishing is done along the coast throughout the year except during monsoon (June-September) with peak operations during November to March mostly by hook & line. Hook no. 15 is used for night fishing using light. For light fishing, four tubelights fitted with storage battery are used in a vessel; two each are fitted on either sides of the boat. Petromax, which was in vogue during the previous decades, has almost faded out at present. Of late, portable gaslight of 2 kg fuel capacity is also used for light fishing and about 1 kg of liquefied gas is required for 12 h and four gas lights are needed. Mainly *Decapterus* spp., mackerel, scads, lesser sardines, squids and cuttlefish are caught by light fishing method.

Light fishing using boat seine or *thattumadi* is also practiced along this coast. In this fishing method, along with two catamarans or fibreglass coated plywood boats, three additional boats of size 18 feet fitted with 4 to 6 lights in each boat are employed for operating boat seines. On reaching the fishing ground, lights are switched on in the three boats. When fishes aggregate around the light emitting boats, they are caught with boat seines. Subsequently light boats depart to shore. This type of fishing is done during the dark phase of the moon. The crafts venture to the sea at 6 pm and return to the shore around 6 am. Usually 13 fishermen go for this fishing, one person each for the light boats and 5 each for the main two boats. The fishing season is from November to March and area of operation is from 3 to 24 nautical miles from the seashore. The catch includes lesser sardines, squids, mackerel, carangids, barracuda, *Decapterus* spp., ribbon fishes, *Nemipterus* spp. and balistids.

Gear-wise production

The yearly total catch of the important groups of fish forming about 0.5% or more in major gears, together with their annual average percentage composition in the landings by that gear and the rank are presented in Tables 3 to 6.

Boat seine: Boat seine was operated throughout the study period with peak operation during monsoon months. The number of units

Table 2. Details of important gears operating along Vizhinjam coast

Gear	Gear characteristics	Craft	No. of fishermen	Distance from shore/Depth	Season	Catch composition
1. Hook & line						
a. Hand line (*Aachil*)	Main line-nylon monofilament 15-20 m, for Day fishing No. 8 to 13; Night fishing No.15 (using light); Light fishing with squid jig, Bait-crab	28 foot FRP (Fibre coated plywood) 9.9 HP OBM & Catamaran	3-4	5 - 15 nautical miles	Throughout the year except monsoon, Peak season- November - March	*Decapterus* spp., mackerel, scads, lesser sardines, tuna, squid, cuttle fish
b . Long line i. Ttuna long line (*Chooramattu/ Ayiramchoonda*) (Fig. 3)	Main line-No. 80 monofilament length-5 nautical mile with 3 m branch lines attached with hooks No. 9 for tuna, No. 8 for cobia and 6 and 7 for grouper, Bait-sardines	28 foot FRP boats OBM-9.9 HP	1-3	15 - 25 nautical miles	November - March	Tuna, cobia, grouper, snappers
ii. Long line for large scads (*Vattamattu*) (Fig. 4)	Main line No. 110 monofilament, Length- 4 nautical miles with 3 m branch lines attached with hook No. 7 and 8, Bait-sardines, tuna and squids	28 foot FRP boats with two OBM having 9.9 HP	4	7 - 8 nautical miles from shore	November - May	Larger carangids, snappers, lethrinids, sciaenids, rock cods, priacanthids, cobia
iii. Reef long line (*Paruamattu*)	Main line No.120 monofilament, length-4 nautical miles, 1.5 m branch lines attached with hook No. 9, Bait-sardines and tuna fillets	28 foot FRP boats OBM -9.9 HP	4	30 -110 nautical miles	November - February	*Pristipomoides* spp., rock cod, carangids, skates, cobia
iv. Shark long line (*Shravumattu*)	Main line No. 140 monofilament, length-25 to 90 m; branch lines attached with 1 feet long thin silver wire-rope with hook No. 2 or 3, Bait-live little tuna and mackeral	28 foot FRP boats OBM -9.9 HP	4-5 4-5	25 - 35 nautical miles	November - April	Billfish, sail fish, sharks, yellow fin tuna, rays
2. Boatseine *(Thattumadi)*	Three parts: (i) a short wide mouthed conical bag called *madi* or net proper made of nylon, (ii) a platform known as *thattu* attached to the lower part of the gear and (iii) two long wings attached to the margin of *thattu* on either side known as *eravala*.	28 foot FRP boats OBM -9.9 HP	6	3 - 10 km from the shore within 20 - 35 m depth	June - October	Carangids, catfishes, clupeids, sciaenids, pomfrets, *Sphyraena* spp., *Sillago sihama*, balistids, ribbon fishes, *Priacanthus*, squids, anchovies, sardines, small tuna, nemipterids, *Lactarius lactarius*
		Two catamarans of 5 m size	6	13-15 fathoms		

