



# Longline Fishing for High Value Species off Southern India with Special Reference to Structural and Operational Changes

P. M. Vipin\*, Renju Ravi, P. Pravin, Saly N. Thomas and Leela Edwin

Central Institute of Fisheries Technology, P.O. Matsyapuri, Cochin - 682 029, India

## Abstract

Longline fishing is a fuel efficient and selective fishing method with low environmental impact. The longline fishing methods of Kerala, Tamil Nadu and Andhra Pradesh are discussed in this paper, based on the studies conducted during 2012-2013. Mechanized vessels of  $L_{OA}$  9.5 to 20 m with 97-250 hp engines are used for longline fishing in this region. Fishing is normally multiday extending from 5 to 40 days. The longline vessel has a crew complement of 6 to 15. Some of the vessels use mechanical or hydraulic winches for hauling the line. The total length of the main line ranged from 15 - 25 km. Longline vessels target commercially important high value species like tuna, marlin, sailfish, seerfish, shark and rays. Structural and operational changes in longline fishing which happened during the last few decades have also been documented.

**Keywords:** Longline fishing, structural and operational changes, Kerala, Tamil Nadu, Andhra Pradesh

Received 18 September 2013; Revised 15 March 2014;  
Accepted 18 March 2014

\* E-mail: vipinpm83@gmail.com

\* Present Address: Central Institute of Fisheries Nautical and Engineering Training, Diwan's Road, Cochin - 682 016, India

## Introduction

Longline fishing is one of the most important commercial fishing method in the mechanized sectors of Kerala, Tamil Nadu and Andhra Pradesh. Longline fishing mainly targets commercially important high value large pelagic fishes like tuna, marlin, sailfish, seerfish and shark. In Kerala,

landings from hooks and lines fishery contribute about 3.3% of the total fishery. Seerfish landings registered an upward trend with 83.3% increase from 2010 to 2011, out of which 54.7% was contributed by longline in Kerala (CMFRI, 2012a). During 2011, 50.8% of elasmobranch catch was contributed by line fishing and grouper contributed about 15% by longline. In Tamil Nadu, 10.6% of seerfish, 1.2% of tuna and 4.2% of elasmobranchs were contributed by hook and line (CMFRI, 2012a). In Visakhapatnam, annual catch of tuna recorded by hooks and lines was 2714 t during 2011 constituting dominant species, *Thunnus albacares* (53%), *Katsuwonus pelamis* (31%) and *Euthynnus affinis* (16%) (CMFRI, 2012a). According to CMFRI (2012b), a total of 29 longliners are operating in Kerala coast, 380 in Tamil Nadu and 21 in Andhra Pradesh during 2010. Increase in demand for "sashimi" grade tuna from international markets combined with improved fishing efficiency through modernisation which increased the endurance of the fishing craft have resulted in extension of fishing activities to distant waters for exploiting hitherto unexploited high value large oceanic resources like yellowfin tuna and shark. Government has also encouraged fishermen to modify the commercial trawlers for longlining, mainly to exploit yellowfin tuna. Yellowfin tuna (*Thunnus albacares*) are harvested at the commercial level mainly by longlines from oceanic waters at depths beyond 300 m while a small proportion is landed by drift gillnets. In the present study, an attempt is made to discuss the existing fishing craft and gear, fishing methods, structural and operational changes that have taken place over the years in mechanized and longline sector of southern India.

## Materials and Methods

Information on vessels, gear, engine, operation and catch composition were collected from fishermen,

net makers, vessel builders and vessel operators using structured questionnaires and templates, during a survey conducted from August 2012 to September 2013, covering main fishing harbours and landing centres of Kerala (Cochin, Kollam and Vizhinjam) Tamil Nadu (Chennai, Kanyakumari and Colachel) and Andhra Pradesh (Visakhapatnam, Kakinada and Machilipatnam) in Southern coast of India. 20% of the total number of longliners from important landing centers of each maritime state was examined. Secondary data were collected from state departments, fishermen cooperative societies and log books maintained onboard fishing vessels. The classification of fishing vessels was carried out using General Classification and Regression Tree (C&RT) model (Breiman et al., 1984) analysis based on  $L_{OA}$  (m), breadth (m), draft (m), material used, engine power (hp), cost of the vessel and fuel consumption ( $l\ h^{-1}$ ) of the registered vessels operated. The design of the gear was documented following Nedelec (1975). Structural changes of longline vessels were compared with findings of Silas et al. (1984); Boopendranath (2000); Jayaprakash et al. (2002); Akhilesh et al. (2011) and Manojkumar et al. (2012). Recent operational changes have been discussed in comparison with documentation by Mohanrajan (1982) and Boopendranath (2000).

