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DEEPSEA FISHING AND NEW FISHERY RESOURCES OF INDIA

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ABSTRACT

Deepsea fishing is a much talked about subject and has been a misinterpreted term often used conveniently for over exploitation of the marine living resources especially fish and fisheries of the coastal waters. It is already reported by FAO and other agencies that over exploitation of the coastal waters has been going on in the name of deepsea industrial fishing. Terminologies like deepsea, continental shelf, continental slope, inshore, off shore, neritic, oceanic, pelagic, demersal, plankton, nekton and benthos are defined. Resources in the inshore, off shore and oceanic realms of the ocean are briefly mentioned. Fishing methods adopted for different zones of the sea are also accounted. New fishery resources for exploitation are mentioned for further investigations and developments achieved are being accounted based on deepsea fishing investigations conducted by large vessels in the country. Unconventional resources like deepsea fishes, mesopelagic like Myctophids (Lantern fishes), Oceanic squids, Oceanic Tunas and tuna like fishes, pelagic sharks and deepsea sharks are some of the new resources for exploitation and commercial utilization.

Introduction

Any fishing activity conducted by larger vessels of 23 m OAL and above in grounds with more than 50 m depths is generally described as `deepsea' fishing in the commercial sense and the fish obtained from such grounds (more than 50 m depths) are usually grouped as deep-sea fish. Hence fishes such as *Nemipterids, Saurids, Priacanthus spp. Decapterus spp. Megalaspis spp., Ribbon fish* etc. are commonly described as deep-sea fishes. But, deepsea, in its true oceanographic sense, is the zone beyond 200 m depth of water from outer edge of the continental shelf as depicted by Sverdrup *et.al.,* (1942). Thus, the term `deepsea' in commercial fishing has become a misnomer. FAO has estimated about 27 million tonnes of discards (by-catch) in the range of 18-40 million tonnes per year as global figure. India's share is about one-lakh tonnes per year.

There are two broad divisions of the sea. They are neritic (inshore) and oceanic. Again, the sea is classified as benthic and pelagic. Benthic includes the entire ocean floor and the whole mass of water is the pelagic realm. There are subdivisions in the pelagic as inshore (neritic), pelagic and open sea (oceanic) pelagic. The oceanic province has the lighted zone i.e. upto 200 m depth and the dark zone below 200 m depth. As in the case of pelagic, the benthic has two provinces. They are the littoral and the deepsea, the dividing line at a depth of 200 m of water at the outer edge of the continental shelf, separating lighted zone from the dark portion of the sea. The littoral zone has the inshore area, i.e. upto 50 m. depth and the offshore i.e. the zone between 50 m-200 m depth. According to the realms of the sea, the population is grouped as benthos, plankton and nekton. Benthos are benthic forms, either sessile, creeping, crawling or burrowing. Plankton are pelagic forms either as wanderers, floating or drifting. Swimming animals like fishes are grouped as nekton.

India has a coastline of 8100 km (inclusive of islands) and 2.02 million km^2 of Exclusive Economic Zone (EEZ). Continental shelf area on the West coast of India is 3,10,000 km^2 and 90,800 km^2 on the West coast when compared to East coast. The increase in catch from West coast is attributed to this factor.

Fishery resources of Indian EEZ were reported by earlier workers like Joseph (1980), Bapat *et.al.* (1982), Joseph and John (1986), Joseph (1986), Joseph *et.al.* (1987), Sivaprakasam (1986), Sudarsan and Sivaprakasam (1987), Sulochanan *et.al.* (1986), Sivaprakasam *et.al.*, (1991), Sulochanan and John (1988), James and Pillai (1989), Bande *et.al.* (1989), Mini Raman and James (1989), Nair and Reghu (1989), Balachandran and Nizar (1989) and Sivakami (1989). Technological advancements made in the field of development of suitable demersal trawl gear for large class of vessels equipped for deepsea fishing like **FORV Sagar Sampada** were reported by Panicker *et.al.* (1989 and 1993), Kunjipalu (1994) and Kunjipalu (1989, 1993, 1994(a), (b) and (c)).

Materials and methods

Fishing results of sixteen cruises conducted by the author as participant and chief scientist on board **FORV Sagar Sampada** have been critically evaluated and assessed in this paper. Vessel **FORV** (Fisheries and Oceanographic Research Vessel) **Sagar Sampada** with 71.50 m OAL and 2285 BHP main engine is a full-fledged research vessel. Cruise results extending from 1985 to 1996 (12 years) have been taken for the studies and discussed in the light of deep-sea fishing.