Gear	Gear characteristics	Craft	No. of fishermen	Distance from shore/Depth	Season	Catch composition
3. Shoreseine (*Karamadi*)	Has three parts, (i) the warps or *kamba* of split nylon fibre rope, 200 to 250 m in length; (ii) the wings or *kayaru* made of nylon, 600 - 900 m in length and (iii) *madi* the funnel-shaped bag net.	Canoes or fibreglass boats of 28 - 36 foot	20 - 40	Nearshore waters	October - May	Inshore pelagic fishes and shrimps such as anchovies, silver bellies, carangids, sardines, mullets, mackerel, saurida, squids, *Acetes* spp.
4. Gill nets						
a. Mackerel gill net (*Ayilavala*) (Fig. 5)	100 - 120 m in length, 15 m breadth, mesh size 62 mm. monofilament (*kangoose*)	28 foot FRP boats, catamaran	2-3	5 nautical miles	Throughout the year	Mackerel and tuna
b. Sardine gill net (*Chalavala/ mathivala*) (Fig. 6)	8 - 10 m breadth, 30 mm mesh size	Boats and catamaran	1-3	3-5 nautical miles Up to 18 fathom	Peak season May - August	Sardines
c. Anchovy gill net (*Netholivala*) (not popular due to low returns)	Mesh size 20 mm. Large sinkers not used as in the case of the other gears	Plywood catamaran of 18 - 20 feet, 28 foot FRP boats	2-3		Peak season June - September	Anchovies
d. Bottomset gill net (*Thathuvala*)	3 m breadth; mesh size 62 mm, Monofilament	28 foot FRP boats	3-8	1 - 1.5 nautical miles	June - September	Flat fishes, crabs, prawns, croakers, skate, rays and chanks.
e. Trammel net (*Disco vala/konchuvala*)	Length 300 m, three layered netting, mesh size: inner net 48 - 50 mm; outer two layers 100 - 120 mm. Gear characterised with two head ropes and two foot ropes, head ropes for attaching three layers of nettings and 100 floats; foot rope for attaching sinkers		4-7	12 km from the shore/ 23 fathom depth		Prawns, crab, croakers, flat fishes
5. Rollnet	300 m length (150-00 mm mesh size)	FRP boats	4-6	15 - 20 km	August - October	Mackerel, flat fishes, croakers, *Auxis rochei, Priacanthus*
		Plywood catamaran	1-2	5-8 km		

Table 3. Catch composition of important groups of fishes (t) during the period 2004-2013 in boat seine

Groups	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Annual. average	%	Rank
Elasmobranchs	28.3		27.9	8		255					319.2	4.15	6
Oil sardine	134.7	1103.2	552.5	493.2	550.3	560.2	180	0.17	48	32.5	365.4	4.75	5
Lesser sardine	35.2	64	34.3	561.3	180	402.3	157	118.5	90.8	122	176.5	2.3	11
Dussumieria sp.	64.5	197.3	122.9	14.2	183.2	91	90	351	592.3	221.8	192.8	2.5	9
Stolephorus sp.	939.22	3297.8	1443	4898.7	4096	5879.3	1087	1599	1405	917	2556	33.3	1
Trichiurids	967.3	1982.2	2930.3	2528.2	194.24	881	92.3	41	3	63	968.2	12.6	3
Decapterus spp.	393.7	1573.8	659.7	1202.5	2122.8	2554.5	275.8	268.7	127.2	1728	1091	14.2	2
Other carangids	151	114.2	114.5	145.4	198.5	172.68	121	124.3	6.02	3.83	115.1	1.5	13
Mene maculata	0	0	6.9	26.5	429.2	127.6	107.6	105	583	1080	246.6	3.2	8
Mackerel	22.6	5.08	18.4	113.64	881.3	1004.8	584.7	4.2	174.7	15.8	282.5	3.7	7
Leiognathids	20.42	72.14	41.4	87.4	160.4	110.3	6.09	35.4	41	84.2	65.8	0.85	14
Nemipterids	0	9.05	1.32	48	4.6	6.4	257	246.5	235	992	180	2.3	10
Balistids	0	0	0	0	0	656.3	57	68.5	80.52	413.8	127.6	1.7	12
Squid	306	353	263.3	546.4	1147.6	1093.4	274.2	211	86.6	606	488.7	6.36	5
Miscellaneous	33	69.9	38.62	66.7	84.2	116.9	26	20.8	21.6	29.4	507.1	6.6	4
Total	3095.9	8841.7	6255	10740	10232	13911.7	3316	3194	3494	6309.3			

Table 4. Catch composition of important groups of fishes during the period 2004-13 in drift gill net

Groups	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Annual average	%	Rank
Trichiurids	192.6	95.20	955.4	16.11	34.3	120.6	658	203.2	182	773	323	5.8	8
Deapterus russelli	239.4	104	85.3	227.7	92.97	244.2	342.3	552	288	243.1	241.9	4.35	9
Selar crumenophthalmus	135.9	131.1	162.7	169.2	196.6	354	126.9	23	8.75	5.184	131	2.36	13
Other carangids	199.5	207	218.63	242.2	247	292.3	635.2	12.8	37.7	117	220.9	4	10
Coryphaena hippurus	137.9	103.5	124.4	177.5	203.7	256.6	21.47	59	20.1	97.9	120.2	2.16	14
Mackerel	323.4	533.3	385.4	657.1	1770	704.2	1310	1117	1207	1106	911.4	16.4	2
Auxis rochei	653.5	994	982.2	1240.4	727.7	699.5	782.9	938.8	848	1091	895.8	16.12	1
Auxis thazard	469.6	396.8	242.6	243.25	251.9	214.9	581.6	176.5	179	544.6	330	5.93	7
Euthynnus affinis	714.6	818.6	767.6	894.62	764.2	667.3	296.1	820	341	610.4	669.4	12.05	3
Katsuwonus pelamis	38	190	336.5	105.55	358.9	398.5	50.45	1.02	0	0	147.8	2.7	12
Sarda orientalis	314.8	660	574.3	585.3	624.4	830.4	197.8	216	213	246.4	446.2	8	4
Thunnus albacares	75.6	257.4	1178	826.75	442	674.7	38.86	28.8	2.23	16.74	354.1	6.4	6
Seer fishes	244	211.3	90.6	542.18	308.6	288.5	99.28	75.16	25.7	166.8	205	3.7	11
Bill fishes	88.6	226.19	548.5	759.02	1092	726	77.3	12.44	15.6	2.647	354.8	6.4	5
Barracuda	102.7	182.67	82.203	119.01	87.8	163.8	33.88	29.07	24.3	15.41	84	1.5	15
Priacanthids	29.6	17.242	29.464	100.41	142	118.4	67.75	42.24	16.7	101.2	66.5	1.2	16
Miscellaneous	51.5	55.692	80.318	76.449	64.15	174.7	18.77	12.22	5.67	2.19	54.16	0.9	17
Total	4011	5184	6844.2	6982.9	7409	6928	5339	4319	3414	5140	55572		

Table 5. Catch composition of important groups of fishes during the period 2004-13 in mechanised hooks & line

