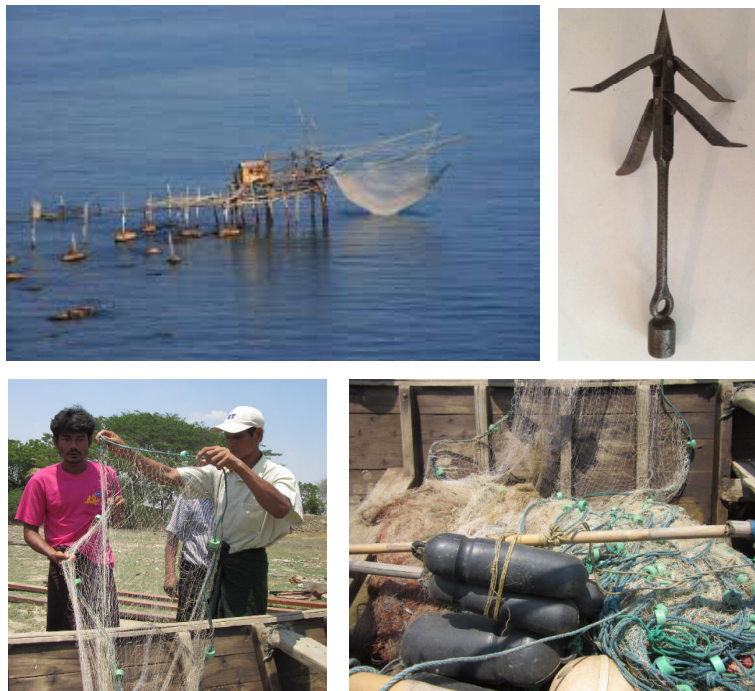


# Small-scale fishery and aquaculture in Myanmar Institutional support for dissemination of European Regulations and Best Mediterranean Practices

## Technical Manual

### Best Management Practices for Fishing Gears



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## PREPARATION OF THIS DOCUMENT

The project “Small-scale fishery and aquaculture in Myanmar. Institutional support for dissemination of European Regulations and Mediterranean Best Practices” is financed by the Italian Cooperation and implemented by CIHEAM-IAM Bari, aiming at growing and consolidating the small scale fishery sector, for the benefit of Myanmar and Italian stakeholders, both at public and private levels.

The Department of Fisheries of the Republic of the Union of Myanmar (DOF) intends to support aquaculture, according to technologies and productive process adequate both to national and Mediterranean context, looking to the new market dynamism. The project is a “leading action” in fishery and aquaculture sectors, supporting the dialogue between the Myanmar private and public actor’s through a global assistance. All the technical approaches will be focused on drawing sustainable development guidelines. The project intends to determine growth and consolidation for Myanmar enterprises, having in mind the strategic approach of responsible and sustainable development. Public Institutions has the duty to give the guidelines to the private enterprises, taking into account both economic and ecological exigencies and needs.

## Best Management Practice for Fishing Boats

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## GLOSSARY

**Best Management Practices.** Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices that prevent or reduce pollution.

**Code of Practice.** Management activities needed to solve a resource management problem. Similar to Best Management Practice.

**Drugs of low regulatory priority.** Drugs that have not been approved but may be used under some conditions. These include such things as salt and ice.

**Environmental Management System.** A plan of activities designed to maintain and improve compliance with environmental requirements.

**Exotic species/ Introduced species.** An organism introduced from a foreign country (i.e., one whose entire native range is outside that country where found).

**FMO.** Fishery Management Organization, a Community of Fishermen.

**Harmful Algal Blooms.** A community of phytoplankton with species that contain toxins or that causes a negative impact to natural resources or humans.

**ICCAT.** International Commission for the Conservation of the Atlantic Tuna

**Invasive species.** A species that is exotic or introduced to the ecosystem whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

**Native species.** Any species living within its historical range.

**Wild fish.** Fish that grow and reproduce in the natural environment; some wild fish may be protected by the Endangered Species Regulations.

## ABSTRACT

This manual is written for all those involved or working in the fishery sector as well interested ones to start such activity. The aim is to spread to the widest extent Best Management Practices between stakeholders in order to reach good standards of hygiene and maintenance and, to achieve the better control of fishing, harvesting and post harvesting according with laws and regulations to obtain quality and safe fishery products intended for human consumption.

## Introduction

Fishing gears are result of human intelligence and of experience to reach the most effective instruments to provide food from the water environment.

The man has thought for more than 30.000 years to systems to catch fish, hooks, nets and traps represent the result of that ancient progresses in fishing techniques and such inventions as applied along time are still valid.

Fishery has been one of the main sources of animal proteins since the prehistory when the resources available from the sea were almost unlimited. Fishery is nowadays still supplying seafood to a large percentage of the world population, however care should be put in not exceeding the natural capacity of the system to regenerate the wild stocks and to supply in sustainable way present and future generations.

There is nowadays big concerns of the sustainable management of the catches due to excessive exploitation of resources due to

## Considerations on fishery sustainability and best management of fishery systems

To reach sustainability in fishery there is the need to consider how many natural resources are consumed to catch fish. Indeed fishery is an extractive action and can heavily impact on the ecosystems.

The progressive increase of the world population and demand for aquatic products as well as the transformation of fishery into a lucrative activity have been pushing fishermen to look at short-term benefit from indiscriminate catches that overexploit the fish stocks.

Because of the opportunities given by of modern technologies to catch preys more easily and in more quantities, and the disinterest in avoiding by-catches and undersized fishes, several inland fishery resources and marine ones are drastically reduced due to the not sufficient number of

The fishing action is concentrated on catching big fishes (mainly spawners), or to prey in areas where fish is more concentrated (to have more profit) and without leaving dedicated areas for natural reproduction. The growth in demand for species amplifies this effect and it does not allow the natural abundance of spawners.

There is the need to plan strategies that keep into account from one side the need of fishermen and fisheries communities to gain their livelihood from a constant access to natural resources, and from the other side the necessity to improve the value of the produce by specifically targeting higher quality-price ratios.

On this fishery should plan a progressive integration with other productive assets to reduce the impact on fishery and guarantee alternative sources of income to support households during both the catching and the closed season. Income opportunities can range from integrated aquaculture-fishery, fish-tourism, fish cum catering, added-value productions (local processing).

On the other hand the development of Best Management Practices for fishing gears can enhance the value of the products by choosing adult fish only and by keeping intact the quality of the product up to the markets, which results in higher revenues to the fishermen and less pressure on natural resources.

At the same time the development of closed areas for reproduction are fundamental to guarantee adequate reproduction of fishes. Natural areas for spawning can be included in natural parks where the main small-scale fishery activities converge to more integrated approaches that link tourism and alternative productions.

Were limitations are imposed to protect breeders the results are evident and big fish can be caught according to regulations that combine both the fishery and reproduction needs.



Male trout breeder in Scotland

### Background information

The first hook in history was discovered in an archaeological site about 20 kilometres of Berlin in Germany and dating back to the Palaeolithic, about 12,300 years ago. Before that it was believed that similar objects were used by more modern cultures. The hook was still missing the barb but the shape was perfectly functional and able to capture the fishes and hold them up to their removal out of the water. Such type of hooks required an active fishing that needed the fisherman's presence and immediate response to pull the string immediately to avoid fish from escaping. This technique was something opposite from the type of fishing currently in use, which is meant to capture animals by passively positioning the lines on the shore.

In the copper-bronze age, hooks were built in the same shape of today and in the following age, iron hooks started to be widely utilized. Indians in America used hawks' nails instead.

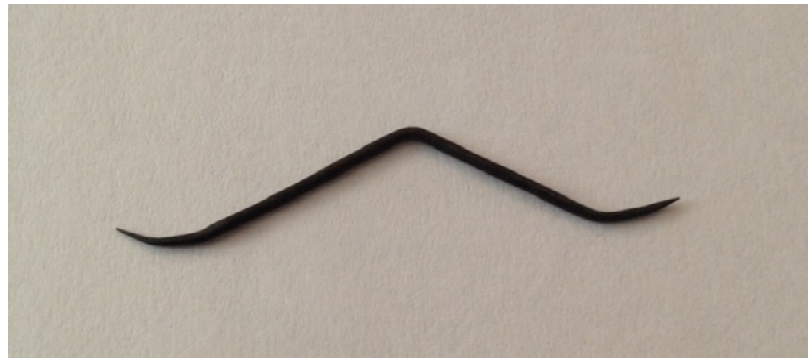
In the present days Maori from New Zealand still produce traditional hooks from whale bones.

One of the oldest fishing gear facility was found in Oman 6-4 thousand years BC utilizing shell of pearl oysters (*Pinctada margaritifera*).

Ancient dwellings were present around the lakes of Ohkrud and Prespa in the Balkan region, from that time a particular Albanian hook different from the common shape is still used in carp fishing. Probably the lack of success of this hook (see figure below) relies in its high selectivity: the size of the prey depends on the hook length and it catches only carps. It may be probably a useful tool for selective inland fishing where only adult fishes need to be caught.



The first hook in history



A particular Albanian hook used for carp fishing

### ***The fishing and hunting Encyclopaedia***

- At the time of the French Revolution (1784) scientists start building the Encyclopaedia (the description of human knowledge) including fishery and hunting gears (1751).

This was the first systematic document on fishery.

### **Harpoons and spear guns**

Harpoons represent one of the oldest fishing systems; their use is under the control of the fishermen so they can be considered the most selective way of fishing.

Harpoons are prone to oxidation of the metal tip and the loss of sharpness due to their continuous use. Furthermore harpoons often break between the metal edge and wood handle, so it is important to periodically control this connection to avoid any loss of the gear.

The hand harpoon fishing is still practiced inland by rural communities to catch salmon, trout, eels and big cyprinids. At sea level harpoons are a valuable tool to capture big fishes like swordfish, seabass and, unfortunately, marine mammals as well.



Fishing with harpoon in S.E. Asia



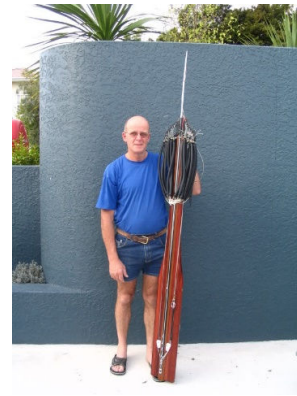
Marine fishing with harpoon





Different shapes of harpoons

The use of harpoons has not declined, but following the human evolution are now mostly used in form of sophisticated spear guns for scuba fishing activities.



