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Catalogue of fishing gear in the Mediterranean and Black Sea region

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by

Alessandro Lucchetti
Food and Agriculture Organization of the United Nations

Andrea Petetta
Institute for Biological Resources and Marine Biotechnologies
Italy

Marouene Bdioui
Institut National des Sciences et Technologies de la Mer
Tunisia

Gökhan Gökçe
Çukurova University
Türkiye

Mahmoud Saber
National Institute of Oceanography and Fisheries
Egypt

Jacques Sacchi
Independent Expert
France

Hüseyin Özbilgin
Food and Agriculture Organization of the United Nations

Anna Carlson
Food and Agriculture Organization of the United Nations

Paolo Carpentieri
Food and Agriculture Organization of the United Nations

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Preparation of this document

This catalogue was prepared by the General Fisheries Commission for the Mediterranean (GFCM) of the Food and Agriculture Organization of the United Nations (FAO). It provides a general overview of the heterogenous fishing gear types and techniques, including significant subregional and local variations, used in Mediterranean and Black Sea commercial fisheries. This work supports the commitments made by Mediterranean and Black Sea countries and partner organizations to improve the sustainable management of fisheries in line with their shared international agenda and within the context of regional strategies, including the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea, in particular its Target 1, Output 3 "Efficient area-based conservation measures, technical and nature-based solutions strengthened to conserve biodiversity and enhance the productivity of marine living resources."

This catalogue gathers information from a review of available literature, as well as contributions from individual researchers and gear technologists working in the region. It was elaborated under the guidance and overall coordination of Alessandro Lucchetti (Fishing Gear Technology Expert), with expert inputs from Andrea Petetta (Fishing Technology Specialist for the Adriatic Sea), Marouene Bdioui (Fishing Technology Specialist for the central Mediterranean), Gökhan Gökce (Fishing Technology Specialist for the Black Sea), Mahmoud Saber (Fishing Technology Specialist for the eastern Mediterranean), Jacques Sacchi (Fishing Technology Specialist for the western Mediterranean), Hüseyin Özbilgin (BlackSea4Fish Project Coordinator), Anna Carlson (Fishery Officer for Socioeconomic Issues) and Paolo Carpentieri (Fishery Resources Monitoring Officer).

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Abstract

The Mediterranean and the Black Sea are host to a large number of marine species found in different geographical regions and habitats (e.g. type of seabed, depth). This biodiversity supports a highly diversified fishing sector, characterized by a wide range of fishing gear and methods targeting multiple species, resulting in a mixed composition of catches and a highly diversified fleet structure. Fishing gear types present great variability, depending on the biological and environmental conditions of the area and season in which they are used, as well as the socio-cultural traditions and the economic and historical contexts of the fishers operating them. Moreover, over the past fifty years, harvesting marine resources has become more efficient due to a progressively improving understanding of the habits and behaviours of target species. Technical advances in fishing gear have generally led to more sophisticated and economically efficient fishing operations and improved access to resources, an evolution that continues to this day. On the other hand, general awareness of environmental problems due to the overexploitation of fishery resources has also increased. Therefore, in order to find ways to conserve fish resources and the marine environment, there is a need to further study fishing gear and its impacts, as well as to develop less impactful techniques. To this end, a comprehensive overview of the fishing gear types and methods in use in the Mediterranean and the Black Sea represents an invaluable resource, ultimately facilitating advances on key priority topics for the GFCM, such as the mitigation of incidental catch of vulnerable species, the mitigation of adverse impacts of fisheries on juvenile fish and discards, the decarbonization of the fishing fleet through more energy-efficient gear, the development of innovative gear to remove marine litter, and the reduction of lost, abandoned and otherwise discarded fishing gear, to name a few.

This publication provides a general overview of the fishing gear and methods used in the different subregions of the Mediterranean and the Black Sea, attempting to describe their main technical characteristics and modes of use, considering also specificities and differences at not only the country level, but also the regional and local levels. The information presented stems from a review of available literature, as well as contributions from individual researchers and gear technologists working in the region. The catalogue is divided into five sections based on the five macrocategories of the GFCM Data Collection Reference Framework fleet segmentation, namely "trawlers", "seiners", "polyvalent", "dredgers" and "longliners". These sections are complemented by two additional sections, namely "other fishing methods and practices", which describes other less common gear that cannot be readily included among the previous categories, and "fishing gear used in lagoons". The individual fishing gear types described in the catalogue are categorized following the Revised International Standard Classification of Fishing Gear (FAO, 2016). The information collected is up-to-date through 2022, and only those legal at the drafting of the document have been considered, although some of them are difficult to catalogue. For each fishing gear, attempts were made to both provide a general description as well as highlight variations within the different GFCM subregions (i.e. western Mediterranean, central Mediterranean, Adriatic Sea, eastern Mediterranean and the Black Sea). For each type of fishing gear, when necessary, illustrations of their operation are provided. Technical characteristics are also reported through technical drawings, albeit these remain general due to the impossibility of reporting the technical details of the myriad variations of fishing gear in use.

The present catalogue is intended to give interested stakeholders – including policymakers, fisheries managers, scientists, researchers, fisheries inspectors and fishers – a useful, practical and in-depth reference guide on fishing technology in the

Mediterranean and the Black Sea. In this way, the catalogue aims to facilitate better understanding of fishing gear used in the region, support efforts to improve the selectivity of fishing gear and, ultimately, promote the sustainable management of fisheries in line with an ecosystem approach and the objectives of the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea.

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Tables

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Abbreviations and acronyms

CWP	Coordinating Working Party on Fishery Statistics
DCRF	Data Collection Reference Framework (GFCM)
EVA	ethylene vinyl acetate
FAD	fish aggregation device
FAO	Food and Agricultural Organization of the United Nations
GFCM	General Fisheries Commission for the Mediterranean
GRT	gross register tonnage
GSA	geographical subarea (GFCM)
GT	gross tonnage
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICES	International Council for the Exploration of the Sea
ISSCFG	International Standard Statistical Classification of Fishing Gear
IUU	illegal, unreported and unregulated (fishing)
LOA	length overall (for vessels)
MEDITS	International bottom trawl survey in the Mediterranean
NEI	not elsewhere included
PA	polyamide, nylon
PE	polyethylene
PES	polyester
PP	polypropylene
PVA	polyvinyl alcohol
PVC	polyvinyl chloride
ROV	remotely operated vehicle
SSF	small-scale fisheries

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Glossary

For the purpose of this document, the following definitions have been used:

Beach seine or shore seine: A type of seine net (with or without a bag) that is usually set by hand or from a boat and is operated from the shore.

Beam trawl: A bottom trawl with the horizontal opening provided by a beam made of wood or metal, which may be 1–4 m long or more. Beam trawls in the Mediterranean Sea are used mainly for flatfish and scallops.

Boat seine or anchor seine: An encircling net consisting of two wings, a body and a bag and operated using very long ropes to lay out the net and ropes on the sea floor before hauling the ropes and the net from an anchored boat. Sometimes called a Danish seine.

Bottom-side chafer: Any piece of canvas, netting or other material that is used below the trawl to limit the wear of the net caused by rubbing along the bottom. More than one bottom-side chafer may be used at the same time and they may overlap.

Bottom or demersal trawl: A trawl towed on the seabed.

Braided netting twine: A netting yarn that is manufactured by braiding. Braiding is the process of interlacing three or more strands in such a way that they cross each other in a diagonal direction. Braided netting yarns are available with or without a core. Normally, the netting panels of a bottom trawl are made of braided netting twine.

Brail net: A small net used to draw fish into a boat.

Branch line: Also known as a snood, gangion or leader. It is the line used for attaching the hook to the mainline in longlines. The term is often used in drift longlines targeting pelagic species such as tuna and swordfish.

Bridles, wing bridles: A system of wires or ropes that extend from the upper and lower wings of a trawl. They are used to increase the vertical net opening of a trawl, connecting the net wingends (upper and lower) to sweeps or danleno, if present.

Bunt: The small mesh part of a seine net (purse seine, surrounding nets without purse lines, boat seine or beach seine), where the catch is accumulated before being landed on board.

Chafer: A piece of netting underneath the codend of the net that is used to protect it against wear and tear.

Clump (weight): An additional central weight employed to maintain the horizontal opening of the two nets simultaneously towed in the twin trawl technique.

Codend: The rearmost part of a trawl net, of the same mesh size, having either a cylindrical or a tapering shape, whose transversal cross-sections are nearly a circle of the same or decreasing radius respectively.

Codend length: The length of the last netting panel section, along the top side, of a trawl net. The length of the diamond-mesh codend is defined as the number of meshes counted along the longitudinal axis of the net multiplied by the stretched mesh size. The length of the square-mesh codend is defined as the number of square meshes counted along the longitudinal axis of the net multiplied by the mesh bar.

Codend circumference: This circumference is calculated differently based on the mesh configuration. For diamond-mesh netting of a trawl net, it is calculated as the number of meshes in that cross-section multiplied by the stretched mesh size. For square-mesh netting of a trawl net, it is calculated as the number of meshes in that cross-section multiplied by the mesh bar.

Combined net: A bottom-set gillnet combined with a trammel net constituting the lower part. Combined nets also include nets composed of gillnet-to-gillnet and trammel net-to-trammel net.

Cut-wing: A trawl wing divided into an upper and a lower section.

Danleno (or spreader): A triangular piece of iron or steel attached to the outer end of a trawl net wing to keep it stretched vertically or spread. It can also be used to link the sweep and the bridles.

Denier system: The system used to specify the thickness of a multifilament yarn. The denier number is the weight in grams of 9 000 m of yarn; one denier is equal to one filament 9 000 m long and weighing 1 g. When 9 000 m of yarn weighs 210 g, it is designated as 210 denier, which is the most commonly used in Mediterranean passive nets. The denier number is usually reported as "d". The expression "210d/3" refers to a multifilament composed of three yarns of 210 denier each twisted together.

Dredge: A rigid structure, usually made of a metal cage or a metal frame to which a strong netting bag is attached, that is towed along the seabed usually to target shellfish.

Driftnet: Any gillnet (one single netting panel) held at the sea surface or in the water column by floating devices that is allowed to drift with the tide or current either independently or with the boat to which it may be attached.

Echo sounder: A device that uses sonar technology (sound waves) to measure the water depth below the vessel and can also be used to detect shoals of fish.

Encircling gear: A fishing gear or part of it (nets or ropes) that is set out in the form of a circle to catch the enclosed fish.

Euryhaline: Describing organisms able to adapt to a wide range of salinities.

Extension piece: The untapered section, made of one or more panels, between the trawl body and the codend.

Fixed nets: Any type of passive nets (gillnet, trammel net or combined net) whose two ends are anchored at the bottom.

Fry: The young stage of fishes, particularly after the yolk sac has been absorbed.

Fyke: A rectangular, cylindrical or semi-cylindrical net mounted on rings, hoops or a rigid structure, usually with wings and/or a leader, and fixed to the substrate with anchors, weights or stakes.

Gangs: A variable number of netting panels of set nets connected in a row.

Gillnet: A passive net made of a single netting wall held vertically in the water by floats on the headline and weights on the leadline, typically made of monofilament or multifilament twisted nylon.

Groundrope or footrope: The lower frame ropes of a trawl to which the netting is attached. Usually made of wire protected with rope. Its main function is to maintain ground contact through the use of several weights (leads) attached to the rope. In bottom trawl nets, a chain may be joined to the groundrope to increase the ground contact.

Hanging ratio: The hanging ratio (E) is commonly defined as the quotient of the length of rope on which a net panel is mounted (L) and the length of stretched netting hung on the rope (L_0) ($E = L/L_0$). In passive nets, it defines how the net is stretched along the headline: in nets with low hanging ratios (i.e. < 0.4), netting will present a marked slack.

Haul: A single fishing operation.

Headline or headrope or floatline: The upper frame ropes of a net to which the netting is attached. Several corks or floats are attached to the headline to lift the upper part of the net and spread the net vertically in the water. In passive nets, a floating rope with floats integrated inside the rope or a flexible foam core rope (a rope made of a polypropylene or polyethylene jacket with a foam core) have recently been introduced (no external floats needed).

Headline length: A proxy metric for direct estimation of the net dimension. The measurement of the headline length is also the most feasible information to be collected on board a fishing vessel by simply spreading the net and measuring its length with a measuring tape.

Jig: An artificial lure used to attract the prey towards the hook, mainly used in drifting longlines and handlines.

Leadline or leadrope: The weighted line along the bottom of a passive net. It is usually made of polyamide or polyethylene. Older nets have small leads attached to the line, but most nets built in the last 15 years have a string of small leads inserted into the line (leadcore rope).

Lessepsian: Describing the migration of marine species across the Suez Canal, usually from the Red Sea to the Mediterranean Sea, and more rarely in the opposite direction.

Longline: A fishing gear that comprises a long mainline (up to 60 km) that can be anchored either adrift on the surface or in the water column, with numerous baited hooks on branch lines or snoods.

Mesh configuration: Nets used in trawling usually have a diamond-mesh configuration in the wings, body and extension piece. At the codend, nets may be equipped with diamond or square meshes; square meshes are usually obtained from a diamond mesh netting panel turned 45°. Recently (at least in the Mediterranean Sea), some selectivity tests have been carried out with a T90 mesh codend, which is obtained from a standard diamond mesh netting panel turned 90°. In addition, the hexagonal-mesh codend has been tested at an experimental level.

Mesh opening: In knotted netting, it is the longest distance between two opposite knots in the same mesh when fully extended; in knotless netting, it is the inside distance between the opposite joints in the same mesh when fully extended along its longest possible axis.

Mesh side or mesh bar: The distance between two sequential knots or joints, measured from centre to centre when the yarn between those points is fully extended.

Mesh size: In knotted netting, it is the distance between the centres of two opposite knots in the same mesh when fully extended in the N-direction; in knotless netting, it is the distance between the centres of two opposite joints in the same mesh when fully extended along its longest possible axis.

Mesopelagic: Fish and other organisms inhabiting the intermediate depths of the sea, between about 200 m and 1 000 m.

Métier: A group of fishing operations targeting a specific assemblage of species, using a specific gear, during a precise period of the year and/or within a specific area.

Monofilament yarn: A twine composed of a single filament that is strong enough to function alone as a yarn. The diameter of this yarn is commonly expressed in millimetres.

Multifilament yarn: A twine composed of a group of fine filaments twisted together.

Multimonofilament: A twine composed of a group of monofilament twines twisted together.

Multirig trawling: A type of trawl rigging that implies towing more than one net behind a vessel.

Net height or stretched (or fictitious) net height: In passive nets and purse seines, it is the total length of netting stretched in the vertical direction. It shall be defined as the sum of the length of the meshes (including knots) when wet and stretched perpendicular to the floatline. The stretched height is calculated by multiplying the mesh length by the number of meshes from the floatline to the leadline. The actual (or real) net height while the net is operating is smaller.

Net winch: A mechanically driven machine used for hauling the net (trawl or passive nets). It can also be used for hauling ropes, such as the mainline of a set of pots.

Otterboard or otter trawl or trawl door: Rectangular or oval-shaped structures that, by gripping the seabed, also drag the sweeps, bridles and wings by spreading the mouth of a trawl. In general, they are large and heavy steel, or wood, plastic and iron structures, weighted at their base by a protective iron shoe. Otter trawls are most frequently towed over relatively flat soft bottoms. Two or, on rare occasions, four doors (in single boat pelagic trawling) are used with three main functions: a) to spread the trawl horizontally during towing; b) to provide the front bottom contact points of the trawl gear; and c) to herd and stimulate fish to swim towards the trawl path.

Otterboard rigging: Different rigging between the net wing and otterboard.

Otter trawl: A towed net held open by a pair of otterboards (trawl doors).

Pair trawl: A trawl towed between two vessels, held open by the distance apart of the two vessels. In the Mediterranean, the mid-water pair trawl is used to target small pelagic species (pelagic pair trawl).

Passive gear: Any fishing gear for which the catch operation relies on fish behaviour but does not require an active movement of the gear. This category includes gillnets, trammel nets, lines, pots and traps, as well as troll lines and driftnets.

Pelagic trawl: A trawl that is towed somewhere between the seabed and the surface, without touching the seabed.

Power block: A mechanized pulley made of a large rubber-covered central roller. It is used for hauling purse seines.

Pots or creels: Small enclosures with one or more entrances that allow easy entry but make exit difficult. They come in several different shapes and dimensions and are movable types of gear that, after a variable soak time (hours to days), are hauled on deck and emptied. Pots can be baited to lure the prey.

Preopercle: A boomerang-shaped bone whose edges form the posterior and lower margins of the cheek region. They are also the most anterior of the bones comprising the gill cover.

Purse line: The line that threads through purse rings to close the bottom of a purse seine when it is drawn.

Purse ring: Metal or plastic rings attached to the lower edge of a purse seine through which the purse line is thread.

Purse seine: A netting wall framed by a floatline on the top and a leadline (or sinking line) at the bottom, set to surround a school of fish. The bottom of a purse seine is characterized by the presence of a steel wire (purse line) which runs into steel rings (purse rings) joined to the lower edge of the net. The purse line, once recovered by means of winches, enables the net to be closed from the bottom like a purse and thus to retain all the encircled fish.

