CHAPTER 3

FISHING OPERATIONS

INTRODUCTION

This chapter describes horizontal tuna longline fishing operations. It covers the steps in deciding where to fish when leaving port, when arriving at the fishing ground, and during the trip. Several sections are devoted to the targeting of the gear, looking at depth of set and the parameters that need to be considered. Setting and hauling the gear are covered in detail, looking at the way both monofilament and rope gear are handled including variations on setting based on oceanic conditions. Common problems encountered in hauling the gear are also described, with solutions presented to assist new entrants to this style of fishing operation.

A. PREPARING FOR A FISHING TRIP

Preparations for a trip actually begin on the previous trip. Good skippers, engineers, and fish masters will begin making notes while they are still at sea, of what maintenance needs to be done and what equipment and gear needs to be purchased. Essential items can be ordered by radio before returning to port. This will shorten turnaround time and make the operation more viable. In addition to the normal pre-departure checklist (Appendix E), the skipper should have checklists of specific items noted from the previous trip.

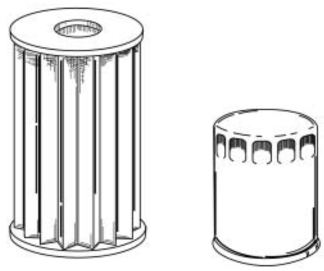
The engine room

Fuel, usually industrial diesel, should be topped up after every trip unless the tanks hold enough fuel for two or more trips. After several trips, the skipper or engineer should know the average daily fuel consumption. Some boats have sight gauges on the fuel tanks or a dipstick, so it is easy to read how much fuel has been used.

If the fuel consumption is not known, it can be roughly calculated using the formula for fuel consumption for a turbo diesel engine running at full RPM: 0.175 litre/HP/h. The actual fuel usage would be less than the calculated fuel consumption because the main engine would not be running at full RPM continuously.

Enough motor oil should be on board to make one oil change on all engines, plus spare oil for topping up the sumps. There should be enough hydraulic fluid to fill the reservoir and system in case all of the fluid is lost, plus some for topping up.

Any engine spares that were used on the previous trip should be replaced. This includes routine items such as oil filters and fuel filters, and parts that are only periodically used such as pump rebuild kits, electric starters, fuel pumps, etc. Spares should also be carried for refrigeration equipment, including refrigerant gas, oil and filters. Spare nuts and bolts, assorted hose and hose clamps, lubricating spray, cleaning rags etc. should also be kept in stock. Lastly, any tools that were lost or broken should be replaced.



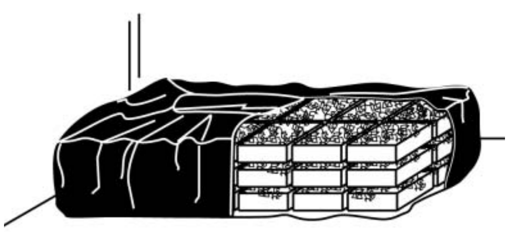
The wheelhouse

There are not many expendable items in the wheelhouse of a typical longliner. However, there are some things that need to be replaced from time to time. These include: paper for recording echo sounders, for the weather fax receiver, for the printer on the Inmarsat-C receiver and PC; fuses and circuit breakers for all electronic devices; bulbs for all lighting; logbooks, catch report forms, pencils, pens and erasers. All electronics should also be tested before departure. Any medicines or first aid supplies that were used on the previous trip, or those with expired dates, should be replaced to keep a good supply on hand. Recording paper, fuses, first aid supplies, etc. should all be stored in watertight ziplock plastic bags, and labelled with a felt-tip marking pen.

The deck

The most important items for the deck on a longliner are ice, bait, replacement fishing gear, and spare parts for the fishing equipment. Ice boats and CSW (chilled seawater) boats need to load ice before departure. Usually enough ice is loaded to fill the holds or bins. In some ports there are no shore-side mechanised delivery systems for ice so transport and labour have to be arranged to coincide with ice purchases.

The amount of bait needed for a trip is fairly simple to calculate. Bait usually comes in 10 kg boxes and the number of pieces is usually marked on the outside of the box. A typical box of saury, for example, contains 120 pieces of bait. If ten sets are to be made using 1200 hooks per set, then 100 boxes of bait would be needed (120 pieces x 10 = 1200 pieces x 10 sets = 12,000 pieces or 100 boxes). Some boats take one or two days' extra bait in case they run out or an extra set is made. Bait can be stored in a fish hold on ice or it can be stored frozen. If the bait must be stored on ice in the fish hold, it is a good idea to wrap the bait in a plastic tarp, with a thin layer of ice between each layer of boxes. If there was bait left over from the previous trip then this bait should be loaded last so that it will be used first. If the bait is to be iced, the ice should be delivered before the bait.



Replacement fishing gear consists of hooks, snaps, crimps, loop protectors, monofilament or tarred red line for branchlines, monofilament for the mainline, batteries for the radio buoys and light buoys, light bulbs for light buoys, mutton cloth, and, for swordfish, chemical lightsticks. Something like five to 10 per cent of the branchline gear may be lost each trip on a medium-scale longliner. If 1200 hooks are set each day for 10 sets, for example, then a sufficient amount of hooks, leader material and crimps will be needed to repair 60 to 120 branchlines. A much smaller percentage of snaps and leaded swivels will have been lost, however, and the mainline on the reel is usually only topped up once or twice a year. Radio buoy batteries usually last for several trips but light buoy batteries, unless they are rechargeable, generally need to be replaced each trip.

Spare parts for the reel and line setter are usually kept on board and are used as needed. If any are used they should be replaced before the next trip. Spare longline blocks and longline block bearings are also essential items. Waterproof or high speed water resistant grease cartridges and a grease gun are also essential for lubricating the fairlead shaft and all bearings on the reel, line setter, and longline blocks.

Numerous miscellaneous spares are needed for the deck including: duct tape, silicone spray, buckets, gaff heads, gaff poles, gloves, brushes for cleaning fish, knives, killing spike, meat saw blades, meat hook, ice shovel, deck brushes, detergent and bleach. Some boats provide foul weather gear and gumboots for the crew. Other boats require that each fisherman purchase his own. In any event, it is necessary that each member of the deck crew have a suit of foul weather gear and a pair of gumboots, especially on ice boats. If any of these items are missing they need to be replaced.

The galley

Longline fishing is hard work and the crews need to be well fed. Providing galley stores for a medium-scale longliner is fairly easy. It is not much different than going to the market for a normal household except it is for all adults and one trip to the store has to last you three or four weeks. If something is forgotten you are out of luck — there are no markets at sea. One easy way to shop is to plan a menu for one week and just multiply everything by three or four, depending on trip length.

Meat should be frozen, but if the boat does not have a freezer, meat can be put in plastic bags and buried in ice in the fish hold, where it will keep for several weeks. Fresh fruit and vegetables can be kept for several weeks if they are properly packed and stowed. One way to ensure that things such as cabbage, lettuce, tomatoes, carrots, and fruit stay fresh is to wrap them in newspaper and store them in a cardboard carton or plastic fish basket in the ice hold, or loosely in a refrigerator. Items such as taro, cassava, potatoes, onions and eggs should be stored in a cool dry place. For longer trips taro can be peeled and frozen. Cassava can be peeled and stored in the ice hold, where it will keep for several weeks. Bread and fresh milk can be stored in the ice hold or freezer. UHT milk or powdered milk is the best choice, as they will keep for several months with no refrigeration.

Besides the normal provisions, a longliner should have emergency rations on hand at all times. The best emergency rations are tinned (canned) foods and dried foods. At least one week's worth of items such as tinned fish, tinned corned beef, tinned spaghetti, tinned fruit, tinned vegetables, rice, biscuits, sugar, coffee, tea, and powdered milk should be stowed in a secure place such as in the skipper's cabin or in a lockable storage cabinet. The emergency rations should only be used if the trip is longer than originally planned for, or if the normal provisions run out or are somehow spoiled. Any of these items that are used on a trip should be replaced before the next trip. The emergency rations should be checked periodically so that expiry dates on tins and packages are not exceeded. When the expiry dates are approaching, the tins or packages should be cycled into the everyday provisions and new emergency provisions should be purchased.

If the boat has a propane gas stove then the gas bottle needs to be checked and filled if necessary. If the boat has an electric stove then at least one spare electrical element for the stove should be on hand.

Fresh water

Prior to departure, the fresh water tank should be filled up. In addition, emergency water should be stored somewhere on deck in plastic jugs. These jugs should be watertight and should be about 85 per cent full. The air space will allow them to float if needed in an emergency.

B. DECIDING WHERE TO FISH: WHEN LEAVING PORT

Once a longliner is loaded and on its way, the skipper has to make some important decisions. At the beginning of a trip he has to decide which direction to go. This decision is usually based on where he fished during the last trip, where the rest of the fleet is fishing, and where there were catches for the same season in the past. Talking to others both on shore and on the radio can yield valuable information. He may also rely to a certain degree on remote sensing data, or satellite imagery, for SST, sea surface colour, or sea surface height.

Note that major shipping lanes are usually avoided, and closed fishing areas should always be avoided.

Talking to other fishermen

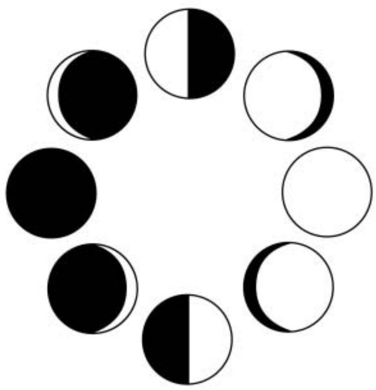
The best source of information about how, when, and where to catch tuna or swordfish is by talking to other longline fishermen. Fisheries scientists learn about fish stocks and fish behaviour by analysing data from satellites, research cruises, and logsheets from fishing boats. The conclusions they come to usually have global or regional significance and may be useful to a commercial fisherman, but only in a general way.

Fishermen who have spent years at sea have learned a great deal about the fish they catch, about the sea and the weather, and about fishing boats and gear — by being directly involved. Fishermen can be independent and are often reluctant to ask others for advice; and some may be reluctant to share their knowledge. However, many fishermen love to chat to anyone who will listen. Talking to other fishermen, either in port or on the radio, is an important part of a good fishing strategy. It also increases safety to know where the other boats are and how they are doing.

Fleet fishing is probably one of the best ways to find fish. Five or six boats searching for fish are much more effective than one boat. Most successful longline operations fish in a fleet. They stay in daily contact and share position and catch information. Several longliners travelling in a general area can find a temperature front (see next section) and chart its boundaries. They can also monitor the movements of fish as catches are compared against positions. Important information such as local weather anomalies and whale sightings can also be shared. Safety is also increased when vessels operate as a fleet. Some fleets report daily to a land base by SSB radio or Inmarsat-C, giving catch data and position. The fleet manager on shore then passes information on to other boats in the fleet, especially those just leaving port.

The moon

Moon phases affect longline fishing. It has been documented that swordfish catches are better on the full moon. Swordfish longliners try to time their departures and travel so that they will be fishing around the full moon. Bigeye catches are slightly better during full moons and bigeye can sometimes be caught in abundance on a full moon. When tuna are targeted, however, the phase of the moon is not generally considered, as the trips are short compared to swordfish trips, and tuna boats do not travel as far as swordfish boats. Tuna longliners usually attempt to keep turnaround time between trips to a minimum, departing when the boat is ready to go, and not on the basis of the moon phase. When the moon is full while a tuna boat is out fishing, however, it may be a good idea not to make any moves but to stay in that area and fish. Tuna usually come closer to the surface during a full moon, so the line should be set shallower and hauling should start later. Some fishermen will say, however, that the new moon is the best time to fish for tuna.



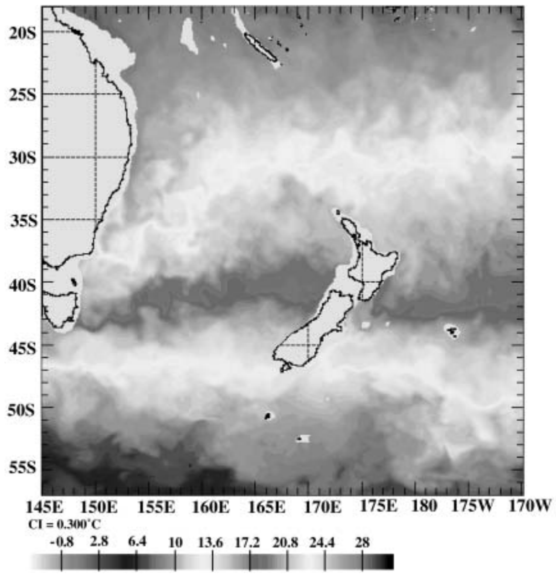
General weather forecast or prediction

The weather prognosis chart should be examined and taken into consideration when setting out on a longline trip. If the prediction is for foul weather then the boat should travel in a direction to avoid the weather or stay close to a safe haven until the foul weather passes.

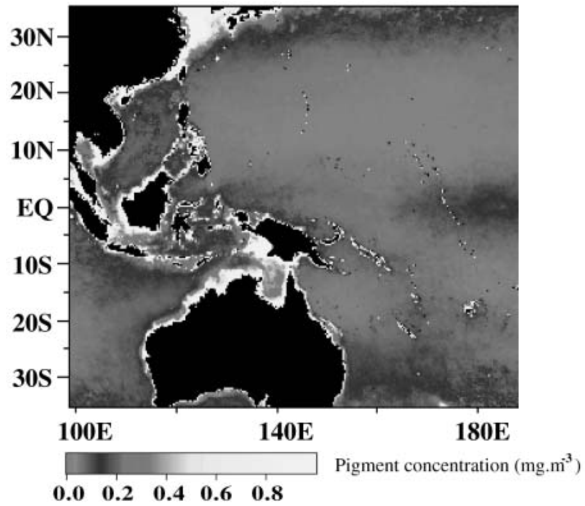
New developments in remote sensing

Tuna and swordfish generally tend to stay within a range of temperatures. Remote sensing data in the form of maps showing sea surface temperature (SST), sea surface colour and sea surface height are useful in deciding where to fish.

SST: maps made from data obtained from satellites have proved to be useful in locating fish. The maps show isotherms — lines connecting points with the same temperature. This can be displayed with isotherm lines or with colour.



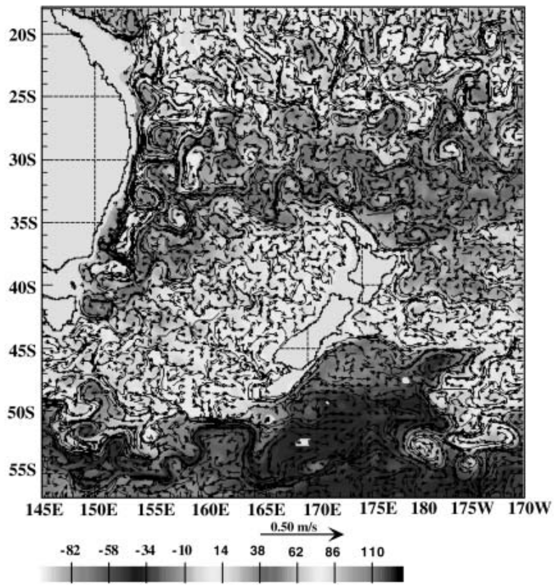
Sea surface colour: is an indication of how much microscopic life (plankton) is in the water. Green colour, for example, indicates the presence of an abundance of plankton. Baitfish and larger predator fish (the target species of longline boats) are likely to be found near areas with green colour.