Modern harpoons

Spear guns are commonly used. Two are the most used models:

- Oleopneumatic
- arbalete



Oleopneumatic gun (air propulsion)



arbalester (elastic propulsion)

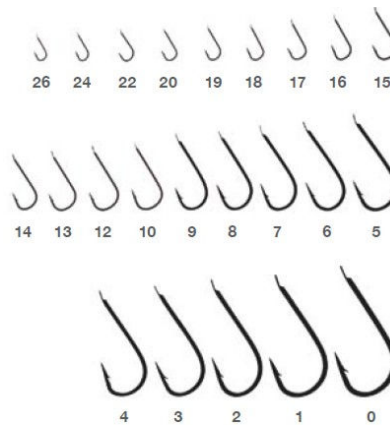
For oleo pneumatic it is necessary a good maintenance with programmed substitution of the O-ring and oil. It is important to wash carefully the gun after use to avoid that sand or stones enter inside the head of the gun causing damage to the aluminium pipe and piston which results in air pressure and oil loss.

The arbalest maintenance is simpler, limited to the periodical check of the elastic integrity, the release mechanism and the good condition of the rope between the spear and the gun.

The duration of the elastic is strictly linked to the use, UV exposition as well as ozone when stored. It is recommended to keep the elastic in a closed envelope if not in use for a long time.

## Hooks

The size of hooks varies accordingly to the materials used. Hand-made hooks were very limited in their lower size by the resistance of the materials used. However, the present technology allows to produce carbon steel hooks of 2 mm of gape.



Stainless steel hooks

Hooks are made of iron or steel and need to be protected by oxidation, stainless steel hooks are also available on the market but they are more flexible.

While iron hooks are destroyed by corrosion, thus leaving them into the mouth of an escaped fish for just a little time, stainless steel hooks can last longer, and can be the cause of the successive death of escaped fish.

## Hook maintenance

Hooks need to be protected by oxidation that occur especially when they are fixed on a soft substrate like plastic, polystyrene or cork containing moisture or salt water.

It is a good management practice to let the hooks dry before fixing on substrate or treat them, or the substrate, with oil (ideally silicon oil) in order to avoid contact with water for the time they remain fixed on.

Particular care is needed for artificial bites. Feather bites need to be dried and closed in dry boxes with aromatic leaves, cloves or pepper in grains to prevent insect attacks that can destroy the feathers. On the other hand the plastic and metallic artificial bites must be washed from salt and dried before storage



Feather bites



Artificial bite made of plastic



Artificial bites in the shape of fish, frog and metal spoon

## The longline and handline

Line fishing can best be described as a massive scale hook and line operation. This systems of capturing fishes is used for both small and large-scale fishing.

The simplest form of fishing requires only a line and a baited hook. The line is cast into the water where the fish supposedly are. The fish is attracted to the hook by visual stimuli, either natural bait or more commonly in the form of artificial imitations of prey organisms like lures, jigs, rubber worms. The fish take the bait and are hauled in.

Hook and line fishing is inexpensive and easy, although some bait is needed to be procured. Almost any boat or shoreline can be used and the catch is live and of high quality. Different sizes and type of hooks and lures can be used to catch different fish species and sizes.

Longlines can be made with different materials or a combination of them:

- Monofilament (nylon or polyester)
- Synthetic rope, or rope & monofilament
- Metallic wire, or wire & rope

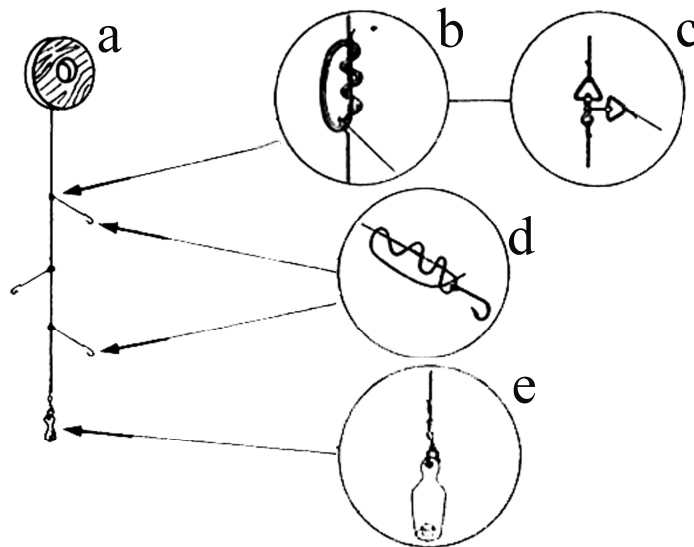
The nylon monofilament can be easily damaged by UV as a consequence of the long exposition to direct sunlight. Alternatively ruptures can be caused also by abrasion on stones.

The ropes, if made of synthetic materials, must be checked in order to avoid cuts or production defects. The ropes must be washed and dried after use.

Wire parts must be controlled in their connections with swivels, hooks and rings because of rust.

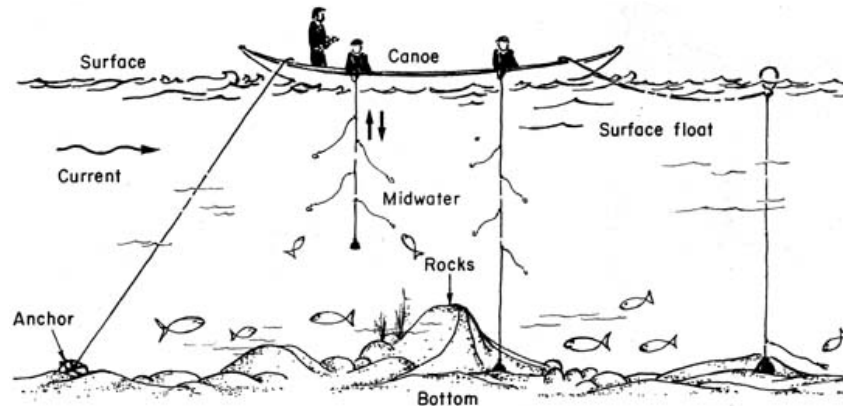
### *Handline*

The hand line is simple: a nylon monofilament is commonly used as line with one to several hooks at the end with bait or lures.

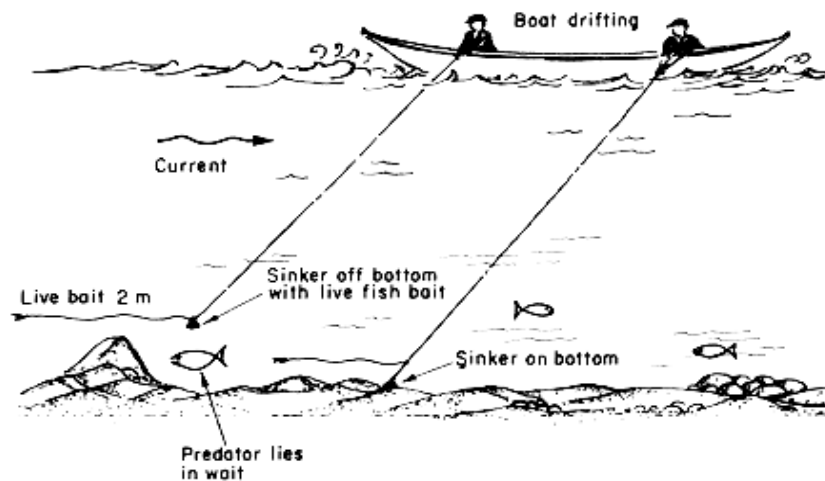


Particular of a handline. a) wooden spool; b) branchline attached to mainline loop; c) alternative branchline attachment, with swivel; d) hook attachment; e) sinker attached with swivel (FAO, 1992)

The fishing line can be used vertically from a drifting or anchored boat or from the shore. In case of boat the fishing can be scaled up by using several lines on larger vessels. Often multiple hooks on the same line are attached in pairs to form balanced lines. Hooks and line can also be used in trolling where the fishing line is towed behind a moving boat.



Handlining from an anchored boat (FAO, 1992)



Handlining from a drifting boat (FAO, 1992)

At the sea typical target species with handlining are demersal fishes like snapper. Trolling is more used for pelagic species like mackerel and tuna.

BMPs focus on taking good care of the fishing gear, regardless its simplicity. Never leave a line or hooks lying around on board or anywhere else. Hooks and even loose lines can cause serious injuries. Use a spool to wind your line on. Spools can be easily made from pieces of bamboo, wood or from plastic bottles.

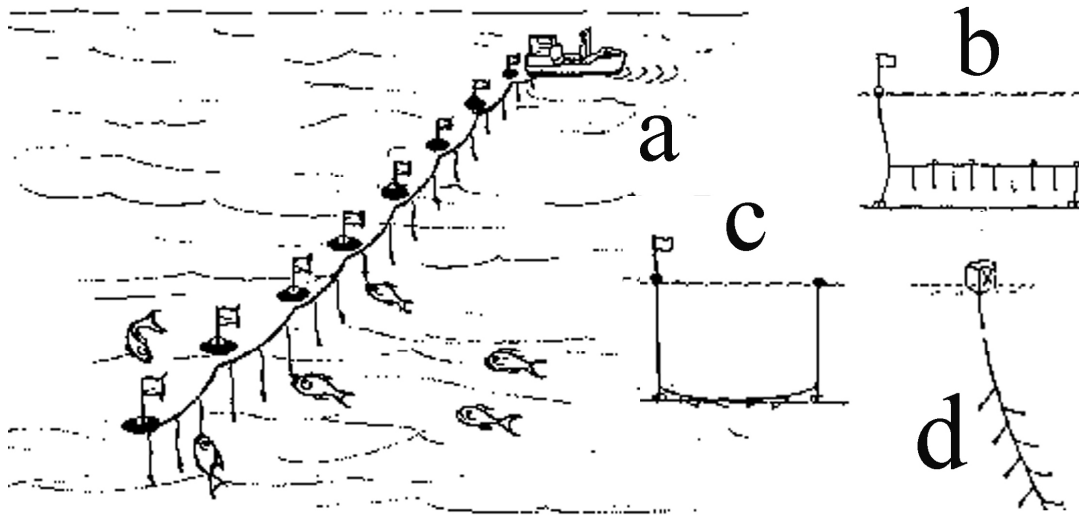
### **Longline**

Longlining is based on attracting fish by bait attached to the hook. While handlining and trolling visually attract the fish through by artificial lures, longlining attracts the prey with the odour released by the bait.