## Results and Discussion

Mainly two types of hook and line fishing *viz.*, handlining and longlining are prevalent in Southern part of India. Traditional fishermen use *catamarans* and small scale motorized canoes with length overall ( $L_{OA}$ ) ranging from 3 to 7 m for operating handlines and small scale longlines. The total length of line varied from 200 to 300 m with 10 to 20 hooks, operating at a depth of 25 to 100 m. Mechanized vessels with  $L_{OA}$  of 9.5 to 20 m fitted with 97-250 hp engine are used for multiday longline fishing.

In Kerala and Tamil Nadu, combination fishing vessels *viz.*, gillnet cum longline are used for longline fishing whereas in Andhra Pradesh, trawler-cum-longliner is used where, the fishermen seasonally change the equipments like line hauler onboard so as to carryout lining operation. The length overall of longliners varied from 9.5 to 20 m and are made up of wood, steel and FRP. Longliners were classified into three categories; *viz.*, small (< 12.0 m), medium (12.1- 16.0 m) and large (16.1- 24.0 m), based on  $L_{OA}$ . The deck arrangement of longliners are similar to trawlers except that the longline hauler is fitted on

the port side of forward deck. Longliners in Tamil Nadu have the hauler at the aft deck. Longliners are powered by diesel engines ranging from 97 to 250 hp. On a comparative basis Kerala vessels are larger and hence have engines with higher horse power and thus the fuel consumption also higher. Diesel storage capacity of the vessel also is higher in Kerala compared to Tamil Nadu and Andhra Pradesh. Most of the longliners undertake multiday fishing operations of 5 to 40 days duration. Ice storage capacity of vessels ranged from 6 to 15 t. Total number of crew onboard a longliner varies from 6 to 13. Mechanized longline vessels are equipped with modern electronic equipment such as echo sounder, Global Positioning System (GPS) and Very High Frequency (VHF) sets. The gears are operated from the aft of the vessel and some of the vessels have hydraulic winch for hauling the gear. All multiday longline fishing vessels have fish holds with a capacity 10 to 20 t. Now-a-days, vessels equipped with larger fish hold, freshwater and diesel capacity are used for multiday fishing. Details of structural and operational differences in longline fishing observed in different states are given in Table 1.

The longline consists of a main line to which a number of branch lines are attached. Each branch line is connected to the hook by a snood wire. A schematic representation of longline gear is given in Fig. 1. During longline operation, a total of 700-1000 hooks are operated. The total length of the main line ranged from 20 – 25 km. A swivel is used between the branch line and snood wire to avoid twist. Branch lines are connected with main line by snap clip or by knots. The main line is usually made of polyamide (PA) monofilament material with a diameter of 3-4 mm. George (2009) described that the breaking strength of the main line should be at least 10 times the weight of the largest size of the target species. Breaking strength of the branch lines is about 30% of the breaking strength of the main line and is equal to twice the weight of the largest fish expected to be caught.

The longlines targeting high value deep-water fishes are operated up to 300 m depth or more. Total length of longline ranges from 15-25 km and PA monofilament ( $\varnothing$  3-4 mm) having 500-1000 hooks are operated in southern India. Specifications of longlines used in different states of the southern coast of India are given in Table 2. Buoys and buoy lines are used to position the long line at the appropriate fishing depth. Plastic, HDPE floats of 10

