FISHING NETS AND FISHING GEARS

Key words: Seines, Trawlers, Dredges, Hooks

INTRODUCTION

A **fishing net** or **fishnet** is a net that is used for fishing. Fishing nets are meshes usually formed by knotting a relatively thin thread. Modern nets are usually made of artificial polyamides like nylon, although nets of organic polyamides such as wool or silk thread were common until recently and are still used.

Fishing tackle is a general term that refers to the equipment used by fishermen when fishing. Almost any equipment or gear used for fishing can be called fishing tackle. Some examples are hooks, lines, sinkers, floats, rods, reels, baits, lures, spears, nets, gaffs, traps, waders and tackle boxes.

Gear that is attached to the end of a fishing line is called **terminal tackle**. This includes hooks, leaders, swivels, sinkers, floats, split rings and wire, snaps, beads, spoons, blades, spinners and clevises to attach spinner blades to fishing lures.

Fishing tackle can be contrasted with fishing techniques. Fishing tackle refers to the physical equipment that is used when fishing, whereas fishing techniques refers to the manner in which the tackle is used when fishing.

The term *tackle*, with the meaning "apparatus for fishing", has been in use from 1398 AD. Fishing tackle is also called **fishing gear**. However the term fishing gear is more usually used in the context of commercial fishing, whereas fishing tackle is more often used in the context of recreational fishing.

TYPES OF NETS

Taking for granted the limitations of size imposed by the nature of artisanal fisheries, the following types of nets may be used by such fisheries: gillnets, tangle nets, trammel nets, beach seines, lampara nets, [small] purse seines, [small] bottom [shallow-water] trawlnets, lift nets, dip nets and cast nets.

Gillnets:

Gillnets are normally rectangular, being much longer than high, with a float (or cork) line along the upper edge and a lead (weight) line along the lower edge.

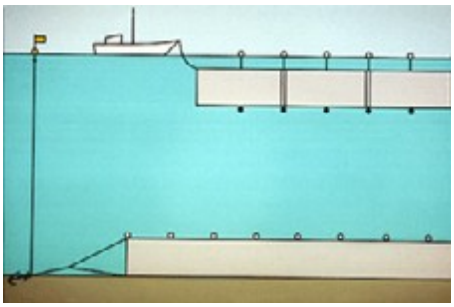


Fig.12.1 Diagram showing a drifting (floating) gillnet (top) and a set gillnet (bottom); gillnets may also be set in mid-water or allowed to drift freely

They are designed to be set vertically in the water. Fish do not apparently see them or, at least, are not deterred by them; they force their head through a mesh as far as it will go, only to find, in most cases, that their body is deeper than their head. When they try to back out, the gillnet twine passes under their gill cover (or operculum), thus trapping them. Fish without opercula (as sharks) or with bodies of uniform width (as eels) are less likely to be trapped. And some fish with spines, barbels or similar organs at the front end of their body may simply become snared. Sometimes, marine turtles, birds and mammals (as seals, dolphins) are trapped if the mesh gets behind fins, wings or shell protrusions. Often these "higher" animals may just die of fright and drowning. Modern large-scale drifting gillnets may be several tens of kilometres long, but those used in artisanal fisheries are only, at most, a few hundreds of metres long. Gillnets may also be fixed, by anchors or stakes, to the sea bed (as in tidal bays and inshore water), towed by the setter boat (sometimes encircling the target fish) or, as just noted, allowed to float freely in a vertical plane. They may be set at mid-depths though anchored to the sea bed. In shallow water, they may occupy the whole water column.

What they capture is determined by the net's mesh size relative to the sizes of individual fish in the fishing area. The conversion from natural fibres (as cotton) to synthetic monofilament (as nylon) for netmaking has greatly enhanced the effectiveness and durability of gillnets as well as other types of net gears. Gillnets come in many versions in the artisanal fisheries of the Mediterranean. The main characteristics are:

- the size of the panels (of netting)
- the number of panels constituting the gear (hence the overall dimensions)
- the mesh size (adapted to that of the target species, obviously)
- the filament used (commonly nylon or a similar plastic, normally as monofilament)
- its thread diameter, hence its "visibility" to target species and its resistance to a fish's effort to escape from the net.

Panels may also differ in their construction to catch more than one target species according to their habitual depth in the water column.