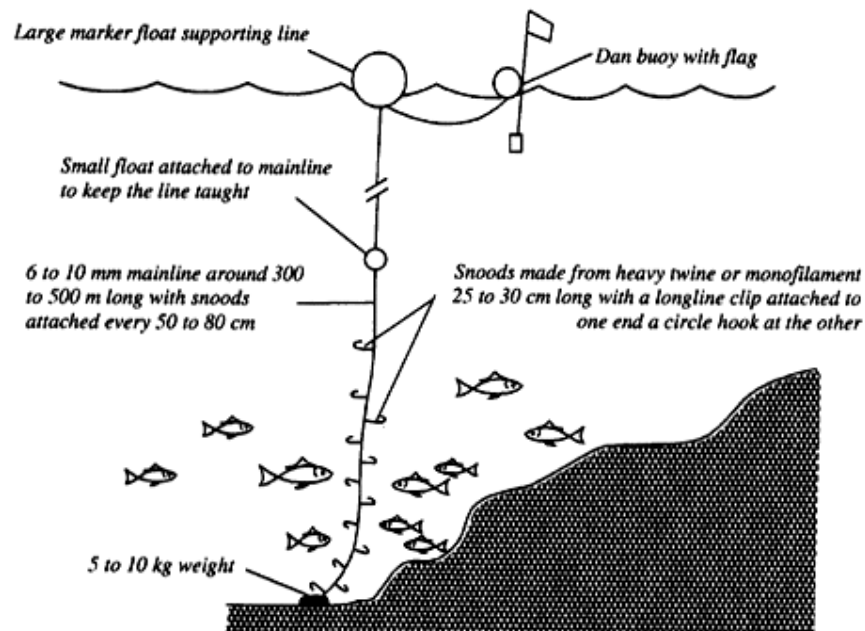
The construction is simple, as hooks attached at given spacing and are connected to the mainline with relatively shorter and thinner leader lines (snoods, gangions). Different designs are possible depending on the type of fishery. Differences mainly concern the thickness and material of main and leader lines, the spacing between hooks, as well as hook and bait types.

Fishing cycle includes the following steps: positioning of the bait on each hook, setting the longline, fishing for some hours, retrieval, removal of fish and old bait, gear maintenance.

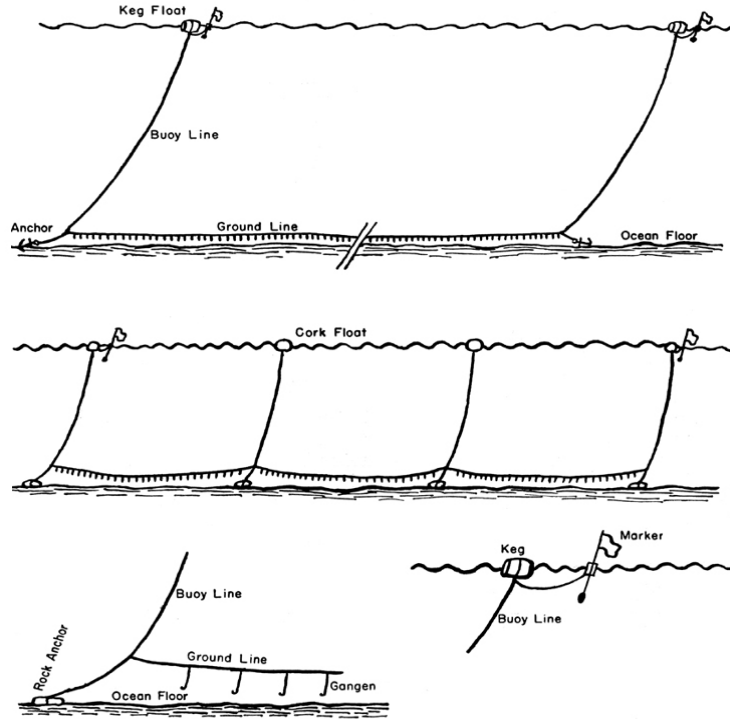
At the sea longlines can be either pelagic, bottom set or vertical (droplines). The first are mainly utilized for tuna and swordfish (drifting), the second for demersal species like snapper, ling, tusk, hake and toothfish, the third for fish moving from the bottom to the surface.



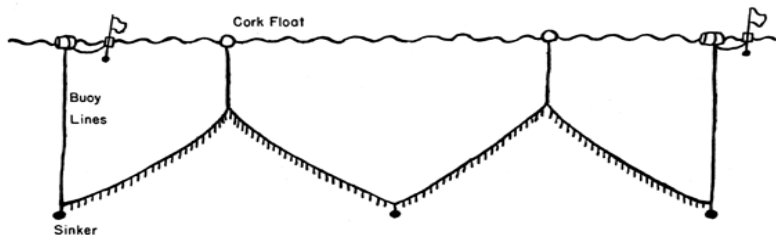
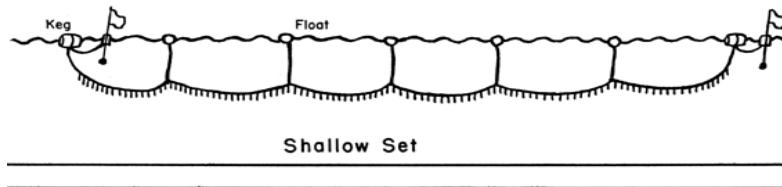
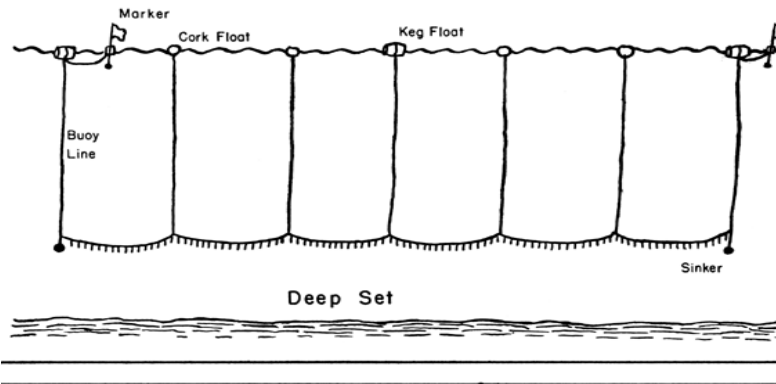
Long lines deployed at: surface (a), mid water (b), at the bottom (c), or vertically (d) (NRC 1988)



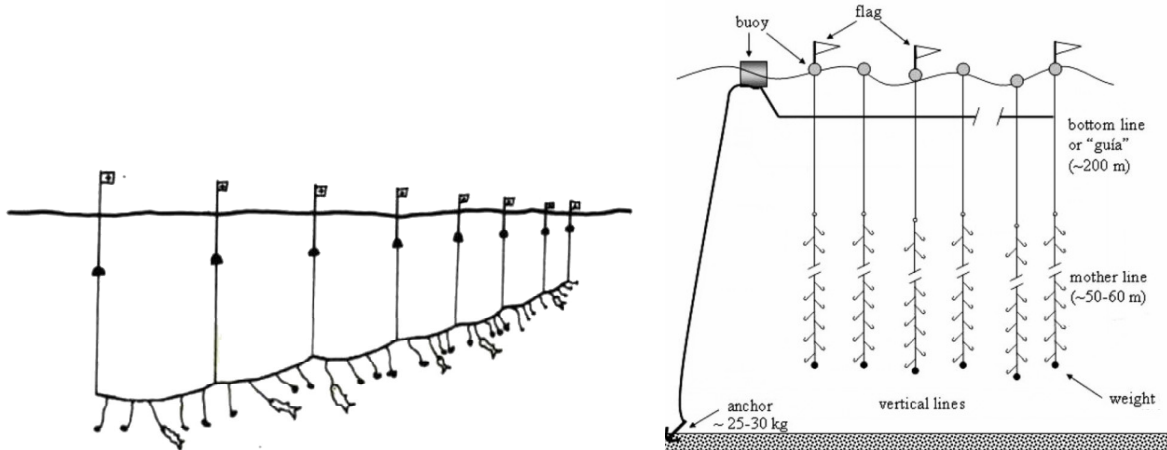
Dropline with 5 kg of weight at the bottom suspended by a float. This gear can catch fishes that move from the bottom. The mainline is 300-500 m (FAO 2006)



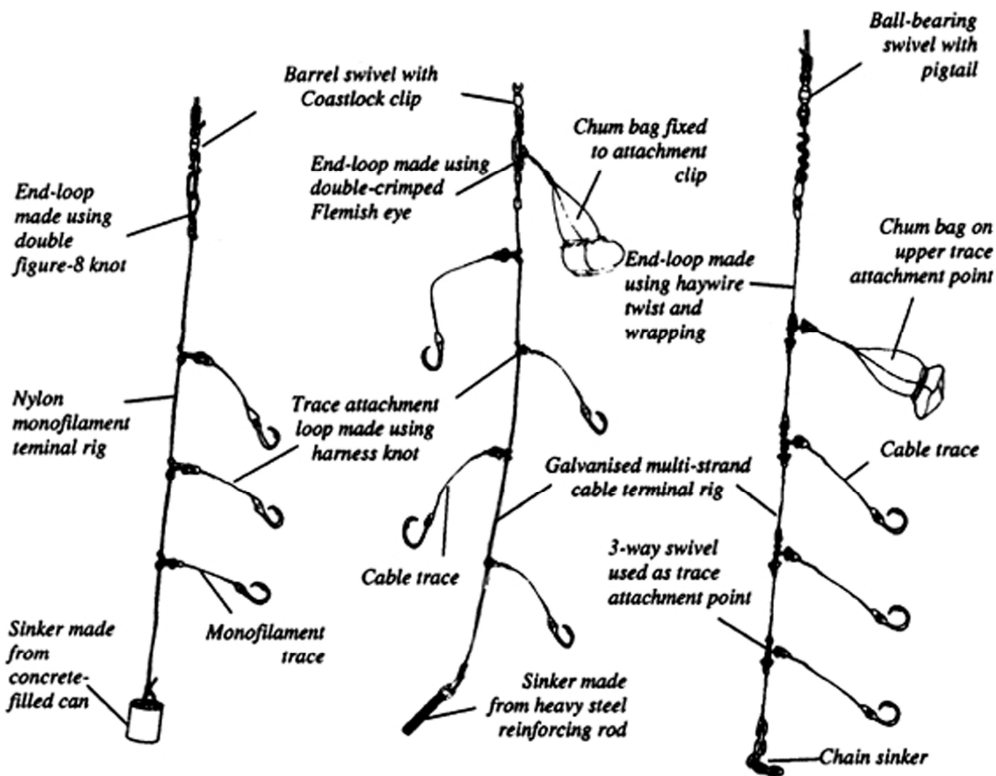
Set longlines for bottom (Scofield, 1947)