At present, in India, deepsea fishing is conducted in ground in the depth of 50 m – 200 m and harvesting around 6 lakh tonnes. Few observations were made in the deepsea realms as can be seen from Table 1(a). Table 1(a) gives the

Table 1(a) : Particulars of Cruises participated from FORV Sagar Sampada for Demersal Trawling

Sl. No.	Cruise No.	Period of cruise	Depth Range (m)	Area Studied	Lat. And Long.
1	5/85	15/07/1985 to 26/07/1985	40-212	East Coast – Southern Sector, Wadge Bank and South West Coast	07°00'N-13°00'N 75°30'E-80°44'E
2	13/86	18/02/1986 to 20/03/1986	23-160	East Coast	10°30'N-20°30'N 80°00'E-88°30'E
3	18/86	07/07/1986 to 27/07/1986	42-180	West Coast – Central Sector	13°00'N-17°30'N 69°30'E-74°45'E
4	21/86	12/09/1986 to 27/09/1986	42-160	West Coast – Central Sector	14°00'N-18°30'N 69°30'E-74°30'E
5	33/87	24/07/1987 to 10/08/1987	32-95	Quilon Bank, Wadge Bank and Gulf of Mannar	07°00'N-09°00'N 75°28'E-78°43'E
6	35/87	08/09/1987 to 21/09/1987	32-175	East Coast – Central Sector	14°30'N-18°00'N 80°18'E-86°00'E
7	36/87	29/09/1987 to 14/10/1987	30-95	North East Coast	18°30'N-20°50'N 84°23'E-87°50'E
8	38/87	17/11/1987 to 02/12/1987	45-90	North West Coast	17°00'N-23°00'N 66°00'E-72°30'E
9	40/87	28/12/1987 to 30/12/1987	37-310	Off Cochin for Demonstration Cruise	09°00'N-10°35'N 75°50'E-75°58'E
10	42/88	05/02/1988 to 20/02/1988	60-362	South West Coast and Quilon Bank	08°40'N-10°35'N 75°30'E-78°09'E
11	59/89	21/06/1989 to 29/06/1989	55-101	South East Coast	10°30'N-16°00'N 80°06'E-80°36'E
12	97-A/ 91-92	20/12/1991 to 08/01/1992	60-75	North West Coast	20°13'N-21°08'N 69°21'E-70°52'E
13	103/92	28/08/1992 to 25/09/1992	70-137	North West Coast	18°05'N-22°53'N 67°08'E-70°47'E
14	110/93	08/07/1993 to 29/07/1993	52-340	South West Coast Wadge Bank and Quilon Bank	07°07'N-08°55'N 75°51'E-77°58'E
15	137/95	04/10/1995 to 24/10/1995	68-147	North West Coast	17°54'N-22°31'N 68°00'E-71°41'E
16	143/96	10/06/1996 to 24/06/1996	50-200	North West Coast	17°46'N-18°38'N 70°25'E-73°16'E

In the first twelve cruises, the author was a participating Scientist-in-Charge of fishing gear operations and was Chief Scientist for the last four cruises.

particulars of cruises conducted on board **FORV Sagar Sampada** and the catch composition in Table 1(b). Table 2(a) and (b) give the details regarding pelagic/mid-water/semi-pelagic trawling. Figures 1 & 2 show the depth contour lines of the mainland, continental shelf and shelf areas along the mainland. Fishing trails were conducted all along the Indian EEZ.

Table 1(b) : Fishing gears operated during various cruises and the results obtained with regard to demersal trawling