Sea surface height: maps reveal the presence of currents, fronts, and eddies. Eddies and fronts (see next section) identified by sea surface height maps may be good places to fish.

The sea surface height is measured by radar from satellites. Sea surface height is expressed relative to the average, or mean, sea level, which is called zero sea level. The sea surface height maps, also called altimetric maps, show sea surface height as contour lines connecting points with the same sea level, in much the same way that weather maps show atmospheric pressure.

Concentric contours with high or low sea levels in the centre indicate the presence of eddies, also called gyres. Closely spaced parallel sea level contours may indicate the presence of a temperature front.



Gyres produced by low-level areas (holes or negative anomalies) are cyclonic while gyres produced by high level areas (peaks or positive anomalies) are anticyclonic. Anticyclonic gyres (peaks) spin counter-clockwise in the Southern Hemisphere and clockwise in the Northern Hemisphere. Cyclonic gyres are just the opposite. Usually the peaks are warmer than the holes.

Because altimetric information is obtained by radar, it is not affected by cloud cover. Unlike SST and sea surface colour, altimetric information is available all the time worldwide.

Some SST, sea surface colour and sea level maps are available on the Internet, while others are available for commercial subscribers.

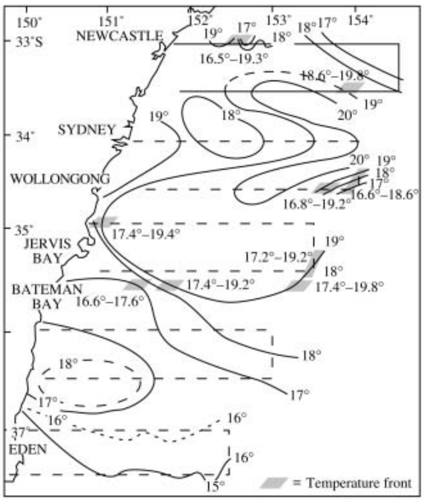
C. DECIDING WHERE TO FISH: WHEN ARRIVING AT THE FISHING GROUND

Once the boat has arrived in the general fishing area, the skipper has to make daily decisions on where, exactly, to set his line. He also has to decide whether or not to move each day, depending on the results from the previous set. These decisions are based on a number of factors.

Temperature fronts

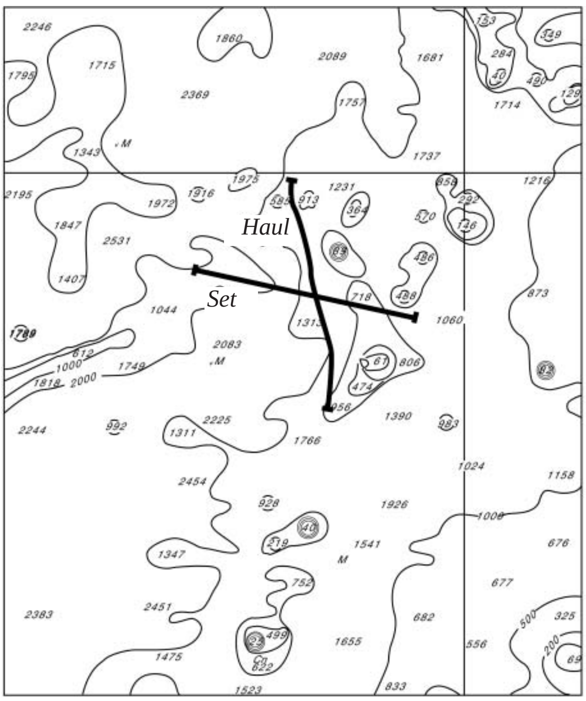
SST is one of the most important environmental parameters that longline fishermen use to determine the location of fish aggregations. Tuna and other species aggregate near sea surface temperature fronts, shown on surface temperature charts as places where isotherms are close together. It may be that the fish are acclimated to a certain temperature range and, thus, seek out water within that range. It may be that forage species — the species the baitfish and tuna feed on — prefer that temperature range. It may be that the temperature front has resulted from a current convergence, and the convergence aggregates the fish. Tuna and broadbill swordfish are usually associated with the warm side of a temperature front.

Charts of SST data from remote sensing satellites are available. Government agencies in many countries provide SST information to fishing vessels and other subscribers. CSIRO in Australia, NIWA in New Zealand, JFIC in Japan, Zoneco in New Caledonia, and NOAA in America all provide remote sensing data. The information can be obtained by fax or on the Internet. Remote sensing charts can be obtained by weather fax two times a week, or in real time using special receivers and software.



SST charts give a general idea of where to find a temperature front. The front must be located by searching and by communicating with other boats in the area. Most longline boats have a SST monitor that has a sensor located on the bottom of the hull and a monitor in the wheelhouse. SST can be read as a number or displayed graphically on an echo sounder monitor.

A front can be seen as a rapid rise or fall in temperature on the SST monitor. Some SST monitors have shear alarms to alert the skipper when a front has been crossed. The change in temperature may range from 0.5º to 2.0ºC. In order to determine the orientation of the front (north/south, east/west, north-east/south-west, etc.) the boat would have to cross over the front in several locations. Once a front is found, the SST chart may be helpful in determining its orientation.



Current convergences

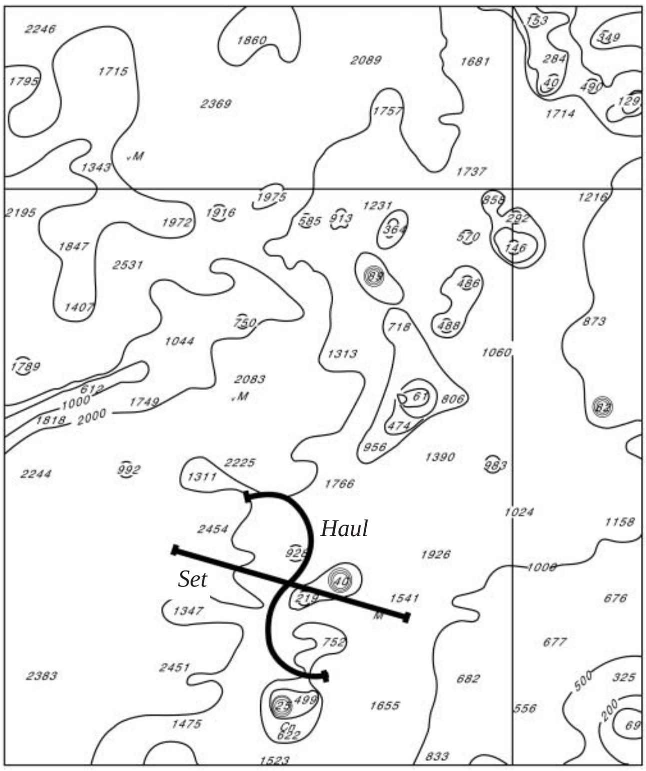
A current convergence occurs when two currents come together, or converge. Convergences can be identified by changes in current direction over a short distance, changes in the sea surface state along a line, changes in water colour (green on one side, clear on the other), flotsam in the water, scum lines (a line of discoloured, foamy water), or rapid changes in SST.

A convergence causes surface water to sink and mix with deeper water. SST fronts are often the result of current convergences, as the two currents may have different temperatures. A current convergence can often be identified on the plotter after the longline has been set and hauled. For example, if one end of a long east-west set drifted north and the other end drifted south during the soak, this may have been due to a convergence.

Generally, the warmer side of a convergence and the side with clearer water are best. If there is flotsam or a scum line then the set should be made on the side without the flotsam or scum. Tuna are sight feeders. They are not usually found in greenish waters near convergences or upwellings, but on the boundaries where the water is clear.

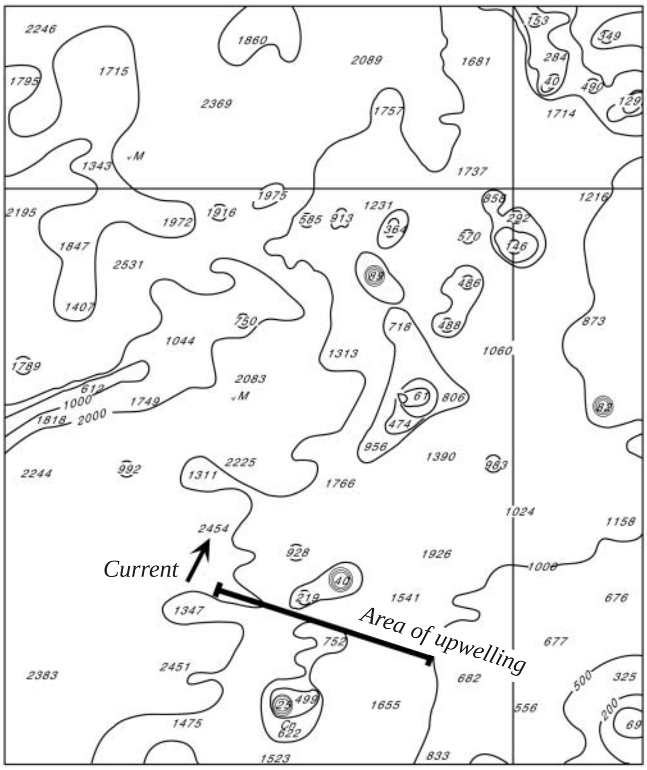
Eddies

An eddy, or gyre, is a spiralling movement of water. Small eddies are caused by currents running through channels between islands or reefs, or over seamounts. They are similar to whirlpools but on a much larger scale. Eddies are usually found offshore of points between the windward and lee sides of islands, reefs, or seamounts — in between the side where the current is striking and the sheltered side.



Eddies can cause mixing of water and can be areas where fish aggregate. They can also be the result of upwellings. Water that rises from an upwelling flows away from the upwelling and turns either left (in the Southern Hemisphere) or right (in the Northern Hemisphere). This produces an eddy. Larger eddies are formed near convergences or where water masses come together. A large eddy may be identified on a surface temperature chart as concentric isotherms with the warmer water in the centre. Eddies can also be identified on sea surface altimetric maps as concentric rings.

A longline skipper may be able to identify an eddy on the plotter after he has hauled a set. An eddy will appear when the hauled longline has an ‘S’ or ‘Z’ shape on the plotter. It is best to set across an eddy.



Upwellings

Upwellings are vertical movements of water caused by wind and currents. A current moving past a shelf or over a seamount will cause bottom water to rise from the depths toward the surface. This deep water is usually cooler than the surface waters and may contain a greater concentration of nutrients than surface waters. Aggregations of baitfish and forage species are often associated with upwellings. Upwellings cannot usually be seen but can be deduced from SST changes or from fish aggregations, and from bottom topography and currents. An upwelling will often occur on the edges of the up-current side of a seamount; that is, the side that the current is striking. As a current carries water toward a seamount the bottom gets shallower. The water has to go somewhere so it rises and moves to either side of the seamount. It is best to set the line so that it drifts into the upwelling.

D. DECIDING WHERE TO FISH: DURING THE TRIP

All available information is considered when choosing the position and direction of each set. This may include: previous catch results, SST, bottom topography, current direction, bird sightings, fish sightings, bait visible on the echo sounder, water colour, proximity to reefs or land, other boats fishing in the area, weather conditions, and wind and sea direction. If dolphins or whales were sighted during the set or if some of the catch was whale damaged, a new fishing area has to be found.

The previous set

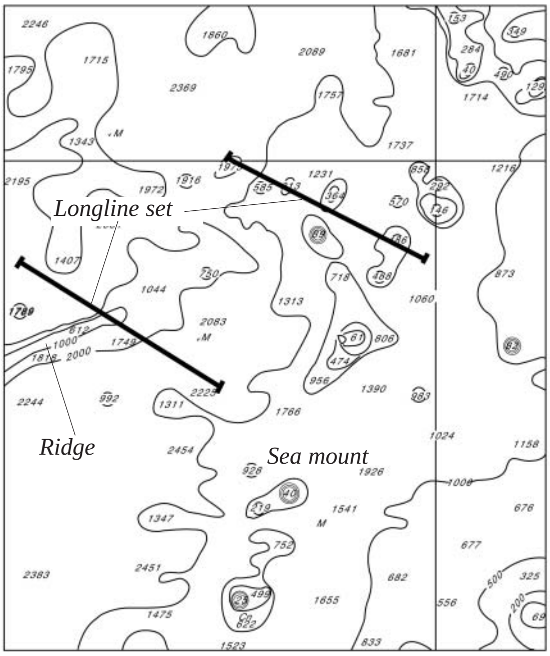
The outcome of the previous set is probably the most important factor in determining the parameters of the next set. Obviously, if the previous set yielded one of the best catches ever, it may be wise to repeat the set exactly. Usually, however, longline fishermen do not set exactly the same way twice in a row. For example, if there were many dead fish on the line of a tuna set and few live ones, this may mean that there was a morning bite and not an afternoon bite. The next day's set might start earlier to take advantage of this. By contrast, if there were more live fish coming up, then the set and haul might start later the following day, taking advantage of an afternoon bite.

If there were more fish caught on the west end of an east-west set, then it would be a good idea to shift the next set to the west. If the line did not drift much because the current was parallel to the set then the next set should be in a different direction. These are all small moves — sometimes bigger moves have to be made. If there was a poor catch or if whales ate most of the catch, it would be time to make a major move and search for fish. Sometimes a vessel has to run for one or two days to find fish or to get away from whales. Typically, a medium-scale longliner will fish two or three days in an area and then move on. It is rare to get lucky and stay lucky for an entire trip.

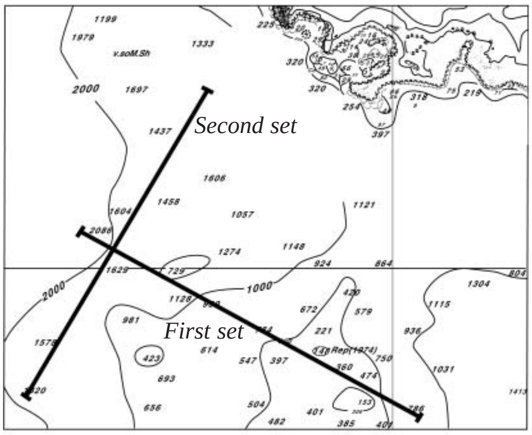
Bottom topography

The seabed has topography much like the land, only on a grander scale. There are mountains, mountain ranges, plains, plateaus, banks, basins, deep trenches, valleys, and canyons on the sea floor. Aggregations of pelagic fish are often associated with bottom topography.