Drift longlines for surface and mid-water (Scofield, 1947)



Examples of longlines with leader rope hanging terminals with single or multiple hooks. Signals and buoys help fishermen to pull up the longline (Moreno et al. 2006 – modified)



Type of terminals from the main line (FAO 2006)

For both longline or handlines it is good management to use handreels to quickly recover the gear and to fasten the removal of the catches. Reels reduce the risk of personnel being wounded by spare hooks onto the boats.





Different type of handreel to recover the fishing gear

### ***Long line building***

Three steps in the building of a long line of monofilament are suggested:

- 1) The leader has to be forcefully pulled as much as possible in order to take easily the shape of the box
- 2) The terminals must be fixed to the leader rope, so that they cannot slide on the leader
- 3) After tying the hook cut off the excess monofilament.

Boxes of particular shape allow a fast descent into the sea of the long line without interruptions (in some case at low engine speed).

A good management practice is to put several signals (more than two) on the long line.

The signals help the fishermen to pull up the maximum quantity of the gear if it gets hooked at bottom rocks.



A longline box with nylon leader and hooks



A longline for tuna and swordfish

A tuna/swordfish Mediterranean long line of medium size is usually composed by a monofilament leader of about 10 km with not less than 500 hooks.

A tuna long line with rope leader is made of expensive components and it needs a lot of work to build it.

Consider in the investment the costs of bites: tuna and swordfish eat squid, mackerels and sardines but of good quality.

Because of the unpredictable big prey reactions it is highly recommended to divide terminals from the leader and link them together during the descent into the sea in order not to expose the fishermen to the risk to be wounded by hooks jumping out of the boat pulled by a big fish in its escaping attempt.

The same should be done when pulling up the long line's dividing terminals from the leader in different boxes.



A tuna captured with longline



System to tie the hooked terminal to the leader

It is important to check periodically all metallic parts of the long line in order to evaluate the state of corrosion affecting such structures and eventually replace those that appear damaged.

## Traps

In the past traps were built by fishermen, who used their experience and the cheap/free materials available locally such as wood, bamboo, handmade ropes. Nowadays traps are mostly made with metal or plastic and add to the costs of fishing because they need to be purchased.

Traps are made of different materials and can be divided in:

- Wooden/bamboo
- Plastic
- Metal

As traps have to stay for several days in the water is important to check the structure and to repair them as soon as some damages are spotted.

Wooden traps can be repaired by substitution of their components with new wood fibres or sewed with rope. The same can be done with plastic and metallic ones by using repairing materials such as nylon or plastic. Clay pot traps are usually substituted if damaged.

In saline environments avoid to put in contact different kinds of metals in order to reduce the galvanic corrosion.

On an environmental point of view gears made with natural materials reduce the risks that a lost trap may continue to catch fishes over a longer period of time, since the organic materials used degrade in short time. It would be a good practice to secure the traps with robust ropes and check them regularly.



Traps for eels



Traps for fish



Clay pot traps



A modern trap made with net and metal

### **Fixed traps**

Fixed traps can be divided in inland (mainly estuarine) or marine.

The inland traps are used to catch anadromous and catadromous fishes that move between the saline/brackish to the freshwater environments.

The coastal marine are built to intercept demersal or pelagic fishes during their seasonal migrations.

Fixed traps are big and costly. They are usually managed by communities or FMO.

### ***Inland fixed traps***

The fixed fish traps are permanent/semi-permanent chambers made with different materials according to local availability. In general metal grids or other openings in the materials used for the construction allow spaces that are calculated to allow fingerling to escape but to capture larger individuals. The fishes moving toward the sea (or vice versa) remain captured into the traps. It is

important to construct these chambers with proper dimensions to let the fish stay alive till harvesting. Insufficient space or water circulation can in fact cause oxygen depletion into the water with consequent death of fish.

In traps harvesting is done with hand nets on a regular basis or upon verification of fish captures.



A fixed trap made with metal and nets



Barrage traps made with nets and stakes

Required actions to improve productivity:

- Reach the right salinity by using channels to circulate water from outer sources.
- Avoid the highest and lowest temperatures by adding holes, promoting higher water exchange with channels, improving shadow by growing trees.
- Ensure the easy migration of fry during tides.
- Ensure a proper management by correctly sizing the dimension of the fishing gears (net mesh size to allow juveniles to escape), and the fixed trap functioning by regulating the spaces between wooden structures or metal grids to capture fish of adequate sizes.

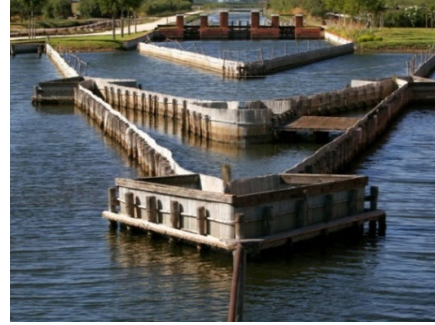
Water exchange is essential to maintain good oxygenation of water and to control salinity. Good management should:

- Ensure the best water circulation inside the lagoons by using tidal effects.
- Maintain open sea channels while controlling the tide and wave effects.
- Evaluate the quantity of clear water inlet

### ***Choice of the fixed trap***

According with the quantity and the quality of fishes available, and the economic possibilities of the fishermen/communities, different systems have been developed during many centuries of experience, by developing designs adapted to the geographical characteristics of the area, the tide/flow of the water and the local materials available.

Net, wood, bamboo, common reeds are the most economic materials in the S.E. Asia, they can be integrated with existing structures such dikes or shallow canals. BMP should consider the incidence of the water flow and the tides in the area to correctly dimension the supporting structures, also in view of the high water flow occurring during monsoons and the risk of debris impacting the walls.



Photos of barrage traps made with wood in Europe

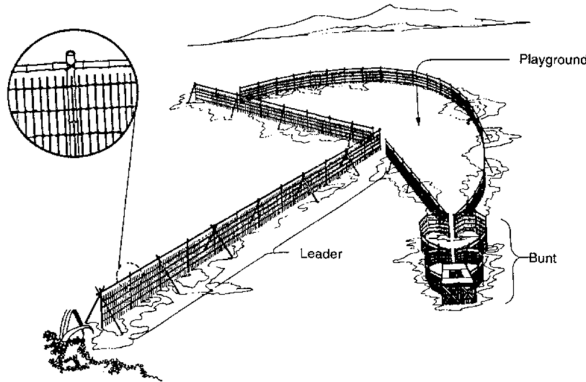


Designs of fixed traps in Europe

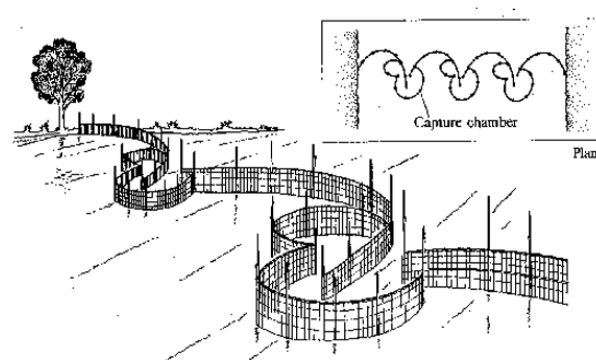


Barrage traps made with stakes and nets

Structures, frames or nets must be regularly inspected to prevent fish from escaping. In Asia, where the excursion between the high and low tides is high, it is possible to carry out regular monitoring during when the sea level is low.



Fence trap (IIRR, 1995)



Barrage trap in Benin (FAO 1995)

Closed seasons are locally established by the government, in that period the grids and nets are removed from the water for an easier migration of the fish.

Lagoon fishes are sensitive to temperature variations so it is important to monitor the environmental conditions as well as to ensure a good water circulation through channels. This is particularly important to bring in more oxygenated or less saline water. The control of the water is

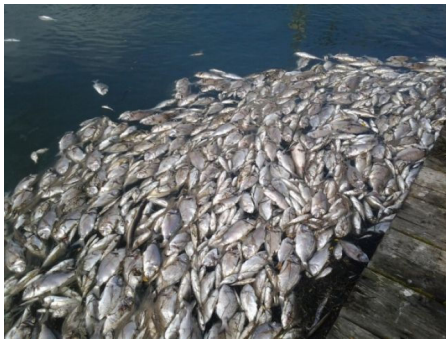
very important for lagoons where the increase of salinity due to evaporation and the raise of temperatures may harm the fishes and procure widespread deaths.



Constructed channel in Lesina, South Italy



Salt & temperature checks in lagoon (blue dot)



Deaths in lagoon due to poor oxygen



Aerated nursery serving a lagoon

Nurseries for restocking the fish inside the lagoon are possible if permitted by the Government. Nurseries can be variably managed also by means of net cages, pens, and the use of aeration.

### Marine fixed traps

Like the inland fixed traps the marine gears should be carefully designed to capture the species of the size desired. Contrarily to the inland traps the construction should take into account of the impact from waves. Opportune moorings, buoys should be put to secure the traps.