Groups	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Annual average	%	Rank
Decapterus spp.	347.2	65	59.74	137.16	71.32	216.4	205	531.3	414	399.4	244.6	6.4	4
Selar crumenophthalmus	24.45	32.4	52.323	77.3	58.4	38.65	0	0	0	48.6	33.2	0.87	12
Other carangids	160	83.7	82.7	38.81	24.44	25.83	7.482	18.39	18	30.54	49	1.3	10
Coryphaena hippurus	33.77	6.308	0.59	9.759	63.97	43.36	388.5	160.1	4.36	2.828	71.35	1.86	7
Mene maculata	17.03	71.561	6.956	35.963	94.77	79.08	110.1	21.34	138	25.26	60	1.6	8
Rastrelliger kanagurta	117.7	105.4	54.39	73.8	202.2	258.6	380.5	380	92.5	375.6	204.07	5.3	5
Seer fishes	6.689	3.915	0	11.249	0	0	0	0.5	0	0	2.2	0.6	14
Auxis rochei	1372	815.98	1510.5	570.21	792.4	810.4	3936	3578	4292	1596	1927.3	50.3	1
Auxis thazard	30.45	24.897		6.312	2.848	2.14	92	104.2	164		42.7	1.1	11
Euthynnus affinis	135.4	228.35	358.42	261.01	257.8	753	1296	392.5	1645	666.1	599.3	15.64	2
Priacanthids	6.323	0	6	3.729	10.77	54.96	58.35	138.7	0	2.225	28.1	0.73	13
Epinephelus spp.	38.44	7.983	0	40.087	127.5	49.01	78.36	64.6	21	7.818	43.5	1.13	9
Cuttle fish	135.8	113.23	128.85	171	113.9	93.24	139.2	389.7	273	186.1	174.4	4.6	6
Squid	192.3	198.76	228.56	88.331	152.3	261.8	582	860	648	306.4	351.8	9.2	3
Total	2617	1757.5	2489	1524.7	1973	2686	7273	6639	7709	3647	38316		

Table 6. Catch composition of important groups of fish (t) during the period 2004-2013 in non-mechanised hooks & line

Groups	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Annual average	%	Rank
Decapterus spp.	18.9	24.8	18.6	19.6	24.2	15.5	14.93	17.75	25.6	8.523	18.8	35.2	1
Other carangids	7.4	9.94	1.8	12.4	6.42	4.5	27.2	12.4	11.7	11.34	10.5	19.64	2
Mackerel	1.528	2.911	2.12	3.407			1.775	1.077	2.05		1.49	7.9	5
Auxis rochei	3.832	1.05									0.5	0.9	9
Saurida spp.	0.844	0.169	1.14	2.201		0.356	1.2	2.58	4.58	2.2	1.53	2.86	7
Nemipterus spp.	6.909	1.443	3.09	7.32		9.25	14.5	12.98	11.1	4.834	7.14	13.4	4
Sciaenids				4.851							0.5	0.9	10
Balistids	5.08	4.26	2.4	2.22		14.18	23.21	16.46	9.8	4.57	8.22	15.4	3
Mene maculata						21		7.7	3.2		3.19	5.96	6
Squid	5.558					0.271	1.057	2.1	1.63	0.473	1.1	2.05	8
Cuttle fish	4.074					0.23	0.05	0.065	0.08	0.214	0.47	0.8	11
Total	54.13	44.573	29.15	51.999	30.62	65.29	83.92	73.11	69.7	32.15	53.44		

employed ranged from 15,851 in 2010 to 51,570 in 2008 with an average of 33,787 units per year. This wide range in the number of boat seines operated was mainly due to the variation in the migration of fishermen with their craft and gear to Vizhinjam area during periods of good fishery, particularly during monsoon. The total catch ranged from 3,540 t in 2010 to 51,570 t in 2010. The annual average catch was 7495 t. The range of annual C/E was between 142 kg in 2012 to 262 kg in 2007, with the average (over the whole period) at 210 kg.

Anchovies were the most dominant group of fish caught in boat seine, accounting for 33.3% of the average annual catch, followed by *Decapterus* spp. (14.2%), trichiurids (12.6%), squids (6.36%), oil sardines (4.75%), elasmobranchs (4.15%), mackerel (3.7%) and *Mene maculata* (3.2%) respectively. Other important groups recorded were *Dussumieria* spp., nemipterids, lesser sardines, other carangids and balistids (Table 3).

Drift net: Drift net (Fig. 7) was operated in all the years during the period under study. Total number of units operated each year varied from 22,224 in 2011 to 89,432 in 2005 with the average at 61,222. Minimum catch was recorded in 2011 (3492.5 t) and maximum in 2006 (8633 t), but minimum (53.45kg) and maximum (134 kg) values for CPUE were recorded in 2004 and 2010 respectively. The annual average catch and C/E were 6011.86 t and 110 kg respectively and the relative efficiency factor of this gear was 0.52.

As a group, tunas (*Auxis* spp., *Euthynnus affinis, Sarda orientalis, Katsuwonus pelamis, Thunnus albacares*) accounting for 51.2% formed the dominant catch in this gear. In species-wise abundance, the bullet tuna *Auxis rochei* (16.12%) dominated the catch followed by mackerel (16.4%), *Euthynnus affinis* (12 %), *Sarda orientalis* (8 %), bill fishes (6.4%), *Thunnus albacares* (6.4%), *Auxis thazard* (5.93%), trichiurids (5.8%), *Decapterus russelli* (4.35%), other carangids (4%), seer fish (3.7%) and the skipjack tuna *Katsuwonus pelamis* (2.7%), others being *Selar crumenophthalmus, Coryphaena hippurus, Sphyraena* spp. and priacanthids (Table 4).