Seamounts, ridges, and isobath curves (a line on a chart connecting places with the same depth — also called bottom contours) are often targeted by longliners. Seamounts are identified on a chart as a cluster of concentric isobaths, with the shallowest ones in the centre. The best way to set near a seamount is to set the line so that the current carries it over the seamount during the soak. This way, advantage can be taken of upwellings and eddies. Often there are aggregations of fish near the summit of a seamount as well. Ridges are similar to seamounts but they are elongated. Seamounts and ridges are good places to target broadbill swordfish.



Setting on ridges and seamounts



Setting on isobaths

If everything else fails, isobath curves on a chart can be targeted. In certain areas tuna are known to be associated with certain bottom depths. If there are no other parameters to go by, the 1000 m or the 2000 m isobath are often targeted. A good way to find out where the fish are is to set perpendicular to the isobaths on the first set. For example, if a set is made crossing the 1000 m and 2000 m curves and fish are found just inside the 2000 m curve, then the next set might be made following a line just inside the 2000 m curve. If the curves are spaced far apart on the chart, the bottom is flat and fairly uniform. If the curves are close together, the bottom is steep and there may be upwellings or eddies associated with it.

Seabirds

Seabirds are the fisherman's friends. Birds are constantly looking for small fish, squid, and other organisms to prey on. Larger fish are also looking for the same small fish and squid, but from the depths rather than from above. If there are birds in the area, there are probably fish in the area. If the birds are in a 'bird pile', actively striking the water and feeding on baitfish, then there is probably a school of skipjack tuna or yellowfin tuna beneath the baitfish, feeding from below. If a skipper is searching for a convergence or a front and he finds birds, he has probably also found the convergence or the front. Often there will be larger tunas under the surface feeding tunas, so setting the gear in association with bird activity can yield good results at times.

Deep scattering layer

Concentrations of planktonic organisms and bait species can sometimes be seen on the echo sounder at depths ranging from 50 to 250 m or more depending on conditions and the time of day. These organisms form a layer that rises at night and sinks back into deeper water during the day. The oceanographers that originally discovered this phenomenon called it the deep scattering layer, because it scatters echo sounder signals.

The deep scattering layer can be picked up on most colour echo sounders. If this layer suddenly becomes more dense on the echo sounder monitor, or if there are red dots or red arches within the layer on the screen, that may mean that there is a high concentration of baitfish in the vicinity, and possibly an aggregation of tuna or swordfish. Red is usually the colour that represents dense material on an echo sounder and arches usually represent fish. If there is an overabundance of forage species and baitfish in an area, the longline bait may not be effective.

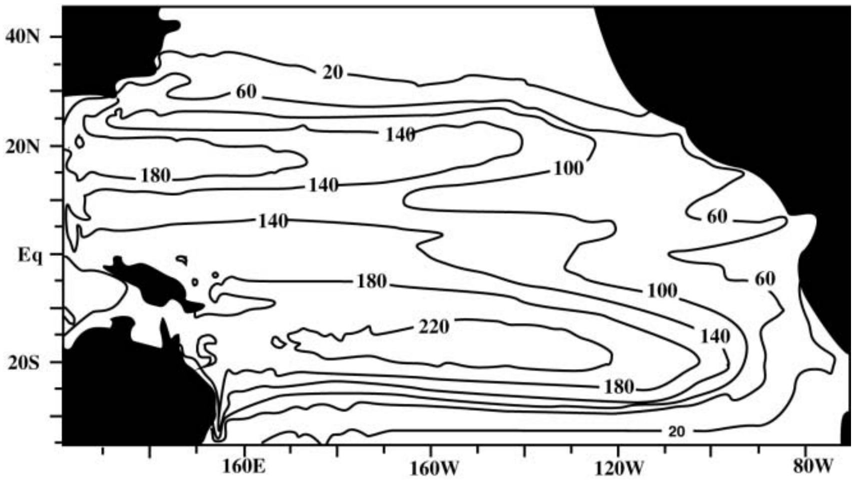
Eavesdropping on other boats

If there are no friendly fishermen in the area, information can still be garnered from other longline operations by eavesdropping. Most skippers and fish masters will not give out position and catch information over public channels — they use Inmarsat-C or coded (secret) frequencies — but if they are broadcasting anything on their SSB radio then a relative bearing to their position can be found using a radio direction finder. If two boats spy on a third using their RDFs, they can triangulate the approximate position of the other boat.

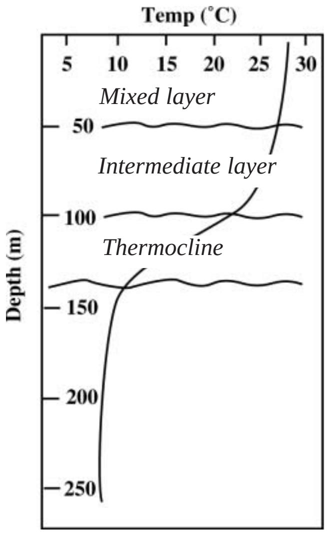
RDFs can also be used to discover positions of radio buoys. While travelling and searching for fish, a skipper can scan the frequency band for radio buoys (1610 to 3000 kHz). This can be done by going up and down in frequency on the tuning dial on the RDF, listening for a beep. Once a beep is picked up, the course is changed to the direction of the radio buoy. After steaming for two or three hours, either the buoy will be found or the other longliner will be spotted on radar. If more than one longliner is spotted there are probably fish in the area.

E. TARGETING THE GEAR: THE SURFACE LAYER AND THE THERMOCLINE

The surface layer is that portion of the water column where the temperature of the water remains fairly constant, or decreases gradually with depth. It extends from the surface down to the thermocline. The surface layer can be divided into the mixed layer and the intermediate layer. The mixed layer occurs from the surface down to where the temperature is 1ºC below the surface temperature. It is mixed by a combination of wind, waves and convection (warm water rises as cooler water sinks). The intermediate layer extends from the bottom of the mixed layer to the top of the thermocline. The temperature drops very gradually with depth in the intermediate layer.



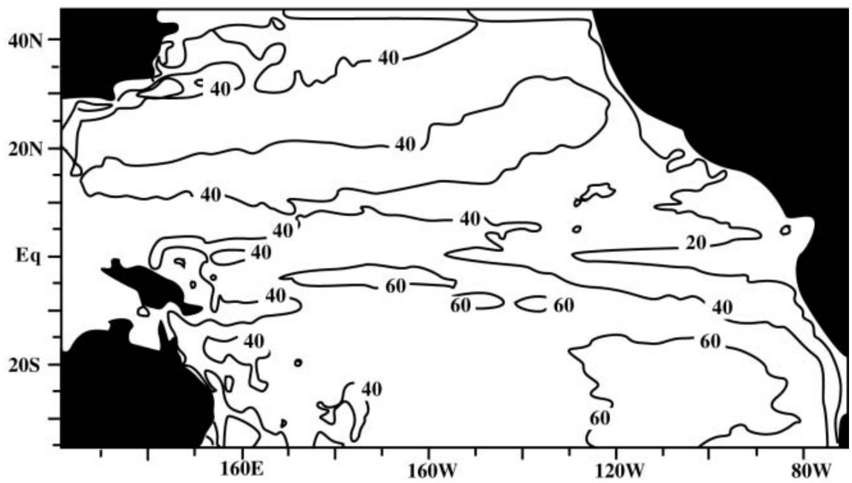
Average depth (m) of the 20˚C isotherm (thermocline) in the Pacific Oceans.



The thermocline is that place in the water column where temperature decreases sharply over a relatively small depth range. In a temperature profile showing temperature against depth, the thermocline shows up as a bend in the graph. The 20˚C isotherm is usually used to define the thermocline.

Yellowfin tuna and broadbill swordfish are associated with the surface layer, and particularly with the mixed layer (Chapter 1 C). When these fish are being targeted the longline should be set so that the hooks fish within the mixed layer.

Bigeye tuna and albacore tuna are usually associated with the thermocline. In fact, the optimum temperature range for catching bigeye tuna is 10º to 15ºC, just below the thermocline. If a boat is equipped with a bathythermograph, or BTG, a new probe should be taken for each new fishing area. Once the depth of the thermocline is established, the gear can be adjusted to target that depth or just below that depth. Most longliners do not have BTGs. The depth of the thermocline can still be estimated, using information from fisheries scientists and oceanographers. In the tropical central Pacific Ocean the depth of the thermocline generally ranges from 80 to 350 m. It is at its shallowest at 10˚N latitude and it is at its deepest at 20˚S latitude. Table 3 gives the average depth of the mixed layer and the 15˚C isotherm at various latitudes in the central Pacific Ocean along the 180º meridian. The depth of the thermocline decreases slightly going in an easterly direction and increases slightly going in a westerly direction.



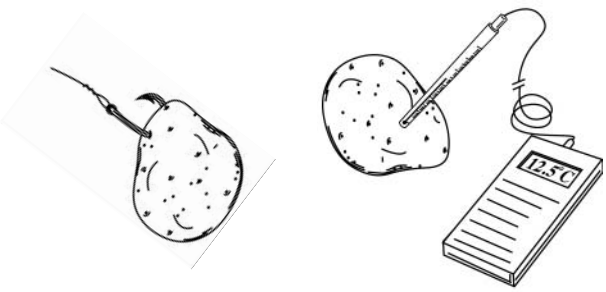
Average depth (m) of the mixed layer in the Pacific Ocean.

Table 3: Depth of the mixed layer and the 15˚C isotherm in the tropical Pacific at different latitudes along the 180˚ meridian

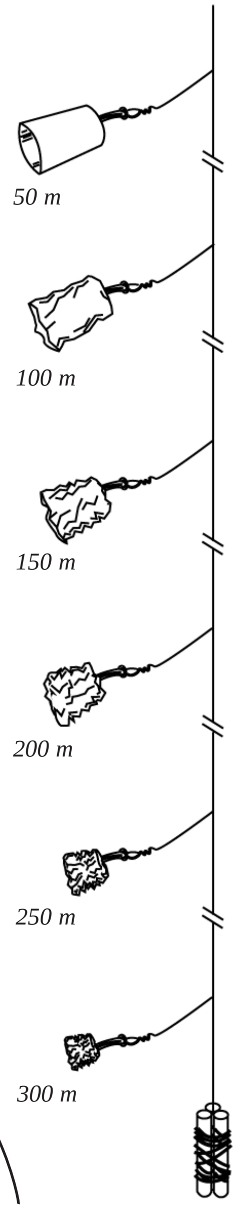
Latitude	Mixed layer (1°C below sea surface temperature)	Average depth of the 15°C isotherm
20°N	near the surface	225 m
15°N	80 m	150 m
10°N	25 m	80 m
05°N	100 m	175 m
Equator	100 m	200 m
05°S	125 m	250 m
10°S	100 m	300 m
15°S	80 m	330 m
20°S	near the surface	350 m

Some tricks for determining temperature and depth

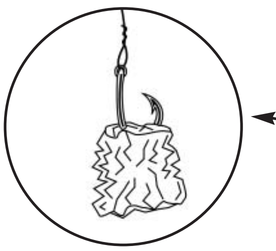
Water temperature at the depth of any hook in a longline set can be determined without the use of expensive equipment. All that is needed is a potato and a thermometer. While setting the gear, a potato is hooked onto one of the branchlines, usually in the middle of the basket. When the branchline with the potato is hauled back later, a thermometer is inserted into the core of the potato. The temperature of the potato core will be very close to the temperature of the water column where the hooks were soaking.

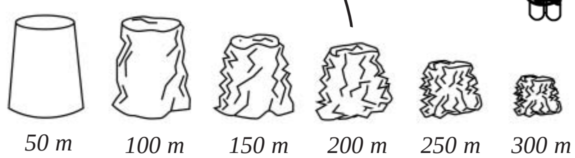


Another way to determine the temperature the gear has reached is to insert a thermometer into an opah as soon as it is gaffed and hauled aboard (tuna are thermoregulators so do not work as well as opah). This should give an indication of the target temperature for bigeye and albacore tuna, as both are often associated with opah.



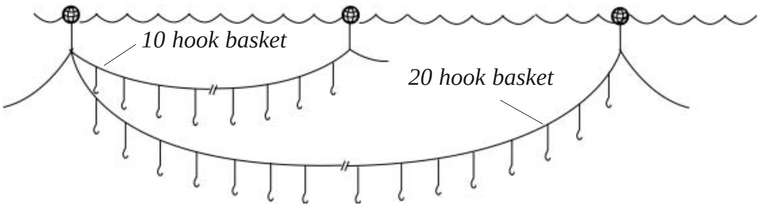
The depth reached by the deepest hook can be determined using a styrofoam coffee cup. First, several cups must be lowered to different depths on a weighted line. The cups will collapse as a result of the water pressure. The deepest cup will come back the smallest; the shallowest cup will be the biggest. They will stay compressed. Several cups can be kept on board as references, showing different depths at 20, 40 or 50 m intervals. While setting the longline, a new cup is attached to one branchline, usually in the middle of the basket. When the cup is hauled back later it can be compared to one of the reference cups to determine the depth it reached.





F. TARGETING THE GEAR: DEPTH OF SET

The depth of the set is important. If a line setter is not used, the length of mainline that goes out is equal to the distance the boat travels during setting. This is called towing the line. A towed line will generally only be as deep as the floatlines. There will be some sag between floats but not nearly as much as when a line setter is used. However, there are ways of achieving a deeper set without the use of a line setter. The gear can be set deeper if longer floatlines are used or if more branchlines are put into each basket. For example, a longline with 30 m floatlines and baskets with 20 branchlines will be deeper than a longline with 30 m floatlines and baskets with 10 branchlines, even though the floatlines are the same length.



Another way to achieve a deeper set is to attach weights to baskets near the middle branchline. There is a risk, however, that too much weight may cause the line to collapse. When a line collapses, the branchlines sink and the floats come together. In the case of increasing basket size or adding weights, floats should be doubled — two floats to a floatline.

The best way to regulate the depth of the set and to achieve a deep set is to use a line setter (Chapter 2 B). A line setter throws out the mainline at a greater speed than the boat is travelling. That way, there will be a curve or sag in the basket, between the floatlines. The branchlines will not be at a uniform depth but most will be at a depth greater than the length of the floatlines. There are several ways to control the depth of a set when a line setter is used.

Calculating the depth of the mainline

A horizontal longline sinks in a series of catenary curves, each suspended between two floats (one basket of gear). A catenary curve is the natural curve formed by a line or cable suspended between two points (e.g. telephone lines between telephone poles). On a longline the deepest hooks are found in the middle of the basket. The curve, or sag, of the line is a function of the speed of the boat, the number of branchlines per basket, and the rate at which the line setter deploys the line. The length of the floatlines and the length of the branchlines also determine depth of the line but these dimensions do not change so can be added on after calculating the depth of the catenary curve. However, the true depth will be less than the calculated depth because of currents pushing the floats together, pulling them apart, or pushing up or sideways on the mainline.

