Long lines and their Operation

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Fishing hooks and lines are among the simplest of fishing gear. In the opinion of some scientists, the hook was the first fishing gear to be used by man. However, regardless of the development of fishing on a larger scale and mechanized fishing with nets and seines, hooks and lines are still very important in contemporary commercial fishing. Hooks and lines contribute about 12% of the world fish landings

The simplicity of hooks and lines is such that it is cheaper to equip ships with these gadgets than with other fishing gear. Compared to towed fishing gears such as trawls, this is low energy fishing gear. More over in many cases hooks and lines are more efficient in catching fish than nets. Large and predatory fish, especially in transparent water, easily escape from nets which frighten them, where as appropriately arranged and set hooks and lines attract them with their bait. Finally, hooks and lines make it possible to fish in places with rocky and uneven bottom, where it is impossible to deploy the most powerful fishing gear, the seine and the trawl. Hook and line fishing is known to exhibit better size selectivity, particularly when the hook sizes are larger. Hook and line fishing also ensure high quality of catch as the fishes are caught individually.

The fishing hooks have the following parts. The shank, ending in a head to facilitate tying the hook. The bend, consisting of two parts – adjacent to the shank and adjacent to the barb. The spear is that part which contains the barb for better retention of the caught fish. The relation between these parts in general and the shape and dimensions of hooks are extremely varied.

The hooks are made of hardened and tempered steel wire under two scales of sizes. The old Redditch scale, of which the finest is 18 works up numerically backwards to size 2, 1 and then 1/0, 2/0, 3/0, etc., towards the largest sizes. The new scale is simpler, starting at the smaller hook size of 0000 or 000 and working up gradually, increasing sizes to 0, 1, 2, 3 and so on. However the length of the shank of different types of hooks bearing the same number usually differs and the thickness of the wire from which the hooks are made is also not uniform.

Shark long lines

Sharks are exploited by a wide range of fishing gears such as long line, pole and line, troll line, gill nets and trawls in the small-scale sector. It forms a significant percentage of the bycatch of tuna long liners. Long lining is an efficient fishing method for capture of both pelagic and demersal sharks. Central Institute of Fisheries Technology has developed shark long lines, based on comparative fishing experiments in the shark rich fishing grounds off north-west coast.

In recent times, as the revenue from fishing operations, particularly trawling, by small and medium size mechanized boats are unsteady and showing trends of diminishing returns, fishermen are in need of diversified methods of fishing with lower operational expenditure. The deployment of mechanized boats for long lining targeted at sharks by fishermen from Thoothur (Tamil Nadu) is noteworthy in this context. The small-scale mechanized gillnetters operated by them conduct shark long line operations, seasonally. When trawling become uneconomical due to scarcity of traditional trawl resources, fishermen along southwest coast often shift to long lining, as a low energy fishing activity with low operational investment.

Long lines are passive fishing gears widely used in both traditional and modern fisheries. 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. Long lines are especially suited to catch scattered and sparsely distributed fish populations.

Types of shark long lines

Based on structure and method of operation long line are grouped into two categories, viz., (i) subsurface drift long lines and (ii) bottom set long lines. Subsurface drift long lines are operated close to surface or middle layers, for pelagic sharks (Fig. 1). Bottom set long lines are operated close to bottom for sharks and other predatory demersal fishes.

Structure of shark long line

Long line consists of a main line to which a number of branch lines are connected (Fig. 2). A hook is attached to the end of the branch line. Other accessories are buoys, buoy lines, sinkers and weights, 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 recently introduced monofilament long lines (monolines), the main line is continuous and stored on powered reels.

Main line

Main line is made of high specific gravity material such as hard-twisted 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. Breaking strength 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 shark expected to be caught. Total length of the main line varies according to fishing ground, scale of operations and other considerations. Each unit of main line may have 5 or more branch lines. In monolines PA monofilament of 2.5 to 4.0 mm Ø is used as main line.

