



Chapter 16

Lines: Design and Operation Strategies for Resource Conservation

P. Pravin

Central Institute of Fisheries Technology

Matsyapuri P.O., Cochin - 682 029

E mail: pravin2005@gmail.com

1.0 Introduction

Fishing hooks and lines are among the simplest of fishing gear. Handline, troll line, set line, drift line, pole and line, squid jigging and long lines fall under hook and line fishing. Handline may be defined as a simplest form of hook and line gear consisting of a hand held single line, with rod, weighted, and with one or more hooks spaced along the far end of the line. It is usually employed to take snappers and groupers in the rocky bottom seas. For this fishery each line uses few hooks, each fastened to the main line by a branch line. A weight is attached to the end of the line.

Swivels are used to prevent excessive fouling and kinking of the line. Lines are usually hauled manually and sometimes taken up using rollers fixed on the side of the vessel. The design details of kalava hand line used in India is described here. The main line is made up of nylon monofilament of 2 to 3 mm diameter having a length of 80 to 100 m. At the bottom of the line 7 to 9 branch lines with hooks are attached at a distance of 1 meter apart. The length of the branch line is 45 to 50 cm. The branch line is connected to the main line through swivel to avoid twisting and entangling of the lines. The upper end of the main line is tied to a reel and the entire length of line is wound in the reel. A weight (sinker) is attached to the bottom end of the line during fishing operations which enables the branch lines to reach bottom when released from the reel.

The fishing ground for kalava is located using echosounders which easily demarcates the

rocky bottom and fish shoals. As soon as the fishing ground is located, the hooks are baited and the handline is dropped in the water from the reel. The line is released till the sinker touches the bottom. When the fish bite the bait it can be felt on board and at once the particular line is hauled up and the fish is removed and the hook is again baited and the line is released for fishing. If the fish concentration is more in the area of operations then there may be fish hooked in many or all the branch lines.

2.0 Pole and line fishing

Pole and line fishing is extensively used in the Lakshadweep islands for catching tunas especially skipjack tunas. The bamboo poles of size ranging from 2.4 - 2.7 m in length, about 5 cm at the base and 2 - 2.5 cm at the tip are used. A heavy linen loop is seized to the tip of the pole. A 75 - 90 cm line is fastened to this loop. 60 cm piano wire leader (size 18 to 22) bearing the lure is fastened to this line.

A plain barbless hook is used. When the fish range in size from 15 - 20 kg each, the fisherman fishes individually with his own pole and line. For larger fish the single leader is attached to the lines from two poles are used. For fish over 25 - 30 kg 3 lines are united to a single ring to which is attached a swivel, leader, and single lure. Swinging these huge fish aboard requires utmost co-ordination of the men involved in operations.

On sighting a school of tuna, the vessels slows down and live bait is tossed overboard. If tuna strikes the bait, the boat stops and the fishermen line up on racks hung over the side of the vessel. The squid is used whenever the fish will take it as it saves much time in re-baiting and the hook usually falls out as the fish come aboard.

3.0 Trolling

Fishing with troll lines, baited with artificial lures, popularly known as trolling is an effective and important gear for the capture of pelagic fishes like seer, tuna, skipjack, bonito, etc.

This gear can be operated from small mechanized boats as well as from small sailing vessels without much of alterations in the deck arrangements. Only a limited crew is required for the operation of this gear. Two or three bamboo poles of 8 to 11 m in length are required for the operation of troll lines. 2 to 3 lines can be towed from each side pole and 2 lines from the central pole. The lines can be secured on the pole at a distance of about 1.5 m by way of haul in lines, permanently secured to the poles. The central pole is having 2 lines one just above the deck and the other on the top of the pole. Generally 6 to 10 lines are operated from one boat. The extra lines can be secured on two awning post of the boat or any other part of the boat as convenient.

Nylon lines of 3 mm dia are generally used as main line. The length of line must be 40 to 50 m and they are marked at an interval of 2.5 m in order to ascertain the length of line while in operation.

Haul in lines are used to facilitate hauling of the main line. The specification of these lines is also the same as the main lines. These lines are secured on the poles permanently. Rubber springs are attached to the free end of the line. One end of the spring is attached to the main line and the other end to the haul in line.

No.4/0 corkscrew heavy duty brass swivels are used. The dorsal end of the swivel is attached to one end of the main line permanently by splicing.

Stainless steel wire of 1 mm dia and 1m length is used as snood of troll line. By making a loop on one end of the wire it can be attached to the swivel and the other end to the jig with the hook.

Double hooks are usually used for lines to minimize the escape of fish while operation. Size of hook depends upon the size and species of fish to be caught. Cotton rags, coir fibres, sisal fibres and synthetic material are used as artificial bait for troll lines. But in mechanized fishing the lure used are metal spoons, bone jigs, feather jigs, rubber worm jigs, etc.

Stabilizers or hydrofoil depressors are widely used for coastal fishing. These are used to take the line below the water surface.