Tangle nets:

Tangle nets are similar to gillnets but are more loosely set, usually on the sea bed. They are aimed at entangling such prey as spiny lobsters and spider crabs, the spines of which make it

almost impossible for them to detach themselves once caught. The role of the netting quality in terms of mesh size and material (e.g. whether monofilament or braided) is also relevant here.

Trammel nets:

Trammel nets, although they resemble gillnets, operate on a different principle. They are in fact two or three nets in one: one net with a fine mesh made of fine flexible (usually braided) twine is laid against another, or sandwiched between two others, of larger mesh and stronger thread. A fish, in attempting to pass through the larger mesh, pushes the fine-mesh net (which is also much less stretched than the larger-mesh net) through the larger mesh forming a bag on the other side in which the fish is entrapped.

Like gillnets, they are made up of several or many panels, but are usually set to touch the bottom and may, also like gillnets, occupy the whole water column in shallow water, even if they are set far more slackly. When set over rocky or "dirty" bottoms, a heavy-mesh skirt may be attached to the leadline to prevent the gear from snarling on rocks or to pick up the debris while saving the main netting from becoming filled up with this debris.

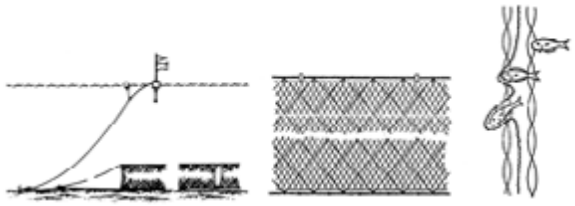


Fig.12.2 Diagram showing: on the left, the usual way a trammel net is set on the sea bed; in the middle, a frontal view; and, on the right, an end-on view showing how the fish become trapped (successive stages, top to bottom)

Trammel nets are sometimes combined with gillnets, to extend the variety of target species catchable at one time and place with one gear. Usually, gillnet occupies the upper part of the combined gear, and the trammel net, the lower part, which normally rests on the sea bed. Such combination gears are nevertheless generally more difficult to operate, so are comparatively uncommon in the western Mediterranean.

Seines:

Seines are designed to surround schooling fish; they are of four general types. The first two now briefly described may be used in artisanal fisheries. The last two are generally too large to be operated successfully by artisanal fishermen.

(i) The **beach seine** consists essentially of a bag (a sort of large cod-end) with a long rectangular and relatively narrow panel of netting (known as a wing) attached to the bag on either side of the "mouth", with corkline and leadline to keep it vertical in the water; for fishing, it is usually staked at one end (of a wing) to the beach, then, from a boat, set around a school of fish. The other wing is then hauled onto the beach, leadline first, and the captured fish school removed from the bag.

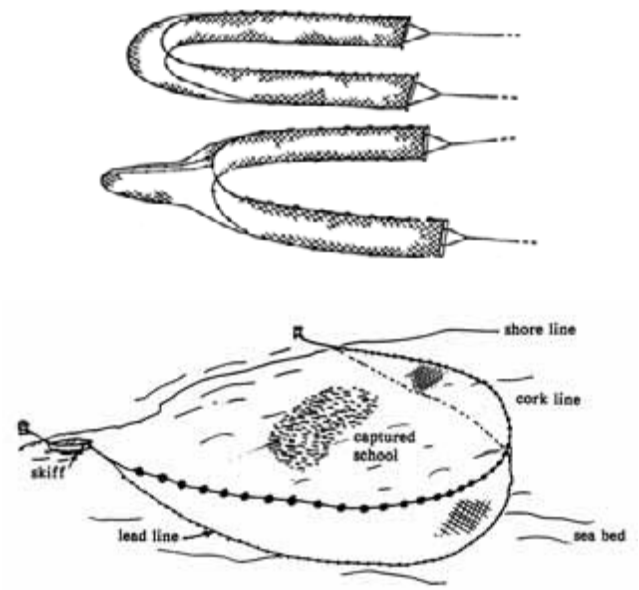


Fig – 12.3 Diagrams of a beach seine, a lampara net (top) and a schematic representation of a typical beach seine operation (bottom)

(ii) The **lampara net** is a relatively loose and open net bag with two wings, somewhere between a Danish seine (see below) and a beach seine in conception; it is fished from small boats or long the beach to catch schooling fish, and, like the beach seine, it is hauled leadline first. Large lampara nets are also operated from large fishing vessels.