Sl. No.	Fishing gear operated	Average CPUE (kg/h)	Significant/high catch rates*	Major composition in the order of abundance
1	a) Star Trawl b) Gov Chalute	415.6	Nil	Misc. fishes – mostly uneconomic varieties
2	a) Gov Chalute	150.0	Nil	*Sciaenids*, Ghol, Karkara, Drift fish, Mackerel, Misc. fish, etc.
3	a) CIFT-HSDT-I and II	387.0	2.0 tonnes/h	*Nemipterus* spp., Ghol, Ribbon fish, *Saurida* spp., etc.
4	a) CIFT HSDT-I	212.0	Nil	*Priacanthus* spp., Kalava, Otgher perches, Misc. fish, etc.
5	a) CIFT HSDT-I and II	2301.0	10.0 tonnes/h 6.6 tonnes/h 5.0 tonnes/h 4.0 tonnes/h 2.5 tonnes/h 2.0 tonnes/h 1.0 tonnes/h	*Nemipterus* spp., Barracuda, Kalava, Other perches, *Caranx* spp., etc.
6	a) CIFT HSDT-II	624.0	2.5 tonnes/h 2.0 tonnes/h	*Priacanthus* spp., Barracuda, etc.
7	a) CIFT HSDT-I	645.0	5.0 tonnes/h 3.5 tonnes/h 1.0 tonnes/h	Mackerel, Caranx spp., Sharks, Skates, Perches, Ghol, Eel, Wolfherring, Indian herring, Seer, Misc. fish, etc.
8	a) Gov Chalute b) Expo High Opening Trawl	1550.0	3.0 tonnes/h 2.5 tonnes/h	*Nemipterus* spp., Ribbon fish, Misc. fish, etc.
9	a) CIFT HSDT-III	124.4	Nil	Misc. fish and Deepsea fishes

10	a) CIFT HSDT-III	1800.0	12.0 tonnes/h 10.0 tonnes/h 9.3 tonnes/h 3.0 tonnes/h 2.0 tonnes/h 1.0 tonnes/h	*Chloropthalmus* spp., *Cubiceps* spp., *Centrolophus* spp., *Psenes* spp., *Psenopsis* spp., Deepsea Ribbon fish and sharks, Deepsea shrimps and lobster, etc.
11	a) CIFT HSDT-II	377.0	Nil	Perches, Caranx spp., Mackerel, Misc. fish, etc.
12	a) CIFT 50 m HOT	1303.0	3.0 tonnes/h 2.5 tonnes/h 2.0 tonnes/h 1.5 tonnes/h 1.0 tonnes/h	*Decapterus* spp., *Upeneus* spp., Ribbon fish, *Caranx* spp., *Megalaspis* spp., Perches, Cat fish, Elasmobrachs, Cephalopods, Seer, Barracuda, Leather jacket, *Nemipterus* spp., *Sciaenids*, Ghol, etc.
13	a) CIFT 50 m HOT	812.7	2.5 tonnes/h 2.0 tonnes/h 1.5 tonnes/h 1.0 tonnes/h	*Nemipterus* spp., *Atrobucca marleyi*, *Saurida* spp., etc.
14	a) CIFT 50 m HOT	1064.2	5.0 tonnes/h 4.0 tonnes/h 2.5 tonnes/h 1.0 tonnes/h	Balistids, Perches, *Nemipterus* spp., *Upeneus* spp., Deepsea species, etc.
15	a) CIFT 50 m HOT b) CIFT Bobbin Trawl c) CIFT HSDT-I	316.4	2.0 tonnes/h	*Saurida* spp., *Nemipterus* spp., Perches, Cephalopods, etc.
16	a) CIFT HSDT-II b) CIFT Hybrid Trawl	166.0	Nil	*Priacanthus* spp., *Nemipterus* spp., Perches, *Decapterus* spp., African angel shark etc.

* CPUE of 1.0 tonnes/h and above

Ghol	:	*Protonibea diacanthus*
Kalava	:	*Epinephelus spp.*
Perches	:	*Lutjanus spp., Lethrinus spp.*
Barracuda	:	*Sphyraena spp.*
Karkara	:	*Pomadasys hasta*
Ribbon fish	:	*Trichiurus spp.*
Seer	:	*S. commersoni and S. guttatus*

Table 2 (a) : Particulars of Cruises participated from FORV Sagar Sampada for Mid-water/Pelagic and Semi-pelagic trawling