On arrival at the fishing ground, the outer most outrigger lines of either side are shot first, followed by the central as well as inner lines attached to the outrigger poles. The lines attached to the central pole must be released subsequently. The length of line paid out should be adjusted so as to reduce the entangling of the lines. When the shooting operations are over, the boat is propelled at a speed of 4.5 to 6 knots. A constant watch must be maintained on the line to observe for any fish striking on the line. On noticing a fish strike at the jig, the speed of the vessel is reduced considerably to reduce the resistance and to prevent de-hooking. Then, the line with the hooked fish is hauled in. After the removal of the fish, the line is shot once again and the operation is continued.

4.0 Squid jigging

Squid jigging as the name implies is for catching squids. Artificial jigs or lures are used and a great variety of jigs have been evolved for this purpose. They consist of a stem made of a sufficiently flexible plastic with one to three rings of sharp, barbless hooks at the lower end.

Stem and hook rings are held together by a steel rod or wire with eyes at both ends for the attachment of the line. One jigging line may carry upto 30 such jigs, which may be of the same or of different colour and shape. Adequate pull and hauling speed of the line are required to prevent the attached squid from disentangling its arms and tentacles from the barbless hooks. Jigging lines are made of polyamide (nylon) monofilament. The line should ideally not be visible and the thinner the line, the better its transparency and efficiency. Jigging is done with single hand line jigs or in serial jigs. Hand operated line reels were introduced first and later automated squid jigging machines were developed. The individual design of squid jigs reflects the practical fishing experience of the fishermen regarding the

reaction of the target species and also regional differences in fishing conditions and availability of materials.

Hand operated jigging reels were developed to increase smooth jigging and catching efficiency and for reducing labour. A winding gear or drum with a handle is used to unwind and haul back the fishing line and for jigging. This facilitates the operation of longer lines with more jigs reaching into deep water. A wire mesh frame with downward inclination toward the boat is placed between the out board roller and the rail to collect the squids which fall off the hooks and guide them into the boat. A simple hand operated jigging reel could be fabricated in local workshops and used in small boats and also multi-purpose vessels. They are also used in large squid jigging vessels along with automated jigging machines for test fishing.

To increase the catching efficiency, automated jigging machines were introduced. It operates two drums one on each of the central power and steering unit. In order to simulate the jigging or jerking movement of line and jigs, the drums have elliptical or oval cross section. The power requirements for one jigging machine are about $\frac{1}{2}$ hp (0.4kW). Electric drive with 220 volts or hydraulic drive also is used. The machine lowers and retrieves the lines from a desired depth at a predetermined speed. A wire mesh frame is positioned in such a way that the squid falling off the jigs after passing over the leading roller slide directly into boxes on deck or to a conveyer system which takes the to the hold for icing or freezing. The automated squid jigging machine enable considerable savings in crew and labour and are indispensable in larger vessels.

5.0 Long lines

Long lining is an efficient fishing method for capture of both pelagic and demersal fishes. The principle of capture is based on the feeding and hunting behaviour of target species and the fish are individually caught and retained by hooks. It is known to be highly fuel-efficient, eco-friendly and size and species selective, compared to fishing methods such as trawling. They are operated from a wide range of vessel classes ranging from small coastal vessels to large automated liners. There are two methods of operation viz., (i) subsurface drift long lines and (ii) bottom set long lines.

5.1 Shark long lines

Shark long line consists of a main line to which a number of branch lines are connected. A hook is attached to the end of the branch line. Other accessories are buoys, buoy lines, sinkers, swivels and connectors, flag poles, light buoys, radio buoys and radar reflectors. In traditional operations, sections of main line with the accompanying branch lines are kept coiled in units known as baskets or held in wooden hangers for ease of handling and storage. In case of monofilament long lines (monolines), the main line is continuous and stored on powered reels.

Main line is made of hard-twisted synthetic materials like polyester (PES), polyvinyl alcohol

(PVAA), polyamide (PA) and their combinations. Breaking strength of the main line should be at least 10 times the weight of the largest size of the target species and that of the branch lines is about 30 percent of the breaking strength of the main line and is equal to twice the weight of the largest fish expected to be caught. Total length of the main line varies according to fishing ground, scale of operations and other considerations.

Branch lines are connected to the main line and the length of branch lines is, generally, limited to less than half the spacing between two adjacent branch lines, in order to prevent entangling. Success of long line fishing greatly depends on the deployment of the hooks correctly in the swimming layer of the target fish.

Branch line consists the branch line proper, sekiyama or secondary leader and is made of three-stranded twisted steel wire seized by cotton twine. Snood wire or leader wire connects the hook to sekiyama or directly to the branch line proper through swivel. It protects the hook from loss due to shark bite. Appropriate hooks size and shape are used. Mean selection length of fish caught is generally proportional to hook size. Hooks used in shark long line are traditional round bent hooks or J-hooks. In India, hook sizes of 1 to 3 are being used for small and medium size sharks and 1/0 to 4/0 for large sharks. Hard plastic buoy lines are used to position the long line at the appropriate fishing depth corresponding to the swimming layer of the target species. Light buoys are used during night operations and Radio buoys and radar reflectors are used in large-scale long line operations.