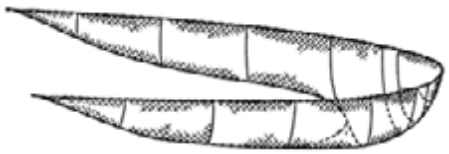


Fig – 12.4 Diagram of a Danish seine

(iii) The **Danish seine** is similar to a trawl, a big net bag with two wings, though fished in a different way (it is used to catch fish living just over the bottom); it is operated from a fishing boat.

(iv) The **purse seine** is basically a rectangular encircling net, with a float line and with metal rings attached to its footrope and "threaded" onto the "purse string". It is set around a school of fish, usually offshore and off-bottom (i.e. it avoids touching the sea bed), and the purse line is drawn in to close the net at the footrope, thus trapping the school. Generally, the fish are taken aboard by **dip** (or **brail**) **net** while the purse seine remains in the water.

Small purse seines may be operated from a beach, rather like a sophisticated beach seine. Sometimes, this gear is used in combination with night lights which encourage schooling fishes to congregate and become more accessible to a fishery.

Trawlnets:

Trawlnets vary greatly in size according to the local fishing situation, but, generally speaking, are not used in artisanal fisheries, since, to be effective, they are normally large and therefore require powerful vessels to tow them. The low-powered artisanal fishing boats cannot tow them fast enough to be effective. Whatever the size of the net, the bag itself has a more or less rectangular mouth and tapers towards the bottom or end of the bag; a second, detachable, smaller-mesh bag, at the tapered end and known as a cod-end, constitutes the actual end of the main bag; it greatly facilitates the emptying of the trawl.

Usually the bag also has two "wings", one attached to each side of the mouth. These wings are attached to the towing ropes (warps). Usually, a more or less rectangular board (otter board) is attached between the wing and the tow rope proper. The board, by resisting the water during towing, forces the wings to open as far as possible. The net mouth is also maintained open by means of floats on the top rope (headline) and by weights on the bottom or ground rope (leadline). Such trawls are called **otter trawls**.

The maximum horizontal opening can also be achieved by using two boats to tow the net, one for each wing, the boats themselves maintaining the tension by appropriate manoeuvring. Such trawls are called **pair trawls**.

In some fisheries, two trawlnets are attached to each other and hauled by one vessel; these are known as **twin trawls**.

Trawlnets can be towed along the bottom (provided it is smooth and soft enough not to snag the net), just above the bottom, depending on the behaviour of the species of interest to the fishermen. Those that are dragged along the bottom (generically called bottom trawls) have a low mouth and are usually fitted with a tickler chain between the wings and just in advance of the net-mouth leadline. This chain has the effect of forcing the typical target species – shrimp and flatfish – upwards and into the net mouth, thus improving catches.

Some smaller bottom trawls are fitted with a metal or wooden beam rather than a cork line and are called beam trawls which are often preferred for catching demersal flatfish and shrimp, particularly closer to shore; the towing warps are attached to the beam (at its ends).

Trawls can also be towed in mid-water to catch pelagic species (as sardines, anchovies, sprats) and are called therefore midwater trawls.

Trawlnets may be towed from the side of the fishing boat, and usually still are in artisanal (smallscale) trawl fisheries, but the introduction of powerful mechanical net-hauling devices (power blocks) in the early 1960s led to a preference for stern trawling, in which the net is shot over the stern, which in turn is designed in the form of a ramp, with a so-called "A" frame above it, to facilitate net handling.

Lift nets:

Fig – 12.5

Lift nets are usually set more or less flat on the bottom, particularly in tidal areas in which the passage or aggregation of fish is predictable. They are attached to a lifting mechanism which is normally operated physically, by human muscle power, at the appropriate time to catch the fish directly over the net or in the water column above it (obviously, this water column must be shallow in relation to the speed with which the net can be hauled, so as to avoid escape by the fish). Such nets are common along the banks of river estuaries in some parts of the world. The relatively low catching power of lift nets usually limits them to use in artisanal fisheries. In some places, however, mechanical devices are used to haul lift nets rapidly and even automatically at a given time. Lift nets may also be operated from boats or can be portable and set and hauled by hand. Sometimes, as with purse seines, this gear is used in combination with night lights, for similar reasons.