Table 1. Details of longline fishing vessels in different south Indian states

| Particulars            | Kerala                     | Tamil Nadu                 | Andhra Pradesh         |
|------------------------|----------------------------|----------------------------|------------------------|
| Vessel                 | Gillnetter-cum-long liner  | Gillnetter-cum-long liner  | Trawler-cum-long liner |
| Material               | Wood and Steel             | Wood and Steel             | Wood                   |
| $L_{OA}$ (m)           | 13.5-20                    | 12-17                      | 9.5-11                 |
| Engine power (hp)      | 110-250                    | 110-180                    | 97-110                 |
| Fuel consumption (l/h) | 12-18                      | 9-12                       | 8-12                   |
| Electronic equipments  | GPS, Echo-sounder, VHF     | GPS, Echo-sounder, VHF     | GPS, Echo-sounder, VHF |
| Net hauling            | Manual & hydraulic winches | Manual & hydraulic winches | Hydraulic winches      |
| Steering               | Box type                   | Box type                   | Box type               |
| Batteries              | 12 V x 2                   | 12 V x 2                   | 12 V x 2               |
| Dry docking            | Once in a year             | Once in a year             | Once in a year         |
| Fish hold (t)          | 10-20                      | 10-15                      | 10-12                  |
| Ice storage (t)        | 8-15                       | 8-12                       | 6-10                   |
| Diesel capacity (l)    | 1500-6000 x 2              | 1000-3000 x 2              | 800-2000 x 2           |
| Freshwater (l)         | 4000-6000                  | 4000-6000                  | 1000-3000              |

l capacity are commonly used as buoys. Polypropylene (PP) rope of 4 mm diameter is mainly used as buoy line. Bamboo poles with flags are attached to the longline to keep track of the line during daytime. Light buoys serve this purpose during night operations.

Commercially available indigenous and imported hooks of different types and sizes are used for longline fishing according to the target species. The hooks are made of hardened and tempered steel. Normally fishermen use locally available hooks due to lesser cost than imported hooks. Most commonly

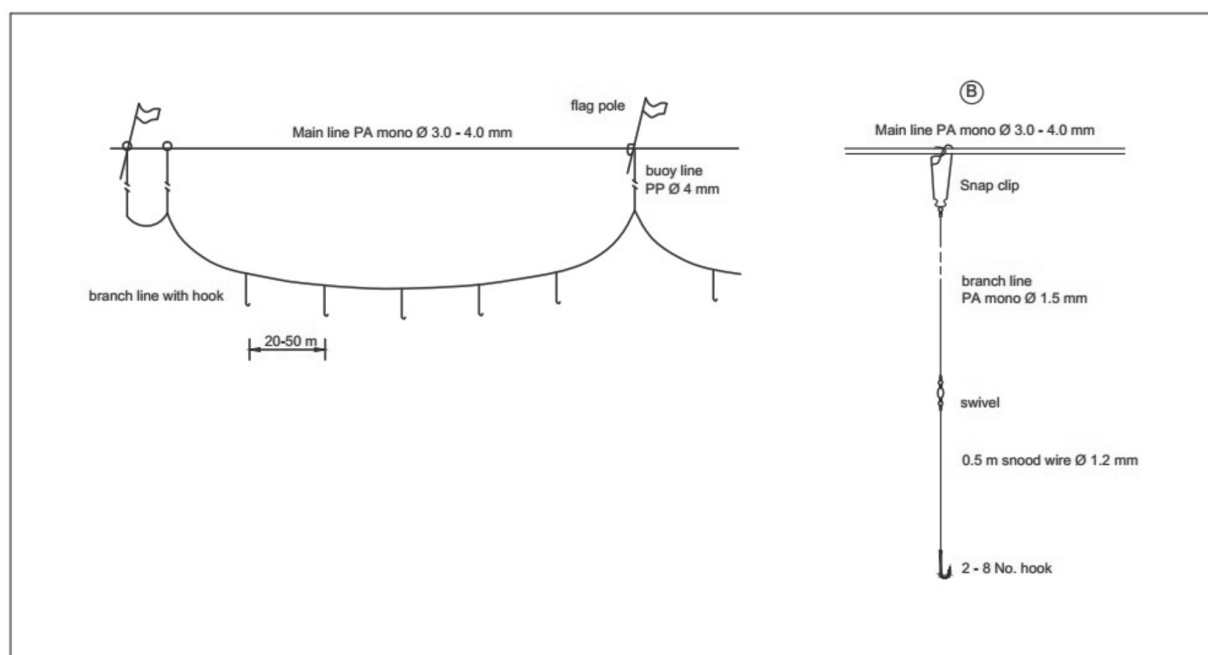


Fig. 1. General structure of a typical longline operated in the study area

Table 2. Specifications of different types of longlines operated in southern India