Scoopnet: A net consisting of a bag of mesh material attached to a frame to hold the bag open, and a handle. The net is small enough to be used with one hand by one person. This gear is also known as a hand net.

Seine: A net that is usually lowered from a boat surrounding an area and that can be operated from the shore or from a boat itself. The net is usually operated by means of two long ropes fixed to the two wing ends; the ropes are used to herd the fish and haul the net.

Selvedge: A strip of net reinforcement connecting the headline to the main layer of a gillnet or a seine net.

Skiff: A light rowing boat, typically for one person.

Snood: A thin twine or monofilament line that attaches the hook to the mainline in a longline or vertical line. It is also called a gangion or branch line.

Soak or soaking time: The amount of time (number of hours or days) from the date a passive gear (e.g. set net or pot) is set in the water until the date it is next hauled.

Sonar: An electronic device that uses sound waves to locate and track fish shoals in the vicinity of the vessel.

Static gear: A fishing gear set in the water to wait for fish to swim into it, such as passive nets (gillnets, trammel nets, etc.), or attracting fish with lures and baits (such as longlines and pots). These types of gear can be anchored to the sea bottom (fixed gear) or left free to drift with the currents (drifting gear, such as driftnets and surface longlines).

Strengthening or lifting bag: A cylindrical piece of netting completely surrounding the codend of a trawl to strengthen it during the hauling procedure in case of a huge catch. Strengthening bags prevent the codend from bursting when it is being lifted on board the vessel. The mesh opening and the dimensions of this netting panel can strongly influence the selectivity of the codend.

Sweep: A rope usually made of wire or combination rope that connects the otterboard to the bridle, if any, or directly to the trawl wing. The sweep is much longer than the bridles. In some trawl typologies, e.g. the *Americana* trawl, sweeps are not used and bridles are connected directly to the otterboards.

Target species: The species or group of species of fish, crustaceans and molluscs that the gear is designed to catch.

Tender: A boat for transportation and fishing (e.g. in purse seines, tenders are equipped with lamps to attract the schools of fish) employed from a larger vessel.

Tex: A unit of measure for the linear mass density of fibres, defined as the mass in grams per 1 000 m. The most commonly used unit is actually the decitex, abbreviated dtex, which is the mass in grams per 10 000 m. Sometimes, on net drawings, the resultant linear mass density of the rope is given (Rtex).

Tickler chain: Chain towed ahead of the leadline to disturb fish, crustaceans or molluscs lying on the seabed.

Towing warps or wires: The wires (steel) used for towing fishing gear.

Trawl belly: The section of the lower panel between the lower wings and extension piece of a trawl.

Trawl body: The tapered section in the front part of a trawl net.

Trawl length: The length of the whole trawl net in metres (codend excluded). The trawl length is the total sum resulting from the addition of all the netting sections of the upper panel. The length of each netting is calculated as the number of meshes along the longitudinal axis of the net multiplied by the stretched mesh size. The trawl length, together with a few other gear metrics (e.g. headline length, square width and fishing circle), can be considered as a good proxy metric for the estimation of trawl dimensions.

Trawl rig: Term used to cover all the components in a trawl net rig (e.g. doors, sweeps, bridles and net).

Trawl winch: A mechanically driven machine used for hauling and storing trawl warps, sweeps and often the trawl net (net-winding winch or net drum). This winch has one or more drums, which may operate independently or simultaneously to hold in or let out trawl warps and sweeps. In a modern trawl, usually two winches are present: one for warps and one for sweeps and the net.

Twine: It is formed by twisting yarns or filaments and used to manufacture netting.

Twin rig trawl: The trawling technique in which a vessel simultaneously tows two identical otter trawls side by side.

Twisted netting twine: A twine composed of two or more filaments twisted together. Twisting is the spiral disposition of the filaments to compose a single netting yarn.

T90: It is the traditional diamond mesh netting turned 90°. This netting configuration is sometimes used in seines and driftnets.

Warp: The towing rope or wire that connects the trawl and the trawler.

Vertical slack: In passive nets, it is the ratio between the real height (the effective height while the net is on the bottom) and the stretched net height. The amount of slackness facilitates the entanglement of a fish. In the case of trammel nets, the vertical slack is the ratio between the height of the external panel and that of the internal netting panel.

Wings: The tapered sections extending forwards from two sides of the main body of the net, with each wing being divided into a bottom wing and top wing. The wingends are the nearest part of the net to the boat during towing.

Wingend: The terminal point of the wing of a trawl. It may refer to the upper wingend or lower wingend.

Introduction

In the Mediterranean and Black Sea region, fishing has been practised since ancient times. Several prehistoric and ancient historical finds in Mediterranean countries (e.g. cave paintings depicting tuna fishing in Sicily's Egadi Islands archipelago dating back to the Palaeolithic and Neolithic periods and ancient Roman mosaics dating back more than 2000 years) testify to the importance of this activity and clearly show detailed illustrations of both the gear used and the species exploited (Plate 1). Some of these catching practices have remained effectively unchanged over the centuries, except for the fact that new materials, vessels and technologies are used.

PLATE 1
Mosaics found in Tunisia depicting fishing using a boat seine (a), falling net (b), pole-line (c) and pots (d)

However, over time, fishers have progressively developed their fishing skills and have contrived to catch fish, crustaceans, molluscs and other marine organisms in any environment: throughout the water column, on the bottom or even by excavating the bottom to catch the organisms living in the sediment or taking refuge inside burrows. As a result, a wide range of fishing gear is employed in the Mediterranean fishing sector, designed to catch organisms in different environments.

Towards a rational and sustainable management of fishery resources, it should be remembered that fishing is an activity by which humans take resources from the natural environment to obtain food, but also to produce a good that can be bought and sold. This resource is renewable but also depletable; thus, fishing is an activity that should be managed responsibly by setting certain technical requirements through regulations. It is essential to know the technical characteristics of the gear that may influence selectivity, impact the bottom or catch sensitive and vulnerable species, among other negative effects.

In the last fifty years, the harvesting of marine resources by humans has become increasingly efficient, as the understanding of the habits and behaviours of the target species has steadily increased. Over time, fishing technology has markedly developed with fishing systems becoming ever more sophisticated and adept at catching the most desirable species. This evolution is still in progress, as technological development continues. Consequently, these technical advancements in fishing gear have generally led to more economically efficient fishing operations and improved access to resources. On the other hand, they have also led to an increased exploitation of living marine resources, including overexploitation of certain species, as well as impacts on the marine environment and vulnerable species.

As a result of improved awareness of the environmental impacts of fisheries, a stronger focus has been placed on understanding the effects of different fishing gear on living marine resources and the marine environment, as well as developing less damaging and more selective techniques. To this end, fishing technologists play an important role in providing fishery managers, fishers and other stakeholders with useful advice and technical solutions for mitigating the adverse impacts of fishing gear.

The present catalogue was prepared in order to provide relevant stakeholders – including policymakers, fisheries managers, researchers and scientists, fisheries inspectors and fishers themselves – with a practical and comprehensive reference document on fishing technology in the Mediterranean and the Black Sea. The catalogue provides readers with a review of the different types of fishing gear used in the region, as well as the main subregional variations. In this way, the catalogue is foreseen as a tool to:

- help Members of the Food and Agriculture Organization of the United Nations (FAO), regional fishery organizations, and others involved in fishery statistics and management to properly identify and report fisheries captures made using various types of gear;
- support the preparation, implementation and enforcement of fisheries management measures, by giving monitoring, control and surveillance personnel information to identify the type of fishing gear with regard to licensing and authorizing fishing operations;
- aid in the prevention, deterrence and elimination of illegal, unreported and unregulated fishing;
- support efforts to improve selectivity in order to reduce bycatch (both discards and the incidental catch of vulnerable species) and reduce impacts on the marine environment; and
- support efforts to optimize fishing vessel performance, including measures to improve cost-effectiveness and energy efficiency.

In this way, the present document supports an ecosystem approach to fisheries management and the implementation of the FAO Code of Conduct for Responsible Fisheries, which notes that "States and sub-regional or regional fisheries management organizations and arrangements should promote, to the extent practicable, the development and use of selective, environmentally safe and cost-effective gear and techniques" (FAO, 1995).

Given the extreme variability of the fishing gear in use, with technical characteristics that differ from country to country, as well as regionally and locally, this document does not claim to be an exhaustive catalogue of all the different kinds of fishing gear in use in the Mediterranean, but rather aims to provide an overview of the general characteristics of the types of gear and catching methods. Therefore, this catalogue does not contain detailed technical plans of all fishing gear. Instead, a general description of the different types of fishing gear is given with references to local specificities. Where the fishing gear is of considerable importance in an area and/or country, an attempt is made to expand on the description as far as possible. This review is based on a bibliographic search conducted on available documents (scientific publications, technical reports, national fishing gear catalogues, among others) and sometimes on observations and measurements made by the authors and contributors involved.

Therefore, it is possible that some locally used fishing gear may have escaped the survey or that the characteristics of the gear currently in use may show small variations from what is reported in this document.

Overview

Numerous fishing techniques are used in the Mediterranean and Black Sea region, and the same technique may have different variations from one area of the region to another. For this reason, an extensive literature review using various sources (e.g. peer-reviewed, as well as grey literature and reports) was conducted and attempts were made to collect information that is as comprehensive as possible. The information compiled through the literature review was then validated by subregional and national experts. The resulting catalogue presents an overview of the main fishing gear used in the region, including the principal subregional variations.

The catalogue is divided into seven chapters, five of whcih are based on the five macrocategories of the General Fisheries Commission for the Mediterranean (GFCM) Data Collection Reference Framework (DCRF) fleet segmentation (Table 1), namely:

- trawlers
- seiners
- polyvalent
- dredgers
- longliners

These sections are complemented by two additional sections, namely "other fishing methods and practices", which describes other less common gear that cannot be readily included among the previous categories, and "fishing gear used in the lagoons". Each chapter provides a description of the general characteristics of the type of fishing activity, as well as a review of the main target species. Further details are then provided for each of the main types of gear (Table 2), including a review of the main subregional variations.

Classification of fishing gear

Fishing gear is commonly classified into two main categories: active and passive gear.

Active types of fishing gear are those that involve movement of the gear by means of the vessel's propulsion system, or through winches, with the vessel either anchored or slowly moving. The movement of the towed gear may be roughly rectilinear, as in the case of towed nets (bottom trawls and pelagic nets) and some types of dredges, or it may involve encircling an area where the target species are present, as in the case of surrounding nets and seines. These types of gear can be towed by one or two vessels along the bottom or at any depth in mid-water or on the surface to catch demersal as well as pelagic species. Therefore, catching with active types of gear is based on a calculated chase of the target species, combined with different ways of catching it.

Passive types of gear include gear whose use does not require active movement by the fishing vessel to catch fish; these are mainly nets and longlines anchored on the bottom (e.g. gillnets, entangling nets, trammel nets and set longlines) or drifting with the currents (driftnets and drifting longlines) and traps and pots. Passive gear may be anchored to the bottom, drift on the surface or in the water column or be slowly towed by the vessel (troll lines). The capture of fish is generally based on the movement of target species towards the gear. In fact, both demersal and pelagic marine organisms can be caught or entrapped by passive gear incidentally (passive nets), voluntarily enter the gear (traps) or be attracted towards a bait (longline). The catch is harvested only once the gear is hauled back after a period of setting (from a few hours to a few weeks, depending on the gear type). Passive types of gear in the Mediterranean Sea are commonly used by small vessels of the artisanal fisheries.

To facilitate the preparation of scientific advice to inform fisheries management, the DCRF requires data to be collected and transmitted according to relevant fleet segments. The DCRF fleet segments are a combination of vessel groups and length classes (Table 1).

Table 1
Fleet segments considered in the GFCM Data Collection Reference Framework

<table>
<tr><th colspan="3" rowspan="2">Vessel groups</th><th colspan="4">Length classes (LOA)</th></tr>
<tr><th>< 6 m</th><th>6–12 m</th><th>12–24 m</th><th>> 24 m</th></tr>
<tr><td rowspan="5">Polyvalent</td><td rowspan="5">P</td><td rowspan="2">Small-scale vessels without engine using passive gear</td><td>P-01</td><td>P-02</td><td rowspan="2">P-03</td><td rowspan="2">P-04</td></tr>
<tr><td colspan="2">P-13</td></tr>
<tr><td>Small-scale vessels with engine using passive gear</td><td>P-05</td><td>P-06</td><td>P-07</td><td>P-08</td></tr>
<tr><td rowspan="2">Polyvalent vessels</td><td rowspan="2">P-09</td><td rowspan="2">P-10</td><td>P-11</td><td>P-12</td></tr>
<tr><td colspan="2">P-14</td></tr>
<tr><td rowspan="4">Seiners</td><td rowspan="4">S</td><td rowspan="2">Purse seiners</td><td rowspan="2">S-01</td><td rowspan="2">S-02</td><td>S-03</td><td>S-04</td></tr>
<tr><td colspan="2">S-09</td></tr>
<tr><td rowspan="2">Tuna seiners</td><td rowspan="2">S-05</td><td rowspan="2">S-06</td><td>S-07</td><td>S-08</td></tr>
<tr><td colspan="2">S-10</td></tr>
<tr><td rowspan="2">Dredgers</td><td rowspan="2">D</td><td rowspan="2">Dredgers</td><td rowspan="2">D-01</td><td>D-02</td><td>D-03</td><td rowspan="2">D-04</td></tr>
<tr><td colspan="2">D-05</td></tr>
<tr><td rowspan="4">Trawlers</td><td rowspan="4">T</td><td>Beam trawlers</td><td>T-01</td><td>T-02</td><td>T-03</td><td>T-04</td></tr>
<tr><td rowspan="2">Pelagic trawlers</td><td rowspan="2">T-05</td><td>T-06</td><td>T-07</td><td>T-08</td></tr>
<tr><td colspan="3">T-13</td></tr>
<tr><td>Trawlers</td><td>T-09</td><td>T-10</td><td>T-11</td><td>T-12</td></tr>
<tr><td rowspan="2">Longlines</td><td rowspan="2">L</td><td rowspan="2">Longliners</td><td rowspan="2">L-01</td><td>L-02</td><td>L-03</td><td>L-04</td></tr>
<tr><td colspan="3">L-05</td></tr>
</table>

Vessel groups are defined as “fishing vessels, regardless their size, using the same gear for more than 50 percent of the time at sea during the year”. In line with this definition, the five macrocategories of vessel groups (polyvalent, seiners, dredgers, trawlers, longliners) are therefore based on their gear characteristics and, for this reason, the present catalogue is organized according to these macrocategories.

The polyvalent group includes all fishing vessels using more than one gear with a combination of passive and active gear, none of which’s use exceeds more than 50 percent of the time at sea during the reference year. This group includes the types of fishing gear commonly used in small-scale fisheries and those not included in the previous categories.

Within the five macrocategories of vessel groups, numerous types of fishing gear are used. In order to promote standardization worldwide, the different types of fishing gear are classified on the basis of an international standard. The International Standard

Statistical Classification of Fishing Gear (ISSCFG) was originally adopted during the tenth Session of the Coordinating Working Party on Fishery Statistics (CWP) (Madrid, 22–29 July 1980) and published by FAO (Nédélec and Prado, 1990). The revised Classification – ISSCFG Revision 1 (Annex M II) – has been endorsed and adopted for CWP Members' implementation by the CWP at its twenty-fifth Session (Rome, 23–26 February 2016). The new classification is shown in Table 2. Compared with the previous classification, this system was simplified into two tiers (or two levels). As such, this change left the third tier to be defined by users requiring more detailed gear classification.