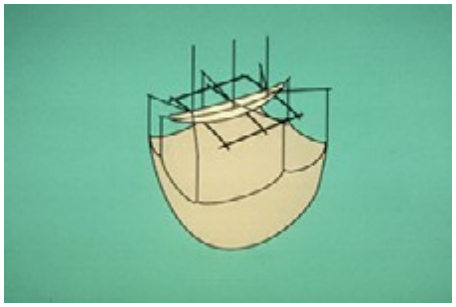


Fig – 12.6 Diagram of a lift net

Dip nets:

Dip nets may be hand held and used to catch fish, such as salmon and trout, in shallow and narrow waterways where such fish are often concentrated. They are exclusively artisanal fishing gear.

Fig – 12.7 Diagram of a dip net

Throw or cast nets:

Throw or cast nets are also exclusively artisanal gear. Usually circular in design, they are thrown, with considerable skill, over a fish school in very shallow water. The fish are trapped on the bottom and can be retained in the net as it is taken from the water by the fisherman.

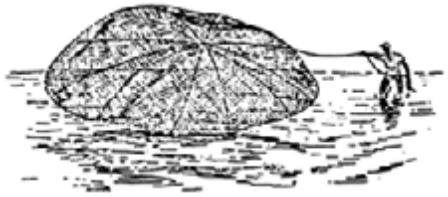


Fig – 12.8 Drawing of a cast net being cast by an artisanal fisherman

Dredges:

Dredges are usually in the form of a metallic frame or cage or a cage to which a strong netting is attached. The dredge is dragged over a soft sea bed where bivalve molluscs (such as scallops and clams) live in the surface mud. The cage has a "mouth" (a rectangular opening) which is presented to the sea-bed surface during fishing. Often, welded to the lower "jaw" – usually a metal bar – are "teeth", usually from 9 to 15 cm long, depending on the target species. These teeth "harrow" the sea bed to disturb the target species, usually molluscs. Since it may be dragged at some speed by a boat, the molluscs, which are essentially immobile organisms, are trapped in the rear end of the dredge or the net attached to it, which, when judged to be full, is hauled aboard.

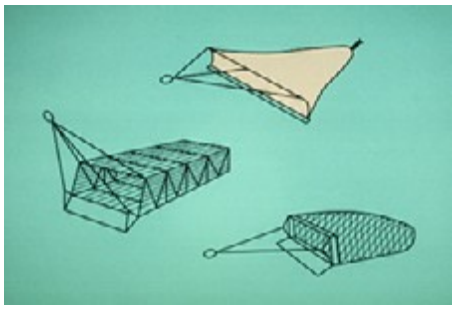


Fig – 12.9 Diagram showing three kinds of bottom dredge;
The teeth that are often welded to the lower "jaw" are not shown here

A modern form of dredge, designed particularly to exploit small clams, is supplied with a forced air system fitted to the leading edge of the dredge, as well as "teeth" on the lower "jaw". The

teeth and the forced air disturb the top twenty or so centimeters of the sea bed, virtually launching the clams into the mouth of the dredge. Some of these dredges are also designed specifically to force the clams through selector meshes so that the clams, when brought aboard, are already sorted into two or three size groups each of which is processed for a different purpose (e.g., canning, fresh consumption in restaurants, canned soup). This form of dredge is too sophisticated to be considered an artisanal fishing gear.

Rakes and scrapers:

Rakes and scrapers are considered as special, elementary forms of a dredge.

Rakes are like the garden tool but adapted to raking soft sea bottom, usually in the intertidal zone, to gather clams and other bivalves. Since they are handheld, they are usually used only for subsistence and artisanal fishing.

Fig – 12.10 Drawing showing four types of rake commonly used by individual artisanal fishermen

Scrapers are similar to rakes, but more usually used to scrape rock surfaces on which sessile or semi-sessile organisms, such as mussels, oysters and limpets, are attached.

Traps:

Pots usually take the form of a rectangular box or a vertical, flattish cylinder or a horizontal half-cylinder, the flat side being on the sea bed. Although usually made of netting (wire, nylon), pots may be made of wooden slats, rattan and other natural materials. The netting is usually attached to a solid frame made of metal or wood.