To calculate the theoretical depth of the mainline, you need to know the speed of the boat and the speed of the line being ejected by the line setter. The ratio of these two speeds is called the sagging ratio, or SR, and is a dimensionless number (a number without length, weight or time). SR can also be expressed as the ratio of the distance the boat travels to the length of line ejected by the line setter during the same period. For example, if the speed of the boat is 6 knots and the speed of the line being ejected by the line setter is 8 knots, then the SR is 6 ÷ 8 = 0.75. The same ratio could be derived by comparing the distance that the boat travels between two floats (900 m for our example) to the length of line between the two floats (1200 m) — 900 ÷ 1200 = 0.75. Once the SR is determined, the depth of the deepest hook on the line can be determined.

To know the speed of the boat, you need only to look at the electronic instruments in the wheelhouse such as the GPS or a speed log. Alternately, the speed can be calculated using chart work and the formula, Speed = Distance ÷ Time, or it can be determined by comparing the engine tachometer with known boat speed.

There are several techniques to determine the speed of the line being ejected by the line setter. If a hand held tachometer is available it can be used to determine the speed, in revolutions per minute (RPM), of the large drive wheel of the line setter. The diameter of the wheel is measured and multiplied by 3.14 to obtain the circumference (c = dia x π). A piece of line can also be wrapped around the drive wheel and measured to give the circumference. As the line passes directly over the drive wheel, the amount of line ejected in one minute is equal to the circumference of the drive wheel in metres times the RPM. To find the speed of the line in nautical miles per hour you need to divide this number by 31 (there are 1852 m/nm, 1852 ÷ 60 = 31, or 31m/min).

Alternately, you can allow the line to be ejected from the line setter for one minute exactly while the boat is not moving. The line is then measured as it is pulled back aboard the boat. Divide this number by 31 to get line speed.

Example: during a longline set, the speed of the boat was 4.5 knots and the speed of the drive wheel of the line setter was 250 RPM. The diameter of the drive wheel was 25 cm so the circumference was 78.5 cm (25 x 3.14 = 78.5), or 0.785 m. 0.785 m x 250 = 196.25 m. Therefore the line setter ejected 196.25 m of line each minute during this set. Dividing this number by 31 gives a line speed of 6.3 knots (196.25 ÷ 31 = 6.3).

The ratio between the boat speed and the line speed, in this case, was 4.5 ÷ 6.3, or 0.71, which can be rounded off to 0.7. This is the SR. To obtain the depth of the curve, you can use a table of pre-calculated depths based on numerous SRs and numbers of hooks in a basket. Table 4 gives the theoretical depths for six SRs against five different basket sizes. These depths were calculated on the assumption that the distance between branchlines (and branchlines and floats) is always 50 m. Note: the calculated depths in Table 4 have been reduced by 20 per cent as experience has shown that actual depth is not usually as great as calculated depth.

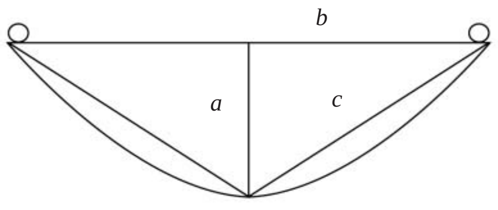
Table 4: Theoretical depths of curve of mainline based on different sagging ratios (SR) and basket sizes (based on 50 m between branchlines and between branchlines and floatline)

Basket size	SR 0.4	SR 0.5	SR 0.6	SR 0.7	SR 0.8	SR 0.9
10	200	190	175	155	130	95
15	290	275	255	230	190	140
20	385	365	335	300	250	185
25	475	450	415	370	310	230
30	570	535	495	445	370	270

Note 1: The calculated depth has been reduced by 20 per cent.
Note 2: Length of floatline and length of branchline need to be added to depth of mainline to give depth of set.

To calculate the theoretical depth directly, you need to know the length of line between two floats and the distance travelled by the boat between floats. Half of the length of the line and half of the distance travelled by the boat each form two sides of a right-angle triangle. The third side is the depth of the curve, and can be calculated using the Pythagorean Theorem — '*The square of the hypotenuse of a right-angle triangle is equal to the sum of the square of the two sides*' — or $a^2 + b^2 = c^2$, where a is the depth, b is half the distance the boat travels between buoys, and c is half the length of line between two buoys.

For example, if the line in one basket is 1050 m long (a basket of 20 branchlines and one float with an interval of 50 m between branchlines, 21 x 50 = 1050), then half of the length of line would equal 525 m, or c. If the boat is travelling at 8 knots during the set (248 m/min: 8 x 31 = 248) and the interval between branchlines is 10 seconds, then during each basket the boat travels for 3.5 minutes (21 x 10 = 210 seconds, divided by 60 = 3.5 minutes) or 868 m (248 x 3.5 = 868). Half of this distance is 434 m, or b. You can now calculate the depth, a, with the formula: $\text{Depth}^2 = 525^2 - 434^2$, or $\text{Depth} = \sqrt{(525^2 - 434^2)}$

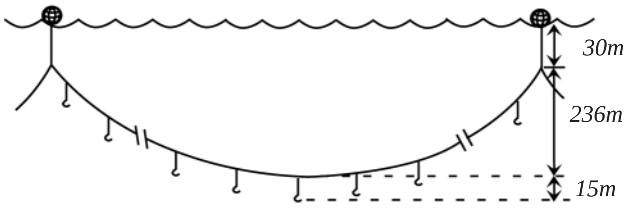


$525^2 = 275{,}625$; $434^2 = 188{,}356$

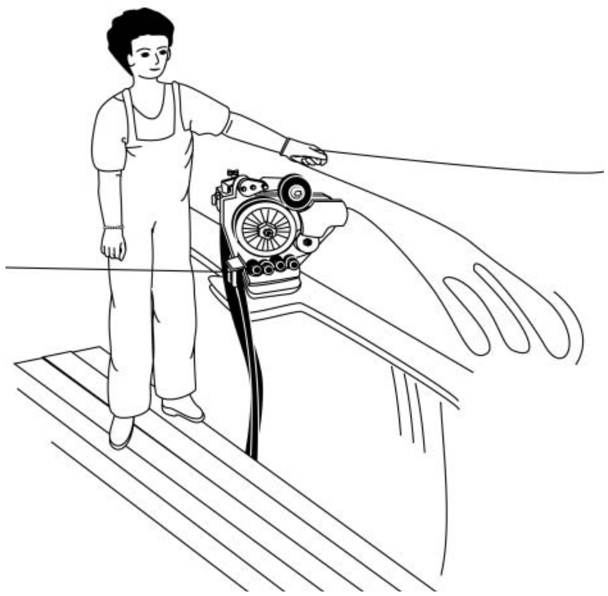
$\sqrt{(275{,}625 - 188{,}356)} = \sqrt{87{,}269} = 295$ m

Experience has shown that actual depths will be about 20 per cent less than calculated depths, so the actual depth in this example would be around 236 m.

The depth of the deepest hook can now be calculated by adding the length of a floatline and the length of a branchline to the calculated mainline depth. For example, if the floatlines are 30 m long, the branchlines are 15 m long, and the calculated mainline depth (less 20%) is 236 m, then the depth of the deepest hook is 281 m.



In lieu of the above methods that all require a certain degree of technology or calculation, there is a traditional method for checking that the line is going deep. As the line is being set, the operator grabs onto the mainline as it comes from the line setter just after a branchline has been snapped on. He grips the mainline and counts seconds elapsed until the line becomes too tight to hold. If the boat speed to line setter speed ratio is too close to 1.0 the mainline will come tight in one or two seconds. As the ratio decreases, the number of seconds lapsed will increase. Experience has shown that a time of about eight seconds for the mainline to come tight is about right when targeting tunas (with a boat speed of about eight knots and baskets with 25 branchlines). This time can be increased or decreased for variation in depth of set and requires some experimentation in all cases.

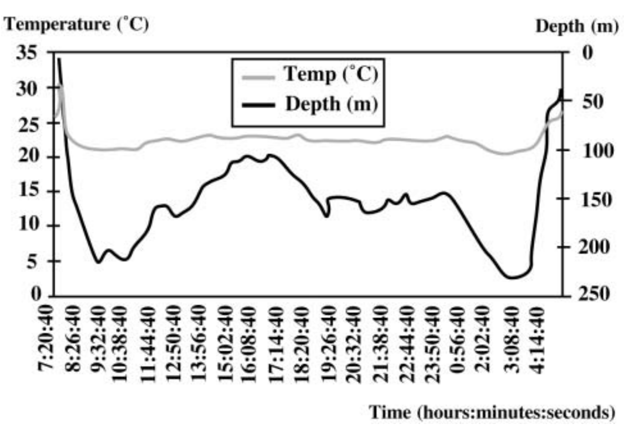


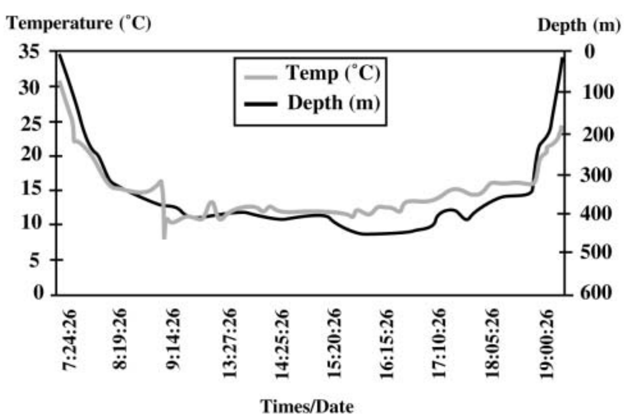
Line setters usually work more efficiently going at their highest speed setting. So for all of the techniques above, it is easier to regulate the speed of the boat rather than the speed of the line setter. Also, the work gets done faster if the line setter is operating at maximum speed, and it would be time consuming to re-calculate the length of line being ejected for different line setter speeds. If you know the length of line when the line setter is going full speed then this calculation does not need to be done again. Boat speed, on the other hand, can be changed easily and a new SR, calculated depth, or hand count of seconds at the line setter can be determined quickly.

Temperature depth recorders

As noted already, the calculated depth of a set does not usually correspond to the actual depth of a set. Currents and current shears move the line sideways or vertically in the water column. For a fisherman, the actual numbers may not be so important. What is important is what works in a given situation. If bigeye tuna are found when baskets have 25 branchlines each, floatlines are 30 m long, and the boat is going at 6 knots while the line setter is going at an equivalent of 9 knots, then that is the right depth to fish.

To determine the actual depth, temperature–depth recorders (TDRs — Chapter 2 H) would have to be used and they are expensive. At the end of the set when TDRs are recovered from the gear, the data are downloaded onto a PC to give a plot of both the temperature and depth of the gear where the TDR was attached.

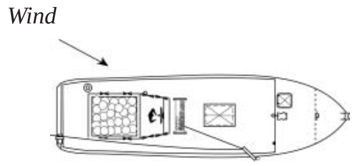




G. SETTING AND HAULING THE GEAR: GENERAL

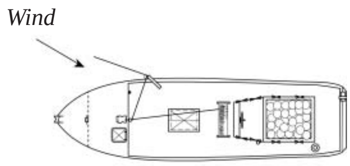
In general, when fishing for tuna, the line is set in the morning sometime around first light (0400 to 0800 hours), and hauled starting in the afternoon or early evening (1400 to 1800 hours). If the line is set too early, much of the bait may be eaten by squid or taken by bycatch species that are night feeders. Tunas tend to bite more at dawn and dusk. This may be because bait is more visible during those times or possibly that is when tuna are making their vertical migrations and they are more likely to encounter the bait. When targeting swordfish, which are mainly night feeders, the line is set starting in the evening (1800 to 2000 hours) and hauled starting in the morning (0600 to 0800 hours).

It is easier to set going downhill, or with the wind, and it is easier to haul going uphill, or against the wind. During hauling, the wind should be kept one or two points (one point is 11.25˚) off the starboard bow as the wind acts like a brake to stop the boat when fish are being pulled in. To ensure that the wind will be on the starboard bow during hauling, the wind should be on the port quarter when the line is set.



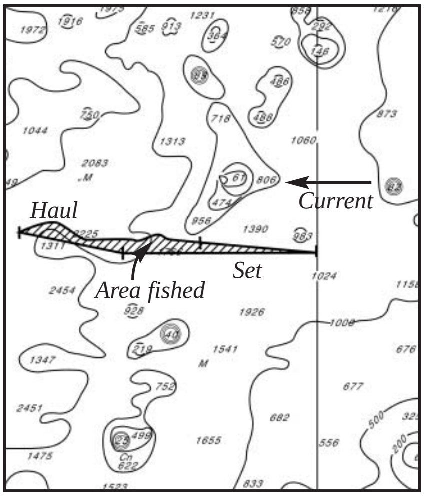
Setting

Usually, the last radio buoy out is the first radio buoy in. This gives the first hooks in the set a much longer soak than the last hooks in the set, but it also gives the crew a chance to rest without having to backtrack to the first buoy. The main reason for hauling the last buoy first, however, is that the line can be set going downhill and hauled going uphill.

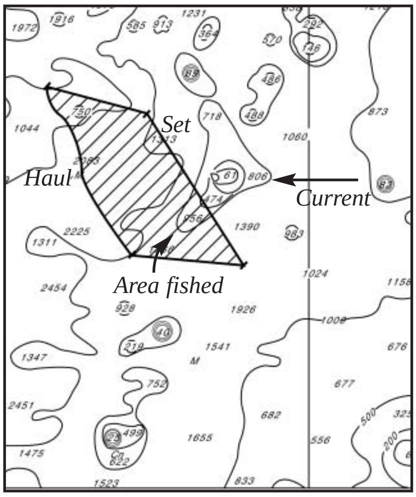


Hauling

Some fishermen backtrack to the first buoy and start hauling with the first buoy of the set. They usually do this to save travel time or to allow all of the hooks in the set to have a more even soak time. Also, it may be a good idea to reverse the line once in a while to spread the wear evenly, as the line closest to the drum gets more compressed than the line on the outside layers.



(a) Set made parallel to current

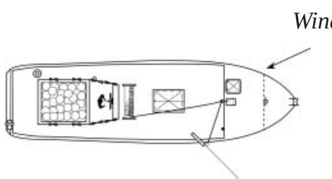


(b) Set made across the current

Ideally, it is better to set the line at an angle to the current. As the line is carried sideways by the current, it will cover a wide area of ocean. If the line is set parallel to the current, it will fish in a narrow band of ocean (a). This cannot always be done when setting downhill and hauling uphill, however. Often the current is running downwind or parallel to the wind. Sometimes a compromise has to be made and the course adjusted accordingly. If the current and wind are parallel then the set can be made so that it is at an angle to both to increase the area fished by the line (b).

It is important to analyse the drift of a line on the plotter after each set has been hauled so that the parameters for the next set can be determined. Currents under the surface often have more influence on the movement of the line than surface currents do, making it difficult to judge the best direction for setting. After the first set is hauled in a new area, movements of the line will be known by looking at the plot of the set compared to the plot of the haul. The next set can then be adjusted so that it fishes the maximum area.