Table 2
Revised International Standard Statistical Classification of Fishing Gear

Gear categories (first tier)	Subcategories (second tier)	Standard abbreviations	ISSCFG code
Surrounding nets			01
	Purse seines	PS	01.1
	Surrounding nets without purse lines	LA	01.2
	Surrounding nets (nei)	SUX	01.9
Seine nets			02
	Beach seines	SB	02.1
	Boat seines	SV	02.2
	Seine nets (nei)	SX	02.9
Trawls			03
	Beam trawls	TBB	03.11
	Single boat bottom otter trawls	OTB	03.12
	Twin bottom otter trawls	OTT	03.13
	Multiple bottom otter trawls	OTP	03.14
	Bottom pair trawls	PTB	03.15
	Bottom trawls (nei)	TB	03.19
	Single boat midwater otter trawls	OTM	03.21
	Midwater pair trawls	PTM	03.22
	Midwater trawls (nei)	TM	03.29
	Semipelagic trawls	TSP	03.3
	Trawls (nei)	TX	03.9
Dredges			04
	Towed dredges	DRB	04.1
	Hand dredges	DRH	04.2
	Mechanized dredges	DRM	04.3
	Dredges (nei)	DRX	04.9

Gear categories (first tier)	Subcategories (second tier)	Standard abbreviations	ISSCFG code
Lift nets			05
	Portable lift nets	LNP	05.1
	Boat-operated lift nets	LNB	05.2
	Shore-operated stationary lift nets	LNS	05.3
	Lift nets (nei)	LN	05.9
Falling gear			06
	Cast nets	FCN	06.1
	Cover pots/Lantern nets	FCO	06.2
	Falling gear (nei)	FG	06.9
Gillnets and entangling nets			07
	Set gillnets (anchored)	GNS	07.1
	Drift gillnets	GND	07.2
	Encircling gillnets	GNC	07.3
	Fixed gillnets (on stakes)	GNF	07.4
	Trammel nets	GTR	07.5
	Combined gillnets–trammel nets	GTN	07.6
	Gillnets and entangling nets (nei)	GEN	07.9
Traps			08
	Stationary uncovered pound nets	FPN	08.1
	Pots	FPO	08.2
	Fyke nets	FYK	08.3
	Stow nets	FSN	08.4
	Barriers, fences, weirs, etc.	FWR	08.5
	Aerial traps	FAR	08.6
	Traps (nei)	FIX	08.9
Hooks and lines			09
	Handlines and hand-operated pole-and-lines	LHP	09.1
	Mechanized lines and pole-and-lines	LHM	09.2
	Set longlines	LLS	09.31
	Drifting longlines	LLD	09.32
	Longlines (nei)	LL	09.39
	Vertical lines	LVT	09.4

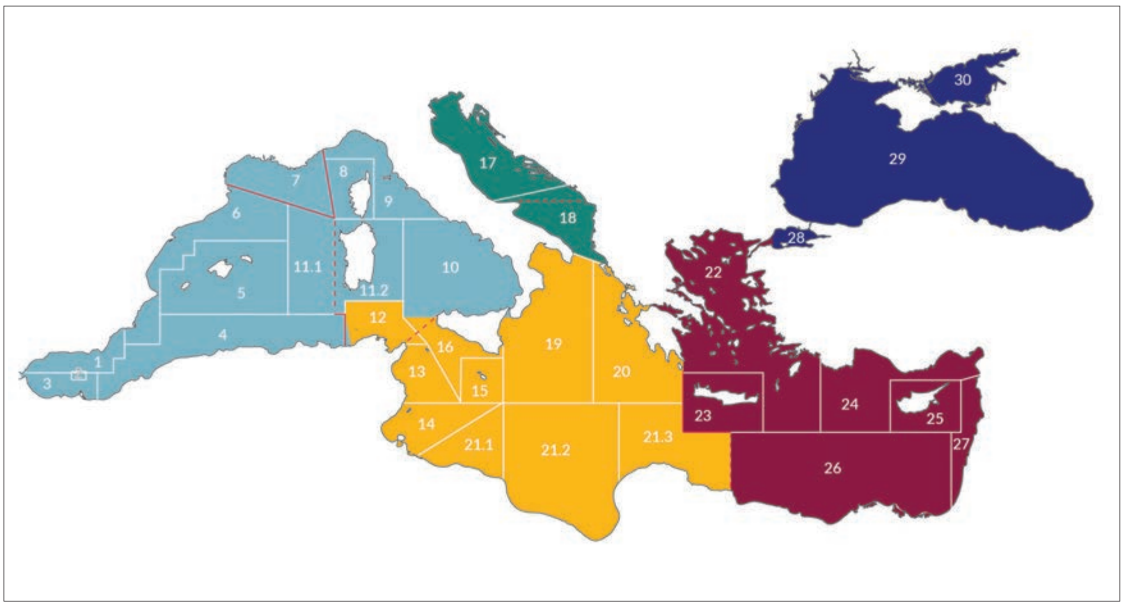
Gear categories (first tier)	Subcategories (second tier)	Standard abbreviations	ISSCFG code
	Trolling lines	LTL	09.5
	Hooks and lines (nei)	LX	09.9
Miscellaneous gear			10
	Harpoons	HAR	10.1
	Hand implements (wrenching gear, clamps, tongs, rakes, spears)	MHI	10.2
	Pumps	MPM	10.3
	Electric fishing	MEL	10.4
	Pushnets	MPN	10.5
	Scoopnets	MSP	10.6
	Drive-in nets	MDR	10.7
	Diving	MDV	10.8
	Gear nei	MIS	10.9
Gear not known			99
	Gear not known	NK	99.9

Source: **FAO.** 2016. *International Standard Statistical Classification of Fishing Gear. Handbook on Fisheries Statistics*. Rome.

Subregional approach

Based on the DCRF, a subregional approach to fishing gear classification was adopted to better address the specificities of the Mediterranean and the Black Sea and to facilitate the integration between these data and the DCRF. The identified five subregions are: western Mediterranean, central Mediterranean, Adriatic Sea, eastern Mediterranean and Black Sea.

FIGURE 1
GFCM area of application, subregions and geographical subareas



FAO statistical divisions   GFCM geographical subareas (GSAs)

GFCM subregions
Western Mediterranean   Central Mediterranean   Adriatic Sea   Eastern Mediterranean   Black Sea

01. Northern Alboran Sea	07. Gulf of Lion	13. Gulf of Hammamet	19. Western Ionian Sea	25. Cyprus
02. Alboran Island	08. Corsica	14. Gulf of Gabès	20. Eastern Ionian Sea	26. Southern Levant Sea
03. Southern Alboran Sea	09. Ligurian Sea and northern Tyrrhenian Sea	15. Malta	21.1. Southwestern Ionian Sea 21.2. Southern Ionian Sea 21.3. Southeastern Ionian Sea	27. Eastern Levant Sea
04. Algeria	10. Southern and central Tyrrhenian Sea	16. Southern Sicily	22. Aegean Sea	28. Marmara Sea
05. Balearic Islands	11.1. Western Sardinia 11.2. Eastern Sardinia	17. Northern Adriatic Sea	23. Crete	29. Black Sea
06. Northern Spain	12. Northern Tunisia	18. Southern Adriatic Sea	24. Northern Levant Sea	30. Azov Sea

Note: At its forty-fifth session in November 2022, the GFCM agreed to divide GSA 21 (Southern Ionian Sea) into three subareas. The subdivision of GSA 21 into GSAs 21.1, 21.2 and 21.3 will be applied in 2023.

1. Trawlers

1.1 General characteristics

Trawling is the operation of towing a net with one or two vessels to catch marine organisms. As such, trawling encompasses a wide range of gear designs and methods of operation. In general, trawl nets, large or small, used on the bottom or in mid-water, are funnel shaped, with side netting panels extended forward to form wings that guide the harvested fish into the centre of the net entrance (net mouth), then towards the main body up to the codend, where the catch is collected. The net may consist of two panels (upper and lower, also called faces) or four panels (upper, bottom and side panels).

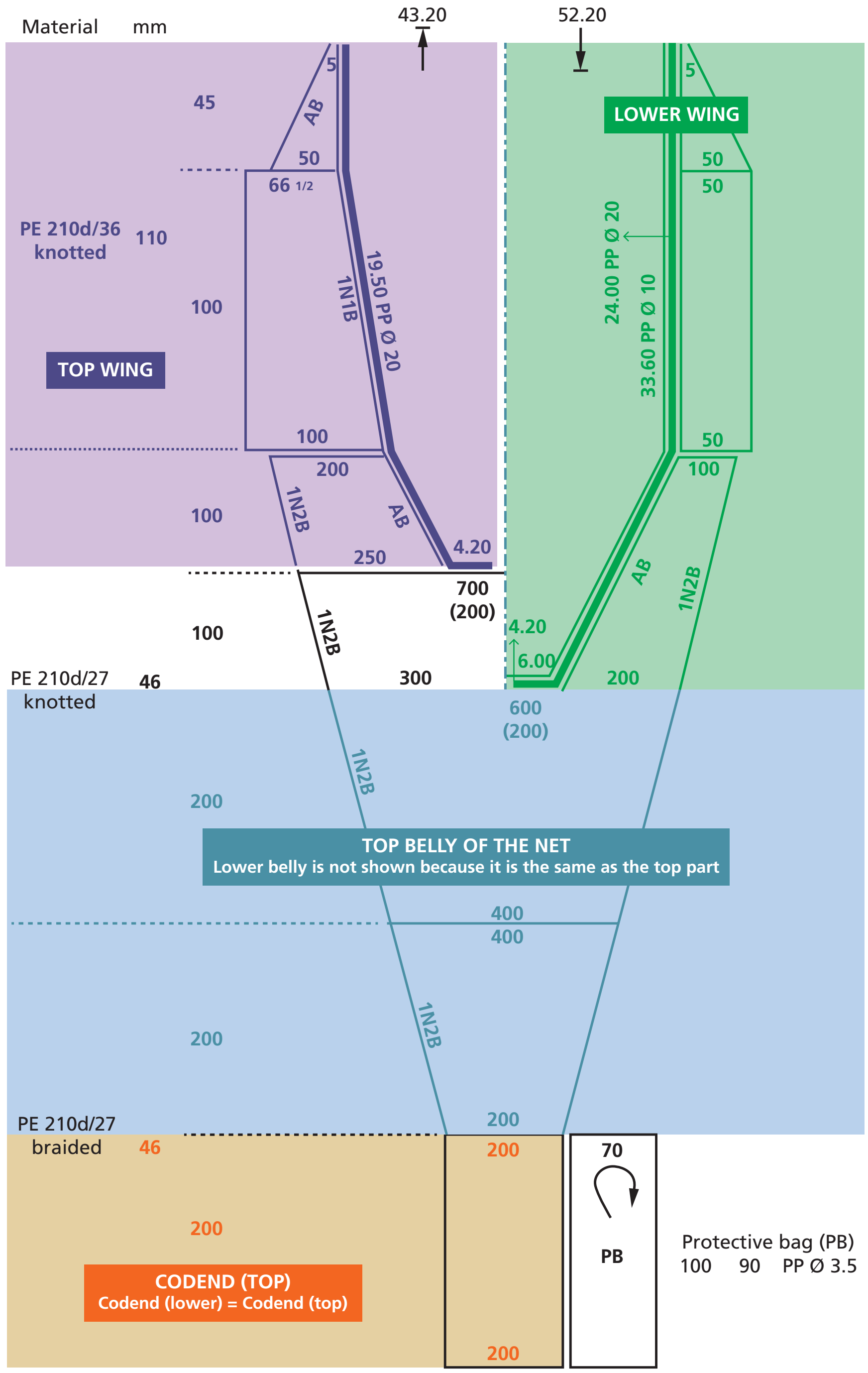
The basic requirements for operating the trawl net are: sufficient power to tow the net; a system to keep the net mouth open while towing; a system of wires to connect the net and gear to the source of towing power; and the ability to haul and lift the gear. Towing speeds range from 2 knots (1 m/s) to 8 knots (4.1 m/s) and fishing in the Mediterranean and the Black Sea is conducted at depths ranging from 10 m to 800–900 m.

In its basic design, a trawl net comprises the following:

- The open end through which fish enter, known as the trawl mouth. It is framed by an upper headrope and a lower footrope.
- A connected section of rope, known as the footrope or groundrope, which is usually made of polyamide (PA) or polyethylene (PE) and maintains ground contact through the use of several weights distributed along it. The length of the headrope and footrope is one of the main proxy metrics for direct estimation of the trawl dimensions. Very often a chain and/or pieces of lead may be joined to the footrope to increase the bottom contact.
- The upper edge of the net mouth, known as the headrope or headline. Several floats are attached to the headrope to lift the upper part of the net. Floats, usually spherical, are made of strong plastic or aluminium alloy to withstand implosion at maximum fishing depth. The opposite effects of the headrope and footrope guarantee the vertical opening of the net.
- The tapered sections extending forwards from two sides of the main body of the net, known as wings, with each being divided into a bottom wing and top wing.
- The central main part or section of the net or trawl, known as the body, which is located between the wings and the extension piece. It is a tapered section and consists of a lower and upper panel.
- The untapered or cylindrical section of netting, known as the extension piece, either inserted between the body and codend or attached to the end of the codend to increase its length. Sometimes the extension is missing and the codend is directly joined to the body.
- The rearmost part of the trawl net, known as the codend, where the catch accumulates during towing, having either a cylindrical or tapered shape. According to Recommendation GFCM/33/2009/2 on the minimum mesh size in the codend of demersal trawl nets, the members and cooperating entities of the GFCM shall adopt and implement, at latest by 31 January 2012, a minimum 40 mm square mesh codend or a diamond mesh size of at least 50 mm, of acknowledged equivalent or higher size selectivity, for all trawling activities exploiting demersal stocks when operating in the GFCM area of application (GFCM, 2022).

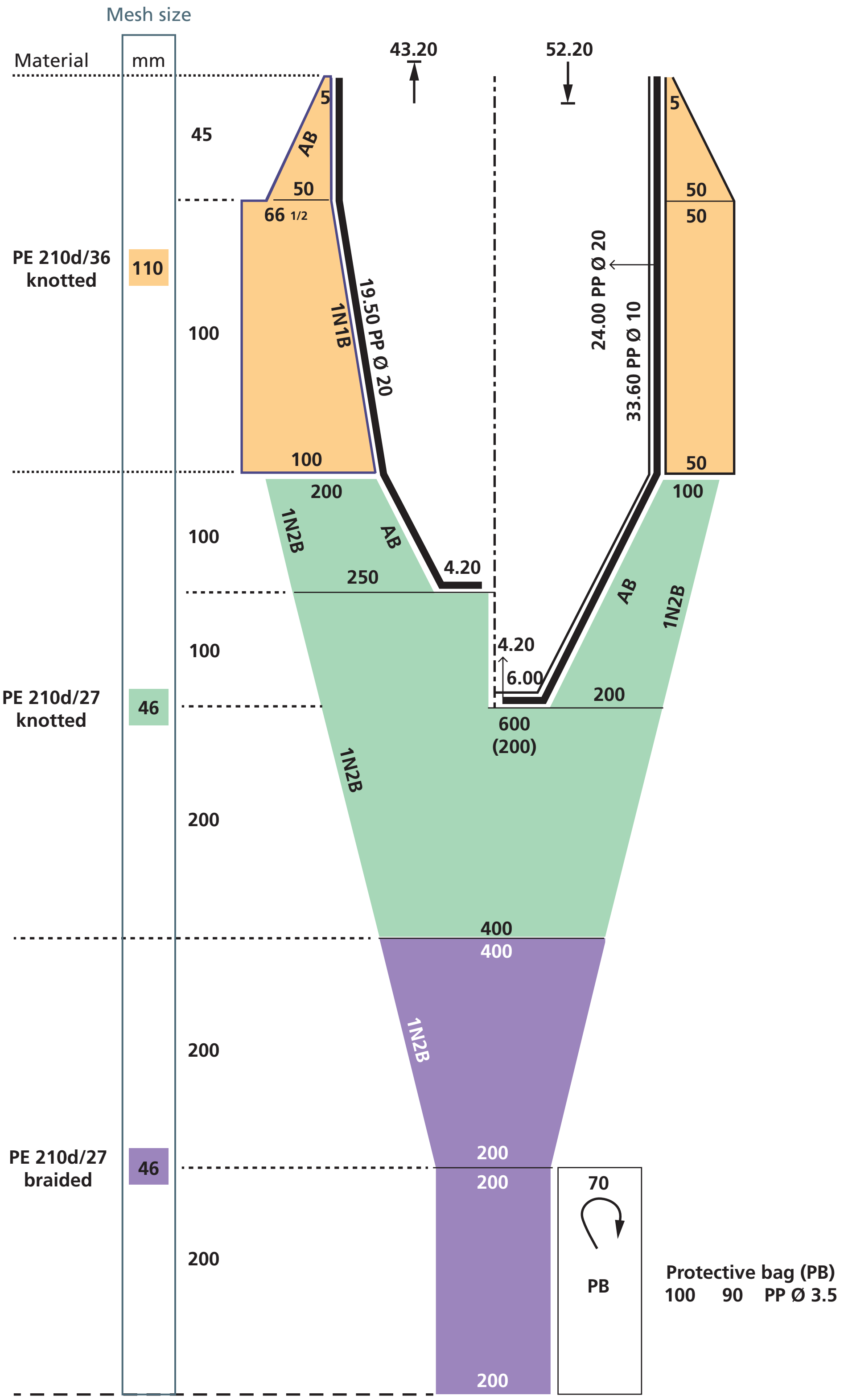
The main sections of a trawl net are the top wing, lower wing, top belly, lower belly, top codend and lower codend (Figure 2). Details of the mesh size for each section are shown in Figure 3 and details of how to calculate the headline and leadline are shown in Figure 4.

