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# Long lines for Sharks

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(Indian Council of Agricultural Research)  
P.O. Matsyapuri, Cochin - 682 029

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## Introduction

Sharks (Class Chondrichthyes; Subclass Elasmobranchii) include around 450 species belonging to 35 families. Many of them have a large size ranging from 50 cm to 18 m. They are cartilaginous fishes with placoid scales embedded in the skin and have gill slits. Sharks are distributed from near shore areas to oceanic waters and some of them are straddling stocks. Over 66 species of sharks grace the seas around India.

Shark products (meat, fins, fin rays and bones) have considerable export potential and earned Rs. 355 million in 2000-01 (MPEDA, 2000). Historically sharks have been harvested for their liver, meat, cartilage and hides. World export trade of fresh, chilled and frozen shark meat has increased significantly in recent years. Shark fin, which is an important ingredient in Chinese cuisine, are among the world's most expensive food products. Liver of tiger shark, hammerhead sharks, dog fish and cat sharks have high content of Vitmain A. Oil from deep sea sharks such as Gulper sharks *Centrophorus* spp. and basking sharks *Centorhinus* sp. is rich in squalene, which is used in a wide range of products from bacteriocides to skin moisturizers. Squalamine derived from dogfish liver oil, has been reported to be effective against bacterial and viral infections. Shark hide (*shagreen*) is a highly abrasive material and is used to produce a variety of leather products. Shark cartilage has been reported to be useful in the treatment of chronic and life threatening diseases.

## Shark resources of India

Estimated potential of sharks from shelf is 45,064 t and pelagic sharks off the shelf 25,200 t. Shark landings varied from 25000 t to 48000 t during 1980-2000 with annual average landing of 35000 t. Over 90% of the sharks are caught by Gujarat (50.8 %), Maharashtra (17.4 %), Tamil Nadu (12.0 %) and Andhra Pradesh (10.3 %) (CMFRI, 2002). Commercially important sharks of India are listed in Table 1

**Table 1 Commercially important sharks landed in India**

1.	<i>Alopias</i> spp.	Thresher shark
2.	<i>Carcharhinus albimarginatus</i>	Silver tip shark
3.	<i>Carcharhinus altimus</i>	Big nose shark
4.	<i>Carcharhinus amblyrhynchoides</i>	Long nosed black shark
5.	<i>Carcharhinus amblyrhyncos</i>	Grey reef shark
6.	<i>Carcharhinus amboinensis</i>	Pig eye shark
7.	<i>Carcharhinus brevipinna</i>	Spinner shark
8.	<i>Carcharhinus dussumieri</i>	White check shark
9.	<i>Carcharhinus hemiodon</i>	Pondicherry shark
10.	<i>Carcharhinus leucas</i>	Bull shark
11.	<i>Carcharhinus limbatus</i>	Black tip shark
12.	<i>Carcharhinus longimanus</i>	Oceanic white tip shark
13.	<i>Carcharhinus macloti</i>	Hard nose shark
14.	<i>Carcharhinus melanopterus</i>	Black fin reef shark
15.	<i>Carcharhinus sorrah</i>	Spot tail shark
16.	<i>Carcharodon carcaharius</i>	Great white shark
17.	<i>Centrophorus moluccensis</i>	Small fin gulper shark
18.	<i>Chiloscyllium griseum</i>	Grey bamboo shark
19.	<i>Chaenogaleus macrostoma</i>	Hook tooth shark
20.	<i>Chiloscyllium indicum</i>	Slender bamboo shark
21.	<i>Echinorhinus brucus</i>	Bramble shark
22.	<i>Eridacnis radcliffei</i>	Pygmy ribbon tail cat shark
23.	<i>Eusphyrna blochii</i>	Wing head shark
24.	<i>Galeocerdo cuvieri</i>	Tiger shark
25.	<i>Hemipristis elongatus</i>	Snaggle tooth shark
26.	<i>Iago omanensis</i>	Big eye hound shark
27.	<i>Isurus oxyrinchus</i>	Short fin mako shark
28.	<i>Lamiopsis temminckii</i>	Fawn shark
29.	<i>Loxodon macrorhinus</i>	Slit eye shark
30.	<i>Rhiniodon typus</i>	Whale shark
31.	<i>Rhizoprionodon acutus</i>	Milk shark