Sl. No.	Cruise No.	Period of cruise	Depth Range (m)	Area Studied	Lat. And Long.
1	5/85	15/07/1985 to 26/07/1985	82-1530	South East Coast, Wadge Bank and South West Coast	07°06'N-10°20'N 76°24'E-80°39'E
2	13/86	18/02/1986 to 20/03/1986	360-3550	East Coast	10°30'N-19°30'N 80°300'E-868°45'E
3	18/86	07/07/1986 to 27/07/1986	230-750	West Coast – Central Sector	13°04'N-14°28'N 73°09'E-73°43'E
4	19/86	30/07/1986 to 11/08/1986	1500-2250	Lakshadweep Sea	10°30'N-13°30'N 71°00'E-74°00'E
5	21/86	12/09/1986 to 27/09/1986	1472-3718	West Coast – Central Sector	13°52'N-18°59'N 68°29'E-72°00'E
6	38/87	17/11/1987 to 02/12/1987	80-90	North West Coast	19°57'N-20°36'N 70°10'E-70°57'E
7	40/87	28/12/1987 to 30/12/1987	64-65	Off Cochin	09°33'N-10°35'N 75°57'E-75°58'E
8	59/89	21/06/1989 to 29/06/1989	180-190	South East Coast	15°02'N 80°22'E
9	97-A/ 91-92	20/12/1991 to 08/01/1992	64-75	North West Coast	20°21'N-21°08'N 69°21'E-70°31'E
10	103/92	28/08/1992 to 25/09/1992	84-117	North West Coast	21°16'N-21°38'N 68°11'E-68°59'E
11	110/93	08/07/1993 to 29/07/1993	55-70	South West Coast, Wadge Bank and Quilon Bank	07°42'N-09°19'N 75°60'E-77°54'E
12	137/95	04/10/1995 to 24/10/1995	58-85	North West Coast	20°36'N-22°22'N 68°00'E-70°12'E

In the first nine cruises, the author was a participating Scientist-in-Charge of fishing gear operations and was Chief Scientist for the last three cruises.

Table 2 (b) : Fishing gears operated during various cruises and the results obtained with regard to Mid-water/Pelagic/Semi-pelagic trawling

Sl. No.	Fishing gear operated	Average CPUE (kg/h)	Significant/ high catch rates*	Major composition in the order of abundance
1	a) German Rectangular Mid-water Trawl with Round Lindolman otter boards – Pelagic rig	306.0	Nil	Pelagic crabs, Myctophids, Oceanic Squid, Deepsea Shrimps, etc.
2	a) German Rectangular Mid-water Trawl with Round Lindolman otter boards – Pelagic rig	7.2	Nil	Black Ruff, Oceanic Squid, Oceanic Pelagics, etc.
3	a) German Rectangular Mid-water Trawl with Round Lindolman otter boards – Pelagic rig b) Expo Model	1.5	Nil	Oceanic Squid, Oceanic Pelagics, etc.
4	a) Expo-Wing Trawl – Pelagic rig	7.1	Nil	*Cubiceps* spp., *Myctophids*, *Psenopsis* spp., *Psenes spp.*, *Psenes* spp., *etc.*
5	a) Expo-Wing Trawl – Pelagic rig	17.6	Nil	*Priacanthus* spp., Myctophids, Juveniles of Tunas, *Cubiceps* spp., Oceanic Squid, Other pelagics, etc.
6	a) German RMT b) CIFT RMT	4.2	Nil	Pelagics, Jelly, Juveniles of fishes, etc.
7	a) CIFT RMT-Pelagic rig	10.0	Nil	Misc. fish (Pelagics)
8	a) CIFT RMT-Pelagic rig	5.0	Nil	Misc. fish (Pelagics)
9	a) CIFT RMT / SPT with perfect Eco-	1054.7	2.5 tonnes/h 2.0 tonnes/h	Perches, Sciaenids, Ghol, *Caranx* spp., *Decapterus*

	nomy model V-form otter boats – Bottom rig		1.5 tonnes/h 1.0 tonnes/h	spp., *Megalaspis* spp., Ribbon fish, Cat fish, Elasmobranchs, etc. (Mostly demersal fishes)
10	a) CIFT RMT / SPT with perfect Economy model V-form otter boats – Bottom rig	867.0	Nil	*Nemipterus* spp., *Decapterus* spp., *Saurida* spp., Barracuda, Sciaenids, *Sepia* spp., etc. (Mostly demersal fishes)
11	a) CIFT RMT / SPT with perfect Economy model V-form otter boats – Bottom rig	283.0	Nil	Ribbon fish, *Caranx* spp., *Sepia* spp., *Octopus*, *Nemipterus* spp., *Upeneus* spp., Balistids, etc. (Mostly demersal fishes)
12	a) CIFT RMT / SPT with perfect Economy model V-form otter boats – Bottom rig	146.5	Nil	*Nemipterus* spp., *Saurida* spp., *Sepia* spp., *Loligo* spp., Barracuda, etc.