FIGURE 2
Trawl net sections



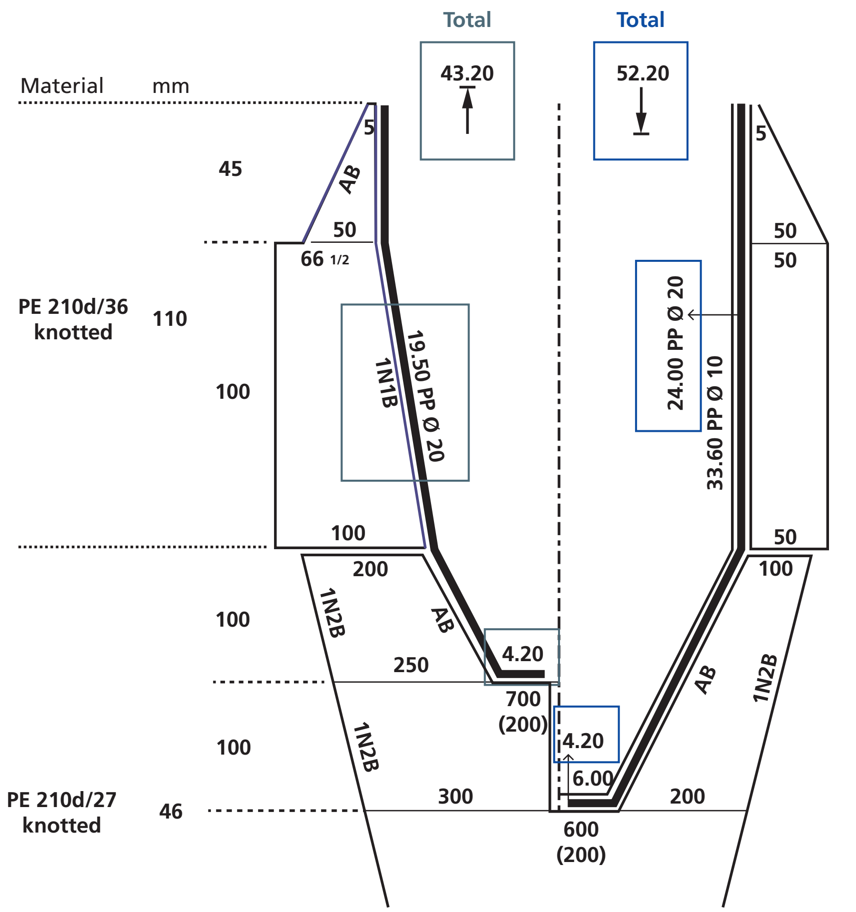
Source: redrawn from **Sala, A., Brčić, J., Conides, A., De Carlo, F., Klaoudatos, D., Grech, D., Lucchetti, A. *et al.*** 2013. *Final project report. Technical specifications of Mediterranean trawl gears (myGears).* Specific project Nr. 5 – Framework service contract Mediterranean Halieutic Resources Evaluation and Advice (MAREA). Bari, Italy, COISPA, Rome, CNR, Attiki, Greece, HCMR, Livorno, Italy, CIBM, Peñiscola, Spain, SUMASPE, Guilvinec, France, SIMRAD.

FIGURE 3
Technical specifications of a trawl net



Source: redrawn from **Sala, A., Brčić, J., Conides, A., De Carlo, F., Klaoudatos, D., Grech, D., Lucchetti, A.** ***et al.*** 2013. *Final project report. Technical specifications of Mediterranean trawl gears (myGears)*. Specific project Nr. 5 – Framework service contract Mediterranean Halieutic Resources Evaluation and Advice (MAREA). Bari, Italy, COISPA, Rome, CNR, Attiki, Greece, HCMR, Livorno, Italy, CIBM, Peñiscola, Spain, SUMASPE, Guilvinec, France, SIMRAD.

FIGURE 4
Trawl net headline and leadline length calculation



Note: diameter (ϕ); headline length: 19.5 × 2 + 4.2 = 43.2 m; leadline length: 24 × 2 + 4.2 = 52.2 m.

Source: redrawn from **Sala, A., Brčić, J., Conides, A., De Carlo, F., Klaoudatos, D., Grech, D., Lucchetti, A. *et al.*** 2013. *Final project report. Technical specifications of Mediterranean trawl gears (myGears).* Specific project Nr. 5 – Framework service contract Mediterranean Halieutic Resources Evaluation and Advice (MAREA). Bari, Italy, COISPA, Rome, CNR, Attiki, Greece, HCMR, Livorno, Italy, CIBM, Peñiscola, Spain, SUMASPE, Guilvinec, France, SIMRAD.

A trawl gear can also be composed of a funnel net fixed to a horizontal beam, or to a frame that determines its horizontal opening, and supported by slides that facilitate sliding along the bottom (beam trawl).

Table 3

Classification of trawl nets according to the International Standard Statistical Classification of Fishing Gear

Gear categories (first tier)	Subcategories (second tier)	Standard abbreviations	ISSCFG code
Trawls			3
	Beam trawls	TBB	3.11
	Single boat bottom otter trawls	OTB	3.12
	Twin bottom otter trawls	OTT	3.13
	Multiple bottom otter trawls	OTP	3.14
	Bottom pair trawls	PTB	3.15
	Bottom trawls (nei)	TB	3.19
	Single boat mid-water otter trawls	OTM	3.21
	Mid-water pair trawls	PTM	3.22
	Mid-water trawls (nei)	TM	3.29
	Semipelagic trawls	TSP	3.3
	Trawls (nei)	TX	3.9

Source: **FAO.** 2016. *International Standard Statistical Classification of Fishing Gear. Handbook on Fisheries Statistics.* Rome.

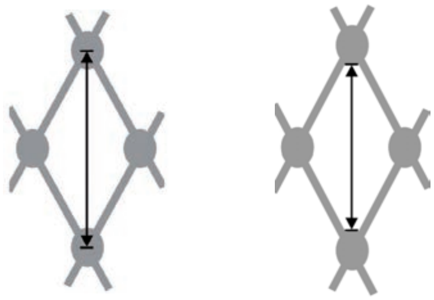
The classification of trawl nets (Table 3) considers different technical and operational factors:

- trawl technique (single boat, pair trawling, multi-rig trawl);
- operating depth (bottom trawl, mid-water trawl, semipelagic trawl);
- type of horizontal opening (otter trawl, beam trawl, pair trawl); and
- information about trawl nets in the Mediterranean Sea that has been collected from the myGears project (Sala *et al.*, 2013), which reports a comprehensive review for the European Union and some non-European Union countries.

1.1.1 Mesh size measurements

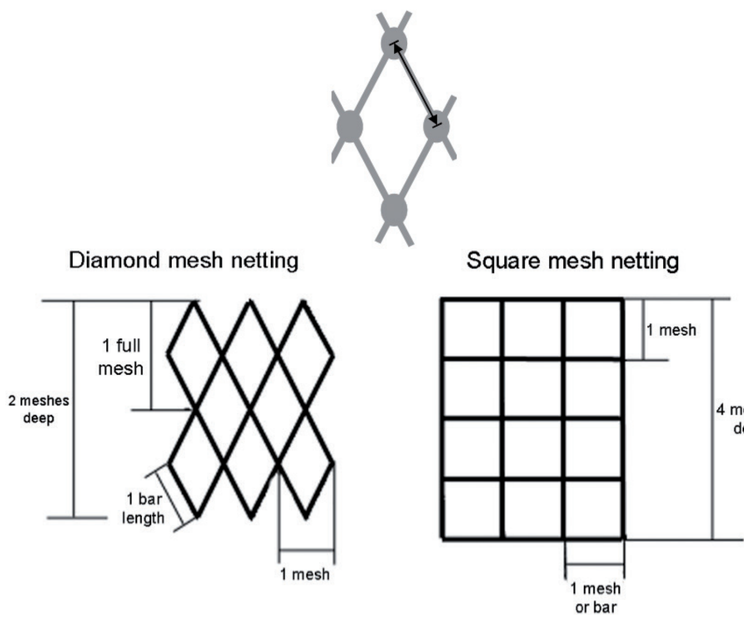
Mesh size is the distance between the centres of two opposite knots in the same mesh when fully extended in the N-direction (the direction at right angles to the general course of the netting yarn, “normal”) or the distance between the centres of two opposite joints in the same mesh when fully extended along its longest possible axis for knotted netting and knotless netting, respectively. Mesh opening is the longest distance between two opposite knots in the same mesh when fully extended or the inside distance between the opposite joints in the same mesh when fully extended for knotted netting and knotless netting, respectively (Figure 5). Mesh side or mesh bar is the distance between two sequential knots or joints measured from centre to centre when fully extended (Figure 6).

FIGURE 5
Method for measuring mesh size (left) and for measuring mesh opening (right)



Source: **A. Lucchetti.** 2012. *MAREA Specific Contract n° 3 – Estimation of maximum net length of trammel nets, gillnets and combined bottom set nets by using the volume or the mass of the net (ARCHIMEDES).* Final report. Rome, CNR-IAMC, Bari, Italy, COISPA Tecnologia & Ricerca, Attiki, Greece, HCMR, Livorno, CIBM, Athens, LAMANS, Tirana, LAPD.

FIGURE 6
Method for measuring mesh bar in diamond and square mesh



Source: **A. Lucchetti.** 2012. *MAREA Specific Contract n° 3 – Estimation of maximum net length of trammel nets, gillnets and combined bottom set nets by using the volume or the mass of the net (ARCHIMEDES).* Final report. Rome, CNR-IAMC, Bari, Italy, COISPA Tecnologia & Ricerca, Attiki, Greece, HCMR, Livorno, CIBM, Athens, LAMANS, Tirana, LAPD.

1.1.2 Trawl techniques

There are basically three main trawl techniques: the single trawl technique (one vessel–one net), the multi-rig trawl technique (one vessel–more than one net), which includes the twin trawl technique (one vessel–two nets), and the pair trawl technique (two vessels–one net).

The single trawl technique is the most widespread demersal trawling technique, through which demersal species are herded by the doors, sweeps and bridles. In such fisheries, the door spread and wingend opening are important parameters affecting catchability, but the vertical opening can also be significant for demersal fish species that have been shown to exhibit upward escapement behaviour when approaching the mouth of the trawl.

The multi-rig trawl technique involves a more sophisticated rigging that allows the towing of two (twin trawl) or more nets by the same vessel. For instance, the Italian *rapido* trawl is a classical multi-rig trawl, as the commercial vessel typically tows four sets of gear simultaneously. In twin trawl rigging, recently reintroduced in the Mediterranean Sea, towing two nets side by side enhances the horizontal opening at the wingends of the trawl, increasing the effective swept area (by approximately one-third), and hence the catch.

The pair trawl technique, where one trawl is towed between two vessels, is used primarily to tow very large nets when targeting dense shoals of pelagic species such as anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*). The use of large nets increases the swept area and the catchability compared to single trawling under certain conditions. Moreover, in pelagic single trawling, the school of fish can be scared by the passage of the vessel directly in front of the trawl, whereas in a pair trawl operation the boats can spread further apart and the fish can be herded back between the boats into the trawl. The demersal pair trawl technique is no longer used in the Mediterranean and the Black Sea.

1.1.3 Operating depths

Trawls may be towed over the seabed by digging into it – bottom trawl – or at any depth in mid-water – mid-water trawls – according to the target species. There is also a third category, not very common in the Mediterranean and the Black Sea and difficult to catalogue, which is defined as a semi-pelagic trawl because the net or otterboards do not touch the bottom.

It is a common practice to refer to the towed nets on the bottom as “bottom or demersal trawling”. They are usually fitted with a weighted footrope that can be equipped with a tickler chain between the wings and just in advance of the net-mouth footrope to enhance the catch efficiency. This chain has the effect of forcing the typical target species – shrimp and flatfish – upwards and into the net mouth, thus improving the catch. Therefore, harvesting of marine resources in the proximity of the seabed requires fishing techniques that often interact with the bottom habitat, making this technique the most impactful at the global scale and especially in the Mediterranean (Amoroso *et al.*, 2018).

Trawls can also be towed in mid-water to catch pelagic species and therefore are called mid-water or pelagic trawls. In mid-water trawling, the net can be towed by one (single boat) or two vessels (pair trawling) and is fitted and rigged to capture small pelagic species such as anchovy and sardine, and to a lesser extent other pelagic fish such as jack and horse mackerel nei (*Trachurus* spp.) and mackerel (*Scomber* spp.). A pelagic trawl is towed at the appropriate level in the water column to intercept the target shoal, with gear depth being controlled by altering the towing speed and/or warp length. Use of electronic equipment such as an echo-sounder is common and is essential to detect fish concentrations ahead of the net and, hence, to allow the trawl path and depth to be adjusted accordingly.

The semi-pelagic trawl is a hybrid system between a mid-water trawl and a bottom trawl used to catch fish off the seabed. The system can be rigged with the otterboards off the seabed (efficient pelagic otterboards with a high aspect ratio are often used) and can also be designed to have the trawl net off the seabed (the footrope may be lightened), while the trawl doors are on the bottom (He, 2007).

1.1.4 Horizontal opening

Three categories of trawls can be distinguished based on how their horizontal opening is maintained: otter trawls, beam trawls and pair trawls.

Otter trawling takes its name from the trawl doors or otterboards used to spread the net horizontally. The otterboards have two additional main functions: to provide the front bottom contact points of the trawl gear; and to herd and stimulate fish to swim towards the trawl path. The basic otter trawl rigging comprises the towing vessel, two wires connecting the vessel to the otterboard, two otterboards (trawl doors) that are used to spread the connecting wires and hence hold the net open horizontally, two sweeps and/or bridles connecting the otterboards to the net, and finally the trawl net. In a single boat pelagic trawl, the horizontal opening is maintained by spreading the two wings by means of two or four doors, i.e. two small pelagic doors and two traditional bottom doors. The otterboards are connected to the trawl wings by sweeps or bridles (generally ropes). These connections vary in length from a few metres up to 300 m.

Otterboards are considered the most significant source of bottom impacts from the entire trawl system. As a consequence, recent growing interest has led to the development of more hydrodynamic efficient doors, in terms of maximizing spread forces while minimizing resistance.

Beam trawling takes its name from the metal beam (or frame) used to maintain the horizontal and vertical opening of the gear. The net of a beam trawl consists of a cone-shaped body ending in a bag or codend that retains the catch. The gear is towed on the bottom by means of sledges or shoes mostly made of steel. No hydrodynamic forces are needed to keep a beam trawl open. As such, beam trawls are often preferred for catching demersal flatfish and shrimp, particularly closer to shore; the towing warps are attached directly to the beam.

In pair trawling, the horizontal opening of the net towed by two vessels is maintained by the distance between the two boats.

1.2 Bottom trawls

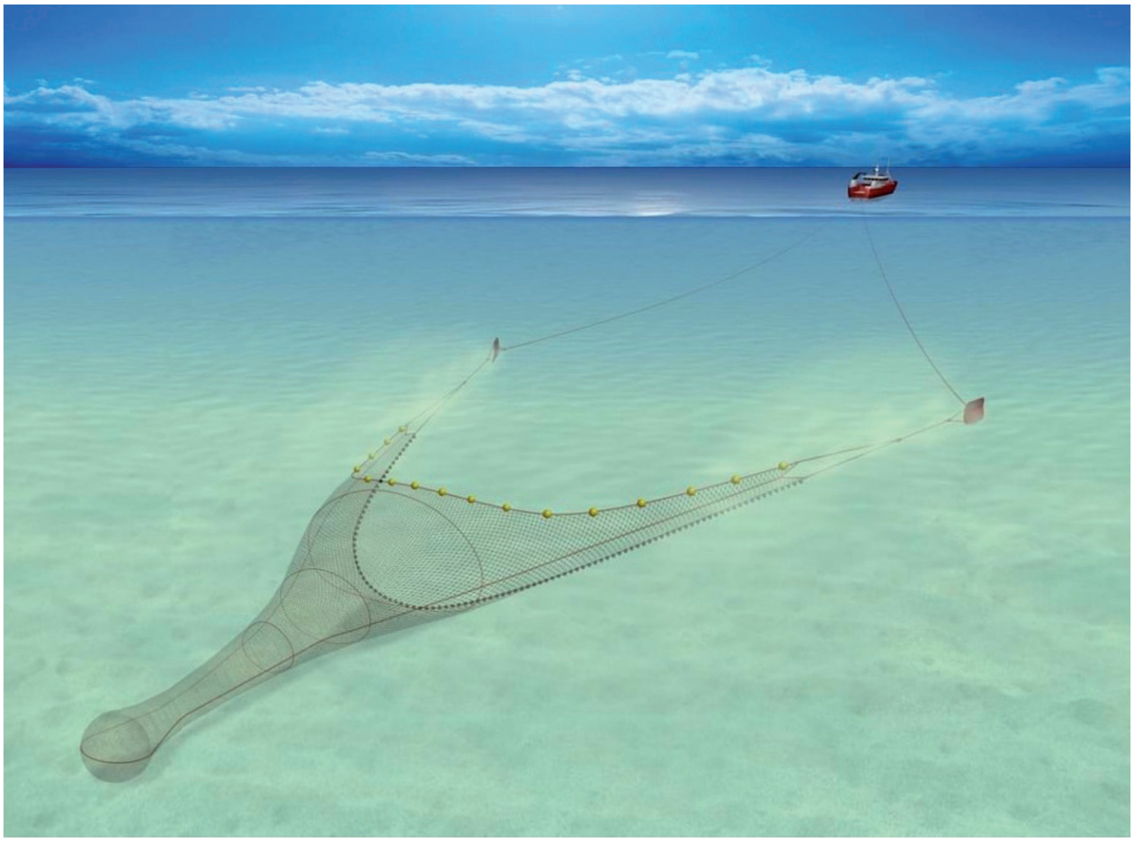
A bottom trawl is a cone-shaped net towed on the seabed and designed to harvest marine resources in the proximity of the seabed, or even sunken in the sediment. Fishers have found ingenious ways to adapt their trawls to the local fishing conditions, so that in each area and country there are several different net designs and characteristics. The footropes of Mediterranean and Black Sea bottom trawls often consist of components such as heavy-duty ropes, chains and weights to ensure that seabed contact is maintained during fishing while minimizing the risk of damage to the net. Otterboards (used in single boat bottom trawls) assist in keeping the net in contact with the seabed and guarantee the horizontal net opening. As such, the horizontal opening can also be defined by a rigid beam or frame (beam trawl). The opposite buoyancies of the headrope and groundrope of the otter trawl or the rigid frame of a beam trawl maintain the vertical opening of the trawl net. The net may have more than one codend that splits the catch in order to reduce fish damage and improve fish quality. In the Mediterranean and the Black Sea, bottom trawling is capable of operating over many types of seabed and at depths ranging from 10 m to 800 m.