32	<i>Rhizoprionodon oligolinx</i>	Grey sharp nose shark
33	<i>Scoliodon laticaudus</i>	Spade nose shark
34	<i>Sphyrna mokarran</i>	Great hammerhead shark
35	<i>Sphyrna lewini</i>	Scalloped hammerhead shark
36	<i>Sphyrna zygaena</i>	Smooth hammerhead shark
37	<i>Squalus blainvillei</i>	Big-eye dogfish shark
38	<i>Stegostoma fasciatum</i>	Zebra shark
39	<i>Traenodon obesus</i>	White tip reef shark

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Source: Froese, R. & Pauly, D. (Eds.) (2001) *FishBase*, [www.fishbase.org](http://www.fishbase.org); CMFRI (2002)

### **Shark long lines**

Sharks are exploited by a wide range of fishing gears such as long line, hook & 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 lines 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.

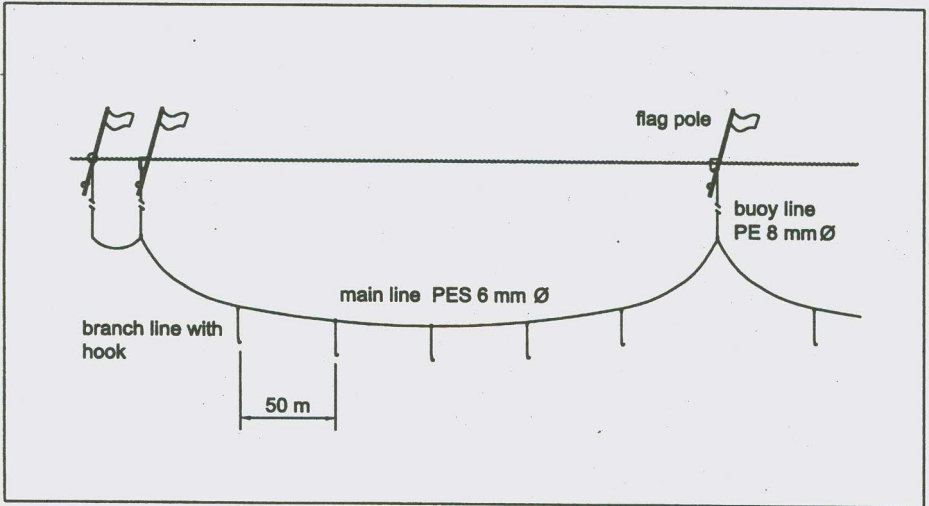


Fig. 1 General configuration of shark long line

### 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,

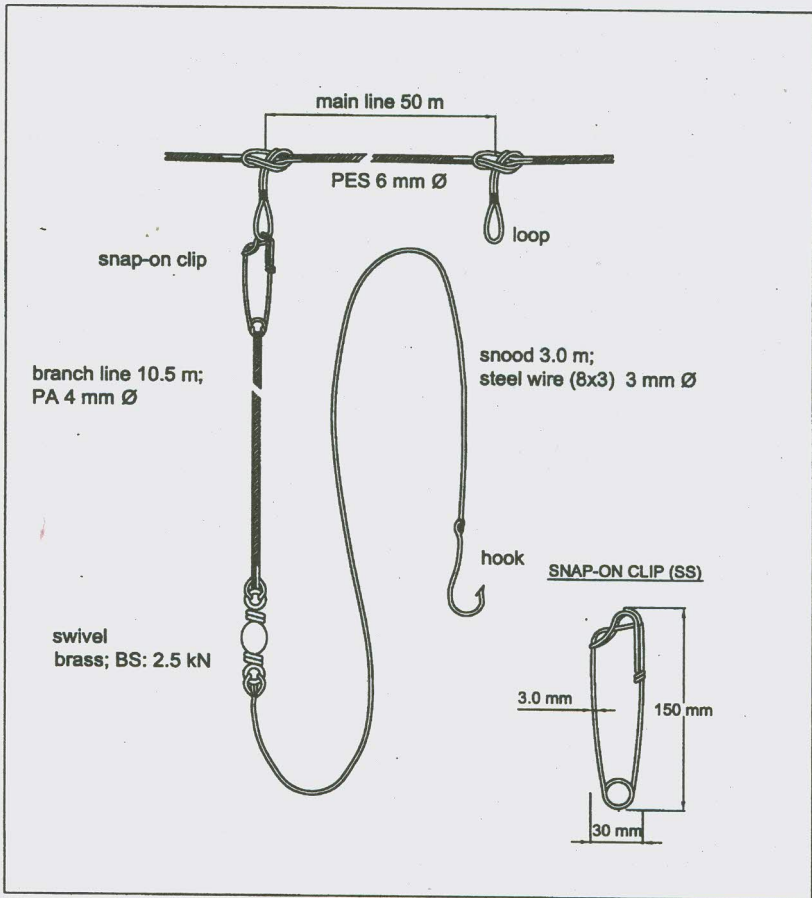


Fig 2. Rigging of shark long line

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.

### **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.

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 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

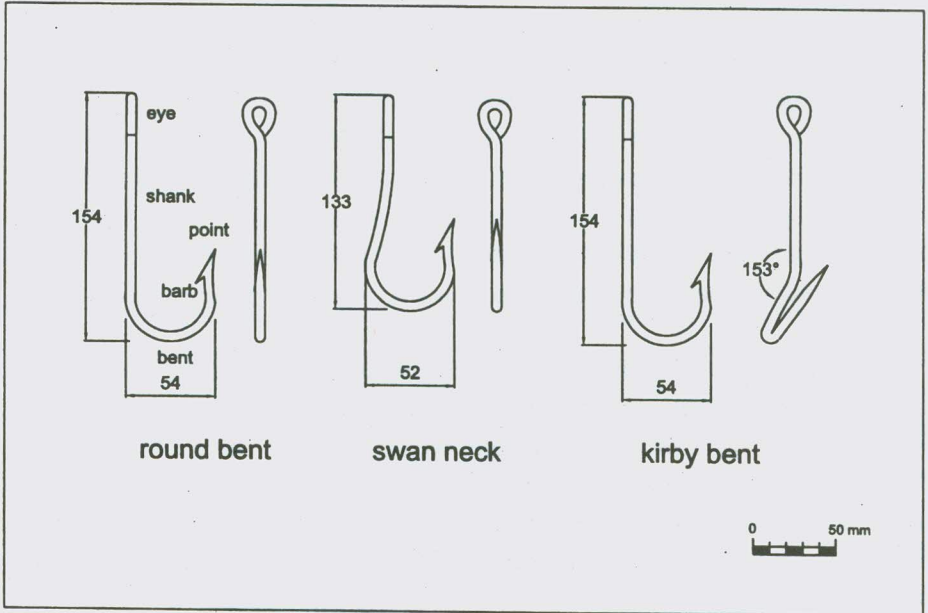


Fig. 3 Profiles of different types of shark hooks

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 and fibreglass floats and large jerry cans are commonly used as buoys. Polyethylene, polypropylene and polyester ropes are used as buoy lines.

## **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 day time. Light buoys serve this purpose during night operations. Radio buoys and radar reflectors are used in large-scale long line operations.

## **Bait type and quality**

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 are used as bait for sharks. Chunks of tuna, dolphin and beef are traditionally used as baits in shark long lines having large hooks. There are reports of the usage of salted fish as bait along Andhra Pradesh coast. Live eel is also known to be an efficient bait.

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 shark 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 sharks that feed during daylight, are set early in the morning before sunrise and hauled by afternoon. For sharks that feed during night, long lines are operated at sunset and hauled before crack of dawn. 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, 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.

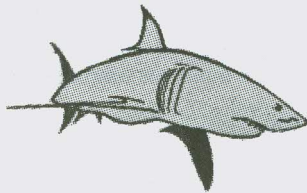
Automated long line system consists of a line hauler with a mechanised method of cleaning the hooks and untangling branch lines from the main line. In some systems, the branch lines are separated and stored on racks or magazines and the mainline is wound and stored on a drum. In other systems, main line 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, which 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 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 principles enshrined in the FAO Code of Conduct for Responsible Fisheries.



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