* CPUE of 1.0 tonnes/h and above

RMT	:	Rectangular Mid-water Trawl
SPT	:	Semi-pelagic Trawl
Ghol	:	*Protonibea diacanthus*
Perches	:	*Lutjanus* spp., *Lethrinus* spp.
Barracuda	:	*Sphyraena* spp.
Black Ruff	:	*Centrolophus* spp.

Results and discussion

Deepsea fishing is capital intensive, difficult and risk prone. It has resulted in the over exploitation of inshore fishery resources, over investment and overfishing of target species like penaeid shrimps etc. Unconventional and new fishery resources and their geographical distribution have been reported as mentioned above. As seen from Table 1(b), deepsea fishes are all unconventional and uneconomic varieties, which have no marketing potentials. Exception is deepsea lobsters, deepsea shrimps and stray catches of deepsea sharks. As it is evident from Figs. 1 and 2, the depth contours 200 m and 1000 m are close by and almost parallel all along the mainland. Hence, the wide banks in the deepsea suitable for demersal trawling are limited. This is more evident on

the east coast. That is why there are no well known deepsea fishing grounds on the east coast. Safe deepsea demersal trawling could be conducted in well known ground like Quilon Bank, Wadge Bank and Ponnani Bank on the south west coast of India (Tables 1(a) and Fig. 1).

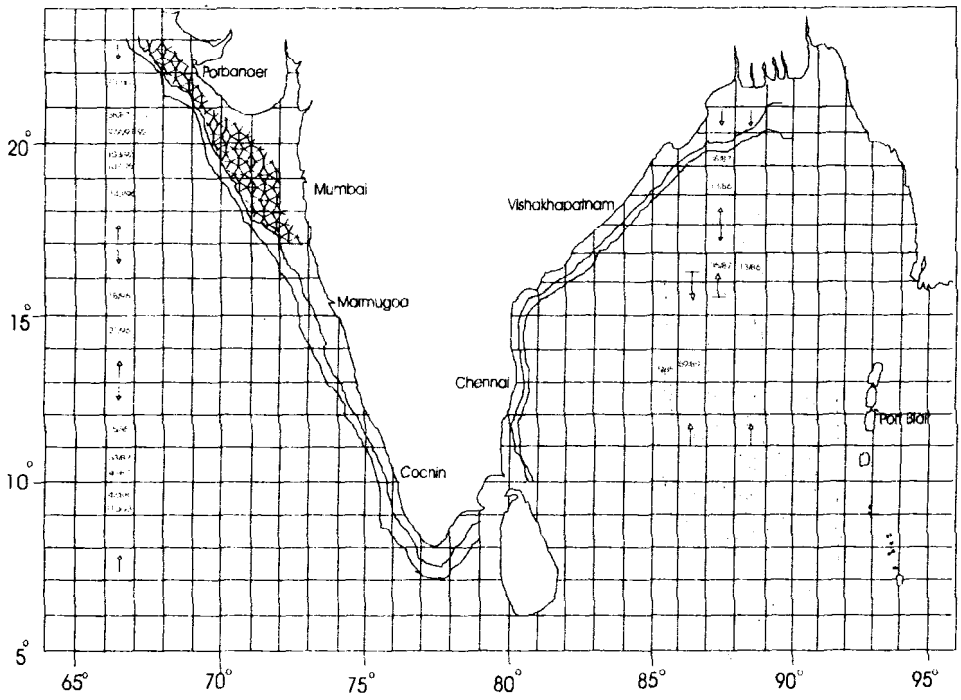

Fig.1 Cruises conducted along the Indian EEZ for demersal trawling

From Tables 1(a) and (b), it is found that fish in deepsea waters of 200 m and more depths were limited in the case of demersal trawling. Reason is due to the unsuitability of fishing grounds as has already been seen from Fig. 1. On the other hand, pelagic/mid-water trawling were conducted with true pelagic rig in oceanic waters as can be seen from tables 2(a) and (b) and Fig. 2.