1.2.1 Single boat bottom otter trawls

The single trawl technique (one vessel–one net), commonly used to target benthic or demersal species, is the most widespread demersal trawling technique. Otter trawls take their name from the trawl doors or otterboards used to spread the net horizontally (Figure 7). In this technique, the door spread and wingend opening are important parameters affecting catchability. The vertical opening can also be important for demersal fish species that exhibit upward escapement behaviour when approaching the mouth of the trawl.

Depending on the target species, bottom otter trawls are usually towed at a speed between 2.5 knots and 4.5 knots. The duration of a tow depends mainly on the bottom depth, expected density of fish (whether fish are aggregated or not), the bottom properties (mud or sand) and the slope in the fishing area. It ranges from 30 minutes to 5 hours (for deep-water crustacean fisheries); commonly it is 1–2 hours.

FIGURE 7
Single boat bottom otter trawl rigging



Source: **Seafish.** 2023. Fishing gear database. In: *Seafish*. Cited 23 May 2023. Edinburgh. www.seafish.org/responsible-sourcing/fishing-gear-database/?t=docGear/

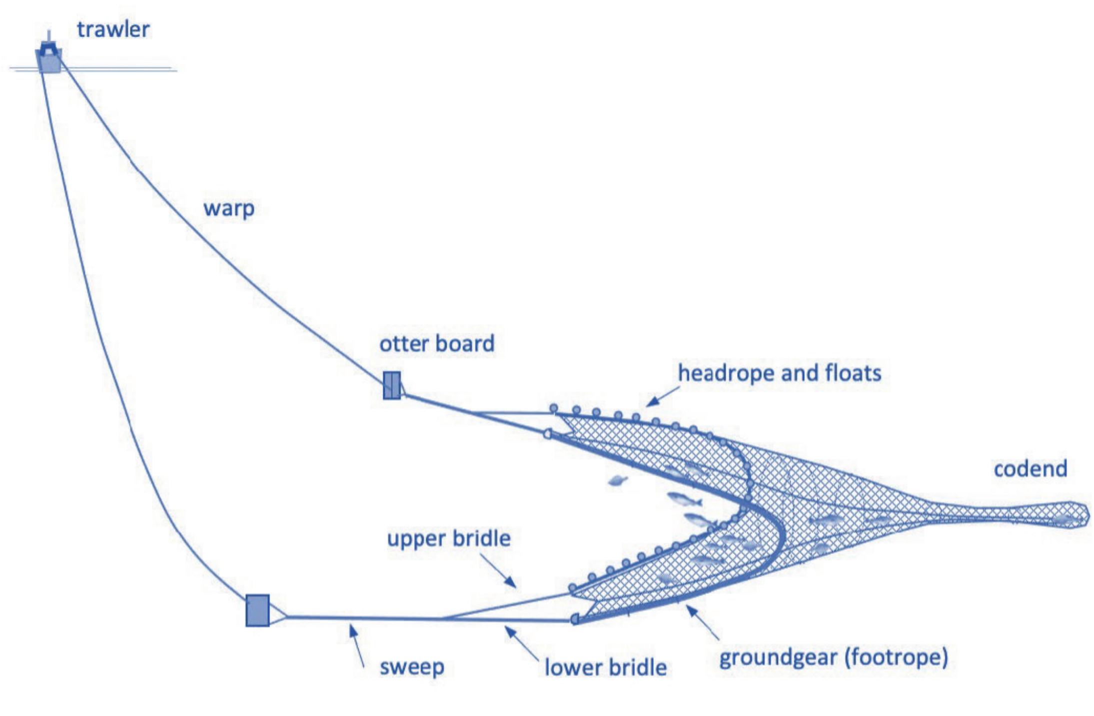
In brief, the traditional rigging of an otter trawl comprises (Figure 8):

- The onboard winch, having one or more horizontally mounted drums and/or warping ends on which a rope may be wound. Auxiliary drums may be used to hold the net after hauling.
- Two warps or wires, i.e. long flexible steel ropes connecting the vessel to the otterboard. The length of the warps strongly depends on the bottom depth. At depths of less than 70 m, the length of the warps is 7–10 times the depth of the seabed (3–5 m for the eastern Mediterranean and the Black Sea), while it is reduced to 2–2.5 times the depth of the seabed in fishing areas deeper than 100 m. In trawl gear, the winches installed on deck control the trawling warps and store them when not in use.
- Two otterboards or trawl doors to hold the net wings open horizontally. The otterboards have three main functions:
  - to spread the trawl horizontally during towing;
  - to provide the front bottom contact points of the trawl gear; and
  - to herd and stimulate fish to swim towards the trawl path.
- Two sweeps, which are the ropes, usually made of wire or combination rope, connecting the otterboard to the net wing on either side of a trawl net.
- The two wingends (upper and lower) can also be linked to the sweeps by means of bridles. Usually, two bridles on each side of the net are present. Certain types of trawl design show that the otterboard is directly joined to the net wing through

a short bridle and without sweeps (i.e. in the Italian *Americana* net). In certain types of nets, two bridles are connected to the main sweep and sometimes directly to the door. The sweeps usually have bottom contact during towing and are used to substantially increase the area of seabed swept by the gear and herd the fish towards the trawl mouth, at very little cost in terms of additional towing power and generating improved productivity. Sweeps can vary in length from a few metres up to 300 m.
- A funnel-shaped net ending with a codend. The net may consist of two faces – top and bottom – or four faces – top, bottom and sides.

The sweeps/bridles and otterboards herd the fish and stimulate them to swim towards the trawl path. The contact of the otterboards and sweeps with the bottom, as well as the water turbulence behind the boards, generate a cloud of mud and sand that, together with the noise created, leads to a herding effect of the fish into the net (Lindeboom and de Groot, 1998). Therefore, the capture success usually depends on how many fish are present in the swept area that are overtaken by the trawl and enter the net and how many are able to escape over or under the trawl. Once the fish have entered the net, escapement is a matter of selectivity.

FIGURE 8
Typical single boat bottom otter trawl



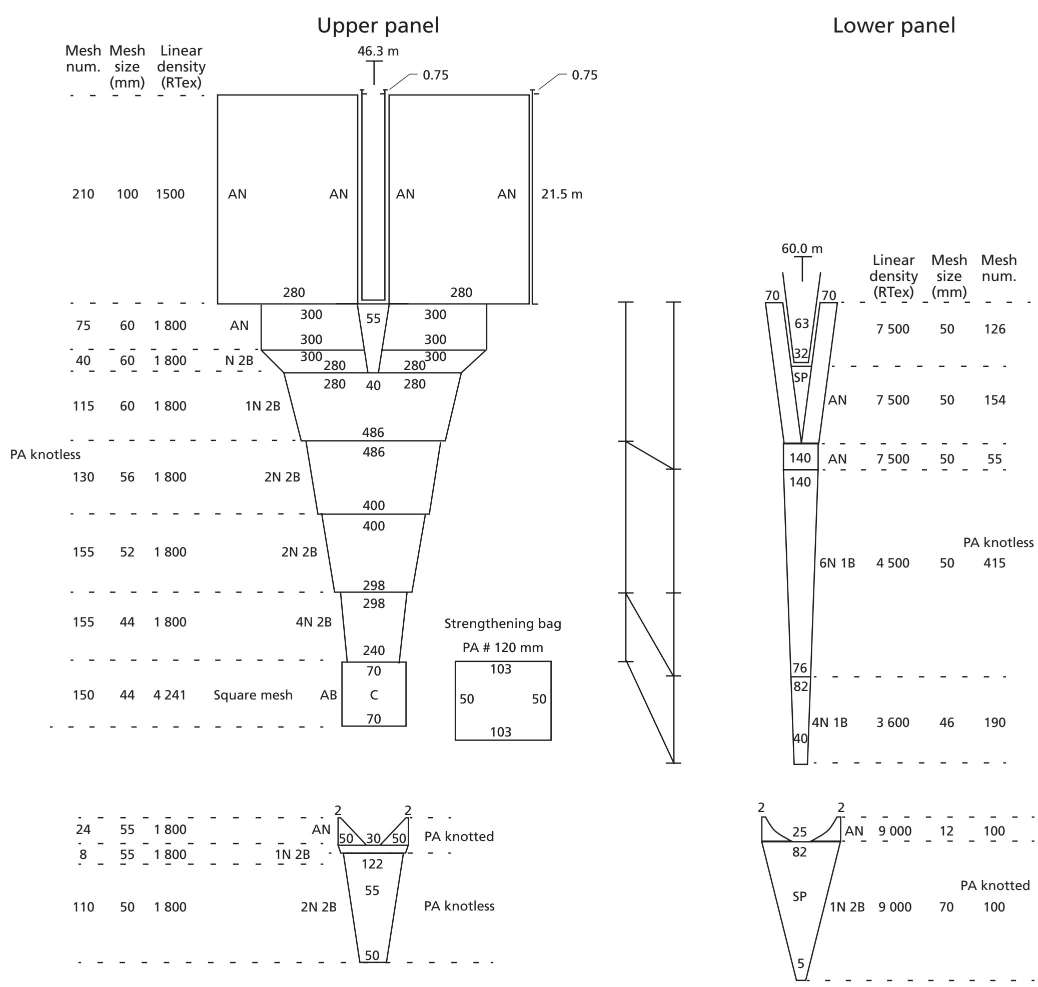
Source: **He, P., Chopin, F., Suuronen, P., Ferro, R.S.T & Lansley, J.** 2021. *Classification and illustrated definition of fishing gears.* FAO Fisheries and Aquaculture Technical Paper No. 672. Rome, FAO. https://doi.org/10.4060/cb4966en

Several different net designs are used in the Mediterranean Sea that are relevant to sea bottom characteristics, traditions and target species, among other factors. Three main conceptual trawl typologies can be defined in Mediterranean and Black Sea bottom otter trawling.

Demersal/bottom two-face trawls

The two-face (or panel) trawls are normally employed for the capture of benthic animals living close to the bottom, such as flatfish, red mullet (*Mullus barbatus*) and shrimp in particular, but also demersal fish such as European hake (*Merluccius merluccius*). These nets usually have long sweeps and short bridles (when present), a large wingend spread and low vertical opening (1–2 m; Figure 9). Most of the traditional Mediterranean trawls belong to this type, including the Italian *volantina* and *tartana* and the Spanish *cadenero*, *huelvano* and *minifalda*. They are commonly made up of knotless PA netting. Short bridles are usually present in the configuration with cut-wings (such as the *volantina*; Plate 2). The headrope and groundrope of the two wingends can be joined to the sweep by means of a danleno stick (an iron rod of around 20–40 cm joined to the sweep by means of short chains or ropes) that keeps the headrope and leadrope apart, as in the case of a *tartana* trawl, or by a danleno triangle, where two short bridles are joined to the sweep by means of a triangle made of steel or iron with swivels, as in the case of *volantina* net. In the first case (with the headrope and groundrope directly connected to the danleno), the net has a low vertical opening while towing is in progress (around 1–1.5 m or less).

FIGURE 9
Technical specifications of a demersal/bottom two-face trawl

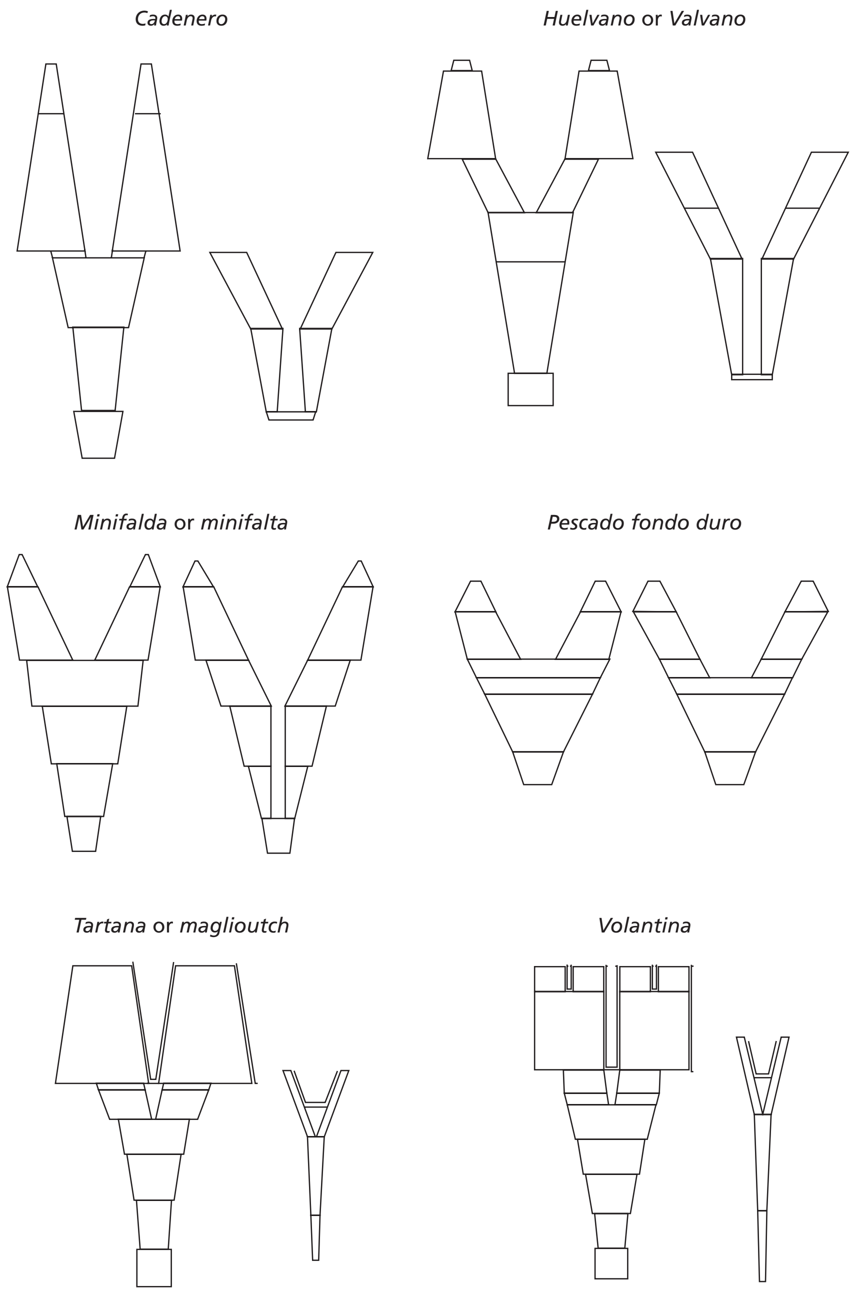


Source: redrawn from **Sala, A. & Lucchetti, A.** 2011. Effect of mesh size and codend circumference on selectivity in the Mediterranean demersal trawl fisheries. *Fisheries Research*, 110(2): 252–258.

However, this basic scheme can have many local variations. In the Mediterranean, there are many types of two-face trawls, as highlighted in the European myGears project (Sala *et al.*, 2013).

Some examples are given in Figure 10.