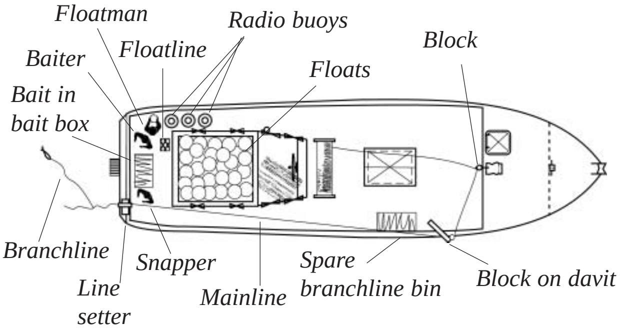
Setting so that the wind is one or two points off the starboard bow during hauling is the ideal situation unless the weather is rough. It is uncomfortable for the crew, especially on a longliner with an aft wheelhouse, to haul going into a strong wind and sea. When the weather is rough it is sometimes better to set so that the wind will be one or two points on the port bow during hauling. To do this, setting is done with the wind on the starboard quarter. This will keep the crew out of the wind and spray. Extra care must be taken, however, not to run over the line during hauling, especially when stopping for fish.



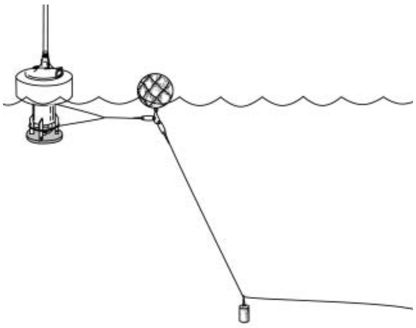
Hauling in rough weather

H. SETTING MONOFILAMENT GEAR

To start a set, the bitter end of the monofilament mainline is routed from the reel to the stern of the vessel, usually through one or more blocks, so that it exits the reel at a 90˚ angle and is routed around any obstacles. If a line setter is being used, the mainline should be entering the line setter at a 90˚ angle as well. The mainline is passed through the line setter and a loop is formed in the bitter end using a figure of eight knot.



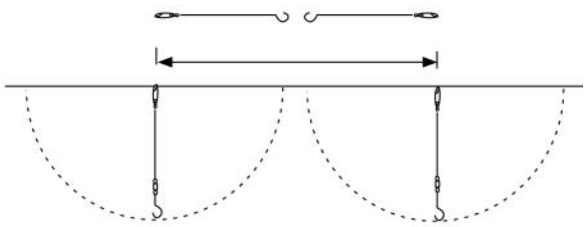
After the boat is underway and the course and speed have been set, the first radio buoy, which is attached to the loop in the bitter end of the mainline, is turned on and thrown over. Usually a float or a float and flagpole is attached as well so that no weight is placed on the radio buoy and it will be easier to find visually. As the boat steams away, line goes out over the stern or out of the line setter. The first basket should be empty — that is, no branchlines attached.

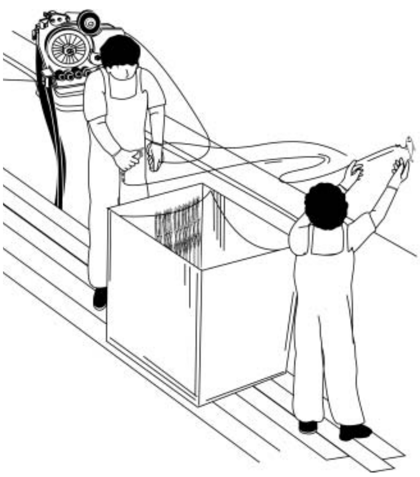


Some longline skippers like to attach weights at each end of the mainline about 30 m or so from the radio buoys. The weights sink the first 30 m of mainline — about the same length as a floatline — so that it does not lie on the surface. Otherwise, another boat passing close to the radio buoy might run over the mainline. This also makes it easier to approach the radio buoy before hauling starts. The beginning portion of line is not always lying in the same direction that it was set and it is almost impossible to see the mainline in the water. Without an end weight, a boat might run over its own line.

Floatlines with floats and baited branchlines are snapped on at appropriate intervals after the first empty basket has gone out. When hauling, the easiest way to remove snaps is to pull them down, away from the moving mainline; therefore, it is best to snap them on upside down. One way to do this is for the snapper, the man snapping branchlines onto the mainline, to turn the mainline around with his hand before he snaps on the branchline or floatline.

The spacing used for tuna sets is usually about 40 to 60 hooks/nm, and 15 to 30 hooks per basket. At 40 hooks/nm of mainline the interval between hooks is about 50 m — or about 7 to 9 seconds on the setting timer (Chapter 3 I), depending on boat and line speed. The branchlines need to be far enough apart so that they cannot tangle with each other, and so that during hauling one can be coiled before the next one comes up. An average setting rate is 400 hooks per hour. At that rate, it would take five hours to set 2000 hooks.





For safety it is important that the snapper coordinate his movements with the person throwing bait, the baiter. He should not snap on a branchline until the baited hook has been thrown, even if the setting timer has sounded a beep. If the branchline is snapped onto the mainline before the baiter throws the baited hook, he may get hooked as the branchline comes tight. The easiest remedy for a fouled branchline is to cut it. It is very dangerous to try to pull the mainline and snap back onto the boat while the boat is moving. If several branchlines get tangled in the branchline bin, it is best to remove them all and give them to someone else to sort out. If too much time is wasted with tangles there will be empty portions on the line and fish may be missed.

Note: a knife or a pair of wire cutters or monofilament cutters should be kept near the line setter at all times while setting, in case a branchline or hook gets fouled.

The setting process continues until all of the hooks are in the water. Another empty basket of mainline (no branchlines) is set at the end. Then, either the end of the line is detached from the reel, or the mainline is cut; a figure of eight knot is tied to form a loop, and the last radio buoy is attached, turned on and deployed. It is helpful to have a flag buoy or a large red inflatable float snapped on near the radio buoy to make it easier to locate.

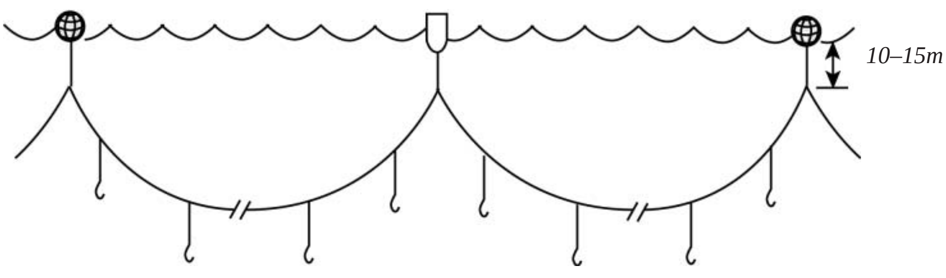
An autopilot is very useful for setting — the skipper can concentrate on monitoring the vessel electronics and on recording data in the logbook. The skipper can also use this opportunity to talk with the rest of fleet. He can also help on deck if necessary as long as he continues to keep a watch. A longline set with an autopilot will be straighter than a longline set by hand steering.

Using a line setter with a reel system

There are at least three ways a line setter can be used with a reel. One method links the reel hydraulically to the line setter with a sensor line. The hydraulic motor on the reel acts like a brake and keeps just enough tension on the mainline to allow the line setter to pull line off without it going too fast or causing a backlash. This system has some inherent problems. Adjustments need to be made two or three times during setting as the diameter of the line on the reel decreases, and there is considerable wear on the rubber parts of the line setter — the drive belts and wheels. Another method utilises the reel motor to drive the line off the reel and onto the deck. The line setter merely picks up the slack line and throws it off the stern. In this system there is little pressure on the line setter and expendable parts last longer than usual. In the third method, the reel is allowed to free spool. This is done by opening a crossover valve — usually located on the reel manifold. The line setter pulls line off the reel as fast as the reel can spin. One fault with this system is that if there is a problem and the line setter must be stopped, the reel will free spool unless it is stopped quickly by closing the crossover valve. This could result in a big tangle, with line jumping off the ends of the reel onto the shaft. The line setter is also under more strain than in the second method above.

Setting gear for swordfish

The gear used for swordfish is basically the same as for tuna, except the hooks are different and the arrangement of the gear is slightly different. The hook spacing is usually about 20 to 30 hooks/nm, and 5 to 10 hooks per basket. At 20 hooks/nm of mainline the interval between hooks is about 100 m — about 14 to 18 seconds on the setting timer, depending on boat speed and sagging ratio. The length of the floatlines is much shorter than for tuna, around 10 to 15 m. Some swordfish boats have additional foam ‘bullet’ floats to suspend the line between hard floats to eliminate the usual curve in the line.

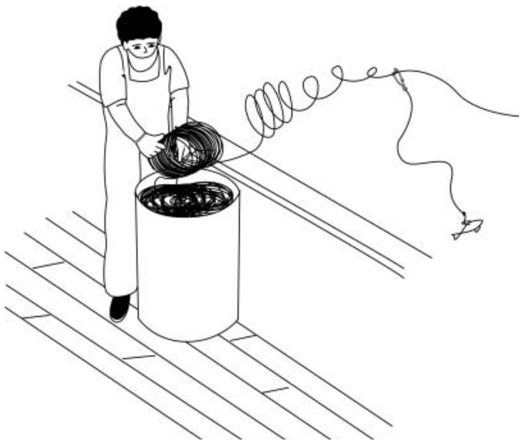


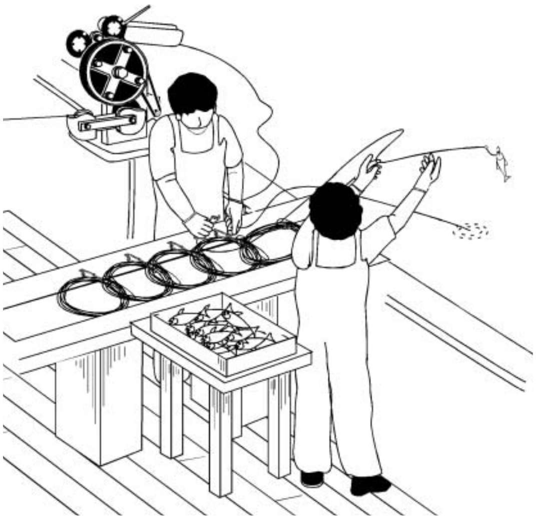
I. SETTING ROPE GEAR, SETTING TIME, DATA RECORDING AND SOAK TIME

Traditional basket gear is set differently than monofilament gear, while setting automated rope gear is very similar to setting monofilament gear. Also, a major part of the setting process for all gear where the branchlines are snapped onto the mainline is to get the correct spacing between branchlines and floatlines along the mainline, and to record the setting data for comparison at the end of the haul and for future reference.

Traditional basket gear

Traditional basket gear is usually set manually, as the branchlines are permanently attached to the mainline. Because of this, the mainline is thrown in coils to ensure the line is slack at all times. The three main men during setting are the baiter, the line thrower, and the float man. The baiter baits the hooks and throws the baited branchlines at regular intervals. The line thrower throws the coils of mainline off the stern from a setting table at a regular pace. The float man throws floats and floatlines. The other men pass coils of mainline back to the thrower, carry baskets of gear to the stern and tie them together, pass floats and bait, etc.



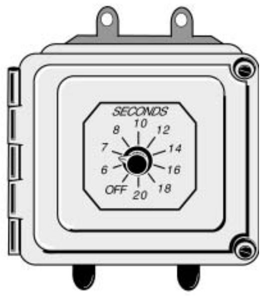


Automated rope gear

Automated rope gear is set in the same manner as monofilament gear. The rope is fed to the stern of the vessel via blocks, with a line setter usually used. The branchlines are individually coiled and transported to the stern on a conveyor. One person unties the slip knot to release the branchline and passes the snap to the snapper, then attaches the bait and throws the baited hook and branchline. The snapper then attaches the snap to the mainline. Another person attaches the floats and floatlines at regular intervals.

Setting timer

Most longliners use a setting timer. A setting timer gives off an audible beep at set intervals, ranging from 6 to 20 seconds. At the sound of the beep the baiter throws a baited hook and then gets the next hook ready. Usually the baiter counts hooks in each basket and calls for a float at the right interval. Basket size can be adjusted on some setting timers, however. The number of hooks in a basket can be set on the setting timer and a different beep sounds for floats. Even more sophisticated setting timers, for example the Hookmaster timer from Japan, allows the operator to set the space interval between every two beeps either in time intervals or in length of mainline. With this type of setting timer the exact length of mainline let out is known, so depth of the set can be better controlled. The Hookmaster works in conjunction with a line monitor built into the line setter.



Often, a longer length of line is allowed between floats and the first and last branchlines in a basket. There are two reasons for doing this: one is to avoid catching shallow water bycatch species; the other is to avoid tangles between floatlines and branchlines. When a simple hook timer is used, the spaces between branchlines and the floatline can be timed by counting two beeps before and after a float is thrown. With a Hookmaster, the time or length interval before and after a float can be increased.

Recording data

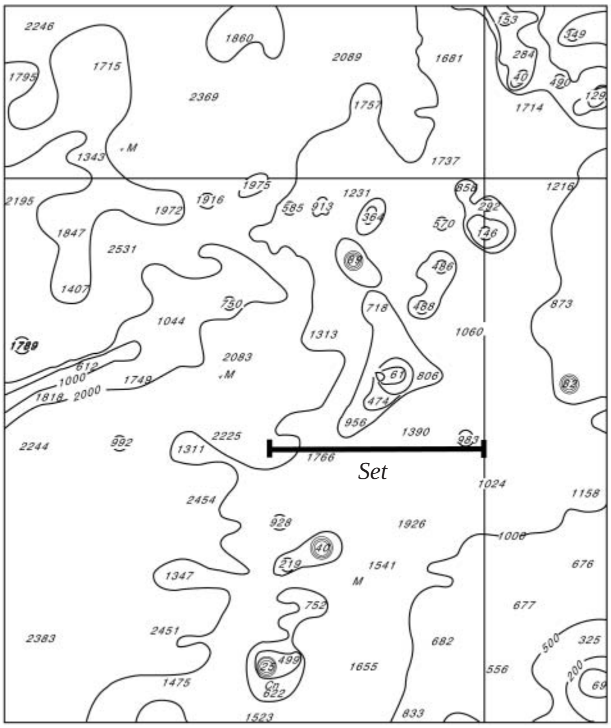
As soon as the last radio buoy is thrown, everything about the set should be recorded including: start and stop times, number of baskets, number of hooks, positions of both ends of the set, radio buoy frequencies, wind and current direction, sea conditions, and moon phase. It is important to write everything down even if some of this information is recorded on a plotter. A plot of the set can also be drawn, with pencil, on the chart or on plotting paper. If the set was made within radar range of land features, then a radar fix should be plotted for each end of the line.

It is also a good idea to watch the drift of the boat for twenty or thirty minutes after it is shut down at the completion of setting, and to record the compass direction back to the end buoy. If the boat drifts away from the last buoy on a course of 270˚T, for example, a reciprocal course of 090˚T would get back to the approximate position of the line. If the electronics fail later, the line can still be found by using this information. It is a good idea to steam back to the end buoy at least once during the soak. The new position of the end buoy should be recorded, along with the set and drift of the current.