5.2 Tuna Long Line

It is used as drifting line to catch pelagic fishes. Earlier basket systems were used, but now monlining system has become very popular. Where the entire PA main line (3.5 to 4 mm dia) is taken into a hydraulic drum and PA branch lines (1.5 to 2.0 mm dia) are attached at regular intervals.

5.2.1 Bait type and quality

The species and quality of bait is an important factor for successful tuna long line operations. Live baits give better results as the predatory fish are not interested in dead baits which are motionless. Different types of fishes and cephalopods are used as bait for tunas. Milk fish is very popular as baits for tuna long lining. In India, mackerel, horse mackerel, flying fish etc are commonly used as baits.

Development of artificial baits impregnated with odour components specific for the target species is still in experimental stage. Artificial baits, when they are commercially available, would alleviate the problem of bait collection and maintenance and prevent the use of large quantities of the food fishes and flesh as bait in long line operations. Use of light sticks (cyalume lights), which is known to attract fishes such as sword fish, billfishes and tuna from long distances, could be useful in attracting sharks also.

5.3 Operation of long lines

Long lines are set over stern and hauled over the bow or side forward. A baiting table and chute are generally located on the stern to facilitate shooting operation. Hauling is generally done manually in small-scale fisheries or by using a powered line hauler in the fore deck in large liners. The baited branch lines are attached to the main line as it is released during setting operation. On hauling, the branch lines are removed from main line and stored separately.

Long lines for fishes that feed during daylight are set early in the morning before sunrise and hauled by afternoon. For fishes that feed during night, long lines are operated at sunset and hauled before crack of dawn. Tuna long line operations generally start early in the morning and completed by around 8 a.m. In sub-surface drift operations, on reaching the fishing ground, the anchor, first marker buoy, light buoy and radio buoy with the connected end of main line are thrown overboard at the outset of operations. The hooks are kept baited prior to shooting. The vessel steams at the set course at 3-5 knots during the setting operation. The marker buoys, light buoys and radio buoys are connected at the appropriate intervals. In bottom long line operations, anchors and weights are additionally attached at appropriate intervals and at the end of setting, the final marker buoy and anchor are connected and thrown overboard. After completion of the setting, the vessel drifts in the proximity of line. At the end of soak time of 4 to 5 hours, the lines are hauled in, fishes are removed as the branch line comes up, main line and branch lines are arranged and stored, and accessories are removed and stored.

5.4 Automated long line system

Traditional long lining is a labour intensive and time consuming fishing method. Mechanical and hydraulic line haulers are now widely used in operations. In large-scale long lining, fishing cycle involves working several kilometers of long line with manual baiting, de-hooking of fish, twist removal of branch lines, hook cleaning, bait cutting and handling of baskets. Automatic methods of baiting and setting have reduced the manpower requirements and enabled working of large-scale long lines from relatively smaller vessels than before.

Automated long line system consists of a line hauler with a mechanised method of cleaning the hooks and untangling branch lines from the main line. In some systems, the branch lines are separated and stored on racks or magazines and the mainline is wound and stored on a drum. In other systems, main line with branch lines are stored on drums. While setting, the hooks are baited by drawing through an automatic baiting machine.

6.0 Ecological issues

Long lines are known to catch, snag or entangle many species such as sea turtles, sea birds and fishes other than target species, during operations. There are no foolproof methods available so far to prevent the incidental capture of these non-target organisms, during long line operations.

The practice of shark finning increased dramatically in certain shark fishing areas is another

concern. In this practice, sharks are killed for their fins alone which constitute only 1 to 5 percent of the animal's body weight and the balance 95 to 99 percent of the shark is often wasted. However, this is not a common practice in Indian fisheries.

Biological characteristics such as slow growth, delayed maturation, long reproductive cycles, low fecundity and long life spans make many of the long line resources such as sharks extremely vulnerable to overfishing. Hence, a precautionary approach is essential in the expansion of fishing effort and the shark fisheries need to be managed to ensure their long-term conservation and sustainable use, according to the principles enshrined in the FAO Code of Conduct for Responsible Fisheries.

7.0 Strategies for resource conservation

Optimised hook design and size, selection of bait type and bait size appropriate for the target species and size class, proper choice of fishing ground, depth and time of fishing are approaches for mitigation of bycatch issues in hook and line fisheries and minimize gear interaction with other species. Interaction with sea birds during long line operation are minimized using dyed bait, deploying bird scaring devices in the area where bait is set and by using sub-surface setting chutes, blue dyed bait, weighted baits and side sets were reported to have reduced the by catch of sea birds. Sea turtle mortality can be reduced by using circle hooks in place of conventional J hooks. Setting of tuna long liners at depths greater than 100 m using weighted lines has been reported to reduce by catch of recreationally important fish species and protected species such as seabirds and sea turtles. Magnetic field generated using rare earth magnets in the proximity of hooks has been reported to deter sharks and has been proposed for reducing the bycatch of sharks in pelagic long lines.

8.0 Further reading

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