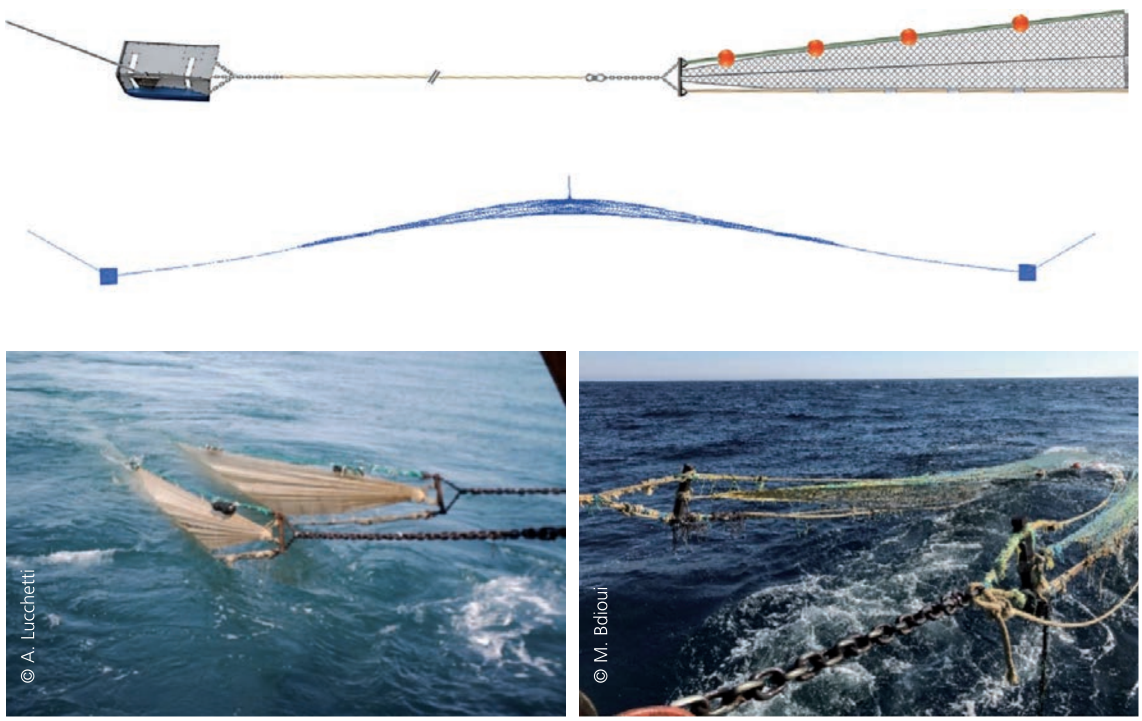
FIGURE 10
Two-face trawl designs used in the Mediterranean



Source: redrawn from **Sala, A., Brčić, J., Conides, A., De Carlo, F., Klaoudatos, D., Grech, D., Lucchetti, A. *et al.*** 2013. *Final project report. Technical specifications of Mediterranean trawl gears (myGears).* Specific project Nr. 5 – Framework service contract Mediterranean Halieutic Resources Evaluation and Advice (MAREA). Bari, Italy, COISPA, Rome, CNR, Attiki, Greece, HCMR, Livorno, Italy, CIBM, Peñiscola, Spain, SUMASPE, Guilvinec, France, SIMRAD.

Normally, the demersal/bottom two-face trawl involves the use of rigging as shown in Figure 11, with the trawl doors and the sweeps directly joined to the trawl wings, usually by means of danleno sticks or spreaders.

FIGURE 11
Details of a classical two-face bottom trawl rigging (side and front view) (top) and of the wingends (bottom)



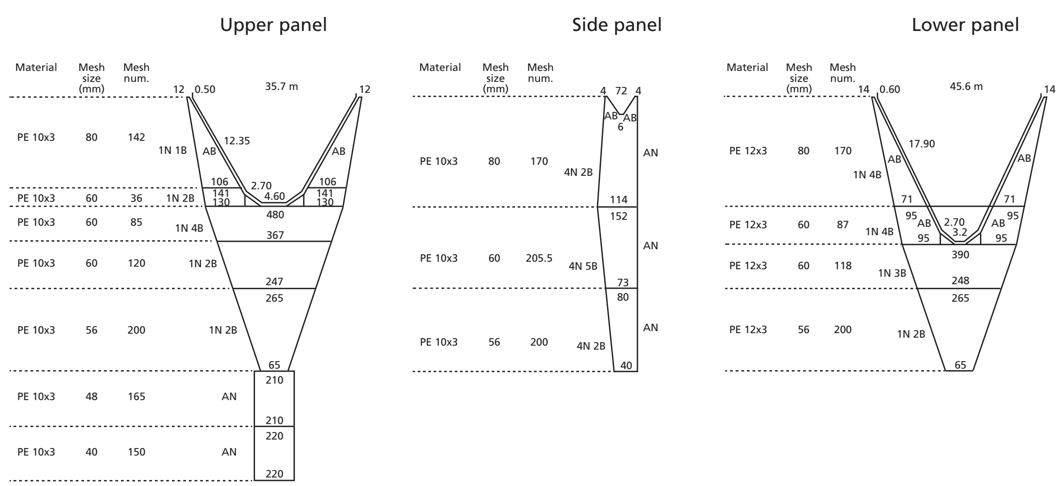
Source: adapted from **Eigaard, O.R., Rihan, D., Graham, N., Sala, A. & Zachariassen, K.** 2011. Improving fishing effort descriptors: Modelling engine power and gear-size relations of five European trawl fleets. *Fisheries Research*, 110: 39–46

PLATE 2
***Volantina* two-face bottom trawl with cut-wings used in the Mediterranean Sea**

Demersal/bottom four-face trawls

The four-face (or panel) trawls normally have higher vertical openings than the two-face trawls, reaching up to 2–5 m (Figure 12). These nets are generally used to target crustaceans such as the deep-water rose shrimp (*Parapenaeus longirostris*), giant red shrimp (*Aristaeomorpha foliacea*) and Norway lobster (*Nephrops norvegicus*). These trawls are characterized by having two bridles of 10–15 m to increase the vertical opening. Typical four-face nets are the Italian *Americana*, the Spanish *cuadrado, dos bocas, espada, tangonero* and *semitangonero*, and the French *jumeaux* and *filet à chains*. Manufactured mainly with knotted PE netting, they can sometimes have knotless PA netting in the lower panel.

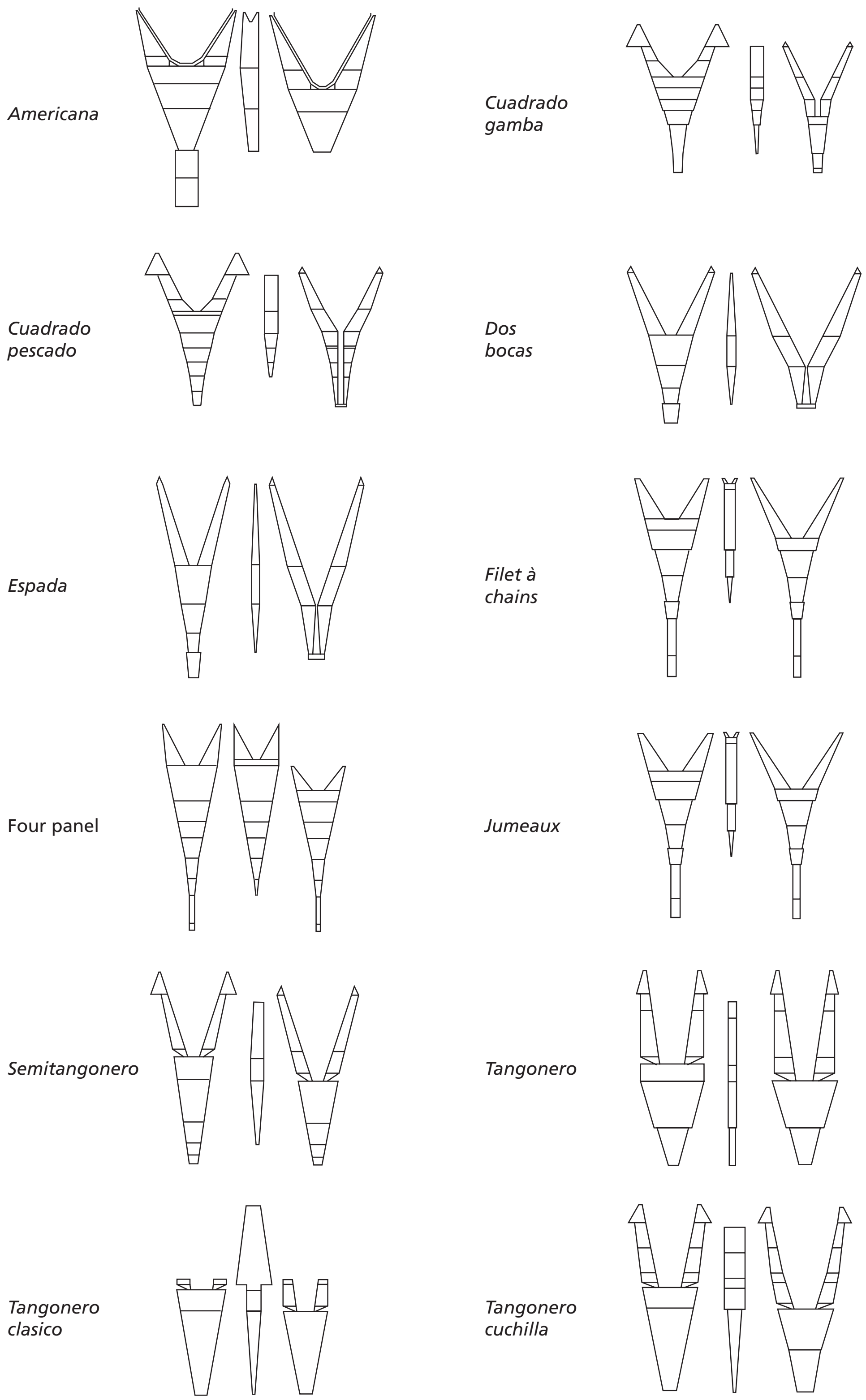
FIGURE 12
Technical specifications of a demersal/bottom four-face trawl



Source: redrawn from A. Lucchetti.

Similarly, in this case, the basic scheme can have many local variations, and therefore in the Mediterranean Sea, many types of four-face trawls are used, as highlighted in the European myGears project (Sala *et al.*, 2013). Examples are given in Figure 13.

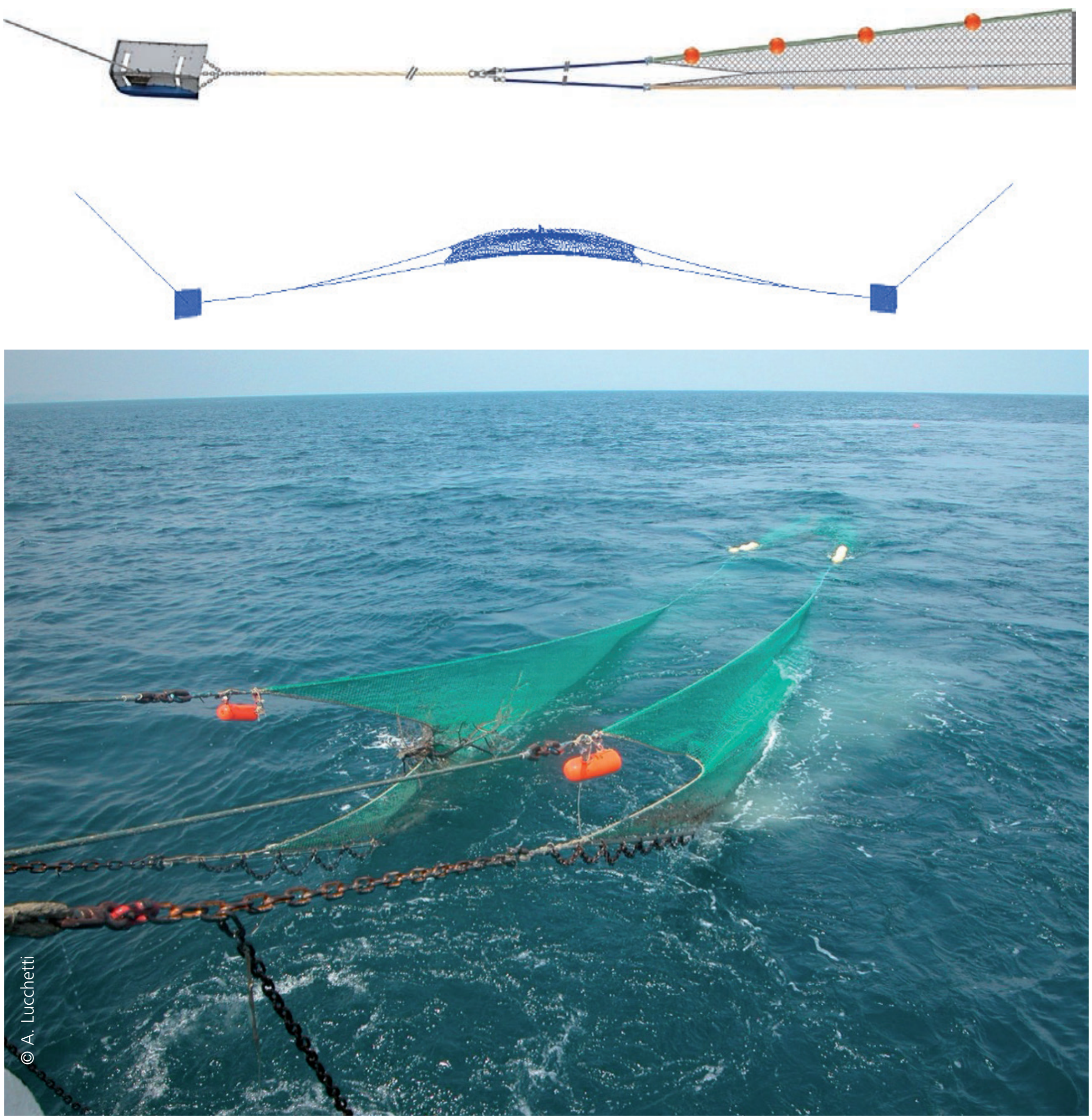
FIGURE 13
Four-face trawl designs used in the Mediterranean



Source: redrawn from **Sala, A., Brčić, J., Conides, A., De Carlo, F., Klaoudatos, D., Grech, D., Lucchetti, A. *et al.*** 2013. *Final project report. Technical specifications of Mediterranean trawl gears (myGears).* Specific project Nr. 5 – Framework service contract Mediterranean Halieutic Resources Evaluation and Advice (MAREA). Bari, Italy, COISPA, Rome, CNR, Attiki, Greece, HCMR, Livorno, Italy, CIBM, Peñiscola, Spain, SUMASPE, Guilvinec, France, SIMRAD.

Normally, the demersal/bottom four-face trawl involves the use of the rigging shown in Figure 14, with trawl doors, sweeps and bridles connecting the bridles with the upper and lower part of the net wings (headline and leadline). This rigging can also be found in two-face trawls with cut-wings (such as the *volantina* trawl).

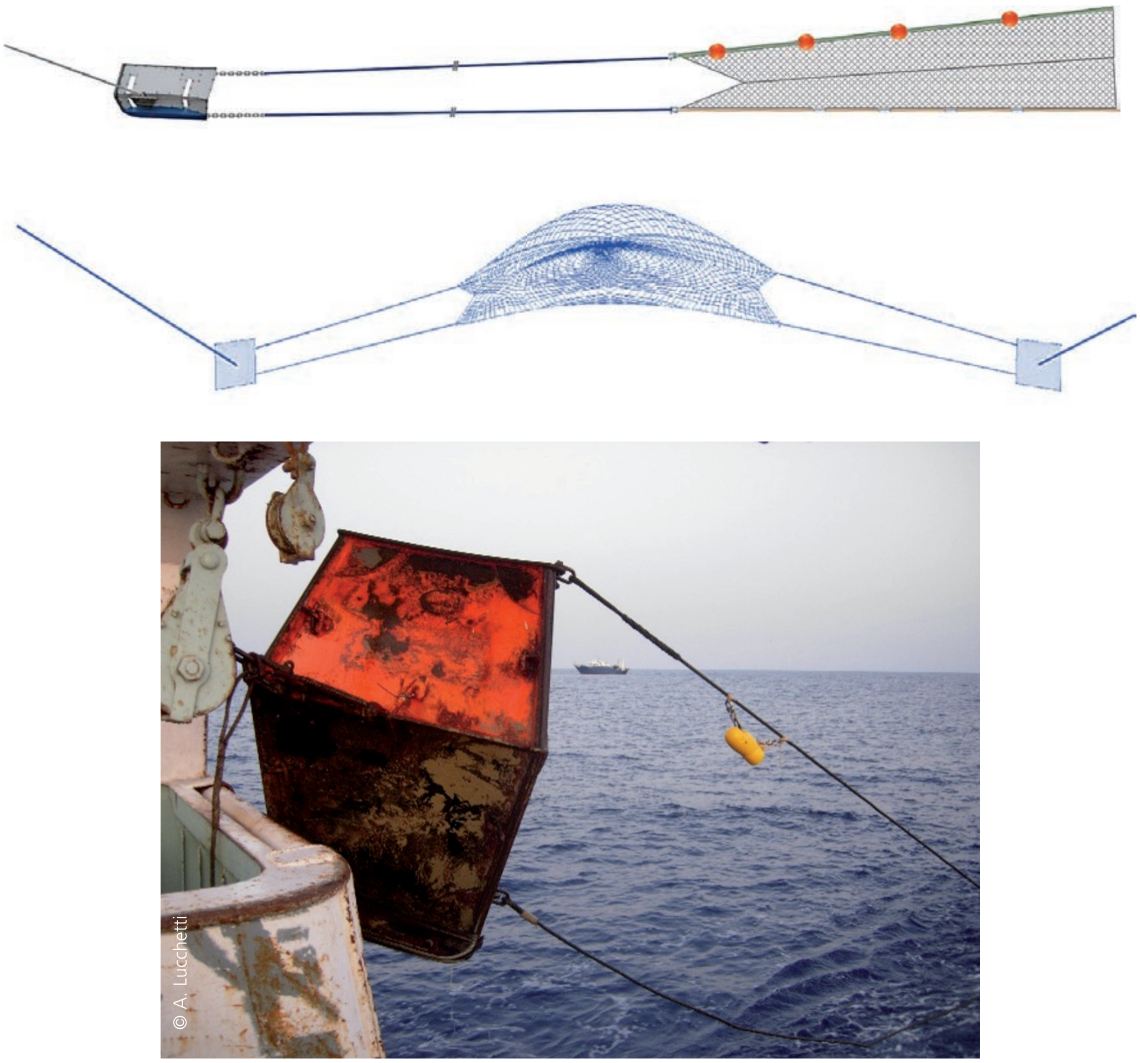
FIGURE 14
Details of a four-face bottom trawl rigging (side and front view) (top) and of the wingends (bottom)



Source: adapted from **Eigaard, O.R., Rihan, D., Graham, N., Sala, A. & Zachariassen, K.** 2011. Improving fishing effort descriptors: Modelling engine power and gear-size relations of five European trawl fleets. *Fisheries Research,* 110: 39–46.