| Location       | Total length (km) | Number of hooks | Main line material and diameter (mm) | Branch line material and diameter (mm) | Length of branch line (m) | Hook size/Type |
|----------------|-------------------|-----------------|--------------------------------------|----------------------------------------|---------------------------|----------------|
| Kerala         | 20-25             | 700-1000        | PA mono; 3                           | PA mono; 1-1.5                         | 10                        | 2-8; 'J'       |
| Tamil Nadu     | 17-22             | 500-1000        | PA mono; 3-4                         | PA mono; 2.5                           | 3-40                      | 2-8; 'J'       |
| Andhra Pradesh | 15-20             | 500-1000        | PA mono; 3                           | PA mono; 2.5                           | 10-50                     | 4-8; 'J'       |

used hooks are 'J' hook and circle hook. Kumar et al. (2013) studied the effect of hook design on longline in Lakshadweep waters and reported beneficial effect of circular hooks in reducing mortality of bycatch species. The hook numbers 2-8 are commonly used for shark and tuna longlining. Sardines, mackerel and flying fishes are the most common baits used in longline operation. Ice stored baits carried onboard in insulated boxes and live

baits are used for longlining. The lines are operated both during night and day time. Schematic representations of locally available hooks and imported Japanese tuna hook used in longlines are shown in Fig. 2. After reaching the fishing ground, baits are attached to the gear and the lines are released from the aft of the vessel which move forward. The lines are then allowed to soak for 8 to 12 h after which they are hauled up.