Hook and line: Hook and line, both mechanised and non-mechanised, were also operated in all the years from 2004 to 2013. The mechanised H&L came third in position with 20%, whereas the share by the non-mechanised H&L was only 0.3%. The annual effort of mechanised H&L ranged between 36,444 units in 2007 and 98,253 units in 2012 with average at 60,612 units and that of non-mechanised from 2083 in 2008 to 7201 in 2012. Hook and line was the most commonly used gear as it requires minimum capital expenditure. The total catch in mechanised units ranged from 1,644 t in 2007 to 7,940.5 t in 2012 with the average at 3,942.5 t. The annual C/E varied from 42 kg in 2005 to 103 kg in 2011 with annual average at 60.7 kg. In the non-mechanised units, total annual catch ranged from 27.15 t

in 2006 to 88.18 t in 2010 and the CPUE varied from a minimum value of 6.08 kg in 2013 to 22.5 kg in 2007 with annual average at 57.54 t and 15.5 kg respectively. The relative efficiency of mechanised gears was 0.29 and that of non-mechanised gears was 0.074.

Among the catches of mechanised H&L, bullet tuna ranked first with 50.3% of the fish landed by this gear. The next dominant tuna species, *Euthynnus affinis* contributed 15.64% in the total catch followed by squids (9.2%), *Decapterus* spp. (6.4 %), mackerel (5.3%) and cuttle fish (4.6%). Other major groups encountered in the catch were, *Coryphaena hippurus, Mene maculata*, *Epinephelus* spp., *Auxis thazard* and *Selar crumenophthalmus* (Table 5).

Decapterus russelli dominated the catch with 32.2% of the total landings in the non-mechanised units followed by other carangids (19%), balistids (13.7%) and nemipterids (14.7%). Mackerel emerged as the next dominant group with 7.5%, followed by *Mene maculata, Saurida* spp. and cephalopods (Table 6).

Chalavala*:* The next major gear, *chalavala* also was operated in all the years, though the catch and effort showed a declining trend from 2010 onwards (Table1). Fishing by *chalavala* is carried out throughout the year except for the monsoon, and it is intense during March-May and November-December months as reported by Luther *et al*. (1982). But in some years, catch by this gear was recorded throughout the year. The number of units operated ranged between 521 in 2013 and 46,385 in 2008, with the average at 20,380. The total catch varied between 4.5 t in 2010 to 3,771 t in 2005, with average at 1504.5 t (Table 6). The annual C/E ranged from 8.4 kg in 2010 to 116.3 kg in 2006 with average at 63 kg. The relative efficiency of this gear was 0.3.

Oil sardine dominated the catch accounting for 61.3% of the total catch recorded during the period from this gear. *Scomberoides* spp. which was recorded only in 2009 and 2010 accounted for 12% of the total catch. Lesser sardines dominated by *Sardinella gibbosa* formed the next major catch accounting for 7.15%, followed by *Decapterus russelli* (5%), carangids (4.2%) and *Leiognathus* spp. (3%) and *Dussumieria* spp. (1.4%) (Table 7). Other minor clupeids like *Pellona* and *Thryssa*, also contributed to the total catch of this gear.

Konchuvala: Operation of this gear started from 1975 (Luther *et al.,* 1982) and operated mainly during monsoon months. Though it was used mainly to catch prawns as the name implies, the targeted species forms only 10.4% of the total catch. Flat fishes with 37.14% formed the most dominant group recorded in this gear followed by *Thryssa* (10.84%), leiognathids (10.6%) and sciaenids (7.4%). Elasmobranchs (6%) formed the next important group followed by *Decapterus* spp.

Table 7. Catch composition of important groups of fish (t) during the period 2004-2013 in *chalavala*

Group	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average catch	%	rank
Oil sardine	1898	2880	1778	1412.2	1423	1515	68.6	17.12	12	0.258	1100	61.3	1
Lesser sardine	79.4	109.1	129.3	265.72	425.1	228.6	29.5	0.86	15.8	0.26	128.37	7.15	3
Dussumieria sp.	0.26	0	0	27.6	36.1	185.7	1.65	0	0	0	25.13	1.4	10
Pellona	23.2	46.8	69	43.44	78.12	62.3	5.36	0	0	0	32.82	1.82	9
Thryssa spp.	21.9	45.7	75.4	59.4	100.4	78.6	1.9	0.13	0	0.33	38.37	2.14	7
Decapterus spp.	99.8	352.8	112.64	19.4	216.6	106.5	1.2	0.32	0	0	90.95	5	4
Other carangids	77.73	172.3	110	130.2	145.4	103.7	14.8	0	0	0.234	75.4	4.2	5
Scomberoides spp.	0	0	0	0	0	2022	122.9	0	0		214.46	12	2
Leiognathus spp.	43.13	64.2	100.3	107.22	129.8	78.4	11.22	0	0.17	5.95	54.04	3	6
Miscellaneous	33.2	76.352	55.396	68.9	70.5	44.22	3.7	4.23	5.3	1.2	36.3	2	8
Total	2277	3747.3	2430	2134.1	2625	4425	260.9	22.66	33.3	8.232	17963		

(5.25%) and theraponids (4.5%). Crabs and other carangids also contributed substantially to the total catch by this gear (Table 8). The number of units operated ranged between 310 in 2011 and 19,391 in 2006 with the average at 6,951. The total catch varied between 5.2 t in 2012 to 1437 t in 2005, with average at 350.3 t. The annual C/E ranged from 12.8 kg in 2012 to 92.7 kg in 2006 with the average at 36.62 kg with average relative efficiency of 0.17.

Rollvala which accounted for only 0.16% of the total landings, was discontinued from operation in certain years (in 2005, 2006, 2008 and 2010) and resumed fishing in 2011 with an annual average catch of 49 t and CPUE of 20 kg. Minor gears which account for very negligible catch, were *katchal, netholivala*, shore seine and bottom set gill net, which were used mainly for catching crustaceans. *Katchal* was operated only for two years *i.e,* 2007 and 2008 and balistids formed the dominant catch, followed by squids. *Kolachivala*, in which bulk of the catch comprised half beaks (66.3%) and mullets (33.6%), was in operation during the initial years only (2004 and 2005), and discontinued subsequently. Fishing using *Netholivala* which was operated for whitebaits, was recorded only during the initial period of study and discontinued from 2010 onwards. So is the case with shore seine which was operated only during 2004, 2005 and 2008. The multiday vessels, locally known as *thangalvallam,* which remain in the sea for 2-3 days, started operation in 2012 and recorded the highest relative gear efficiency of 1.8 compared to other gears. The average annual catch and C/E were at 31 t and 377.6 kg, respectively (Table 1). A comparison of catch, CPUE and effort has been made with that of the observations of Luther *et al.* (1982), prior to motorisation (Table 9).