Sometimes, trawl nets are rigged in such a way as to produce a much higher vertical opening. These types of nets can be either two-face or four-face trawls (Figure 15). The two-face trawl with the higher vertical opening is not so common and usually involves the use of two wingends of the trawl connected to the doors by means of bridles. Typical two-face trawls with high vertical openings are the French high opening net or *grande ouverture verticale*. This trawl typology always has a four-cable rigging.

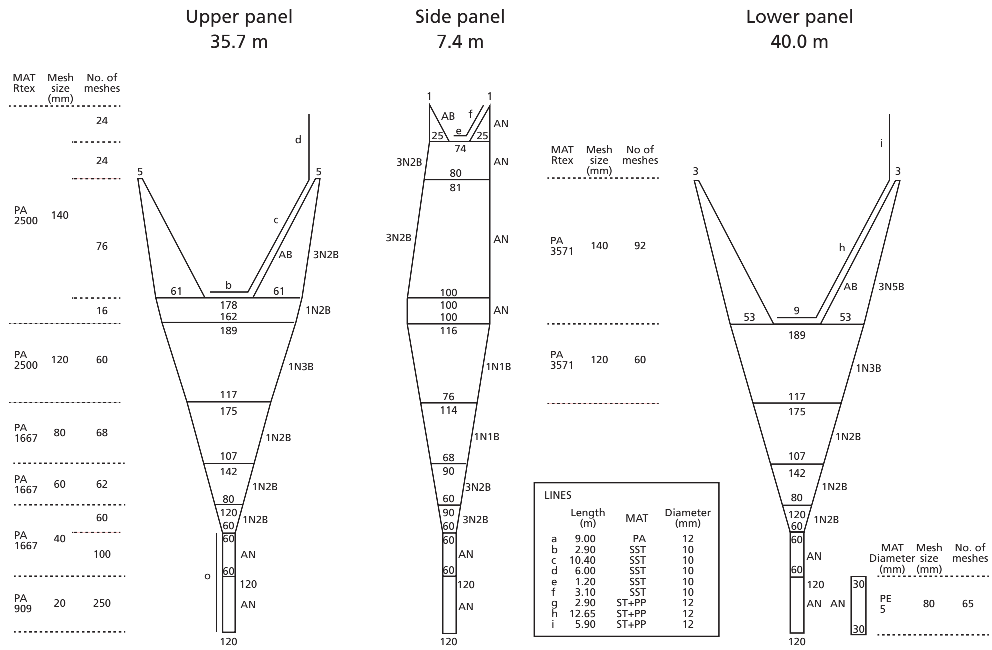
FIGURE 15
Details of a two-face trawl rigging with high vertical opening (side and front view) (top) and of a trawl door rigging of a four-face trawl with high vertical opening (bottom)



Source: adapted from **Eigaard, O.R., Rihan, D., Graham, N., Sala, A. & Zachariassen, K.** 2011. Improving fishing effort descriptors: Modelling engine power and gear-size relations of five European trawl fleets. *Fisheries Research*, 110: 39–46.

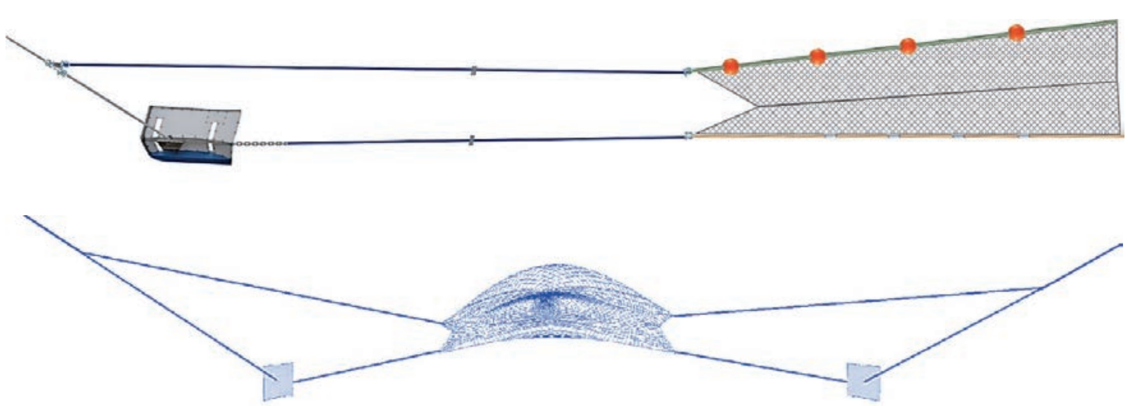
The four-face trawls with high vertical openings are mainly used to catch demersal and pelagic species (Figure 16). Compared to the *grande ouverture verticale* trawl, they have a higher vertical net opening and are more efficient for catching pelagic species. As such, these trawls are designed to have a mean vertical opening of around 4–10 m. This trawl typology always has a four-cable rigging (Figure 17). A typical four-face trawl is the trawl used in the International bottom trawl survey in the Mediterranean (MEDITS). Normally, the four-face trawl involves the use of two ropes connecting the lower wingend to the door and the upper wingend to the warp. It is not always easy to distinguish this type of net from a single boat mid-water trawl.

FIGURE 16
Technical specifications of a four-face trawl with high vertical opening



Source: redrawn from **Sala, A., Brčić, J., Conides, A., De Carlo, F., Klaoudatos, D., Grech, D., Lucchetti, A. *et al.*** 2013. *Final project report. Technical specifications of Mediterranean trawl gears (myGears)*. Specific project Nr. 5 – Framework service contract Mediterranean Halieutic Resources Evaluation and Advice (MAREA). Bari, Italy, COISPA, Rome, CNR, Attiki, Greece, HCMR, Livorno, Italy, CIBM, Peñiscola, Spain, SUMASPE, Guilvinec, France, SIMRAD.

FIGURE 17
Details of a four-face trawl with high vertical opening (side and front view)



Source: adapted from **Eigaard, O.R., Rihan, D., Graham, N., Sala, A. & Zachariassen, K.** 2011. Improving fishing effort descriptors: Modelling engine power and gear-size relations of five European trawl fleets. *Fisheries Research*, 110: 39–46.

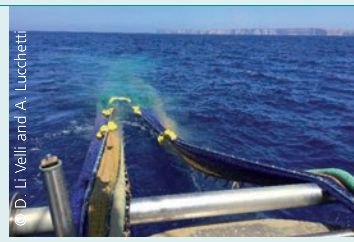
To summarize, the net is designed and rigged to catch species living on, near or within the bottom, and its basic design involves the following components: headrope, footrope, danleno stick, danleno triangle, wings, trawl body, extension piece, codend, bottom-side chafer, strengthening bag, netting material and otterboards. For additional details on these components, see Box 1.

Box 1
Details of the single boat otter trawl

Headrope

The headrope is equipped with a series of floats to guarantee the vertical net opening. The number, material, dimensions and shape of floats depend on the trawl net design and bottom depth.

Examples of headropes used for bottom trawl nets in the Mediterranean Sea



Standard headropes with floats rigged to them.

Footrope (or groundrope)

The footrope is designed to provide good contact with the bottom and increase catch efficiency. Usually equipped with leads and/or chains, it can also be rigged with various types of ground gear (rubber discs, bobbins, etc.) with the purpose of protecting the netting from damage and allowing continuous towing without hook-ups. The dimensions of the groundrope, which range from a few centimetres up to 10 or more centimetres in diameter, depend on the properties of the sea bottom.

Examples of footropes used for bottom trawl nets in the Mediterranean Sea

Standard footropes with leads attached to them.

Chains tightly joined to groundropes to enhance bottom contact.

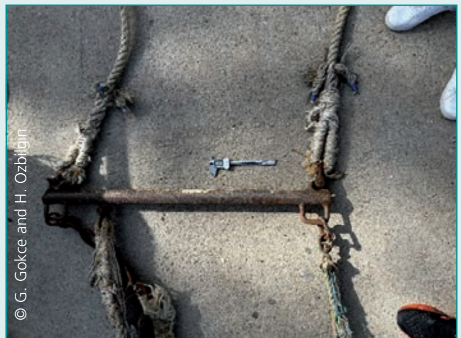
Festoons or loops of chain rigged to the footrope to make it dig into the bottom and disturb flatfish.

Thick footrope used in rough seabeds to avoid trawl entanglement.

Danleno stick (spreader)

The danleno stick is a bar of around 20–40 cm made of iron or steel and attached to the outer end of a trawl net wing to keep it stretched vertically. This iron rod is joined to the sweep by means of short chains or ropes to keep the headrope and leadrope apart.

Example of danleno stick used for bottom trawl nets in the Mediterranean Sea

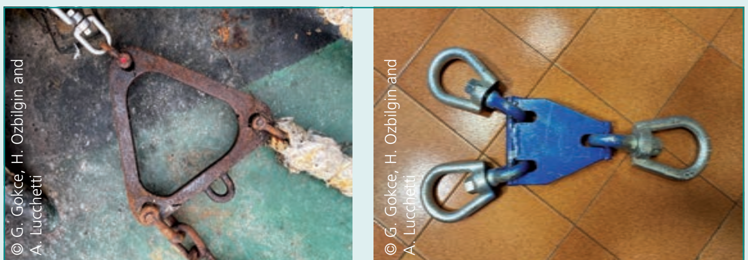


Danleno stick between the headrope and leadrope.

Danleno triangle (triangle with swivels)

The danleno triangle is a triangle made of iron or steel with swivels to link the short bridles to the sweep and the bridles.

Examples of danleno triangles used for bottom trawl nets in the Mediterranean Sea



Danleno triangles with swivels.

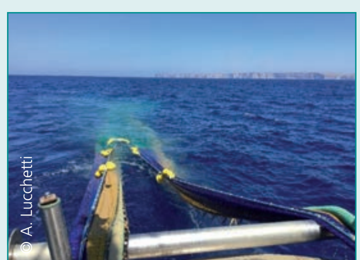
Wings

The wings are sections extending forwards from two sides of the main body of the net. According to the trawl type (two-face or four-face), the wing can be divided into a lower and upper section and can be made either of polyamide (PA) or polyethylene (PE).

Examples of wings on bottom trawl nets in the Mediterranean Sea

Trawl wing made of polyamide netting divided into an upper and a lower section (cut-wings).

Trawl wing made of a single section.



Trawl wings made of polyethylene.

Trawl body/belly

The trawl body, or trawl belly, is the funnel-shaped portion of the trawl that is widest at its "mouth" and narrows towards the codend and is usually fitted with wings of netting on both sides of the mouth. It is long enough to ensure an adequate flow of water and prevent fish from escaping out of the mouth after being caught. Furthermore, it is usually made of diamond-meshed netting, with the size of the meshes decreasing from the front of the net towards the codend. This section can be made both of PA and PE. Sometimes, the upper part is made of PE and the lower part of PA to enhance vertical opening and to help water flow into the net.

Examples of trawl bodies used for bottom trawl nets in the Mediterranean Sea

Trawl body made of polyamide.

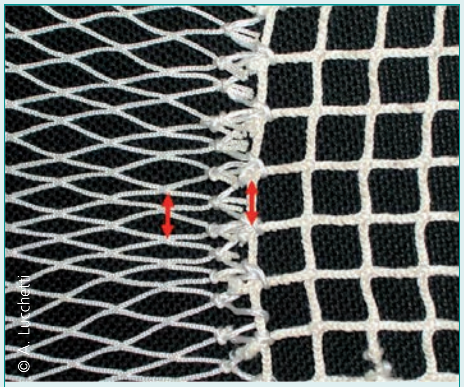
Trawl body made of polyethylene.

Extension piece

The extension piece is the rearmost part of the trawl body (tapered or untapered section) before the codend that is made of one or more panels of the same netting characteristics (mesh size, mesh configuration, twine diameter and material). In a Mediterranean bottom trawl, its length ranges from 3 m to 17 m.[a] In certain types of net, this section may not exist and the trawl body may be directly joined to the codend.

Examples of an extension piece used for bottom trawl nets in the Mediterranean Sea

Trawl body made of polyamide.



Extension piece joined to square mesh codend.

Codend

The codend is the rearmost part of the trawl net that is made of the same mesh size and has either a cylindrical or a tapered shape, with transversal cross-sections that are near circles of the same or decreasing radius, respectively. This section can be made of either PA or PE.

A 50 mm diamond mesh netting or a 40 mm square mesh codend are usually applied in European Union Mediterranean countries.

Sometimes, the codend is divided horizontally into two sections; the fish caught in the codend swim into the upper section, while the rest of the catch, as well as debris (stones, wood, anthropic material, mud, etc.), remains in the lower section. This technical solution is often applied by fishers to provide better-quality fish.

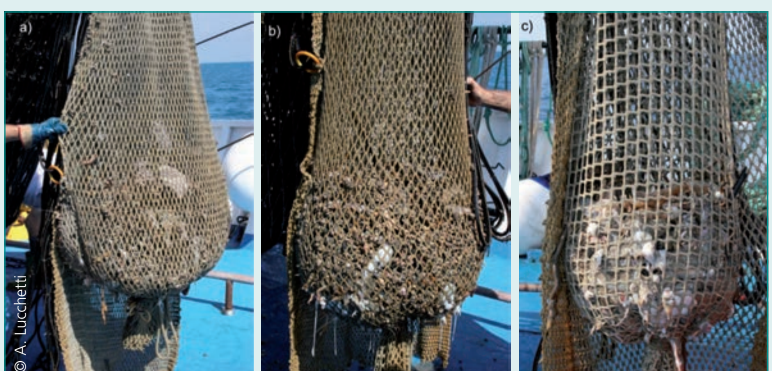
Examples of codends used for bottom trawl nets in the Mediterranean Sea

Codend catch.

Square-mesh codend stored on a winch.

Double codend (or divided codend) used to split catch and provide better-quality catch.

Codend used in Spain.



Codend mesh configurations: diamond (left), T90 (centre), square (right).

Bottom-side chafer

The bottom-side chafer is used to protect the net from damage that could result from rubbing against the sea bottom. It is composed of any piece of canvas, netting, rubber or other material. More than one bottom-side chafer may be used at the same time, and they may overlap. As such, a bottom-side chafer is attached to the outside of the trawl and only to the lower half of any part of the trawl. It is usually fastened only at its front and side edges.

Examples of bottom-side chafers used for bottom trawl nets in the Mediterranean Sea

Bottom-side chafer made of stiff netting.

Bottom-side chafer made of black rubber material.

Bottom-side chafer made of black plastic material.

Strengthening bag

The strengthening bag is a cylindrical piece of netting that completely surrounds the trawl codend. It is commonly used to strengthen the codend during the hauling process in cases of a huge catch. The mesh opening and the dimensions of this netting panel can strongly influence the selectivity of the codend. In fact, the mesh of the strengthening bag can cover the mesh of the codend, thus making it more difficult for young fish to escape from the codend.

Examples of strengthening bags used for bottom trawl nets in the Mediterranean Sea

Strengthening bag with large meshes.

Netting material

Different netting materials are used for the construction of trawl nets in the Mediterranean Sea, with braided, knotless PA and twisted, knotted PE being the most common. Other materials used include polypropylene and polyester. In the last ten years, other materials have been introduced, especially in Spain and Italy, such as those made with the ultra-high molecular weight polyethylene fibre Dyneema.[b]

Examples of netting materials used for bottom trawl nets in the Mediterranean Sea

Polyethylene knotted netting.

Polyamide braided (knotless) netting.