Example: Set #3 started at 0530 hours at 21˚10.450'S and 175˚50.000'W going 280˚T. Set finished at 0930 hours at 21˚06.500'S and 176˚33.100'W, with 32 nm of line and 1600 hooks in 20 hook baskets. Bait is saury. #1 radio buoy is 1732 kHz and #2 radio buoy is 1768 kHz. Wind is moderate from SSE. Seas are slight. Current is NNE at 0.5 knots. Boat is drifting at 250˚T at 0.5 knots. Course back to gear is 070˚T.

After 2 hours of soaking the #2 radio buoy drifted to 21˚06.000'S and 176˚3.100'W. Current set at 000˚ with a drift of 0.25 knots.

In the above example the line did not move in the same direction as the boat. It also did not move in the same direction as the apparent current. The boat was affected more by the wind while the line was affected by the wind and the current and by currents below the surface. It is difficult to predict where the line will be after soaking for several hours. That is why it is best to record everything and then check the line halfway through the soak.



Soak time

Soak time is usually measured from the time the last buoy of the set is thrown until the first buoy — usually the same buoy — is hauled. In a normal set the first baskets thrown will have a much longer soak time than the last baskets thrown, as they are the last to be hauled. The soak time recorded on fishing logs is, therefore, usually the minimum soak time and not an average. This time can vary from about 3 hours to as much as 8 or 9 hours, depending on length of mainline, fishing conditions, fishing strategy, weather, etc. A typical tuna set might have started at 0800 hours and finished at 1200 hours, for example. If hauling started at 1600 hours, then the last hooks thrown would only have had a 4 hour soak. If hauling finished at 2400 hours, then the last hooks hauled would have had a 16 hour soak. The recorded soak time for this set would be 4 hours.

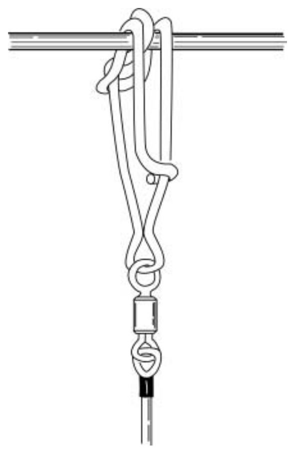
With a more even soak time, such as in a backward set (Chapter 3 J) every hook would have about the same chance of catching a fish, all other factors being equal. Also, there may be fewer dead fish on the line. Yellowfin and bigeye tuna can stay alive for 2 to 3 hours after being hooked, but most fish would be dead after several hours on the line. If the first hooks in a normal set catch fish soon after being deployed, then those fish will likely be dead when hauled and will not be as valuable as other fish that came up alive. Fish left on the line for several hours are also more prone to predation by sharks and whales.

J. SOME VARIATIONS ON SETTING

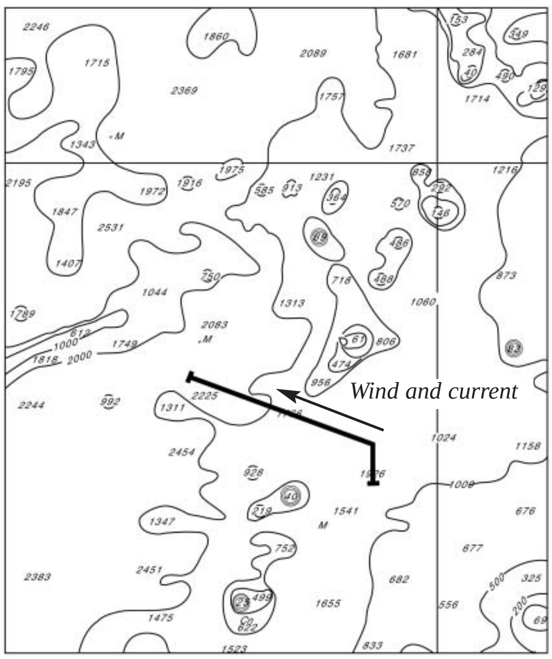
There are many variations on the way the gear can be set. This is true for both monofilament and basket gear.

The backward set

Longlines are not always set going downhill in a straight line and hauled going uphill. Sometimes the line is set and hauled going in the same direction. In other words, after the line is set the boat returns to the first end of the line and hauling starts with the first buoy thrown over. One of the reasons to haul this way is to save time. A longline skipper trying to keep to a tight schedule, for example, might want to save time on the last set of a trip by setting and hauling in a direction that would get him closer to port. If a line is set and hauled backwards, the line is usually set upside down, that is, the snaps are put on the mainline the opposite way they usually are snapped on and the sequence of floats is reversed. If light buoys are usually thrown out first as in a normal day set, they are thrown out last in a backward set. In either case, the light buoys will be on the last part of the line to be retrieved. The disadvantages of a backward set are that the line will be set and hauled with the same orientation to the wind, and that the crew will not have much rest during the soak. One advantage of setting and hauling in the same direction, however, is that all hooks in the set will have a more even soak time.



The hook set

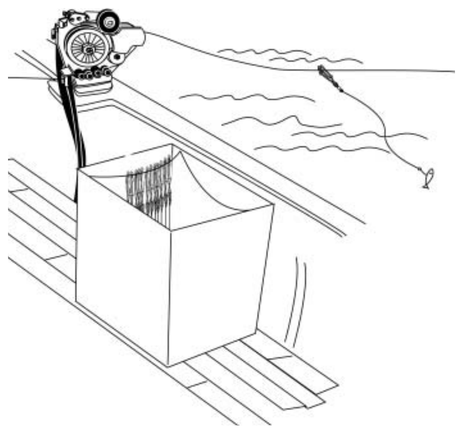


Another variation in setting is to put a hook shape in the first end of the line. Often when a line is set across the current it will be parallel to the wind; or the current may shift after setting so that it is parallel to the set. If the current or wind are strong enough to push the first float and first few baskets of line back on itself, the end of the line may collapse, resulting in a bad tangle. This tangle will be on the last portion of line hauled at the end of the night so this situation can be quite frustrating.

A good way to avoid the first end of the line collapsing is to put a hook into the set — that is, to set the line in an 'L' shape. For example, if the intended course for the set is 290˚T, then the starting course would be 000˚T. After one or two nautical miles of line has been set, the course is changed to 290˚T. During the soak, if the wind or current pushes the end of the line in a westerly direction, it will not collapse back on itself but will pass itself a mile or two to the south, forming a loop. At the end of the haul, a loop in the line is easy to pull. The hook is usually put in the line such that at the end of the haul the boat will turn to starboard.

Stretching the end of the set

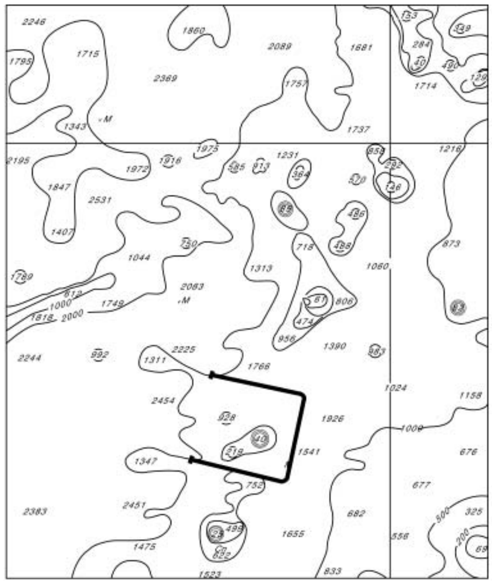
An alternate method to putting a hook in the end of the line is to tow, or stretch, the end of the set. If the current and wind are parallel to the direction of the set, problems can be overcome by towing the first or last few baskets. If, for example, the direction of the set is 290˚T and the current is running in the same direction, then the first five baskets could be set with an SR of 1, by using the line setter as a fairlead only and not engaging the hydraulic drive. The line is towed, or stretched, so that it has no sag. After five baskets of line has been set the line setter is engaged so that the rest of the line is set with an SR of 0.75, for example. If the current was running opposite to the direction of the set then the last end of the line would be stretched rather than the first.

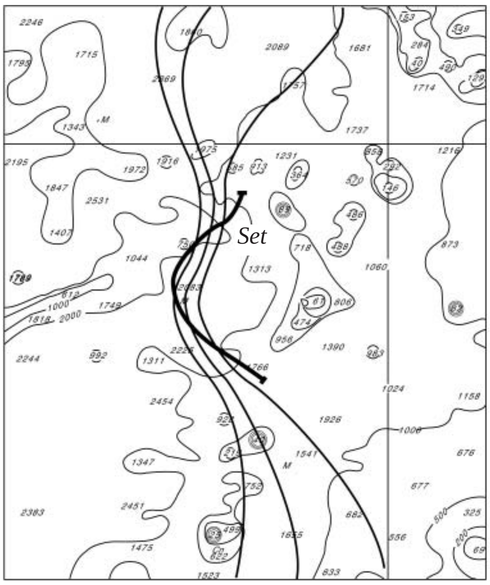


Later, as the current tended to push the end of the line back on itself, a sag would develop but not enough of a sag to collapse the line. Obviously, it would require some experimentation to get this just right.

The horseshoe set

Every time a target fish is landed during hauling, it should be recorded and a position entry should be made on the plotter by pressing the mark or event button. After hauling the line and looking at the catch results on the plotter, it may be found that fish are concentrated in one area. A straight set the following day may miss most of the fish in this case. To avoid this, the line can be set in a ‘U’ shaped loop, or horseshoe shape, to get more hooks in the area where the fish are concentrated. Care must be taken with a horseshoe set that the line does not collapse on itself. The two ends of the horseshoe should be several nautical miles apart and should be parallel to the wind and current. The middle part of the horseshoe should be perpendicular to the wind and current if possible. The main disadvantage of a horseshoe set is that part of the haul has to be done going downhill, part of the haul has to be done going uphill, and part of the haul has to be done in the trough.



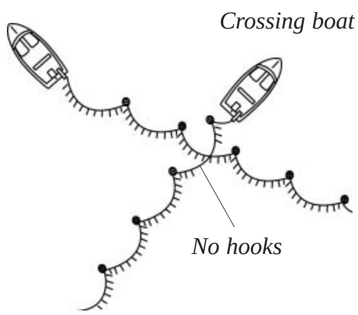


Following a front

Another variation in setting is to follow a temperature front. It may be found that a temperature front runs for several nautical miles over a zigzag path. When setting on a temperature front, it is usually best to set on the warm side. The temperature sensor has to be constantly monitored and the course changed as the temperature goes up and down. If the warmer water is to port, for example, and the water starts to get colder, the boat should be steered slightly to port until the temperature reading goes up again. If the water temperature goes up, then the boat is steered to starboard until the temperature starts to drop again. A set done on a temperature front will not usually be in a straight line. In some circumstances it is better to cross over the front several times. That way, when the line is hauled, it can be determined if fish are on the warm side or the cold side of the front. If the current is running perpendicular to the temperature front then the line should be set on the up-current side so that it will drift across the front.

Courtesy to others

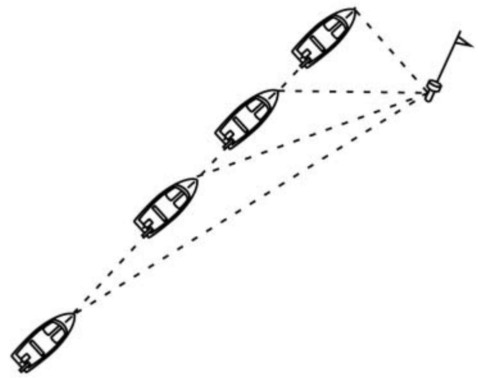
When setting longline gear in the vicinity of other longline boats, problems and conflicts can be avoided. If a set is made parallel to another boat’s gear then a distance of several nautical miles should be kept between the two lines. It is also helpful to contact the other boat to let the skipper know your intentions and to find out what his course will be for the entire set. If a crossing situation cannot be avoided because the two boats are on different courses, then it is best to cross the lines at a 90˚ angle. It is also helpful if the crossing boat does not snap on any branchlines for 100 or 200 m on either side of the other boat’s line. This will help to avoid tangles when the lines are hauled. During hauling, if another longline is found to have crossed over the mainline, the crossing line must be cut. As a courtesy to the other fishermen, the two ends of the cut mainline should be re-joined.

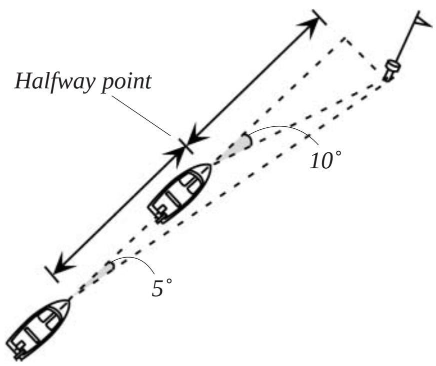


K. FINDING THE GEAR

Before hauling starts, the line has to be found, usually by steaming towards the radio buoy signal. If the RDF or the radio buoy is not working then a search must be conducted. The course back to the end of the line can be found on the plotter or from the skipper's notes in the logbook. The direction would be the reciprocal of the drift away from the line after the last buoy was thrown. When searching for a buoy or flag, all hands should be on watch.

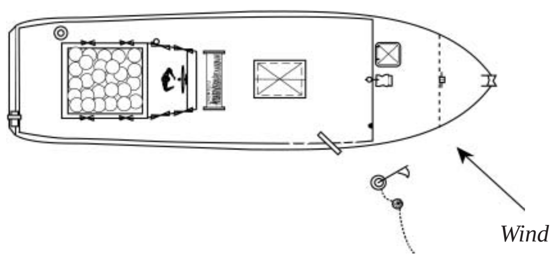
If the radio buoy is giving a good signal, it is best to set the course slightly away from the direction of the signal. The RDF gives some indication of distance by showing the signal strength. However, this can vary with the strength of the battery pack in the radio buoy so should not be relied upon. If the boat steams directly toward the radio buoy, there is a danger that it will not be seen and the boat will run over it. That is why the course should be about 5˚ off to one side. As the boat gets closer to the radio buoy the relative angle of the signal from the radio buoy will increase. If the course is changed periodically during the search so that the bearing is always about 5˚ relative, then the radio buoy cannot be missed. Eventually the angle will increase rapidly until the buoy is bearing at 90˚, or abeam of the boat. By then it should be in sight.

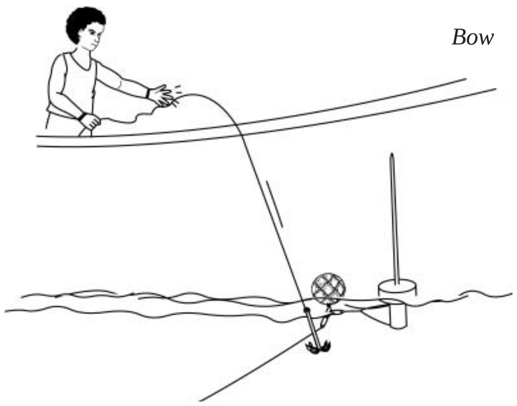




The distance to the radio buoy can be estimated by using the rule of doubling the angle on the bow: when the angle has doubled, the distance is half of what it was when the search started. For example, if it takes 15 minutes for the radio buoy signal to go from 5˚ to 10˚ relative, then the radio buoy is 15 more minutes away, as long as boat speed stays the same. If the boat speed is 10 knots, then the distance to go would be: Distance = Speed x Time = 10 nm/h x 0.25 h = 2.5 nm.