The disappearance of certain gears such as *kolachivala, achil* and reduction in the effort of non-motorised crafts which operate gears like *chalavala, netholivala* and hooks & line, were noticed in the present study (Table 9). Gopakumar *et al.* (1994) also opined that motorisation together with the change in the fishing ground of motorised crafts led to the decline in the catch of certain nearshore resources like sardines and silverbellies in the recent years.

Resource-wise production

Pelagic finfishes formed 78.4% of the annual marine finfish production in the centre, while demersal finfishes, crustaceans and molluscs contributed 10.5, 0.7 and 10.5% respectively. The landings of major pelagic resources registered a marginal growth till 2009, after which the catch decreased drastically. Tunas and clupeids showed an opposite fluctuating trend in catch, decrease in the catch of one resource compensating increased landings of the other. Tunas contributed 33.8% of the pelagic finfish landings, followed by clupeids which formed 27.5%, carangids (15%),

Table 8. Catch composition of important groups of fishes (t) during the period 2004-2013 in *konchuvala*

Fishes	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Ann. average	%	Rank
Thryssa spp.	4.69	6.026	5.304	17.9	2.533	2.72	5.513	1.744		6.038	52.47	10.84	2
Decapterus spp.	19.6	3.84		1.98							25.4	5.25	7
Other carangids	12.18	31.76	30.14	39.65							11.37	2.35	10
Saurida spp.	17.46	35.55	7.34	5.5							6.6	1.36	12
Theraponids	4.7	3.62	8.45	2.55	2.5						21.84	4.5	8
Sciaenids	75.2	109.5	47.27	73.951	8.46	19.2	17.8	1.94	0.916	1.86	35.68	7.4	5
Leiognathids	4.86	4.4	9.84	11.76	0.393	0.267	6.68	0.969	0.055	12.07	51.27	10.6	3
Flat fishes	449	221.7	988.3	101	5.3	8.5	7.6			15.46	179.7	37.14	1
Prawns	23.94	115.31	151.65	81.47	3.461	22.07	23.3	2.83	3.76	75.64	50.3	10.4	4
Crabs	13.8	34.54	33.62	31.2	3.56		2.9		0.021	7.72	12.7	2.62	9
Elasmobranchs	15.7	46.1	84.85	4.203							29.06	6	6
Miscellaneous	10.043	25.005	20.2	13.64	0.333	1.42	2.4	0.31	0.354	1.16	7.5	1.55	11
Total	651.17	637.351	1387	384.8	26.54	54.18	66.19	7.793	5.106	119.95	483.89		

Table 9. Comparative decadal analysis of catch, CPUE and effort between 1969-78 and 2004-2013

Gears	Catch -Annual average		CPUE - Annual average		Effort-Annual average		RE	
	1969-78	2004-13	1969-78	2004-13	1969-78	2004-2013	1969-78	2004-13
Boat seine	2165.8	7495.2	62.6	210.3	34571	33787	1.00	1.00
Drift net	751.1	6011.86	45.2	110.2	16636	61222	0.31	0.52
Mech. H&L	-	3942.5	-	60.7	-	60612	-	0.29
Non Mech. H&L	57.54	51.77	19.5	15.5	5281	3909	0.72	0.074
Chalavala	1504.5	1283.7	19.1	63	10290	20380	0.31	0.3
Rollvala	-	49	-	23.34	-	2448	-	0.11
Netholivala	70.2	23.1	34	37.21	2064	682	0.54	0.18
Multiday	-	31	-	377.6	-	75	-	1.8
Konchuvala	96.3	350.3	13.3	36.62	7248	6951	0.21	0.17
Katchal	232	2.15	51.8	8.15	4479	248	0.83	0.04
Shore seine	110.3	13.4	56.2	81.64	1962	82	0.9	1.9
Nanduvala (BSGN)	50.1	11	34.7	28.9	1445	615	0.55	0.13
Kolachivala	32.6	1.26	36.3	21	900	30	0.58	0.1
Aachil	17.8	-	10.3	-	1723	-	0.16	-

Fig. 3. Long line for tuna

Fig. 4. Long line used for scads

Fig. 5. Mackerel gillnet

Fig. 6. Sardine gill net

Fig. 7. Drift net being loaded into the boat at Vizhinjam

mackerel (8.7%), ribbonfishes (7.8%) and the moon fish *Mene maculata* contributing 2.1% and billfishes and seer fishes contributing 2.5 and 1.25% respectively to the total pelagic landings. The contribution of clupeids and ribbonfishes decreased marginally from 62,375 t and 13,844 t in 2000 to 60,638 t and 9,357 t in 2010 respectively. The reduction in the effort of non-motorised crafts which operate gears like *chalavala* and *netholivala* together with change in the fishing ground led to the decline in catch of certain nearshore resources. During the years 2005-2009, when clupeids were higher, the tuna resources registered a lower catch. During 2010-2013, tunas were higher whereas the clupeid landings showed a drastic decline, from 7,983 t in 2009 to 1,395 t in 2013. The landings of mackerel showed a gradual increase from 465 t in 2004 to 2,869 t in 2008 and after that it started to decline with fluctuations in between. Carangids, one of the major resource, also showed fluctuations in their landings with maximum landing during 2009. Ribbon fish landings showed wide fluctuation with peak landings during the period 2004-2007. Seer fishes, bill fishes and *Mene maculata* were the other commercially significant and highly valuable pelagic resources which showed fluctuating trends in landings over the period (Fig. 8).