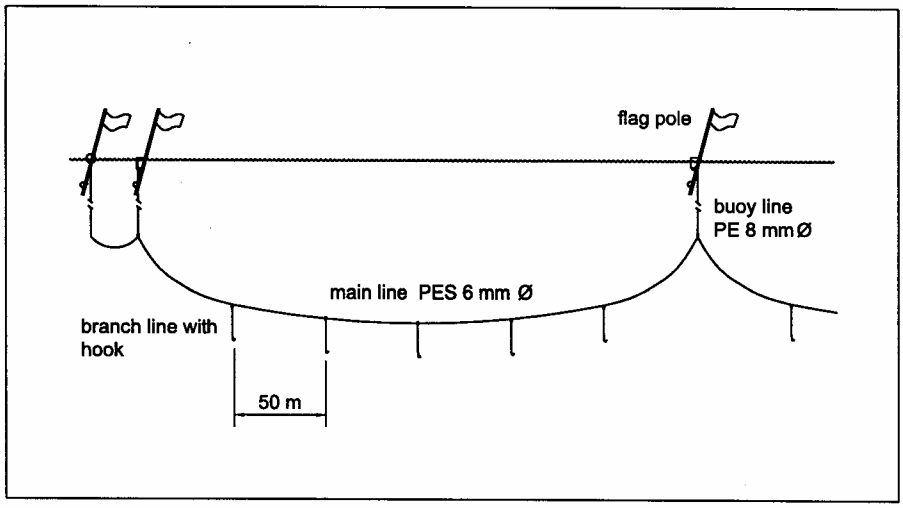

Fig. 1 General configuration of shark long line

Branch lines

Branch lines are connected to the main line at appropriate branch line intervals. Length of branch lines is, generally, limited to less than half the spacing between two adjacent branch lines, in order prevent entangling. Length of branch line for shark long line may vary between 5 and 20 m. Length of branch line together with the length of buoy line and the shape of main line catenary attained during operations determines the fishing depth of hooks. Success of long line fishing greatly depends on the deployment of the hooks correctly in the swimming layer of the target fish. This is done by selection of appropriate branch line length and by adjusting the length of buoy line. Subsurface shark long lines are generally deployed with hooks to operate between 10 and 100 m depth. Bottom long lines for deep-water sharks are operated up to 300 m depth or more.

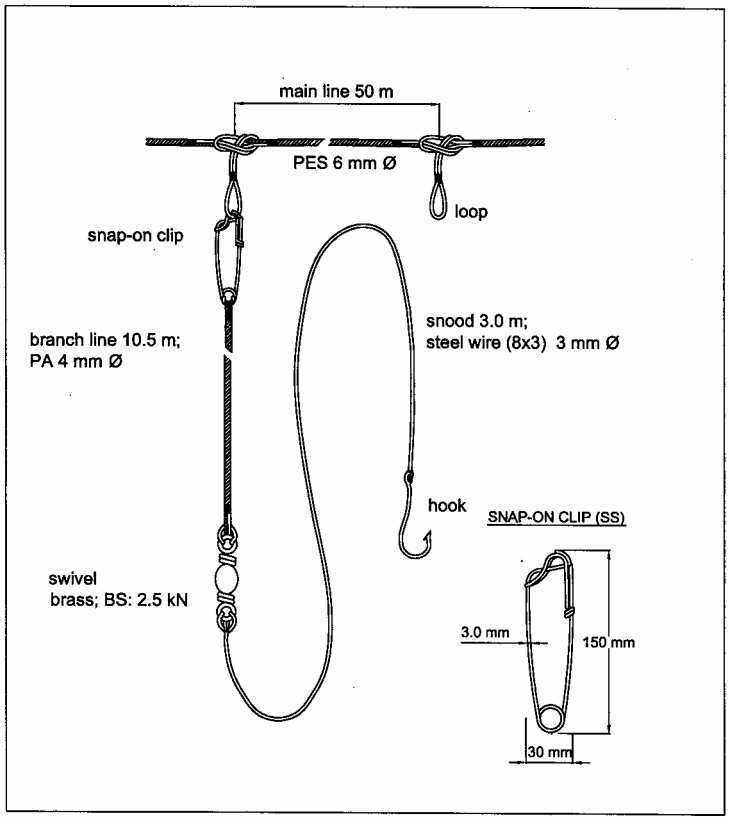

Fig 2. Rigging of shark long line

Branch line interval is determined by taking into consideration the density of distribution of the species, size of the fish and convenience of operation. In subsurface shark long lines, branch lines are widely spaced and in bottom long lines, they are comparatively closely spaced.

Branch line consists of several parts:

Branch line proper (Compound wire)

Branch line proper is usually of the same material as the main line but of lower diameter. The long eye splice at one end is connected to the main line loop by a double sheet bent or more commonly by a snap-on clip. Snap-on clips make it easier to connect and disconnect the branch lines.

Sekiyama (Secondary leader)

Sekiyama or secondary leader may be or may not be present in shark lines. When present, it is connected to the branch line proper through a swivel. Sekiyama is constructed of three-strand twisted steel wire seized by cotton twine. Together with the swivel it has the function of preventing twists, kinks and entanglement.