They all have a conical entrance funnel that narrows towards the interior of the pot; some may have two or more such entrances. They all have a door (often occupying one side of the pot) that can be opened to retrieve the catch. When set on the sea bed, their position may be marked with a surface float attached to the pot by a line, although in some situations, where there is a likelihood of poaching, floats may be subsurface and set to pop up to the surface at about the time of retrieval by the fishermen. In some artisanal fisheries, many such pots are attached at intervals to a longline, which facilitates the setting and retrieval of the gear.

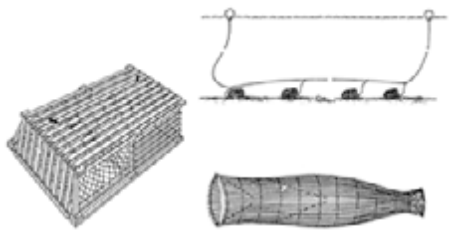


Fig – 12.11 Drawings of two varieties of pot (left and lower drawings) and (upper drawing) a line of pots set on the bottom

Their design is adapted to the target species, taking into account its form and behaviour; however, most species that are disposed to entering the larger opening of the entrance funnel do not seem to be able to escape by returning through the narrow, inner part of the entrance funnel, and so remain trapped. Likewise, the time of day (or week or month or year, even) at which pots are set and hauled takes the target species' behaviour into account. For example, in some species, several specimens caught in a trap may attack each other. In other traps, the captured specimens may die relatively quickly and start to decay if left too long in the pot. Since some species are territorial, as soon as one occupies a pot, it may prevent others from entering the trap, thus limiting the pots' effectiveness, from the fisherman's point of view; but fishermen know this and how to deal with it.

Sometimes, a pot will be baited to encourage a target species to enter it. Since the catch rate (numbers caught per day) is relatively low, and pots are an artisanal method (worked by only one or a very small group of fishermen), the species sought are usually of high economic value (e.g., lobster, prawn, crayfish, crab, snapper).

A special kind of trap may be used to catch octopuses and cuttlefishes (which may also be induced into ordinary pots, however). It consists of a line to which is attached an object to which such species are attracted. The object may be a cylinder to which hooks are attached, or a ceramic pot – rather like a small classical amphora – which is often ballasted by cement in the pot's bottom. These special gears are in common use along the Spanish Mediterranean coast and called "cadups" or "cadufs".

Fig – 12.12 Photo of a cadup (or caduf)

Octopuses can also be caught in a piece of a car tyre. The octopus uses the tyre as a hide and will not attempt to leave it even after it has been hauled out of the water, by which time it is too late. Often, many such tyre pieces (commonly a quarter of a tyre) are attached at intervals to a longline, to facilitate setting and retrieval. This method is not, apparently, used in the western Mediterranean, however.

Traps are usually bigger than pots, although the word trap may used for pots as just described. However, traps (and similar structures called barriers, fences, weirs, corrals etc.) are usually

large, elaborate nets or wooden structures often fixed to the sea bed, particularly in shallow or inshore sites, where the top of the structure extends above the water surface, and placed taking into account the behaviour (especially local tidal migrations) of the target species. The fish are induced to enter the trap through an entrance that likewise diminishes in size towards the interior of the trap. Since the depth of the trap may be several metres and allow some fish the possibility of finding their way out, two or three such entrances may be arranged in sequence, occasionally with fairly elaborate "cul-de-sacs" to one side or the other or both.

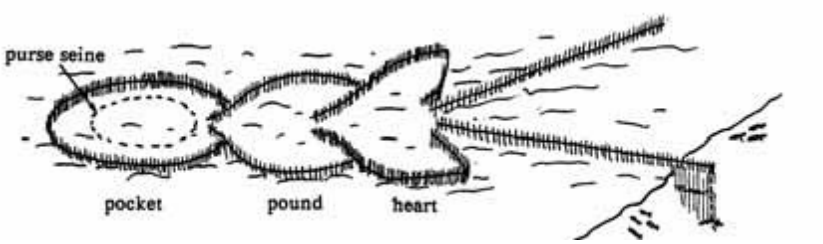


Fig – 12.13 Drawing of a fish trap

Such traps are often placed in the entrance to coastal lagoons, the lagoon itself becoming a large natural trap concentrating fish that may be taken by other fishing gears. Sometimes, all the fisherman does is block the lagoon entrance with a net or other barrier after fish have entered with the incoming sea water.