Among the demersal finfishes, perches formed 26.6% followed by elasmobranchs (21%), flat fishes (10.4%), balistids (8.4%), lizard fishes (8%), silver bellies (7%) and croakers (6%) (Fig. 9). The crustacean landings, which is highly seasonal, showed a declining trend over the years (Fig. 10). Penaeid prawns formed on an average 59.56% of the total crustacean landings followed by *Acetes* spp. which constituted 20.7% and the rest 19.7% was formed by crabs. The total cephalopod production increased from 836 t in 2004 to 2891 t in the year 2010 and was constituted mainly by squids forming 82% of the total landings, followed by cuttlefish (18%) (Fig. 11).

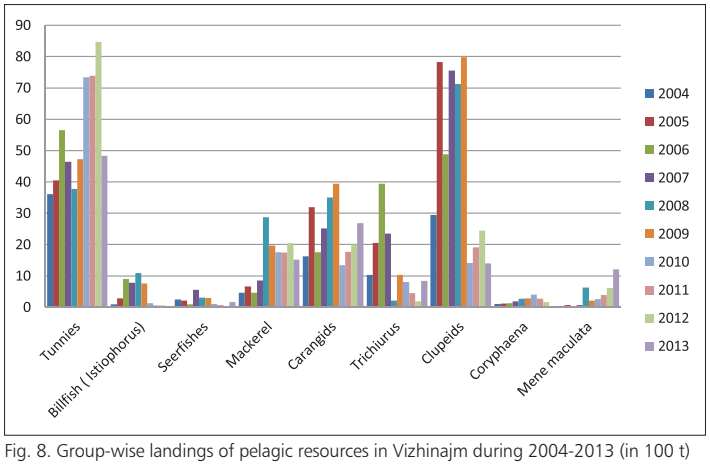

Fig. 8. Group-wise landings of pelagic resources in Vizhinajm during 2004-2013 (in 100 t)

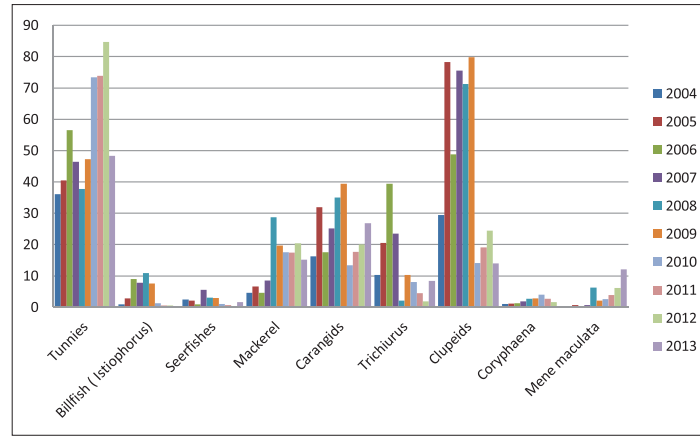

Fig. 9. Group-wise landings of demersal resources in Vizhinajm during 2004-2013 (in 100 t)

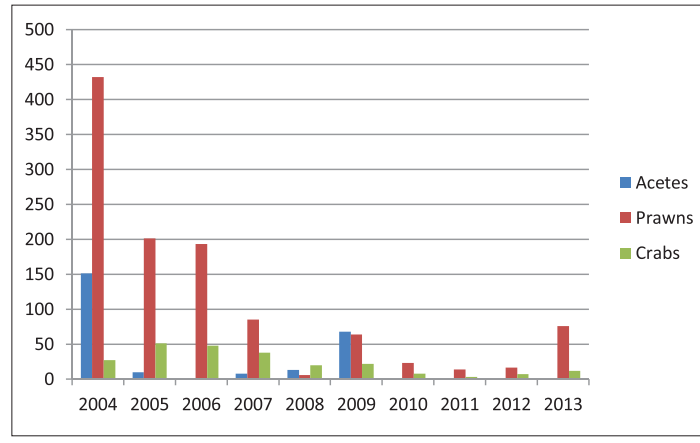

Fig. 10. Average catch of crustaceans during 2004-2013

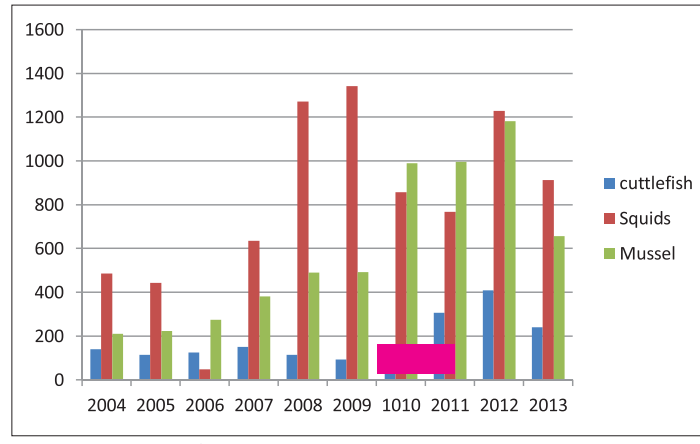

Fig. 11. Average catch of molluscs during 2004-2013

Species composition

Vizhinjam fishery is supported by a large variety of fishes and the landings in each gear have a characteristic species composition (Table 10). In fact, some of the gears such as *kolachivala, netholivala, konchuvala* and *chalavala*, as their name imply are designed to catch particular groups of fish, though most of them are not in operation at present. The seasonal trends in the catches of important groups of fishes are given in the following account.