Snood wire (Leader wire)

Snood wire is made of steel wire and connects the hook to sekiyama or directly to the branch line proper through swivel. It protects the hook from loss due to shark bite. Short lengths of link chain is also used in place of steel wire.

Hook

In long lines, hook size and shape are optimised for the target species and size groups. 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 and variations such as long shank, kirbed and swan neck hooks (Fig. 3). They are manufactured of galvanised iron or stainless steel. In small-scale long line shark fisheries of 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.

Buoys and buoy lines

Buoys and buoy lines are used to position the long line at the appropriate fishing depth corresponding to the swimming layer of the target species. Hard plastic floats, fibreglass floats and large jerry cans are commonly used as buoys. Polyethylene, polypropylene and polyester ropes are used as buoy lines.

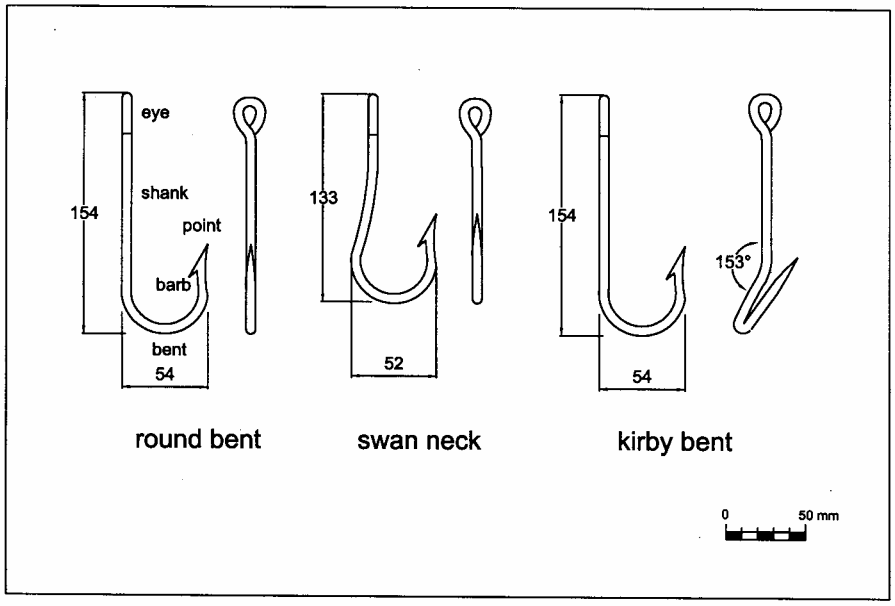

Fig. 3 Profiles of different types of shark hooks

Flag poles, light buoys, radio buoys and radar reflectors

Bamboo poles with bright red or yellow flags are attached to the long line to keep track of the line during daytime. Light buoys serve this purpose during night operations. Radio buoys and radar reflectors are used in large-scale long line operations.

Tuna Long Line

Tunas are highly migratory and predatory species which are amenable to capture by long lines. Important species of tuna caught in long lines are yellowfin (*Thunnus albacares*), big eye (*Thunnus obesus*), skipjack (*Katsuwonus pelamis*), albacore (*Thunnus alalunga*), long tail (*Thunnus tonggol*) southern bluefin (*Thunnus maccoyi*) and northern bluefin (*Thunnus thynnus*). The drifting tuna long line is a sub-surface gear and is generally operated at depths

beyond the reach of other commercial gear. Tuna long line boats generally range from 40 to 1200 GRT in size. The gear usually extends over a distance of 60 to 100 km. Tuna long lining is extensively practiced in Japan, Taiwan, Korea, Indonesia, Cuba and South Africa.

The usual length of each main line section is about 50 m and about 5 or 6 such sections are tied together to form a 'basket' (Fig. 4). Polyester (PES), polyvinyl alcohol (PVAA), polyamide (PA) and their combinations of 6-7 mm dia having breaking strength of about 200 kg are generally used as main line. At the end of each basket, a buoy line is attached which leads to a large float from which the gear is suspended. The length of this buoy line varies according to the depth at which the tuna is found or expected to be swimming. Thus each basket of main line is suspended between two floats and attain the shape of a catenary.