A common type of trap is staked to the sea bed and perpendicularly to the shore; it extends several tens of metres (or even more) out to sea, ending in one (downstream of the coastal current, as a rule) or two (one upstream and the other downstream) curved (semicircular) barriers from which the fish seem unable to escape.

In some circumstances, a trap, like a pot, may be baited to attract species of interest. Special set nets are used as traps; the commonest are fyke nets, stow nets, pound nets and aerial traps.

Fyke nets:

Fyke nets are set in shallow water, particularly in a tidal zone; they are in the form of a cone with one or more staggered conical apertures of (necessarily) decreasing size inside the trap. The trap is staked or anchored to the sea bed. Often a wing is attached to each side of the net to guide the fish towards the entrance. The first aperture is normally about a metre in circumference, whereas the last, if there are, say, three in all, may be only about 30 centimetres across.

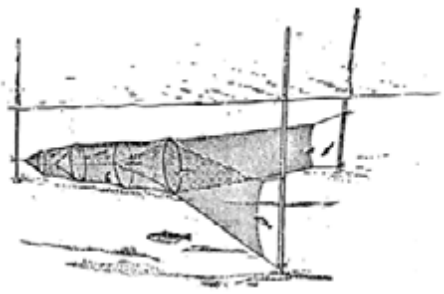


Fig – 12.14 Drawing of a fyke net set on the sea bed in shallow water

Pound nets:

Pound nets are usually quite elaborate structures staked to the sea bed in shallow water. One part of the pound net guides the fish into the main pound, which often has a bottom netting as well and one or more cul-de-sacs to deter the fish from finding a way back out of the pound net.

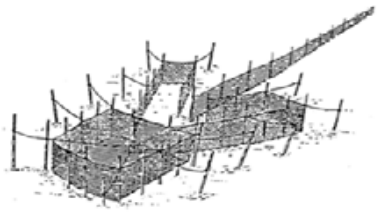


Fig – 12.15 Drawing of a stationary uncovered pound net

Stow nets:

Stow nets are usually in the form of an elongate cone or pyramid, with mouth held open by a frame which is staked to the sea bed or supported by a boat near the water surface. Such nets, or traps, are often grouped and placed with the mouth across the current in rivers or estuaries.

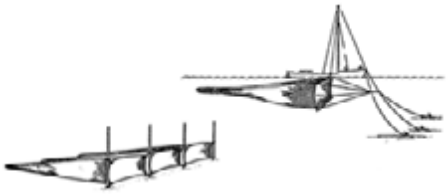
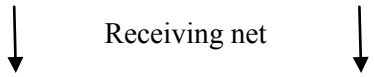


Fig – 12.16 Drawing of stow nets set on the sea bed (left)
or retained by a fishing boat at the sea surface (right)

Aerial nets:

Aerial nets are a special form of barrier set in shallow water between bottom and surface; they are designed to catch jumping fish (e.g. mullets) or flying fish. The fish are diverted by the net "wall" and leap over the net into a horizontally set piece of netting (or boxes) on the other side of the "wall".



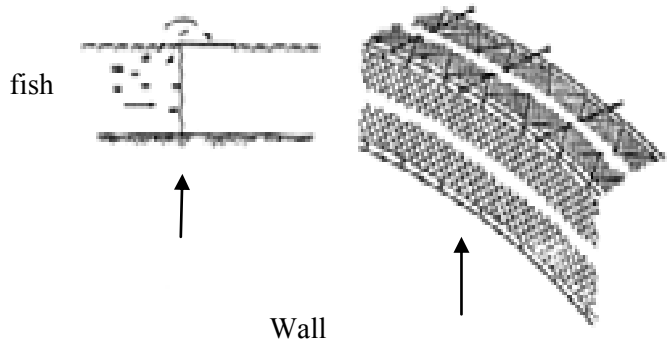


Fig – 12.17 Drawing of an aerial net, in profile (left) and in frontal view (right)

Hooks:

Although the hook is a simple and ancient fishing gear, the means of deploying hooks for fishing are numerous. Generally speaking, hook gear may be fished in rocky areas, as well as in the open sea.