The radio buoy should be approached from the downwind side with the wind slightly to the starboard side of the boat. As the boat stops to recover the buoy, the wind will hold the boat off the buoy and line. The boat should be turned to port just as the buoy is recovered. If the buoy is approached from the upwind side, there is a danger that the boat will blow over the radio buoy and line, causing the line to foul on the bottom or in the rudder or propeller, and possibly causing damage to the radio buoy.

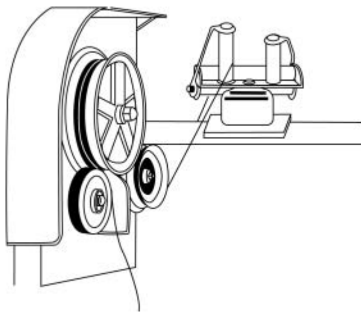




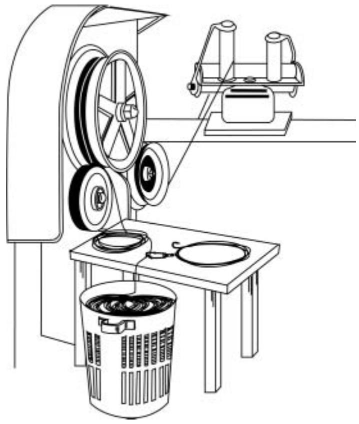
Some vessels use a small grappling hook on a throwing or heaving line to retrieve the radio buoy. When the boat is positioned close to the radio buoy, the grappling hook is thrown over the mainline and allowed to sink over the line. The hook is then slowly pulled in with the mainline hooked on. The radio buoy can then be retrieved.

L. HAULING BASKET GEAR

After the radio buoy is recovered, it is detached from the mainline and moved to its storage position, secured and turned off. If there was a flag buoy close to the end of the mainline, this is also removed and stored. The end of the mainline is then passed through the line hauler, ready for the hauling operation to commence. The mainline is usually guided onto the hauler through a fairlead roller mounted on the rail. The main men on deck are the coilers, the basket maker, and the basket stacker.



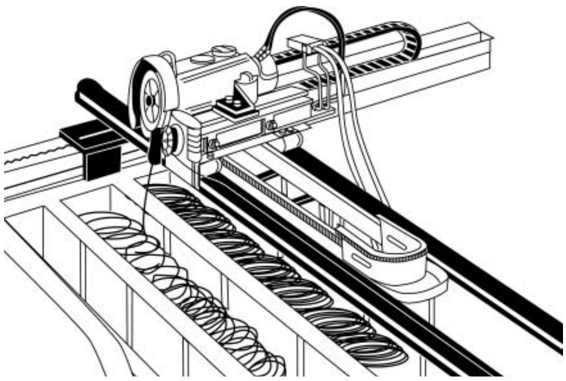
The coilers operate the control valve for the line hauler. As the mainline comes through the roller, each branchline is grabbed by a coiler and guided through the hauler so that the snap lands on the coils of mainline. The hauler keeps going while this is done. The coils of mainline pile up under the hauler, usually on a basket table. A coiler then coils the branchline rapidly and places it on the coils of mainline before the basket maker piles more coils of mainline onto the pile.



The basket maker's job is to guide the line coiling up under the hauler so that the coils are uniform. As each section finishes coiling, he places it on the accumulating pile of coils. This is repeated until a full bundle or basket is made. The basket is then detached from the rest of the mainline by the basket stacker — the joins are made with sheet bends — and tied together with a cord and stacked in a cage or bin. Sometimes there are two bundles per basket so there is a join in the middle. The basket stacker also replaces tangled or damaged branchlines and makes repairs throughout the haul.

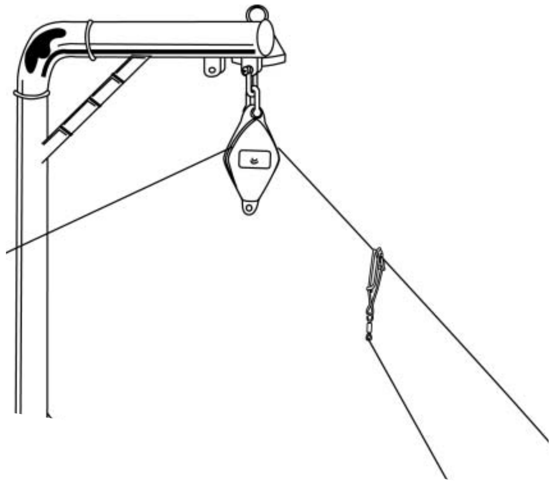
The coilers use the line hauler to pull in floats and floatlines. Other crewmen gaff and handle the catch. The crew usually rotates after every ten baskets or so.

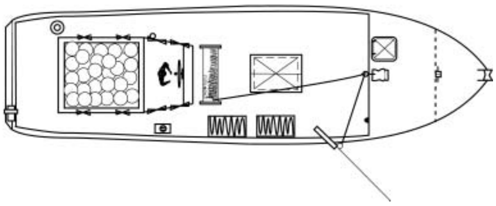
With automated rope gear, the branchlines and floatlines are unsnapped from the mainline, and coiled using a branchline coiler. The mainline is carried from the line hauler to a guide pipe by a small conveyor belt and then is pulled aft by the line arranger. The line arranger arranges the line into bins, which are aft of the wheelhouse. A large conveyor belt carries floats and bundles of floatlines and branchlines aft for storage.



M. HAULING MONOFILAMENT GEAR

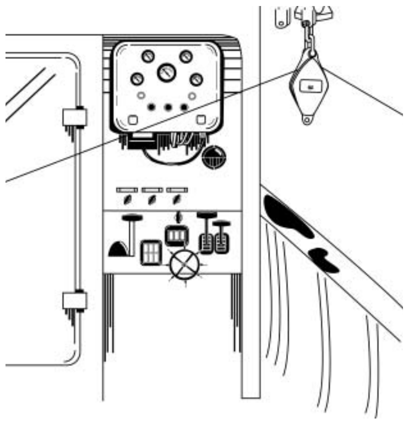
After the radio buoy is recovered, the mainline is secured to a cleat or the rail. The radio buoy is then detached from the mainline and moved to its storage position, secured and turned off. If there was a flag buoy close to the end of the mainline, this is also removed and stored. The end of the mainline is secured to the reel. If the mainline was cut at the end of the set, a blood knot is used to re-attach the line in the water to the line on the reel. The line is then detached from the cleat and guided to the reel by a longline block hanging from a davit. This is usually an open block made of aluminium with a stainless steel sheave and roller bearings. The block is usually hung at about head level so that the operator can position one hand on the mainline in front of the block.





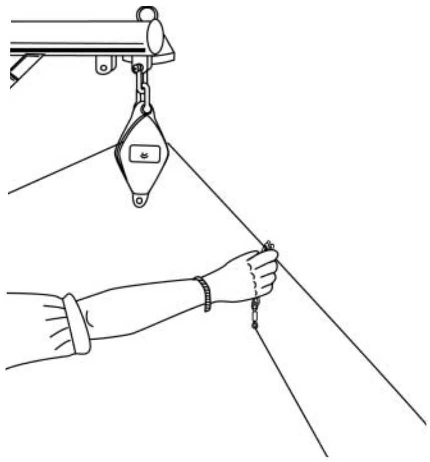
Longline blocks can also be used as line guides to change the angle of the line going from the first block to the reel. Often, two or three blocks are used in hauling to direct the line around areas where people are working and onto the reel squarely. If longline blocks are used as line guides they are often reversed so that they function as closed blocks.

Once the line is secured to the reel, hauling commences. Most reels have a level-wind mechanism to evenly spread the mainline over the drum of the reel. The speed of the boat and the speed of hauling the line have to be matched. This takes a good deal of coordination between the operator and the person controlling the reel. The best layout for hauling is to have an outside steering station, with all the controls for steering the boat and hauling the gear in one place. This allows the hauling operation to be conducted by one person.

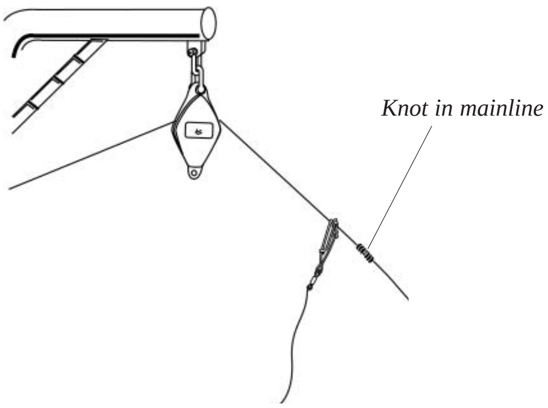


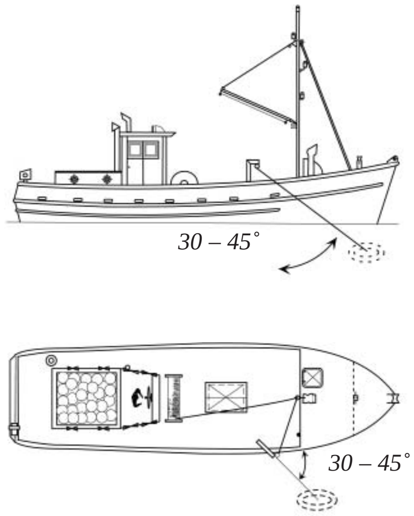
The main man on the deck during hauling is the rollerman. He operates the control valve for the reel, and sometimes operates the boat as well. His job is to control the speed at which the line is recovered and to unsnap branchlines and floatlines as they come up. As each snap strikes the rollerman's hand, it is unsnapped, and pulled down, away from the mainline.

The rollerman should keep his right hand on the mainline while hauling. His left hand should be on the control valve so he can stop the line quickly. With his hand on the mainline he will be able to sense if there is a fish coming up. He can inform the operator — if the roller-man himself is not driving the boat — and the vessel can be slowed so the fish can be played or brought up slowly. He can also feel any bad spots in the line. The reel does not have to be stopped when branchlines come up, unless there is a fish or a tangle. The snaps will slide on the mainline if they are struck with a gloved hand. They can be unsnapped while the mainline is still moving.



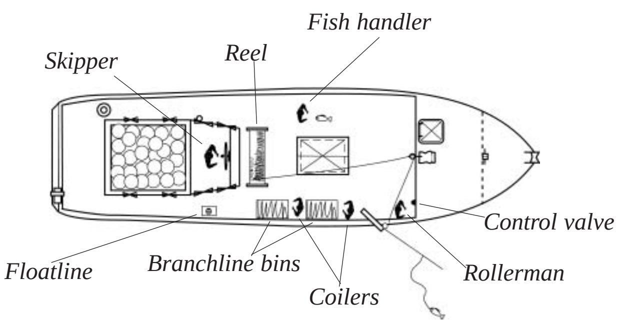
When a knot comes up on the mainline, the reel must be stopped unless the snap can be removed before the knot hits it, as a snap will not slide past a knot. If a knot were allowed to hit the snap and the rollerman's hand was on the mainline, he could get injured as his hand collided with the longline block. Also, the mainline may part. The open block is used in case there is a tangle or a knot on the mainline and the branchline is not unsnapped — the snap will pass through an open block easily.

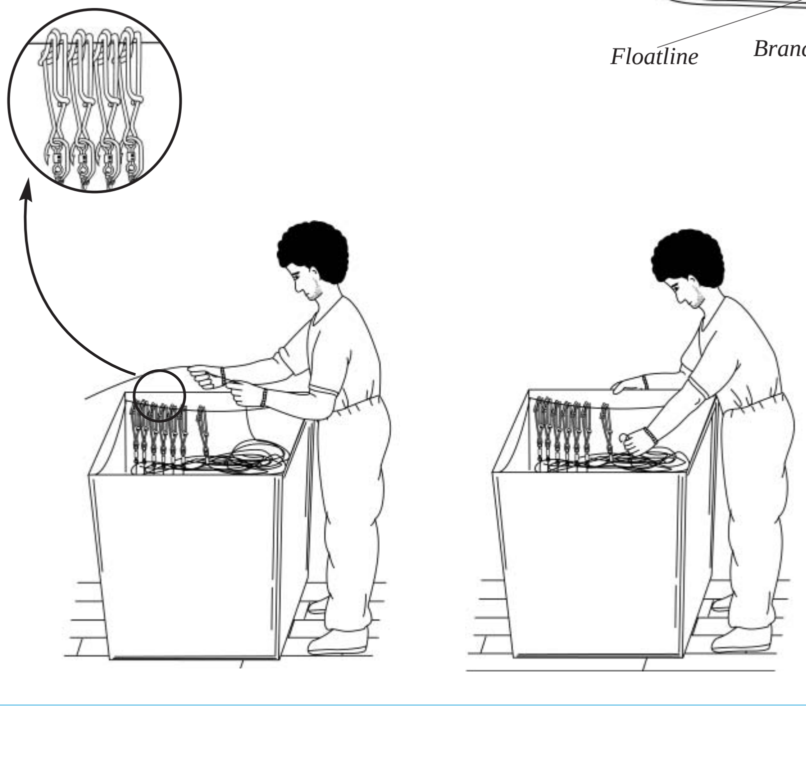




It is important that the line coming up be visible to the rollerman and to the boat operator. The best position for the line is just to the side of the boat and just in front of the longline block. During hauling, the boat is kept slightly away from the track of the line so the line stays at about a 30˚ to 45˚ angle in front of and to the side of the boat. Hauling from this position will keep branchlines and floatlines clear of the mainline. If the boat runs over the mainline there is a danger that an unseen fouled branchline will come up and injure the rollerman, or a fish may be lost. The boat may also run over floats and floatlines. If the line is too far out to the starboard side of the boat there is a danger that the line will have too much tension on it and will part. Too much tension on the mainline will also cause branchlines to spin and wrap around the mainline. If the line is allowed to run at an angle behind the block then it may get fouled in the rudder or propeller, or branchlines or floatlines may get caught in the propeller or get fouled on the mainline.

The coilers stand directly behind the rollerman. Their job is to take the snaps from the rollerman and coil the branchlines into the branchline bins, haul in the floats and coil the floatlines, and gaff and handle the fish.



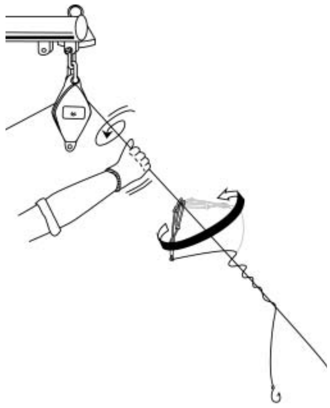


The coiler attaches the snap to the bar or line in the branchline bin, and pulls the branchline in with a hand over hand action. When the hook is reached, any bait is removed and the hook placed through the snap for that branchline. The next snap is attached beside the last, so a sequence or order is formed. This continues until the branchline bin is full or all the gear is hauled. There is usually more than one coiler, and each is coiling branchlines into a separate bin.