The structure of tuna long line, as in the case of shark line, consists of a main long line carrying several branch lines, the whole being suspended from floats set at appropriate distances along the main line. The length of branch line varies from 20-25 m and consists of branch line proper, swivel, sekiyama, leader wire and tuna hook (Fig. 5). Branch line proper has a length between 12 and 14 m. The material used is the same as the mainline but of a lower diameter. It is attached to the mainline by a snap clip. Sekiyama in a tuna long line is made of 2 mm dia steel wire wound with cotton or polyamide twine and its length varies between 6 and 10m. Snood wire or leader wire made of 2 mm dia steel wire varies in length between1.5 to 2.5 m. Different types of hooks are used for different species of tuna. Light buoys are attached to the float line every 10 to 20 baskets.

Recent developments in tuna long lines are the introduction and expanding use of monofilament long lines where main line used is polyamide monofilament of 3 to 4.5 mm dia and the use of light sticks as tuna attractants.

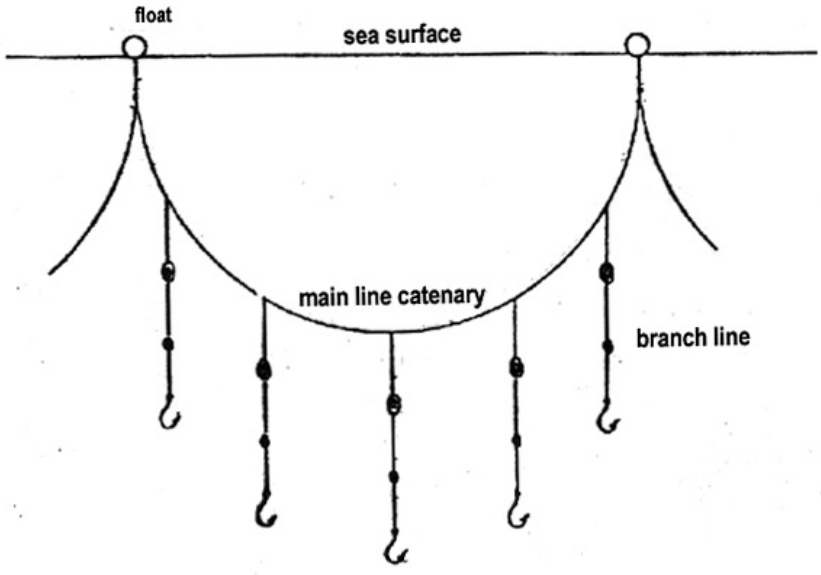

Fig. 4 A unit (basket) of tuna long line

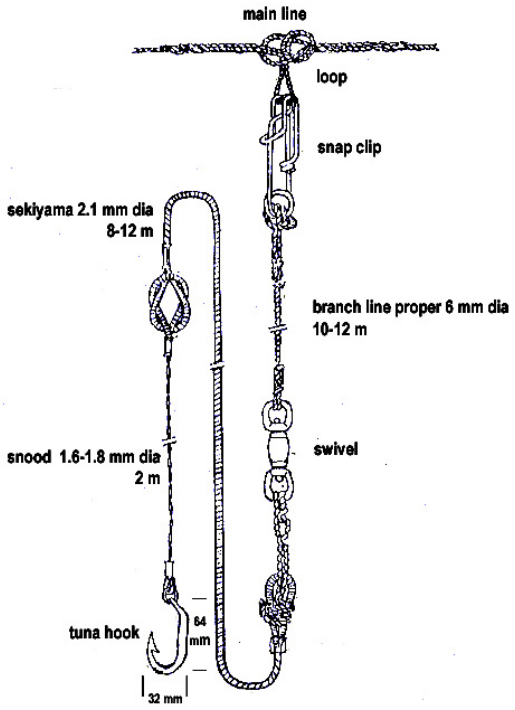

Fig. 5 Details of branch line of tuna long line

Bait type and quality

The best baits are generally those animals on which the fish feed. Predatory fish, the main object of commercial fishing with hooks and lines are keenest on moving bait. When the bait is motionless, the fish in general grasp it very cautiously and even after grasping it in their mouth, they often spit it out when they feel it is inedible, especially if they are pricked by the hooks. Natural baits are considered to be effective fish baits. But procurement of live bait involves many problems. Grasping of the bait varies greatly, not only among different fish species, but also fish of the same species. There are days and weeks when fish do not bite at all, usually shortly after spawning. Hungry fish are less choosy as regards bait.

Bait type and quality is one of the critical factors affecting the fishing success in long line operations. Good bait, which is fresh and has plenty of odour components to form a long plume is necessary to lure the fish from distant locations. Different types of fishes and cephalopods are used as bait for tuna and sharks. Chunks of tuna, dolphin and beef are traditionally used as baits in shark long lines having large hooks.

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.

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.

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 developed and introduced since 1970s, 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.

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 has 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.