Handlines:

Handlines are normally lengths of line to which one or more barbed hooks is attached. A weight is usually attached to the outward end of the line which is cast into the water; the hooks may be baited. Handlines may also be allowed to rest on the bottom, with the hooks baited, or they may be fished at mid-water depth, often with an artificial bait (jig). The line is hauled in (either by hand or by a mechanical device) and recast at regular intervals, depending on the nature of the target species. Sometimes the line may be cast from a moving boat and hauled in mechanically.

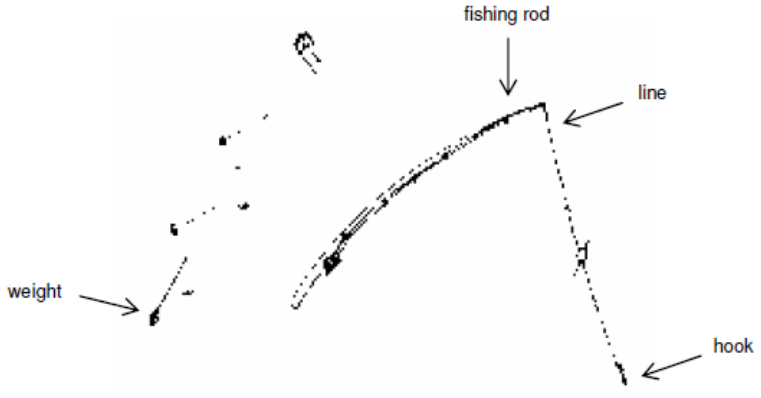


Fig – 12.18 Drawing of a multi-hook handline (left) and a rod-and-line (right)

Angling:

Angling is a specialized form of hand line; it is used normally for sport or subsistence fishing, rather than for artisanal fishing. A baited hook or a hook with an artificial bait (spinner) may be used, as in trolling.

Longlines:

Longlines used in commercial/industrial fisheries may be several kilometres long; smaller varieties, a few hundred metres long, are used in artisanal fisheries. They may be floated horizontally, usually at subsurface depths. At intervals along them, hooklines, or snoods, are attached, the hooks hanging more or less vertically in the water column when the gear is being fished. Usually, the hooks are baited.

Fig – 12.19 Diagrams showing a bottom set longline (left),
a mid-water longline (middle), and a floating set longline (right)

The longline is fished (often being allowed to drift freely) for several hours, or more, before being hauled aboard the fishing vessel, normally mechanically, but also by hand if they are light (short) enough. Swordfish, marlins, tunas, sabrefish, sharks and other species are the principal targets; however, sharks may have come to attack the other hooked fish just mentioned and be caught incidentally.

Longlines may also be laid on the bottom if demersal fish, such as hake, are the target species. And sometimes, by a careful combination of floats and weights on the mainline, the gear can be set in a zigzag fashion to cover a wide range of depth and target more than one species.

Trolls:

Trolls are hook lines dragged through the water, at appreciable speed, to catch such species as swordfish, marlin, tunas, dolphinfish and other high-speed swimmers. The hook usually forms part of an artificial bait (a spinner) that, by intermittently reflecting the light while it spins, attracts these predatory fishes; it must therefore be used in relatively transparent water. This gear is used for sport-fishing and sometimes for commercial fishing, but since the catch rate is relatively low, it is aimed at high-valued fish. Trolling can be used in artisanal fisheries as well although very unusual in the western Mediterranean.

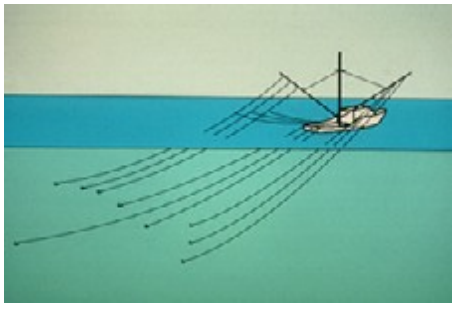


Fig – 12.20 Diagram of a fishing boat trolling nine lines

Harpoons:

Harpoons are a specialized form of spear, usually with a barb; the point is normally fitted to a stock which may be lanced by the fisherman directly into the target species; although not commonly targeted in the Mediterranean by this gear, whales, porpoises, seals (often while basking), sharks and other fishes are otherwise common target species.