### Small and large tuna traps

Small tuna traps are used, but they are not exclusively built for catching tuna but rather a variety of pelagic and demersal fishes. The normal catches are seabream, seabass, yellowtail, pompano, sunfish, bonito, but rarely tuna because of the proximity of the trap to the coast. In the Mediterranean Sea the trap is prepared during spring (April-June) and removed in winter (January-March).

The BMP should focus on the frequent control of the structure and repairing of net.

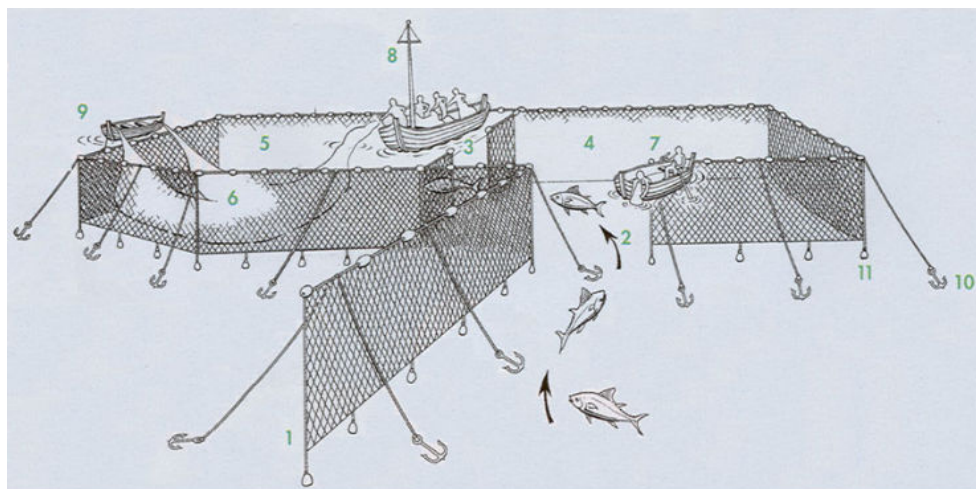
Twice a day fishermen look if fishes are present inside the trap and pull up the bottom of the net in order to push the fish to reach the dead end of the trap, also called the chamber of death.

The fish is manually collected and stored inside the boat in a ice slurry.



Positioning of nets for the small tuna trap

Tuna are pushed towards the death chamber



A small coastal tuna trap, also for pelagic fishes. Barrage net (1), entrance (2), secondary entrance (3), collecting chamber (4), death chamber (5), hauling net (6), fishermen boats (7, 8, 9), anchors (10, 11). (Cattaneo-Vietti et al., 2014)

An ecological system is practiced in Italy, where nets with biodegradable materials like coconut fibre are used. Nets are left at the sea bottom at the end of the season and are left decaying.

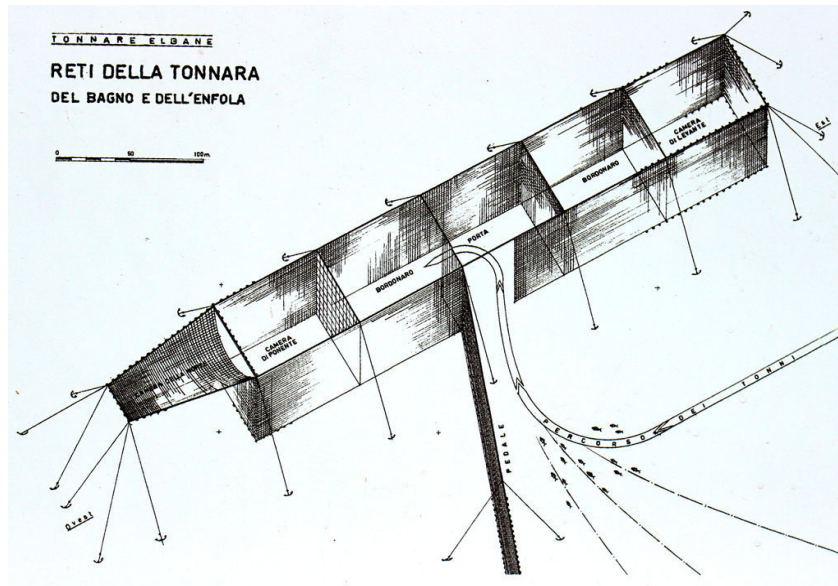
Large tuna traps are built on the migration pathways of Atlantic tuna (Bluefin) and need a lot of persons involved in harvest operations. These follow the same design of the small tuna traps, but with more extensive use of moorings with same BMP and work activity: maintenance of the nets and the supporting structure must be carried out regularly particularly when rough sea occurs.

Tuna, as well as all the fish belonging to the same family (scomberidae) requires BMP application. The main risks are related to histamine raising in the flesh because of high temperature exposition and the transfer of the parasite *Anisakis* from the gut to the flesh. The fish have to be stored and cooled as soon as possible by transferring them from the boat to a cold room or box with ice slurry (the temperature have to be around 0°C) so reducing histamine raising as well as inhibiting *Anisakis* worm migraton.

Presence of *Anisakis* parasite as well as excessive stress of the fish during harvesting are causes of lower prices. Unfortunately the tuna trap system does not allow to reduce stress in fish in particular

when many fishes are present in the same harvest. Reducing the volume of the net, the oxygen is no more sufficient for all the fishes. Before they die they must be pulled out of the water by fishermen to preserve their freshness.

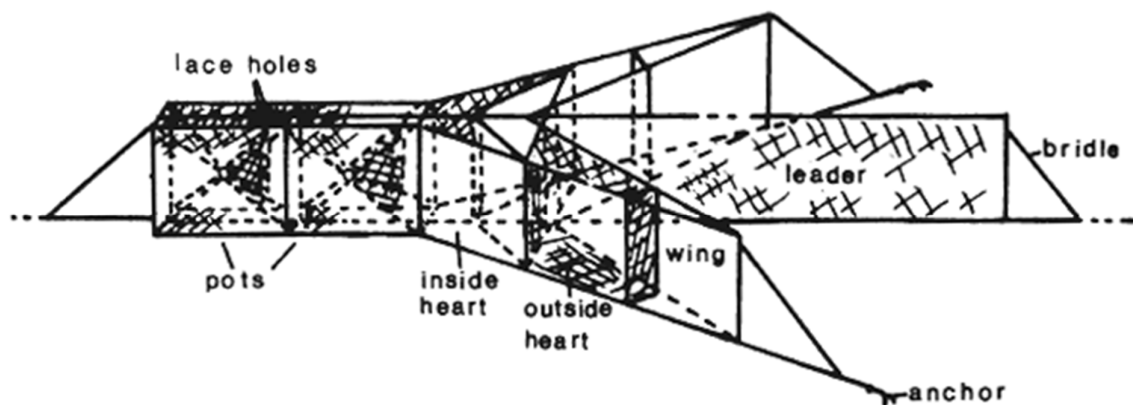
In any case only few animals per harvest action cannot be considered as stressed and sold for high quality tuna (i.e. for sashimi preparation) the main part of the fish is sold for canning industries.



A large tuna trap

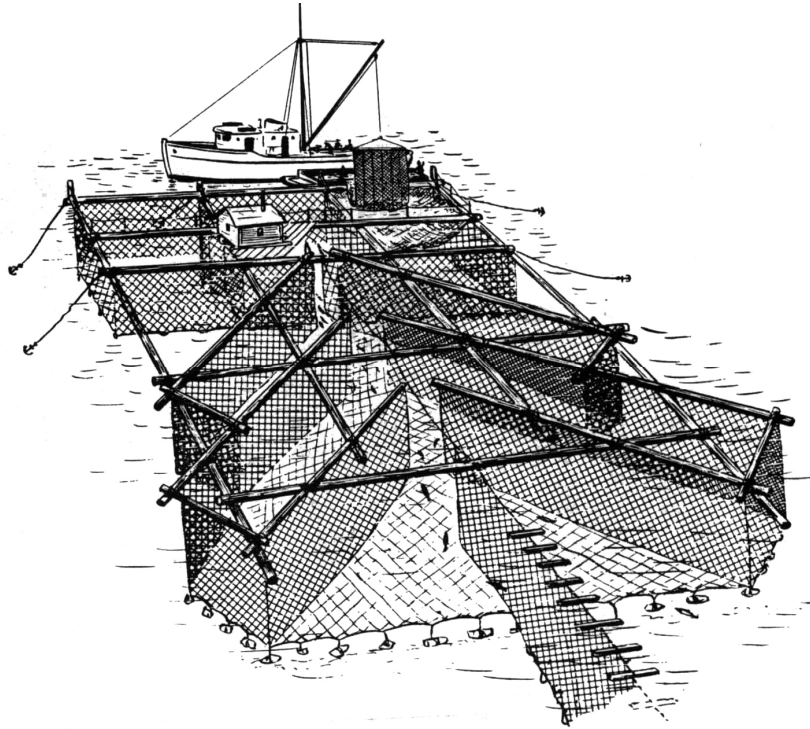
### ***Other marine traps***

Marine traps can be used for capturing other fish species. They are often floating trap nets which are anchored to the bottom. A leader separate the two wings that lead the fishes in the trap. In smaller traps fish are extracted through the lace holes at the end of the pot or, in case of big traps, with hand nets



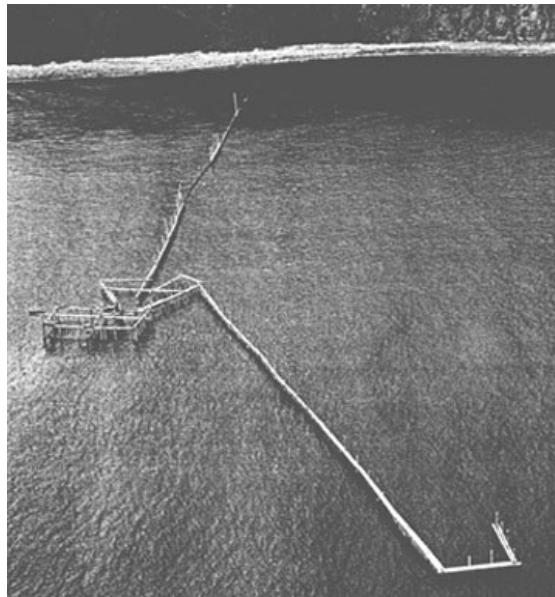
A floating trap anchored to the bottom (FAO 1980)