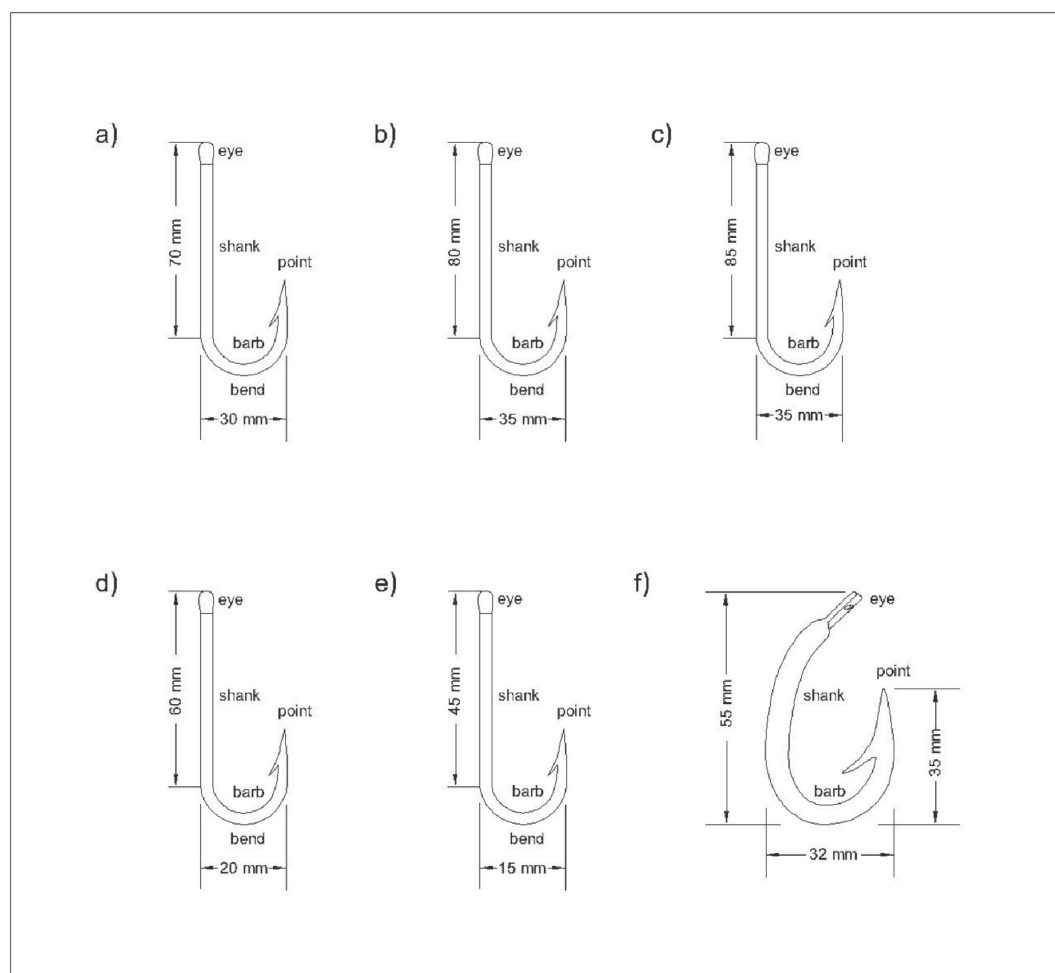


Fig. 2. Schematic representation of locally available hooks (a-e) and Japanese tuna (f) hook used in the study area

Table 3. Structural changes of longline vessels

| Year      | LOA of Vessel (m) | Engine power (hp) | Reference                 |
|-----------|-------------------|-------------------|---------------------------|
| 1960-1980 | 6.2-9.1           | 24-45             | Silas et al. (1984)       |
| 1980-1990 | 9.5-14.0          | NA*               | Jayaprakash et al. (2002) |
| 1998-2000 | 10.0-15.0         | 60-99             | Boopendranath (2000)      |
| 2000-2011 | 9.0 -20.0         | NA*               | Manojkumar et al. (2012)  |
| 2008-2009 | 13.5-20.0         | NA*               | Akhilesh et al. (2011)    |
| 2012-2013 | 9.5.0-20.0        | 97-250            | Present study             |

NA- Not available

Longline fishery in India has a long history in the marine fisheries of the country. In eighties along the coast of Tamil Nadu, tunas and large pelagics were targeted by traditional fishermen using hand lines from traditional crafts. In the mid-eighties chartered commercial longline vessels (Letter of Permit Vessels) were introduced for catching oceanic tunas which witnessed phenomenal growth of catch over the years (Kurien, 1995). The modified mechanized longline vessels mainly targeted yellowfin tuna but, later driven by economic benefits, several of these units diverted their main target from tunas to billfishes and elasmobranchs (Abdussamad et al., 2012) and also shifted their fishing operation to deeper oceanic water by multiday fishing trips (Akhilesh et al., 2011). There have been enormous changes during the last three decades in the structure and operation of longline (Table 3). At the beginning of introduction of mechanized longline/gillnetting off Kerala, fishing craft of 6.17 to 9.14 m  $L_{OA}$  fitted with 24 to 45 hp inboard diesel engine were in use while in the present study, it was found that, the  $L_{OA}$  of mechanized longline vessels ranged from 9.5 to 20 m and are fitted with 97-250 hp engines. This gradual change in size and engine power was based on the requirements for multiday fishing.

Along with structural changes of vessels, significant changes in gear have also occurred in longlining. During the period, 1970-1980, the length of the main line ranged from 1.5 to 2 km with 3mm Ø PP twine having 200 to 250 hooks (Mohanrajan, 1982). Later during, 1997 to 2000, the length of main line had increased up to 13.5 – 16.5 km with 4 to 5mm Ø PP rope having 500 - 600 hooks (Boopendranath, 2000). In the present study, it was found that the length of main line had increased up to 15 to 25 km and 3- 4 mm Ø PA monofilament line was used with

500 to 1000 hooks. Due to the high market demand and resource availability of deep sea fishes, fishermen increased the number of hooks and length of mainline of longline gear.

Longline fishing vessels mainly target sharks and tunas. The fishing area for long lines normally extends from Quilon to Gujarat in west coast and from Tutocorin to Odisha in east coast. Main shark species landed by long liners are *Carcharhinus limbatus*, *C. sorrah*, *C. melanopterus*, *Sphyrna lewini*, *S. zygaena*, *Alopias vulpinus* and *Echinorhinus* sp. Tuna species landed by longliners are *Euthynnus affinis*, *Katsuwonus pelamis*, *Thunnus albacores* and *Thunnus tonggol*. Joshi et al. (2008) has reported that a total of 30 species of sharks belonging to 14 genera and 7 families were landed by longliners at Cochin during the period 2000-2002 and Akhilesh et al. (2011) recorded a total of 25 different species of sharks in southwest coast of India by longline fishing.