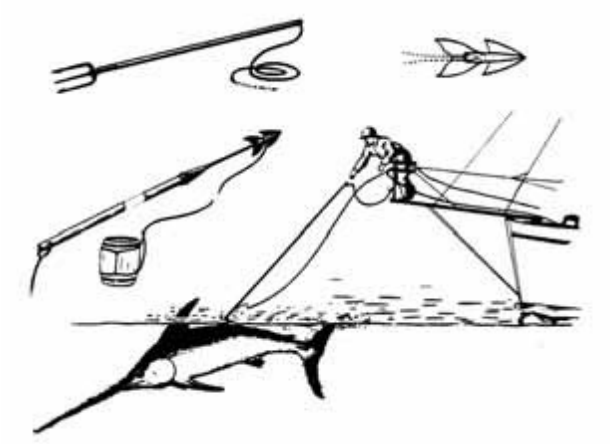


Fig – 12.21 Drawings of harpoons

To prevent the prey from escaping, harpoon and all, a rope is attached to the harpoon and tied to a heavy or immovable object such as the fishing boat. Handheld harpoons, as well as harpoon guns (usually based on the crossbow or catapult principle), are used by scuba divers for sport-fishing or subsistence fishing, but may also be used in artisanal fisheries.

Tongs:

Tongs are used locally for taking shellfish, crabs etc. from the shore or in shallow water.

Fig – 12.22 Drawing of four different types of shellfish tongs; the handles may be up to 5 metres long and be used from small fishing boats to take shellfish off the sea bottom

Other tricks:

There are other fishing gears or methods that do not fit appropriately into any of the aforementioned categories. One of these, not however applicable in the Mediterranean, is the trapping of fish in tide gates at high tide, often with a retaining net to keep the fish as the tide

goes out. At least two others are considered indefensible as legitimate fishing methods, but may be used by unscrupulous artisanal fishermen.

Explosives:

Explosives may be used in the sea to kill or stun fish (and other organisms), which float to the surface and are collected by the fishermen. This method is obviously totally unselective, so that species, sometimes the majority, of no interest to the fishermen are left to decay or be eaten by scavengers later.

Poison:

Poison may be used in a similar way; it is also more or less unselective, although affecting some species more readily than others.

Fish-attracting devices (FADs):

These devices may be used in association with several fishing methods, but are not, in themselves, fishing gear; they may greatly facilitate the use of such gear. The best known, and which may be used by artisanal fishermen, are:

- **Lights:**

  Used at night, powerful lamps set at the water surface or immersed in it attract a variety of marine organisms, particularly schooling fishes which can then be taken by a suitable fishing gear, such as a lift net or a purse seine, as mentioned earlier.

- **Floats**:

Fig – 12.23

  Floats, particularly logs of wood, small rafts, etc., have a similar effect, perhaps less pronounced than night lights, but still able to offer acceptable fishing opportunities, especially for schooling fishes, such as tuna and other large pelagic species and small pelagics (e.g. sardine, anchovy).

- **Artificial reefs:**

Fig – 12.24

As the name suggests, are man-made structures set on the sea bed, usually in inshore waters. They may be dumps of wrecked car bodies or used tyres or building rubble, but an increasing effort is being made to design and manufacture them from modular parts such as concrete blocks and to assemble them in reef parks. In some cases the modular structures are designed to provide niches for fish and large crustaceans to hide in and/or lay eggs in. There is a fish-aggregating effect and there may be, in some cases, a real enhancement of the biomass in the region. Again, the target species (e.g. fish, octopuses, squid, lobsters, etc.) may be caught on or over the reef by conventional methods, though some adaptation to the physical mass of the reef may be necessary.

- **Pumps**:

Pumps are really a sort of vacuum cleaner that can catch densely schooling fish species at the sea surface (often attracted by powerful lights at night); they are obviously energy-intensive, so the economic value of the target species, the efficacy of the pump and the value of the catch play determinant roles in the rentability of this type of gear.

- **"Ghost" fishing**

This is one kind of fishing that no one does! Yet it is not ecologically or economically negligible. Netting is sometimes lost by fishermen by accident (in bad weather or by snagging on rocks, forcing the fishermen to cut loose part of their gear) and sometimes on purpose (dumping of old netting in the sea or on a beach whence it may be washed into the sea). This netting, drifting with the currents, continues to catch fish and snare marine mammals, birds and reptiles, but it may also cause maritime accidents or nuisance. This so-called ghost fishing has so far been very poorly quantified, but its importance is growing and thus is being increasingly taken into account in marine ecological terms.