Table 10. Percentage contribution by different gears to the landings of important groups of fish based on average annual landings during the period 2004-13

Group	BS	CV	DN	MHL	NMHL	KV	BSGN	RV	NV	MD	SS	Annual Average
Elasmobranchs	84.11		9.3			4.09	1			0.9		379.5
Oil sardine	24.31	73.2	1.76					0.56			0.22	1503
Lesser sardine	55.85	40.6	0.37					0.4			2.85	316
Rainbow sardine	87.24	11.4						1.45				221
Anchovies	98.77	0.12						0.02	5.3		0.82	2726
Trichiurids	75		25									1291
Decapterus spp.	63.56	5.3	14.1	14.25	1.09	1.48	0.11		0.007		0.013	1716
Selar crumenophthalmus	5.5		69.31	17.57				7.67				189
Other carangids	22.6	14.8	43.4	9.62	2.06	2.23	1.54	2.83		0.08	0.95	509
Mene maculata	71.07		10.8	17.3	0.92							347
Rastrelliger kanagurta	19.7	0.15	63.6	16.3	0.1	0.018		0.1				1433
Coryphaena hippurus			62.4	37.2						0.4		192
Auxis rochei	0.06		31.7	68.22	0.017	0.0006				0.001		2825
Auxis thazard			42.6	57.5						0.062		775
Euthynnus affinis			52.75	47.23	0.008					0.011		1269
Thunnus albacares			99.75							0.3		355
Sarda orientalis			94.3	5.3						0.34		473
Bill fishes			99.94							0.033		355
Seer fishes			98.8	0.1						0.067		207.5
Flat fishes	0.2					96.09		0.09				187
Cuttlefish	4.6			95.3	0.3							183
Squid	57.96			41.73	0.65		0.01				0.17	843.2
Annual average total catch	7495	1505	6012	3942	57.54	350.3	11	49	23.1	31.05	13.39	
%	38.46	7.72	30.85	20.23	0.3	1.8	0.05	0.25	0.12	0.16	0.07	

Among finfishes, tunas which rank first as a group, comprised mainly six species, the major one being the bullet tuna *Auxis rochei,* which is the only targeted fishery in this coast, followed by *Euthynnus affinis, Sarda orientalis, Auxis thazard, Thunnus albacares* and *Katsuwonus pelamis,* with their relative contributions at about 51.85%, 23.3%, 8.7%, 6.9%, 6.5% and 2.8% respectively together accounting for about 28% of the total fish landings. Two principal gears namely drift net (about 52%), and hook and line (about 48%), contribute to the bulk of tuna landings. Both these gears are operated almost throughout the year. *Auxis rochei* which was reported as stray catch by Luther *et al.* (1972), has become a major species in the fishery (Gopakumar *et al*., 1994) with the popularisation of motorised crafts, and is exploited on a commercial scale throughout the year which forms the backbone of the traditional fishery along this coast. Commercial exploitation is mainly by gillnets and hooks and lines with 0-1 yr old fishes comprising the bulk of the commercial catch (Jasmine *et al.,* 2013).

Clupeids contributing 23.4% to the total marine fish landings in the centre was the second major group among the finfish catch and were represented by anchovies (55%), oilsardine (31%), lesser sardines (6.7%) and rainbow sardines (4.9%). The catch of clupeid resources exhibited wide fluctuations with maximum catch of 15,687 t in 2009 which dipped to a minimum of 2,657 t in 2013. Boat seine lands the bulk of the catch, followed by *chalavala*, drift net, *netholivala,* shore seine and *rollvala.* The anchovy fishery is supported mainly by *Encrasicholina devisi*, *Stolephorus indicus*, *Stolephorus waitei* and *Encrasicholina punctifer*. Other species which contributed to the fishery were *Stolephorus andhraensis*, *Stolephorus commersonnii, Stolephorus baganensis* and *Encrasicholina heteroloba*. Among the lesser sardines, *Sardinella gibbosa* and *Sardinella sirm* formed majority of the catch followed by *Sardinella dayi* and *Sardinella fimbriata*. The bulk of the catch of rainbow sardine, *Dussumieria* spp. was landed mainly by boat seine (87%), followed by *chalavala* (11.4%) and the rest by *rollvala.* Anchovies were landed mainly by boat seine (98.8 %) and the rest by *netholivala* which has been a non-functioning gear from 2010 onwards. The oil sardine catch was mainly by *chalavala* (73%), followed by boat seine (24.4%) and the lesser sardines were landed mainly by boat seine (58%) and *chalavala* (41.7%).

Among the next dominant group, carangids, *Decapterus* spp. with an average annual landing of 1,716 t, accounting for almost 9% of the total fish landings, contributed 70% of the total carangid landings. Among this genus, 95% of the total landings was of *Decapterus russelli* and the rest were *Decapterus macarellus* and *Decapterus macrosoma. D. russelli* was available throughout the year in almost all the operational gears, whereas the other two species were highly seasonal in their abundance. The big eye scad *Selar crumenophthalmus* with an annual average catch of 189 t also formed a major resource among the carangids. Other carangids with an

average annual landing at 509 t, accounting for about 2.6% of the total fish landings, comprised mainly species under the genera *Carangoides, Caranx, Elagatis* and *Scomberoides* followed by stray catches of species of *Alectis*, *Alepes, Atropus, Gnathanodon*, *Selaroides, Trachinotus, Uraspis, Ulua* and *Seriolina.* Carangids were landed almost throughout the year with good catches during the monsoon months. The bulk of the catch of *Decapterus* spp. were landed by boat seine (63%) followed by mechanised hook and line (14.25%) and drift net (14%), whereas those of the other carangids were mainly caught by drift net (43.4 %), boat seine (22.6 %), *chalavala* (14.8%) and mechanised hooks & lines (9.62%).

Mackerel catches with an annual average of 1,433 t annually accounted for about 7.35% of the total fish landings. Drift net was the most important gear for this fishery contributing 63.6% of the annual catch, followed by boat seine (19.7%), and hook and line (16.3%). The ribbonfish fishery, comprising mainly of *Trichiurus lepturus* which ranked foremost among the landings off Vizhinjam during 1960's and 70's (Luther *et al.,* 1972) has now come down to fifth position among the pelagic catch, forming only 6.6% of the total catch. The major chunk of the trichiurids were landed by boat seine (75.4 %) and the rest 24.6% by *chalavala*.