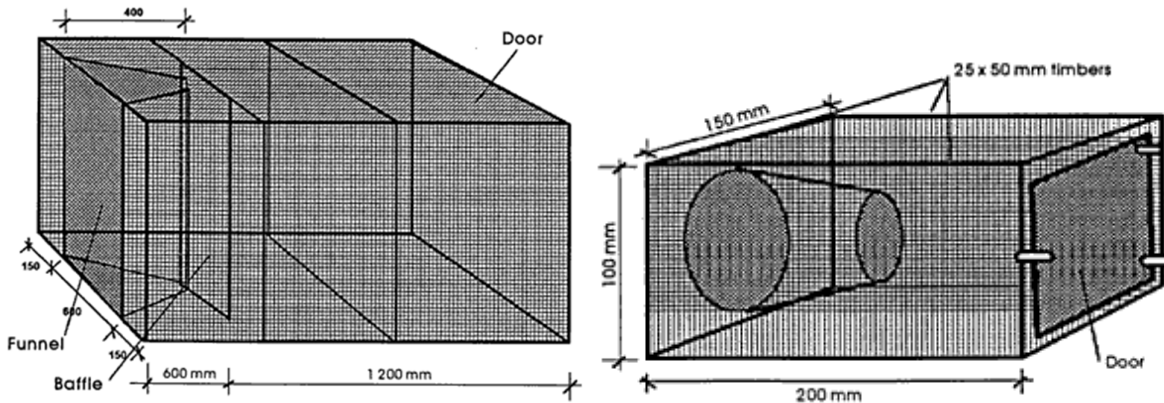
A larger floating trap made with poles and nets (ISER, 2000)

Marine fish traps can have leaders, arms or ears to guide the fishes towards the main chamber, the length vary in length from 10 m to 50 m depending on the stream. The sides of the trap and the strong current prevent the fish from escaping.



Fish trap with arms to convey more fish to the central chamber (ISER, 2000)

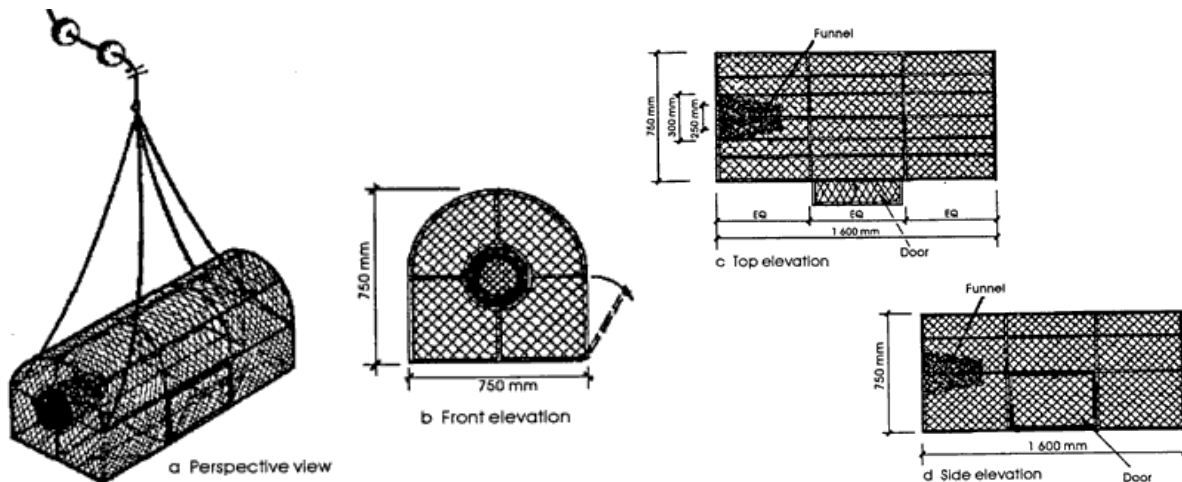
At small-scale level smaller size traps made with local materials, such as rattan, bamboo, nylon net or welded mesh can be used to trap fish. The size vary on the type of catches, with sizes starting from 1-2 meter in length. The entrance can be either funnel or wedge shaped, although the funnel type is more efficient in preventing the fishes from escaping. Rectangular cages are used in areas where the current flow is not great because of their tendency to roll. The bait is tied or placed in a bait basket in the centre of the trap. D" shape is preferable to the traditional rectangular fish trap in areas of stronger currents, as it offers less resistance to water flow and is less likely to roll.



Trap with wedged mouth (FAO 2001)      Trap with funnel mouth and back door (FAO 2001)

The traps can be positioned at the bottom, or can be suspended to catch pelagic fishes. In shallow waters bottom cages can catch snappers, jacks and trevallies.

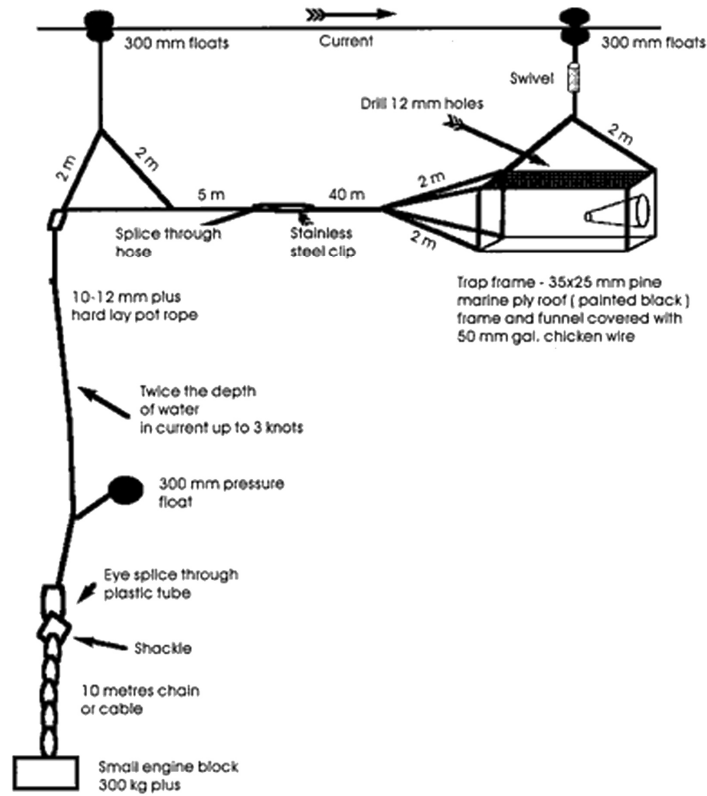
It is always good practice to: soak the trap before fishing, regularly brush the trap with chlorine to remove growth, position the trap on thermocline directly above reef.



D-shaped cages with funnel mouth and side door to take out captured fishes (FAO 2001)

Pelagic fish traps, although not very used are effective in catching pelagic fish due to their attraction to fish that seek "protection" in open waters. In mid-waters they can catch fish such as king fish, rainbow runners, trevallies and jacks. The cages are not built with any weights and have a wooden

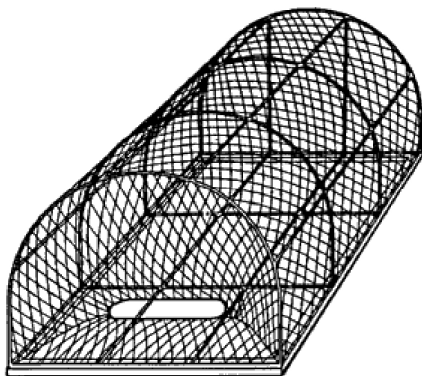
roof painted in black. The shadow created by the roof attracts the fishes seeking for shelter, which makes not essential the positioning of a bait.



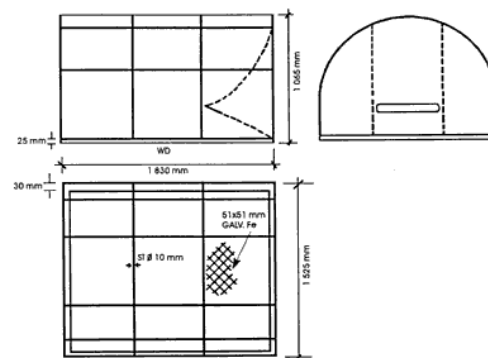
A scheme of a suspended pelagic fish trap (FAO 2001)

### Traps for crustaceans and cephalopods

Lobster traps are either made with wood or metal frames and covered with wire or synthetic mesh, and are covered with mesh that varies according to the prey being captured. The pots can be either rectangular or D-shaped.

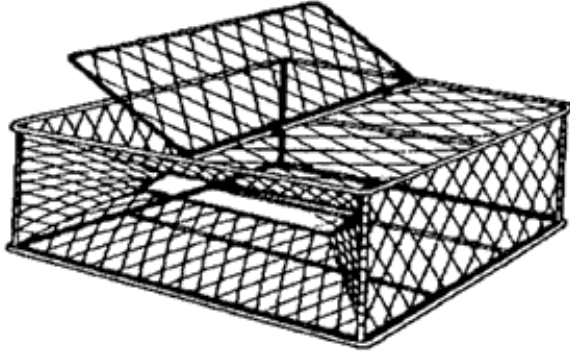


D-shaped lobster trap for bottom (FAO 2001)



D-shaped trap with 50 mm mesh (FAO 2001)

Crabs are often taken by hand or with hand nets, however traps are also an important fishing method. Traps are not large (1.5' x 1.5' x 0.5', on average) and of simple in design. Frames can be made of bamboo, wood or steel and be covered by a mesh of 50 mm size. A piece of fish is used as bait.