N. ENCOUNTERING PROBLEMS WHEN HAULING THE GEAR

A good hauling rate for monofilament gear is 200 hooks per hour. It would take 10 hours to haul 2000 hooks at that rate. However, the rate is usually slower because the line has to be stopped for fish and when problems are encountered. It may take 15 or 20 hours to haul 2000 hooks. Branchlines can get tangled with the mainline. The mainline can get fouled on the bottom of the boat, it can get tangled, and it can part. Sea and weather conditions can change. Sharks often run the line under the boat, fouling it on exposed zinc anodes or on keel cooler pipes. The line can also get caught in the rudder or propeller. There are several things that can be done to prevent or remedy these situations.

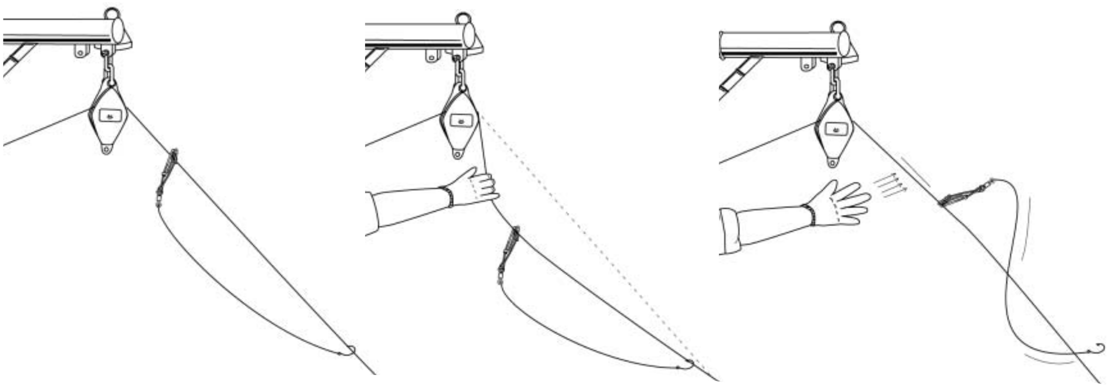
Branchline tangles



Branchline tangles can be minimised by keeping the boat on course and on track, and by hauling the line at a steady pace. Weather and sea conditions, however, can cause branchlines to spin around the mainline. This also can happen when a large fish runs with the line. The reel has to be stopped each time there is a branchline wrapped around the mainline. This can add several hours to hauling time and can be very frustrating. There are several ways to undo tangles quickly. One method is to spin the mainline so that the snap rotates rapidly around the mainline, untwisting the branchline.

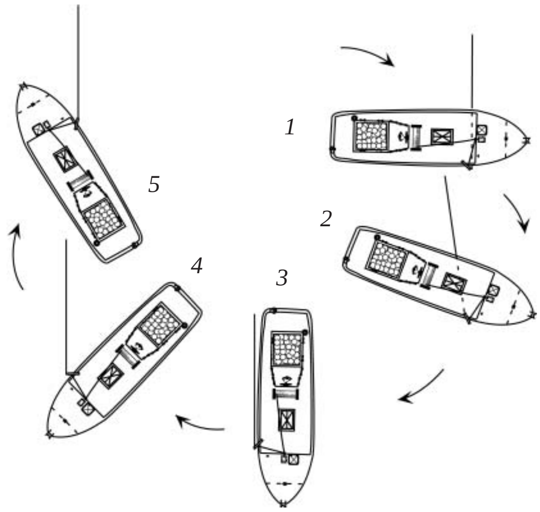
Another method is to unsnap the snap and twirl it around the mainline in the opposite direction of the tangle. The branchline and mainline are gripped together about 20 or 30 cm away from the snap and are twirled together. Then the snap is pulled away from the mainline at a right angle. This may have to be repeated once or twice to get all of the wraps off. If the branchline is badly tangled with the mainline, it is best to cut it loose. The snap and hook can be saved but the monofilament from the branchline is usually kinked and should be discarded.

Fouled hooks on the mainline can often be knocked loose without stopping the reel. When the rollerman sees a hook on the mainline he can pull the line like a bowstring and release it with a snap. This will usually cause the hook to fly off the mainline.

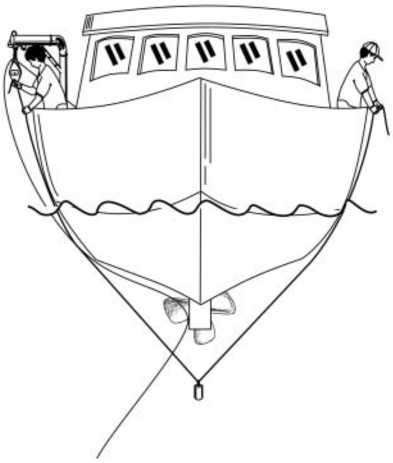


Getting the boat off of the mainline

It is best to try to prevent fouling when the boat blows over the line. One way to do this is to round the line. The boat is turned in a tight right-hand circle while the line is kept taut with the reel. The boat continues moving until the mainline is once again off the starboard bow. Then hauling is resumed. Rounding the line is also helpful when the line is coming up from deep water or if its direction is not known. Another way to get the line out from under the boat is to reverse until the line is stretched tight off the bow. Then the boat is steamed forward and turned to port at the same time until the line is once again off the starboard bow. Care must be taken that the mainline and branchlines do not get fouled in the propeller when doing either of these manoeuvres.

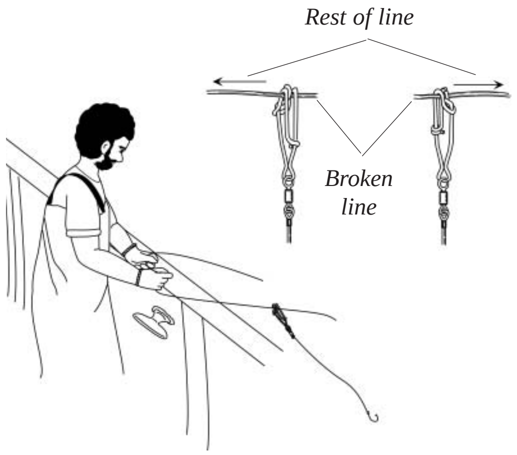


Freeing a fouled line



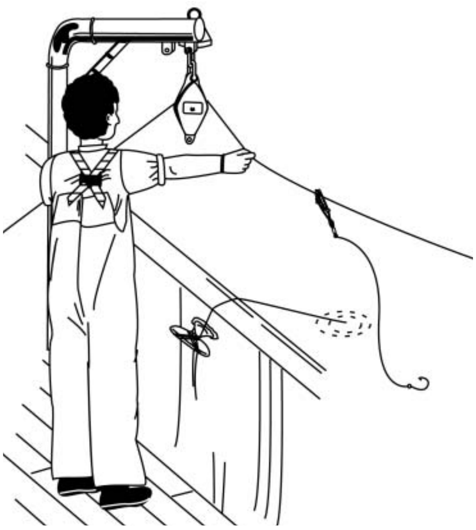
If the longline gets fouled on the boat there are remedies. One is to drag a line under the boat from the bow to the stern. This can be a floatline with a 2 or 3 kg weight attached near the middle. It takes two people to do this job, one on the starboard side and one on the port side. As the weighted line is dragged, or keelhauled, from stem to stern it will pick up the mainline.

A grapple hook can also be used to free a fouled mainline. Often the line can be pulled free after it is hooked and brought on board. However, if both sides of the mainline are in hand and it cannot be freed from the part of the boat where it is fouled, the only solution is to cut the line. Often, it can be cut in one place and then the fouled portion can be pulled free. If the fouled line will not run free after being cut, then both ends have to be cut. They can be re-attached using a blood knot. The fouled section of line can be left on the bottom of the boat and can be cut out later, while drifting or while in port. It is not good to leave line on the shaft for too long, as it can cause damage to the cutlass bearing.

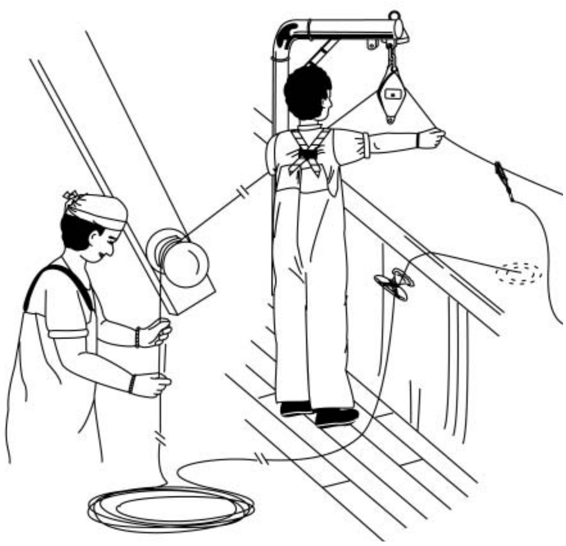


When the line parts

If the mainline parts during hauling, then the broken end has to be located and re-attached so hauling can be resumed. As soon as the line parts, all hands should position themselves as lookouts and a search should begin. If this happens at night someone should man a spotlight. The boat should stay on the same course it was on during hauling and the spotlight should be swept from side to side, looking for the reflections from a float — floats should have reflective tape on them. If a float cannot be located it may be necessary to steam to the next radio buoy.



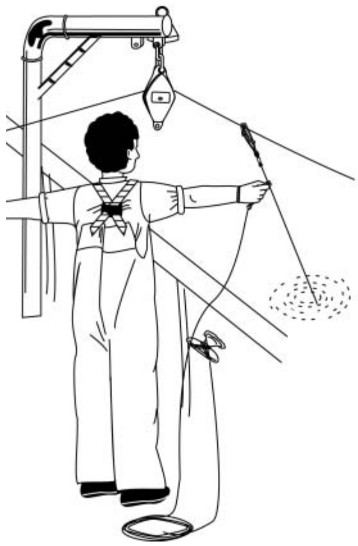
If the length of line to the break is short then it can probably be pulled in by hand, joined to the other end of the line, and wound onto the reel. Hauling is then resumed. If the length of line to the break is fairly long, however, it is better to cut the line free from the rest of the mainline. The rest of the mainline has to be secured to a cleat or to the rail before it is cut. The boat should be lying with the wind on the starboard side so that it does not blow over the line. The loose piece is then attached to the line on the reel and wound in, removing branchlines as they come up. Then the two bitter ends of the mainline are joined and hauling resumes.

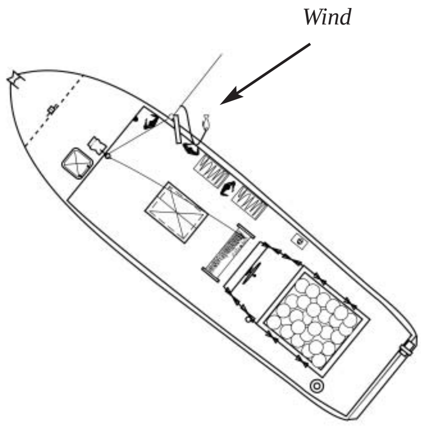


Alternatively, if the boat has a capstan, it can be used to haul in the broken end. In this case there is no need to cut the line. It is hauled in and piled up on the deck until the bitter end is reached, and then joined to the line on the reel. The reel then takes up the slack line on deck and hauling resumes.

O. FISH ON THE LINE

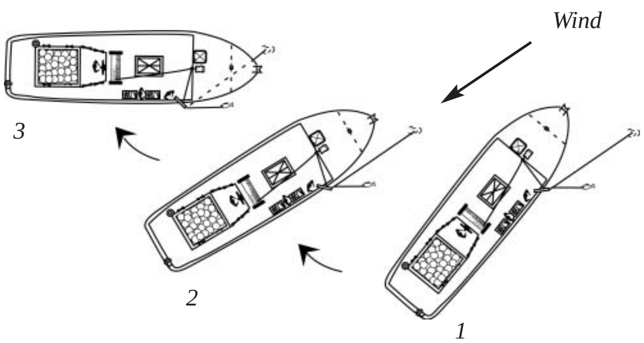
When a branchline has a fish on it, it should not be unsnapped until the fish is gaffed and landed. Otherwise the fish may be lost. Large active fish can be played with a lazy line, or play line — a floatline will do for this, although some boats use lines up to 100 m in length. It should be snapped to the branchline before the branchline is unsnapped from the mainline. This will allow the fish to run a little so it will tire out. Then it can be pulled in and gaffed. The bitter end of the lazy line must be tied to a cleat or to the rail. A float can be attached to the lazy line to help tire the fish out. A fish can also be played with the reel using forward and reverse on the control valve.

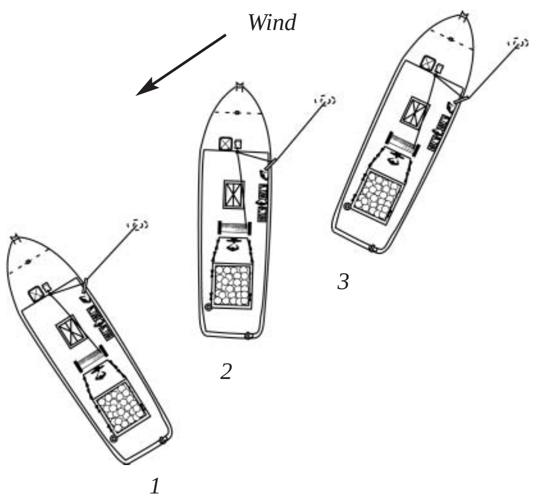




When the line has been set going downhill, initially during hauling the wind will be one or two points on the starboard bow. The wind will act as a break to stop the boat's forward motion when hauling is stopped for a fish or for problems such as tangles. When the boat is stopped the marine gear should be in neutral and the rudder should be turned a few degrees to port. The wind will end up on the starboard beam and will push the boat away from the line.

Some fishermen like to reverse when a fish comes up. This is not a good practice as most single-screw boats have right-hand propellers and they back to port. This means that when they are reversing the stern tends to swing around to port and the bow to starboard. This action would run the boat over the line and put the wind on the port side. That is what should be avoided when stopping for a fish. It is better to slow the boat as the fish is coming up and then let the wind stop the boat.





When the boat is stopped it will usually blow around so that it is lying in the trough. When hauling is resumed the boat has to get back on track. To do this the boat is steered to starboard towards the line and then gradually veered to port until it is back on track. Being on course and on track are not the same thing. If the line was set going east–west, then east is the correct course for hauling but the boat has to be in the right relative position to the mainline to be on track. The boat's course should be parallel to the set of the line but slightly to one side. The autopilot can be used to help keep the boat on course and on track during hauling. If the boat has veered off track, slight adjustments of the course can get the boat back on track. For example, if the course is 090˚T and the boat is too far to port from the line, then the autopilot course can be changed to 095˚T for a minute or two until the boat is closer to the line, and then back to the original 090˚T.