Mechanized longline fishing vessels of 9.6-13.5 m  $L_{OA}$  operated during 2000, have been replaced by 9.5-20.0 m  $L_{OA}$  vessels having increased vessel capacities for undertaking multiday deep sea fishing. Increase in fishing capacity in terms of size of vessel, engine capacity, size/quantity of gear and fleet size over the years, indicate the need for monitoring and regulation.

### Acknowledgments

The study was carried out as part of the project “Green Fishing Systems for Tropical Seas” funded by the National Fund for Basic, Strategic and Frontier Application Research in Agriculture (NFBSFARA)” ICAR. The authors are thankful to the Director, Central Institute of Fisheries Technology, Cochin for providing the necessary facilities.

## References

- Abdussamad, E. M., Said K. K. P., Prathibha R., K. K. Joshi., Ghosh S., M. N. K. Elayathu, D. Prakasan, Manju Sebastine, M. Beni and G. Syda Rao (2012) Fishery of yellowfin tuna *Thunnus albacores* (Bonnaterre, 1788) in the Indian EEZ with special reference to their biology and population characteristics. Indian J. Fish. 59 (3): 43-51
- Akhilesh, K. V., Ganga, U., Pillai, N. G. K., Vivekanandan, E., Bineesh, K. K., Shanish, C. P. R. and Hashim, M (2011) Deep-sea fishing for Chondrichthyan resource and sustainability concern-a case study from south-west coast of India. Indian J. Geo-Mar. Sci. 40 (3): 374-355
- Boopendranath, M. R. (2000) Studies on Energy Requirement and Conservation of Selected Fish Harvesting Systems, 273 p, Ph.D. Thesis. Cochin University of Science and Technology, Cochin, India
- Breiman, L., J. H. Friedman, R. A. Olshen, and C. J. Stone. (1984) Classification and regression trees. Monterey, Calif., U.S.A. Wadsworth
- CMFRI (2012a) Annual Report 2011-12. 186 p, Central Marine Fisheries Research Institute, Cochin
- CMFRI (2012b) Marine Fisheries Census 2010 Part-I India. 98 p, Department of Animal Husbandry, Dairying & Fisheries and Central Marine Fisheries Research Institute, Cochin
- George M. P (2009) Line and their operation. In: Handbook of Fishing Technology (Meenakumari, B., Boopendranath, M. R., Pravin, P., Thomas, S. N. and Edwin, L., Eds) pp 213-225, Central Institute of Fisheries Technology, Cochin
- Jayaprakash, A. A. Pillai, N. G. K and Elayathu, M. N. K. (2002) Drift gill net fishery for large pelagics at Cochin - A case study on by-catch of pelagic sharks In: Management of Scombroid Fisheries (Pillai, N.G.K., Menon, N. G., Pillai, P. P. and Ganga U., Eds) pp 155-164, Central Marine Fisheries Research Institute, Cochin
- Joshi, K. K., Balachandran, K. and Raje, S. G. (2008) Changes in the shark fishery at Cochin. J. Mar. Biol. Ass. India, 50 (1): 103-105
- Kumar, K. V., Paresh S. K., Pravin, P., Madhu, V. R. and Meenakumari, B. (2013) Effect of hook design on longline catches in Lakshadweep Sea, India. Indian J. Fish. 60 (1): 21-27
- Kurien, J. (1995) Impact of joint ventures on fish economy. Econ. Polit. weekly, 30 (6): 300-302
- Manojkumar, P. P., Zacharia, P. U. and Pavithran, P. P. (2012) Fishery of elasmobranchs with some observations on the biology and stock assessment of *Carcharhinus limbatus* (P. Muller & Henle, 1839) exploited along Malabar coast. Indian J. Fish. 59 (4): 35-41
- Mohanrajan, K. V. (1982) A success story of development of mechanized boats for shark longline. Sea Food Export J. 16 (8): 1-9
- Nedlec, C. (1975) FAO Catalogue of Small Scale Fishing Gear, 191 p, Fishing News (Books) Ltd., 23 Rosemount Avenue, West Byfleet, Surrey, England
- Silas, E. G., Pillai, P. P., Jayaprakash, A. A. and Pillai, M. A. (1984) Focus on small scale fisheries: drift gillnet fishery off Cochin, 1981 and 1982, Mar. Fish. Infor. Serv. T and E Ser. 55: 1-23