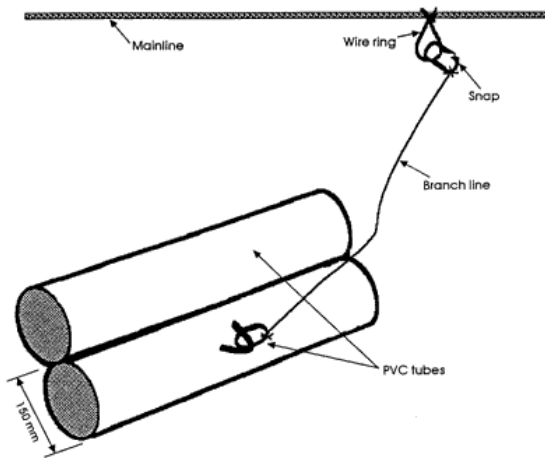


Design of a crab trap (FAO 2001)

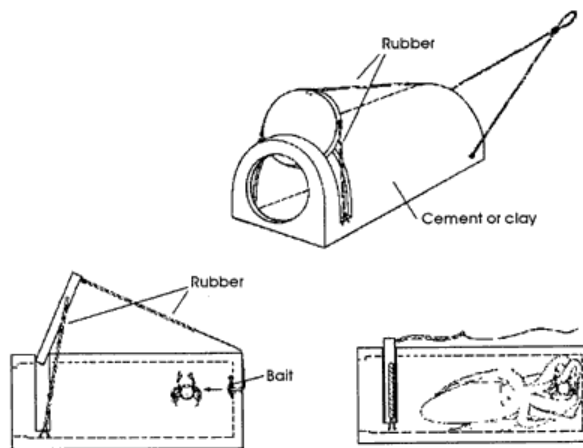


Local crab trap made with small bamboo

Squid and cuttlefish are mainly taken with fishing gears, but some simple traps are efficiently used. Unglazed earthenware pots are used in traditional octopus fishing in the Mediterranean and Southeast Asia. The pots are placed on the sea bed for octopus to use as shelter. Alternatively PVC pipes with a closed end or any empty receptacle that provides shelter can be used. Octopus pots are normally set overnight attached to longlines with up to 100 pots on each line. They are hauled back up in the morning. The number of traps on each line depends on the extent of the grounds and the size of your vessel. Traps can be baited or not



PVC pipes for octopus (FAO 2001)



Baited trap with closure for octopus (FAO 2001)

## Nets

Nets are devices made from fibers woven in a grid-like structure. Fishing nets are usually meshes formed by knotting a relatively thin thread. They are usually linked to floaters in the upper part (head rope) and a sinking rope (bottom rope) in the lower part.

Modern nets are usually made of artificial polyamides like nylon in mono or multifilament.

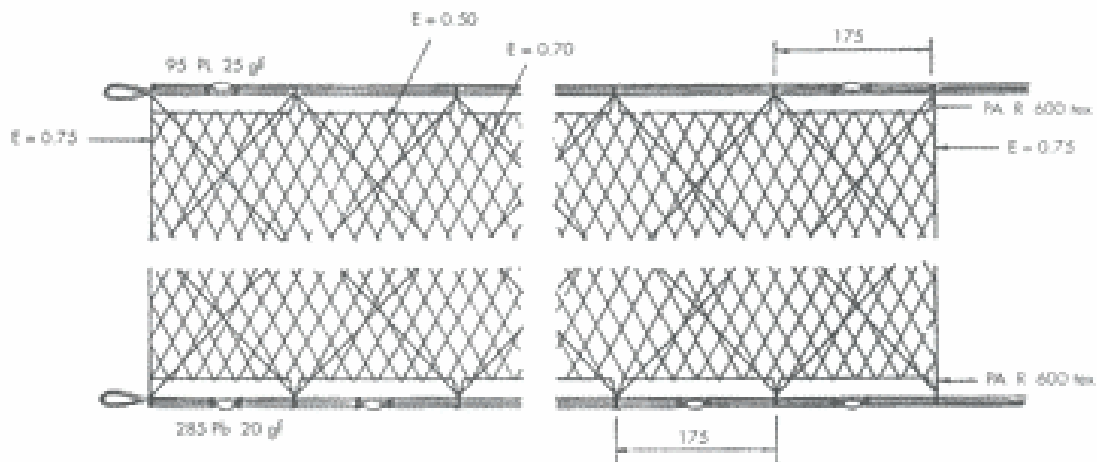
Nets are used to close the fish inside or to trap it between meshes.



Net with head rope with floaters

## Trammel

A trammel is a fishing net with three layers of nets that is used to capture fish or crustacean. A slack central layer with a small mesh is positioned between two outer layers with a much larger mesh. The net is kept vertical by the floaters on the head rope and weights on the bottom rope.

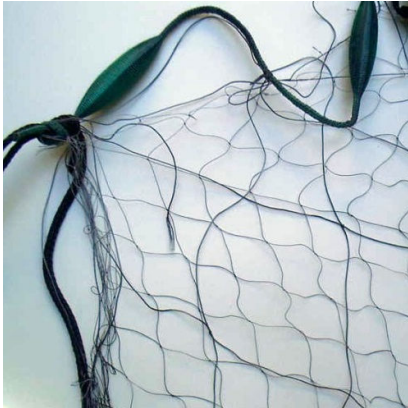


Particular of a trammel net

Fixed to the bottom or drifting the trammel is one of the most effective fishing gear.

Due to the three net of which it is composed, the resistance of this net is high and captured fishes cannot escape.

The BMP for trammel consist in a continuous control and repairing of the three nets of which it is composed. As the particular structure retains a lot of trash (vegetal fibres, shells, stones, plastic, etc) is important to dry the net under sunlight and hand clean before using.



Particular of the end of the trammel



Fish trapped in the trammel net



Sinking rope



Floating rope

### Monofilament net

Monofilament nylon gillnet (sometimes known as glass) is the most common type of gillnet. This net works very well in clear water and in daylight hours. This net is strong, soft and made by a unique nylon filament knotted in mesh.

Monofilaments net are not easy to repair so many fishermen prefer to change them when too damaged.

The success of this kind of net is the low cost and the capacity to be practically invisible when in water. For this reason is very important to wash it regularly to remove clay attached on the mesh knots to avoid the fish can easily see the net.

A better practice is to increase the number of signals not only on at the two extremity, in order to have more chances to pull up the net in case it remains attached to the bottom.

Monofilament degrades with time and can weaken when exposed to heat and sunlight so it is a BMP to wash with clear water and store in shadow when not in use.



A monofilament net made with nylon used for small-scale fishery

**The ecological problem:** the nets are sometime lost by fishermen and they continue to fish for a long time. It is important to take all the necessary remedies to prevent their losses.



An abandoned net still capable to catch fishes

### Lifting nets

Lifting nets are squared net with squared mesh often realized by strong polyamide multifilament.

These are held horizontally by a large fixed structure and periodically lowered into the water. Huge mechanisms hold out horizontal nets with diameters of twenty metres or more. The nets are dipped into the water and raised again, but otherwise cannot be moved. The nets may hold bait or be fitted with lights to attract more fish.

These net are soon lifted from water when fish is seen to cross over or periodically in muddy waters. They can be of different sizes and big ones are pulled by electrical motors.

BMP: The repairing is common practice as well the check of the pulling systems .

For hand lifted net after the transport back home they must be washed and dried before folding and storing so avoiding moulds growth as well as corrosion of the metallic part of the gear.



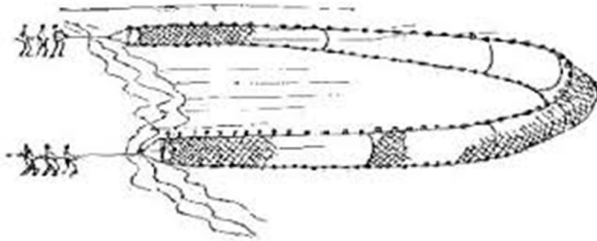
A hand lifted net using bamboo



particular of the lift net

### Shore trawl

It is also called beach seine, because the seine net is operated from the shore. It has some similarities with trawling but the power in this case is the human force and not the boat engine. The net is released by a boat into the water from the shore line, making a circle and returning to shoreline, then pulled by men till it arrives on the shore so collecting all fishes of the circled area.



Shore trawl pulled to the shore



Net should be easy to handle by fishermen

Shore trawl are forbidden in many countries because they collect little fishes.

The BMP for this kind of net are linked to the quality of materials:

- A proper sinking rope must be strongly sewed to the net to resist to the abrasion of the sea bottom.
- The net is constructed with decreasing mesh size till to the thick sack in the end (middle of the length)
- The sack has to be sufficiently long to guarantee that fish cannot easily escape back.
- Ropes on the two sides have to be resistant and of proper measure in order to be easily pulled without causing any injury to the fishermen's hands.

### Other fishing systems

The following fishing gears cannot be considered as small scale fishery in Myanmar as the power of the engine is much more than 25 hp as prescribed by law.



## Bottom and pelagic trawls

Are the evolution and mechanized application of shore trawl.

A trawl is a large net, conical in shape, designed to be towed along the sea bottom. The trawl is pulled through the water by one or more boats, called trawlers or druggers. The activity of pulling the trawl through the water is called trawling or dragging. Trawlers are divided in bottom and pelagic ones according with the position of their operating nets.

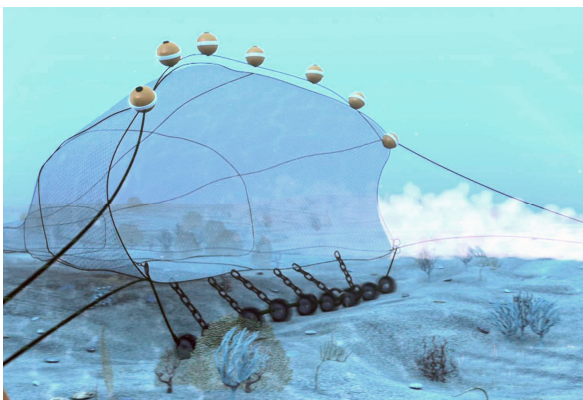
Bottom trawling results in a lot of bycatch and can damage the sea floor. A single pass along the seafloor can remove 5 to 25% of the seabed life.

Pelagic trawls have a lower ecological impact than bottom trawls, firstly because they target small and medium pelagic fish and secondly because they have no destructive contact with the sea bed.

The power of the engine is linked to the fishing capacity so big boats catch more.