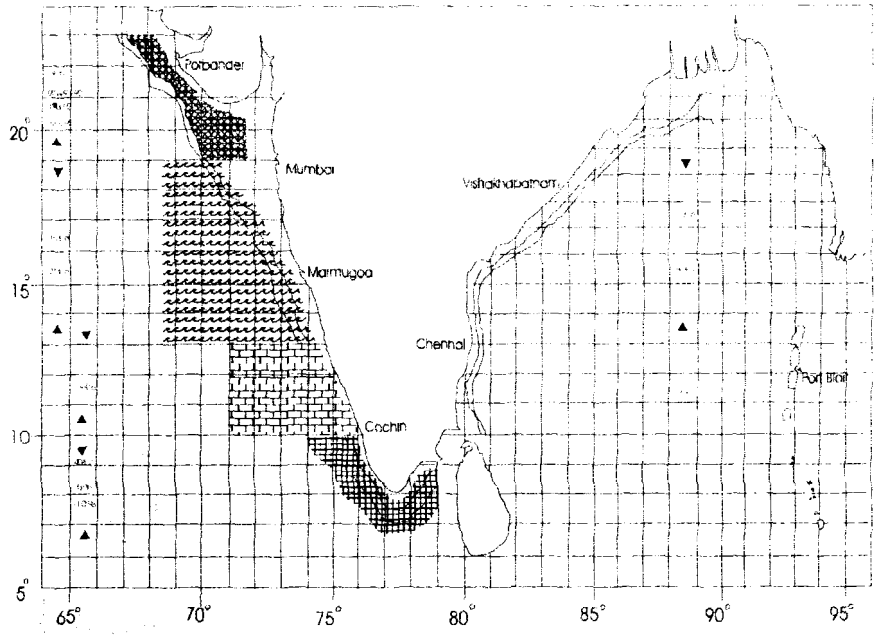

Fig.2 Cruises conducted along the Indian EEZ for Mid-water pelagic and Semipelagic

From the nature of landings, good catch of true deepsea fishes were obtained from Quilon Bank and Wadge Bank area only. Other catches were mainly from 50-200 m depths. Some significant trawl catches with new resources were recorded from north west coast and Wadge Bank (Kunjipalu, 1994(a) and (b)). The geographical distribution of some marine fish along the Indian coasts has been narrated by Kunjipalu (1996) and the abundance of Indian mackerel in demersal trawl has been reported by Mathai *et.al.* (1998) on the north east coast and Varghese *et.al.* (1990).

All types of unconventional and deepsea fishes as reported by earlier workers as mentioned above are also reported in the present communication. Species like *Chloropthalmus, Centrolophus, Cubiceps, Psenes, Psenopsis, Trichiurus auriga* (Deepsea ribbon fish), *Alopias superciliosus* (Deepsea shark), *Echinorhyncus brucus* (Deepsea shark), *Squatina africana* (African angel shark), *Atrobucca marleyi* (African black mouth croaker), Deepsea lobster (*Puerulus sewelli*) and Deepsea shrimps (*Aristeus* spp., *Heterocarpus* spp., *Parapandalus* spp.) were obtained in deepsea demersal trawling (Table 1(b)).

Fishes obtained by true pelagic trawling were very meager in quantity and only insignificant catch rates were recorded (Table 2(b)). Species obtained

were also unconventional and uneconomic varieties such as Myctophids (Lantern fishes) and other mesopelagics like oceanic squids. Following are the species of ocean squids. *Symplectoteuthis oualaniensis* (yellow backed squid), *Ommastrephis bartrami* (Red ocean squid), *Notodarus gouldi* (Gould's squid) and *Sepioteuthis australis* (Southern calamari).

Catches obtained by semipelagic trawling (Table 2(b)) are all neritic species of either pelagic or demersal as semipelagic trawling was conducted with bottom rig and operated well within the continental shelf, most often in less than 100 m depths.

Oceanic resources like oceanic tunas and tuna like fishes and pelagic sharks are the other resources beyond the catch ability of trawls, either demersal or pelagic, can be exploited by tuna purse seining, tuna long lining and high seas gill netting. Squid jigging is another method to harvest oceanic squids. For harvesting mesopelagics like Myctophids (Lantern fishes) and oceanic squids true pelagic trawling has to be operated.

Thus, as we found from the above, true deepsea fishes and other oceanic fisheries resources are under exploited and under-utilised in the Indian Fishing Industry. A concerted and consolidated effort has to be formulated to exploit and utilize the unexploited resources, especially tunas and tuna like fishes, oceanic squids and mesopelagics. In this connection, it may be noted with concern that Srilanka has already entered into a multinational collaboration programme for exploitation of Indian Ocean Tunas.

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