Cephalopods comprising squids and cuttle fish with their relative contribution at 86.95% and 13.05% and average annual catch at 843 and 183 t respectively, ranked third in the fishery of the area, accounting for 5% of the total fish landings. The bulk (71.5%) of the squid catch was landed by hook & line followed by boat seine (28.5 %), while most of the cuttle fish (99%) was caught by hook and line. Large-scale use of fish aggregating devices (FADs) made up of coconut spadix was observed for the capture of cuttlefish, *Sepia pharaonis.* The squid *Uroteuthis (Photololigo) duvaucelii (=Loligo duvaucelii)* formed 70-75% of the total cephalopod catch and the fishery was usually during May to November with peak catch in July to October. *Uroteuthis (Photololigo) singhalensis (=Doryteuthis singhalensis*) also contributed to the squid fishery. The cuttlefish landings mainly comprised *Sepia pharaonis* with stray catches of *Sepia aculeata, Sepioteuthis lessoniana* and *Sepiella inermis* and the fishery was during the monsoon and post-monsoon months with peak fishing during September to December.

Elasmobranchs formed the next major group with their annual average catch of about 379.5 t annually accounting for 2% of the total fish landings. Rays contributed the major share (57%), followed by sharks (39%) and skates (4%). Most of the elasmobranch catches (84%) were landed by boat seine followed by drift net (9.3%) and 4% by *konchuvala.* Fishery was confined to the post-monsoon period mainly from August to December. The important species caught were *Carcharhinus limbatus, Carcharhinus* spp., *Alopias* spp. and *Chiloscyllium* spp. among sharks;

Manta birostris, *Gymnura* spp., *Himantura* spp. and *Rhinoptera javanica* among the rays. Occasionally, the skates *Rhynchobatus* spp. and *Rhinobatos obtusus* were also caught in the area.

Bill fishes contributed mainly by *Istiophorus platypterus*, *Xiphias gladius* and *Makaira* spp. accounted for 2.2% of the total pelagic catch and were landed mainly by drift nets (99.94%) and a very meagre catch by multiday units. The moon fish *Mene maculata*, the sole representative of the family Menidae, a comparatively new resource, ranked next to bill fishes with 1.78% of the total catch and landed mainly by boat seine (71%), followed by mechanised hooks & line (17%) and drift net (10.8%). Seer fish (family Scomberomoridae) landings amounted to 207 t and accounted for about 1.06% of the total annual fish landings. *Scomberomorus commerson* formed the dominant species in the catches, followed by *Scomberomorus guttatus* and stray catches of *Scomberomorus lineolatus*, landed mainly by drift net (about 99%), followed by hook and line (0.1%). Main fishery season lasted from September to November when about 82% of the annual catch was landed. *Coryphaena hippurus,* accounted for about 1% of the total fish landings in the Vizhinjam area.

Perches, belonging to Serranidae, Lutjanidae, Lethrinidae, Theraponidae, Siganidae, Priacanthidae and Nemipteridae, which contributed 2.5% to the total catch together formed a dominant group among the demersal fishes. Some other groups which were seasonal and formed very minor fishery were flat fishes (0.98%) landed mainly by *konchuvala*, silver bellies (Family Leiognathidae) comprising the genera *Leiognathus, Secutor* and *Gazza*. Barracudas caught mainly in boat seine and drift net, *Upeneus* spp. caught mainly in boat seine and *Saurida* spp. caught mainly by hooks and line also contributed to the total fishery of this area. Balistids, dominated mainly by *Aluterus monoceros* which formed a comparatively new resource recorded from 2007 onwards, contributed 86% of the total balistid catch followed by *Odonus niger* and stray catches of *Sufflamen fraenatus, Pseudobalistes fuscus* and *Abalistis stellatus*.

Though crustacean fishery do not contribute considerable percentage in the Vizhinjam area, they are caught in good quantities during certain months. The prawn fishery, which is highly erratic, starts with the onset of monsoon with its peak landings during June-September and the fishery was represented mainly by *Penaeus indicus,* with stray catches of *Penaeus semisulcatus* and *Penaeus monodon* caught by *konchuvala* and boat seine. Crabs are mainly caught by bottom set gill nets (*nanduvala*) and they are dominated by *Portunus sanguinolentus*, whereas the rock lobster (*Palinurus homarus)* fishing is mainly by lobster traps and bottom-set gill net (*rallvala*) kept in rocky areas. The season of trap operation is from August to January with peak during August to November and from August to October for gillnet. A regular fishery exists for brown mussel (*Perna indica*) in Vizhinjam, where the distribution of mussel

on rocks in coastal waters is more or less continuous. Mussel fishing is done by skin diving from catamaran by a particular group of skilled fishermen. The peak season is from August to October and the bulk of the catch is exploited from submerged rocks. A small fishery exists for gastropods, also in this rocky area and the peak season of operation is from December to February.

Though the fishery showed a general decreasing trend, the prices exhibited tremendous increase and for some fishes it was more than 200% increase. Even though catch was less, the importance of this sector remained unaffected due to high price of the fishes. Catch decreased for many resources such as cat fish, trichiurids, lethrinids, oil sardines and lesser sardines and resources such as white fish (*Lactarius lactarius*) and pomfrets almost disappeared from the catch in recent years. Many fishes like balistids (*Aluterus monoceros*), moon fish and caesionids, which were considered as trash or of low value earlier, have become important part of fishery as their price increased drastically. Many commercially important groups like prawns and cephalopods were landed only in less quantity in recent years. The chief gears employed by the motorised units are hooks and line and drift net and the area of fishing also extended to the offshore waters. This has resulted in an increase in yield of certain resources of high unit value like tunas, carangids and bill fishes. Reduction in the effort of non-motorised crafts which operate gears like *chalavala* and *netholivala* together with the climatic changes could be the reason for decline in the catch of resources like sardines, *Thryssa* and silverbellies.

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