BMP for trawl fishing:

- 1) Net and wire repairing and maintainace
- 2) Cleaning of harvest area with clean water, cooling surfaces with clean seawater before harvest
- 3) Fast selection of the fish away from direct sunlight and cleaning from mud and litter with clean water
- 4) Quick cooling of fish in ice and storage in thermal containers of appropriate size to avoid fish being compressed. Put the containers in cold storage area or under shadow
- 5) Net washing in case of operation in muddy seabeds



A bottom trawler can damage the seabed



A trawl pulled out from the water

### ***Environmental and economic aspects that make trawl not sustainable***

- The trawl system is not selective on the type/size of fishes
- The mesh size pulled by the engine don't let little fish to escape.
- Divergent and heavy ropes damage the sea bed and their ecosystem.
- The catch is composed mainly of little fish, often damaged, and sold at low prices.
- The big engine consumes a lot of fuel.

- The net is made of plastic material, if lost on the bottom rocks remain for several years and continue to damage the local fauna by catching fishes
- The person employed are fewer than other fishing activities and in rapport to the quantity of fuel used.
- Investments for trawls are high, which make the trawl a fishery activity for wealth people.

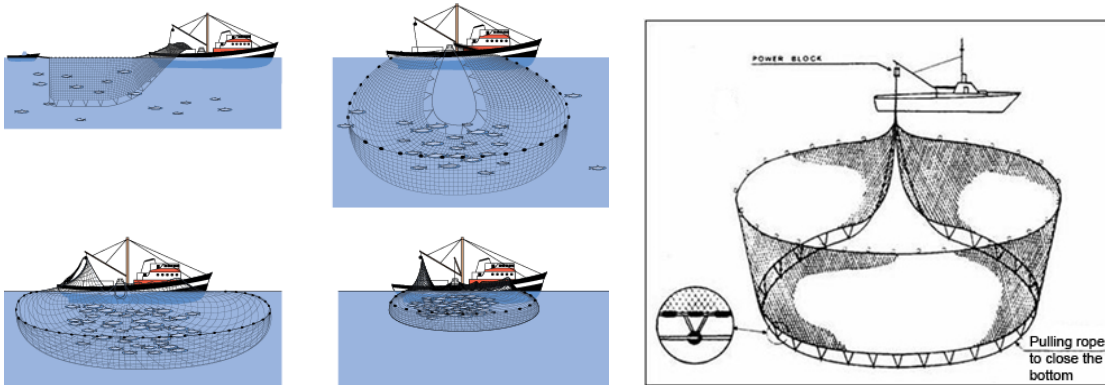
### The Purse seine

Another fishing system that requires strong power engine.

The purse seine, widely used by commercial fishermen, is an evolution of the surround net, which in turn is an evolution of the seine net. A large net is used to surround fish, typically an entire fish school, on all sides. The bottom of the net is then closed by pulling a line arranged like a drawstring used to close the mouth of a purse. This completely traps the fish.

Purse seine are also used to catch Atlantic tuna but the most part of them are concentrated on small, pelagic fishes.

Nowadays assisted by eco-sounder and sonar the purse seine is very effective during the night.



A scheme of purse seine functioning

Small pelagic are attracted by light and when concentrated under one of them they are harvested by the main boat.



Fish attracted by light



Observing fish behaviour

BMPs for purse seine fishing follow the same procedures for trawl fishing. Giving the same type and size of the school of fish the prey can be sudden put in ice slurry to kill and cool the bodies before being put in storage boxes with ice.

### **Best fishing management for fishery sustainability**

The small scale fishery is adversely affected by several factors:

- Fish stock reduction
- Competitiveness with industrial fishery
- Competitiveness with aquaculture
- Raising costs (fuel and oil derived products like plastic net, polistirol boxes etc)
- Pollution
- Number of licences and their costs, taxes, etc.

However in terms of sustainability small-scale has some advantages against large-scale fishery due to the people involved in the fishing and the reduced consumption of inputs, as shown below.

Policies that focus on the development of the fishery sector should widen the horizons by increasing the opportunities of development for both the industrial and the small-scale sector, the latter more oriented on a livelihood and food security level.






Strategies to achieve both should focus on the adoption of good practices for fishery and postharvest: the former for maintaining the sustainability of the catches, the latter to improve the incomes through added-value productions that can differentiate the income in different areas.

### **Sustainable fishery strategies**

- Respect of closed seasons
- Increase of protected areas specifically targeting reproduction, but that can be used for tourist purposes (heritage, recreation)
- Catch only bigger fish by increasing the mesh of the nets. Bigger mesh let more fish reach their mature stage and this would increase the number of wild stocks.
- Keep the quality of the fish high to get better prices at markets.

Such conservation strategies have proven in the Mediterranean Sea that the combination of reproduction areas, extended closed season and the use of bigger mesh (a shift from 20 to 24 mm) in only two years can achieve 30%-400% more profits and a reduction of 80% of undersize fish with low/no value.

Size at maturity of main fishery species

Species name	Size at maturity	Image
Barramundi <i>Lates calcarifer</i> Kaka dit	38.2 cm	
Bronze featherback <i>Notopterus notopterus</i> Nga Phae Khone	19 cm	
Toli shad <i>Tenualosa toli</i> Nga Tha laut Yank Pha	25.9 cm	
Striped snakehead <i>Channa striata</i> Nga Yant Kyar	18 cm	
Spotted snakehead <i>Channa punctata</i> Nga Pa Naw	16.5 cm	
Hilsa <i>Tenualosa ilisha</i> Nga Tha Laut	25.7 cm	
Philippine catfish <i>Clarias batrachus</i> Nga Khu	16 cm	
Pool barb <i>Puntlus sophore</i> Nga Khone Ma Mee ni	8.4 cm	
Catla <i>Osteobrama catla catla</i> Nga Phan Ma	10 cm	

(Source: DoF)

**Many small fish**

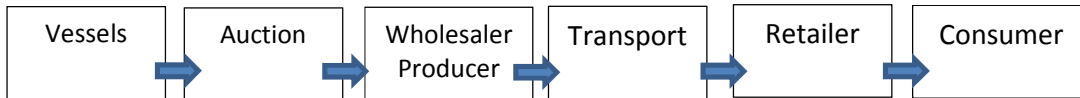
Low profit  
More need to catch  
Exploitation of marine resources

**One big fish**

High profit  
Less catches  
Favours fish reproduction  
more fuel saving

## Sustainable multi-functional strategies

Several steps in the supply chain reduce the small scale fishermen income:



Competitive strategies are adopted in the Mediterranean context in order to have better income from artisanal fishery. Here below some of them:

1. Handling of fish to target the highest standards to obtain better prices from the markets.
2. Access to the markets by fishermen:
  - Direct selling of fish in the local markets
  - Set up cooperatives of fishermen to benefit from scale economies and access to bigger markets
  - Use of modern technologies (internet/Facebook) to sell fish directly to customers who want the highest quality and most fresh fish.
3. Promoting local processing and branding for regional products
4. Promotion of fish-tourism (participation to fishing activities)
5. Promotion of game fishing



Direct sales by fishermen at harbour raise incomes



Market in cooperatives of fishermen guarantee constant supply and profits



e-Commerce of fish is a new opportunity that uses modern communication technologies. Orders are taken from Facebook, phone, SMS, or emails and received by fishermen, who prepare ice boxes with the requested fishes on the boat, ready for delivery: short chain higher profits.



Ichtytourism, is the combination of fishery with catering either on boat or on-land. This activity has proved to give employment opportunities to the whole families of fishermen, guarantee livelihood and prevents emigration of young generation.



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Special events to promote tourism and consumption of local captured fish with local cuisine: fish food festivals or fried fish days.



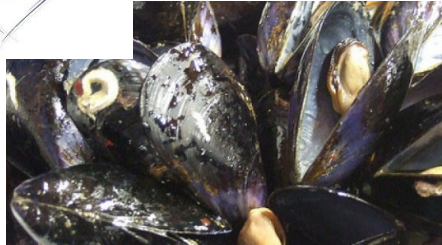
Fish tourism is the combination of fishery with tourism. Guest are hosted on board and participate at the fishing operations. At the end of the day customers can buy the fish they caught.



Game fishing it's a lucrative activity in many countries where boats provide services for anglers



Local processing adds value to the fish and create more job opportunities to local people. Processing ranges from the simple drying of fishery products to the preparation of preserves according to local recipes and traditions.



IGP-DOP on products (products with certified origins)

### Applicability of conservation measures in Myanmar

**Strategies to secure a future for small-scale fisheries sector to improve the socio-economic conditions of fishermen:**

- To have better access to funding, credit and markets
- To improve connections with public administrations and institutions
- Valorisation of small-scale fisheries products
- Safer working conditions and social protection
- The empowerment of role of the women that are just playing these roles :
  - Selling the fish/occasionally buying from middlemen.
  - Processing the fish for the family and for market.
  - Organizing fishermen welfare (dress, food etc).
  - Post harvest loss reduction: by using by-catch or undersize fish for family use and processed product preparations.

### Fishery management



- ✓ A precautionary approach to prevent pollution has to be adopted
- ✓ Regulations for penalties in case of IUU fishing have to be implemented
- ✓ Check of fishing gear is implemented as well extension service
- ✓ Creation of the register of fish caught
- ✓ For some species set quotas of total permitted catch for a vessel
- ✓ Fish is documented and can be traced to its source
- ✓ Hygiene and processing regulations are applied
- ✓ International dialogue on common sea between neighbour States

### **Preserving living marine resources**

- Ensure compliance with the fishing laws and regulations
- Monitor fish stocks through integrated data analysis
- To identifying risks to the marine environment
- Minimum size are defined for the commercial fish species
- Co-management of fishers within marine areas as well as protected ones
- To resolve conflicts and ensure an efficient management of small-scale fisheries

### **IUU fishing: Destructive actions and gears**

Here below the most common practice in IUU fishing, the effects of these activities on the environment and in particular on juvenile fishes are catastrophic.

The use of such non sustainable actions lead to a drastic decrease of fish stocks.

#### **Inland**

- Drying river branch (temporary/permanent)
- Poisons (chlorinated compounds, plants, other chemicals)
- Electricity (dynamo, power inverter, electrical cable lines) Stunning is up to 12 v/0,5 A 50 Ohm
- Explosives (acetilene, dinamite, TNT, self- made explosives )

## Marine

- Trawl near the coast
- Undersize mesh nets, “moroami” fishing
- Exceeding quotas /fishing in protected areas
- Explosives (acetilene, dinamite, TNT, self- made explosives )
- Poisonous compounds
- Shark finning and mammals hunting

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