Otterboards (or trawl doors)

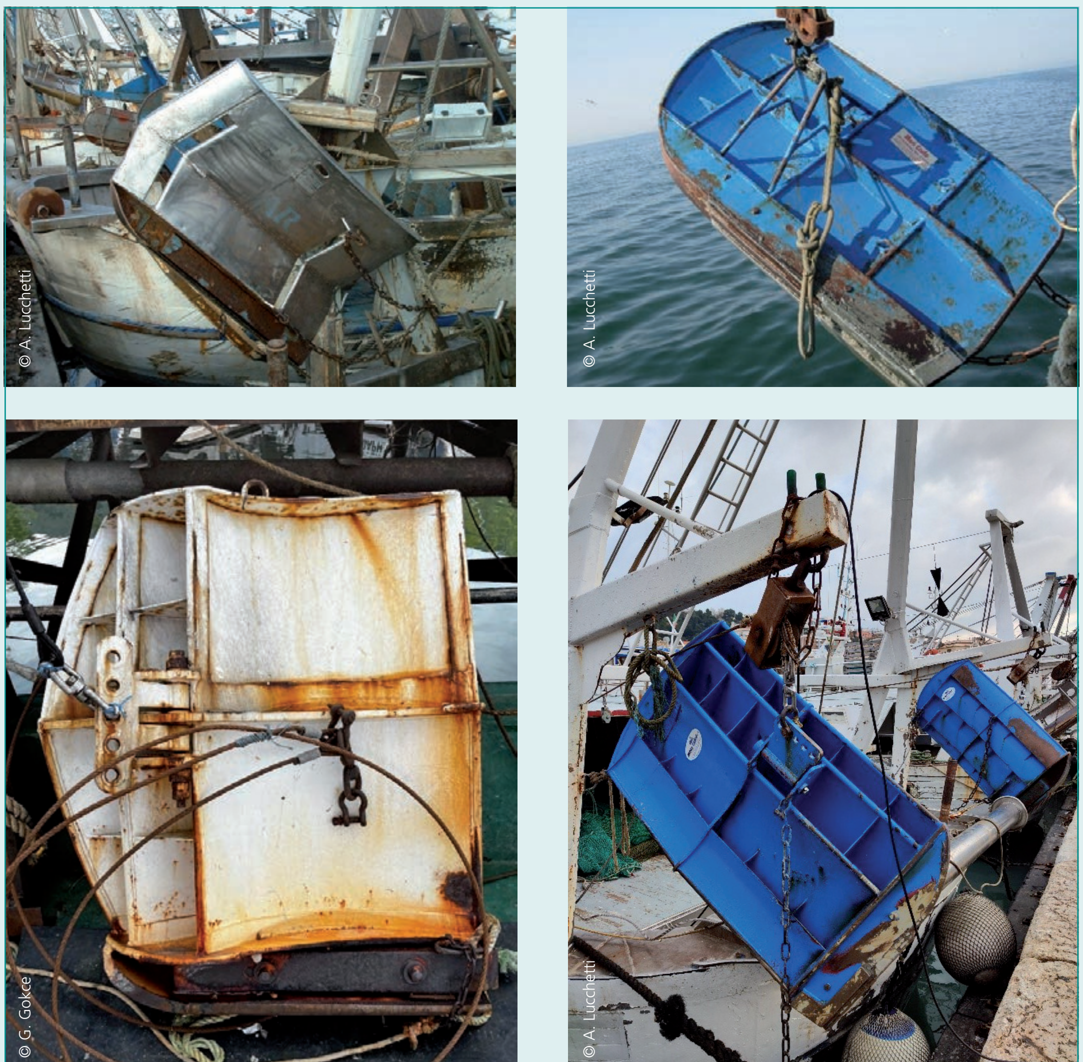
The otterboards are used for the following three main functions:

- spreading the trawl horizontally during towing;
- providing the front bottom contact points of the trawl gear; and
- herding and stimulating fish to swim towards the trawl path.

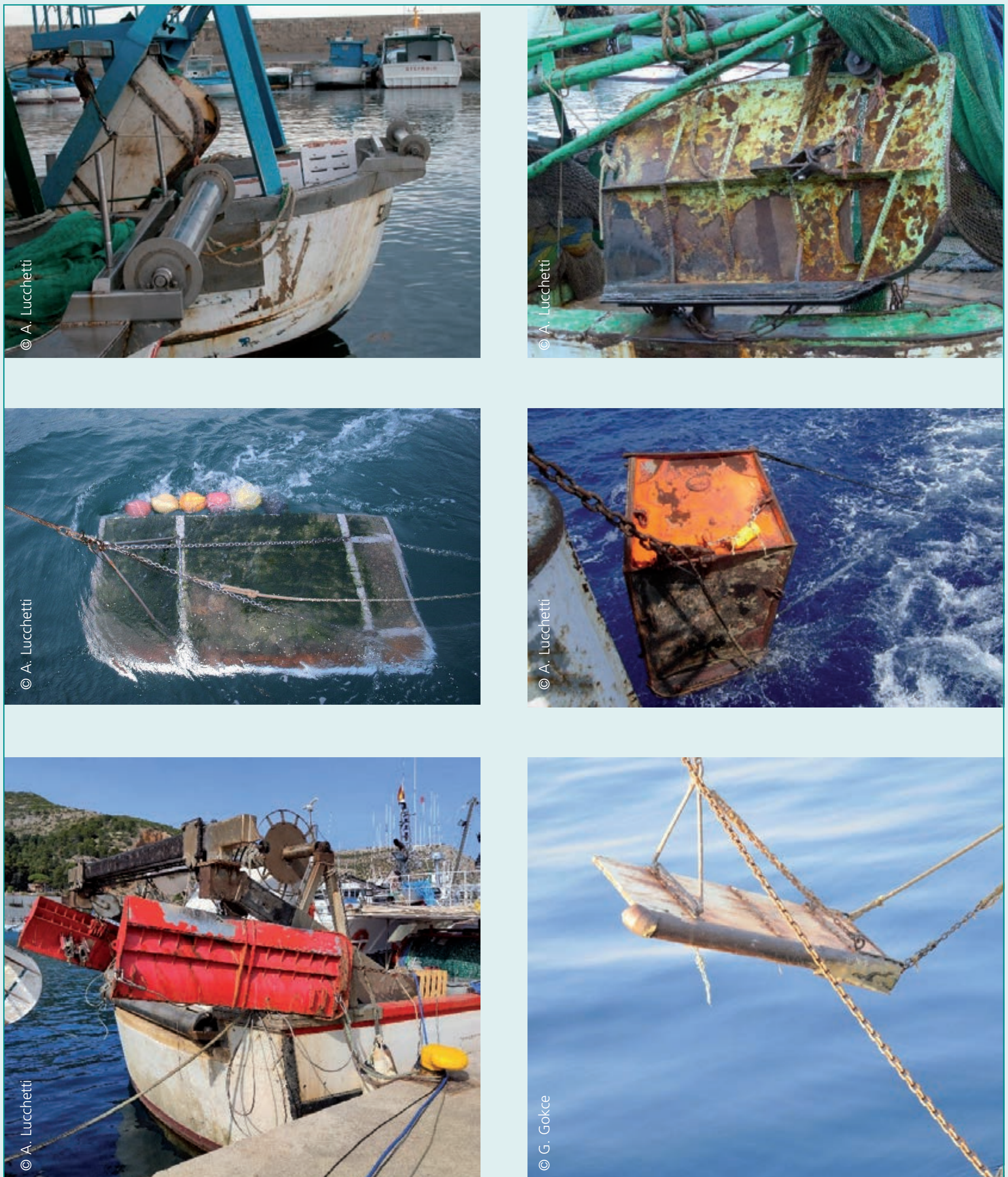
Otterboards are made of different materials, shapes and dimensions according to the vessel size (and engine power), net design, bottom characteristics (sand or mud), traditions, technology and availability.

In general, they are made of heavy steel, wood, plastic and iron structures and are weighted at their base by a protective iron shoe. They are designed to run along the bottom with a certain angle of inclination in relation to the direction of towing. This design is used so that they receive a hydrodynamic thrust that leads them to move away from each other and spread the net horizontally. Otterboards are connected to the trawl wings by sweeps and bridles, and these connections vary in length from a few metres up to 300 m. Therefore, otterboards must be heavy enough to keep the net on the seabed as it is towed along by the trawler.

Examples of otterboards used for bottom trawl nets in the Mediterranean Sea



Various otterboard shapes and materials used in Mediterranean and Black Sea bottom trawling.



Various otterboard shapes and materials used in Mediterranean and Black Sea bottom trawling.

Sources:

[a] **Sala, A., Brčić, J., Conides, A., De Carlo, F., Klaoudatos, D., Grech, D., Lucchetti, A. *et al.*** 2013. *Final project report. Technical specifications of Mediterranean trawl gears (myGears).* Specific project Nr. 5 – Framework service contract Mediterranean Halieutic Resources Evaluation and Advice (MAREA). Bari, Italy, COISPA, Rome, CNR, Attiki, Greece, HCMR, Livorno, Italy, CIBM, Peñiscola, Spain, SUMASPE, Guilvinec, France, SIMRAD.

[b] **Dyneema.** 2023. *Dyneema.* Avon Lake, USA. Cited 23 May 2023. www.dyneema.com

Subregional variations

In Table 4, the characteristics of single boat bottom trawls used in the different areas of the Mediterranean and the Black Sea are summarized.

Table 4

Technical parameters of otter bottom trawl nets used in the Mediterranean and the Black Sea

GSA	Subregion	Country	Gear code	Main target species	Category	Local name	Headline length (m)	Vertical net opening (m)	Horizontal net opening (m)	Sweep length (m)	Bridle length (m)	Rigging	Trawling speed (kn)	Mean depth (m)
1	Western Mediterranean	Spain	OTB	BOY, CTC, DPS, HKE, MNZ, MTS, MUT, NEP, OCC	DB-2	*Tangonero clasico*	59.9–124.0	1.2	45–50	180	Absent	A triangular piece of netting is mounted at the beginning of the wings for greater bottom contact	3.0–3.2	200–500
1	Western Mediterranean	Spain	OTB	BOY, CTC, DPS HKE, MNZ, MTS, MUT, NEP, OCC, SOL, TGS, WHB	DB-4	*Tangonero cuchilla*	55.4–114.7	1.2	45–50	180	Absent	Danlenos joined to the wings by two spreading wires or vientos (6 m long)	3.0–3.2	200–500
1	Western Mediterranean	Spain	OTB	ARA, DPS, HKE, NEP, MNZ, WHB,	DB-4	*Semitangonero Andalucia*	38.1–86.1	2.0–2.5	25–35	200	50		3.0	200–700
1	Western Mediterranean	Spain	OTB	MAC, MUT, HKE, WHB	DB-4	*Cuadrado pescado*	40.6–84	3.5	15–25	Absent		Rigged for light contact with the bottom	3.2	200
1	Western Mediterranean	Spain	OTB	ARA, DPS, HKE, MNZ, NEP, WHB	SP-4	*Semitangonero Alboran*	45.6–94.3	4.0	30–35	Absent	70	Without sweep to keep good control of the net on an irregular seabed	2.5	200–700
3	Western Mediterranean	Morocco	OTB	DPS	DB-2								2.0–5.0	
3	Western Mediterranean	Morocco	OTB	DPS, HKE, MUT, SOL, BOG, FOR, MUT, JAX	DB-2	*Atomique*	51.2					Presence of danleno		100–225
3	Western Mediterranean	Morocco	OTB	SBR, JAX, SOL, MUT, DPS, HKE	DB-2	*Atomique*	46.5			225		Combined ropes with diameter of 25 mm		90–230
3	Western Mediterranean	Morocco	OTB	DPS, HKE, MUT, SOL, JAX, SQC	DB-2	*Atomique*	46.6			220–320		Long combined ropes with diameter of 32 mm		60–380
4	Western Mediterranean	Algeria	OTB	DPS, HKE, MUT, PAX, FOR	DB-2	*Valvano* (*huelvano*)		2.5–3.0	23–26	100–200		Long combined ropes with diameter of 26–32 mm		

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4	Western Mediterranean	Algeria	OTB	DPS, HKE, MUT, PAX, FOR	DB-2	*Minifalta*		2.5–3.0	20–24	100–200		Long combined ropes with diameter of 26–32 mm		
4	Western Mediterranean	Algeria	OTB	DPS, MNZ, PAX, HKE, FOR, GUU	DB-2	*Charleston*		3.0–4.0	20–26	100–150		Long combined ropes with diameter of 26–32 mm		
4	Western Mediterranean	Algeria	OTB	SOL, MNZ, HKE, GUU, FOR	DB-2	*Italian type (maglioutch)*	35.0							
4	Western Mediterranean	Algeria	OTB	ARA, ARS, XKX, DPS, HKE, MON, MUT, NEP, OCM			24.0	2.4–2.6	15.6–18.7	100–150	Absent			700
4	Western Mediterranean	Algeria	OTB	ARA, ARS, XKX, DPS, HKE, MON, MUT, NEP, OCM			46.0	0.6–1.3	19.6–28.8	272	Absent			700
4	Western Mediterranean	Algeria	OTB	HKE, MAC, PAX, MUT, OCC, CTC, RSE, MON	DB-4			6.0						100–300
5	Western Mediterranean	Spain	OTB	ARA, BOY, CTC, DPS, HKE, MNZ, MTS, MUT, NEP, OCC, SOL, TGS, WHB	DB-2	*Huelvano*	46.5–96.2	1.2–1.5	30–40	400	Absent	Presence of danleno, large horizontal opening	2.5–2.8	50–700
5	Western Mediterranean	Spain	OTB	BOY, CTC, MTS, MUT, OCC, SOL, SQC, TGS	DB-2	*Fondo duro*	23.0–47.5	1.5	15–25	270		Small net used at high speed	3.5	50–100
5	Western Mediterranean	Spain	OTB	ARA, DPS, HKE, MNZ, NEP, WHB	DB-4	*Semitangonero*	38.1–86.1	2–2.5	25–35	300		Hybrid net between huelvano and cuadrado; large mesh in the wings and belly	3.0	200–700
5	Western Mediterranean	Spain	OTB	ARA	DB-4	*Cuadrado*		3.5–4.0	15–25	250			3.0	> 500
6	Western Mediterranean	Spain	OTB	BOY, CTC, OCC, MTS, MUT, TGS, SOL	DB-2	*Cadenero*	46.6–96.4	1.0	15–30	150	Absent	Several chains are used to increase bottom contact	4.2	35–60

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6	Western Mediterranean	Spain	OTB	BOY, CTC, OCC, MTS, MUT, TGS, SOL	DB-2	*Espada*	55.2–114.2	1.5	15–30	150	10	Short bridle used for spreading wires (*vientos*)	4.2	60–70
6	Western Mediterranean	Spain	OTB	ARA, DPS, HKE, MNZ, NEP, WHB	DB-2	*Minifalda*	44.1–91.4	2.5	25–35	300	50		3.0	200–700
6	Western Mediterranean	Spain	OTB	ARA, DPS, HKE, MNZ, NEP, WHB	DB-4	*Tangonero*	46.2–95.5	2.0–2.5	15–32	120	45		2.5	> 250
6	Western Mediterranean	Spain	OTB	DPS, HKE, MAS, MNZ, NEP, WHB	DB-4	*Cuadrado pescado*	40.6–84.0	4.5	15–30	Absent	70	Rigged for a high vertical opening in order to catch demersal fish	3.5	100–300
6	Western Mediterranean	Spain	OTB	ARA	DB-4	*Cuadrado gamba (shrimp)*	38.3–84.6	4.5	15–30	Absent	70	Without sweep to keep a good control of the net on irregular seabed	3.0	500
6	Western Mediterranean	Spain	OTB	DPS, HKE, MNZ, NEP, WHB	DB-4	*Dos bocas*	44.1–91.4	3.0	20–35	200	50	Presence of two chains from the wings to the middle of the bosom	3.0	100–350
6	Western Mediterranean	Spain	OTB	ARA	DB-4	*Cuadrado*		3.5–4.0	15–25	250	50	Rigged for high vertical opening	3.0	> 500
6	Western Mediterranean	Spain	OTB	DPS, HKE, NEP, MNZ, WHB,	DB-4	*Dos bocas*	44.1–91.4	3.0	20–35	200	50	Presence of two chains from the wings to the middle of the bosom. Strong bottom contact	3.0	100–350
6	Western Mediterranean	Spain	OTB	ARA	SP-4	*Butterfly*	53.5–114.3	5.0	20–30	Absent	50 (three)	Rigged for high vertical opening	2.5	500
6	Western Mediterranean	Spain	OT–B	ARA	SP-4	*Butterfly*	53.5–114.3	5.0	20–30	200	50 (three)	Rigged for high vertical opening	2.5	> 500
6	Western Mediterranean	Spain	OTB	HKE, MUT, MTS, DPS, SQM	DB-4		84.3						3.6–3.8	70–90

GSA	Subregion	Country	Gear code	Main target species	Category	Local name	Headline length (m)	Vertical net opening (m)	Horizontal net opening (m)	Sweep length (m)	Bridle length (m)	Rigging	Trawling speed (kn)	Mean depth (m)
7	Western Mediterranean	France	OTB	Demersal species, deep-water crustaceans		*4FF*	40.5	3.0–5.0	25–30	50–150	20		3.0–3.5	50–650
7	Western Mediterranean	France	OTB	Demersal species		*4FF*	60.0–70.0	2.7–4.5	40–60	80–100	Absent		3.0–4.0	30–100
7	Western Mediterranean	France	OTB	Demersal species		*Gangui à panneaux*	16.0	1.0	10	1535	Absent		1.0–1.5	12–30
7	Western Mediterranean	France	OTB	Demersal species, deep-water crustaceans		*2FM14*	47.2	1.8	16.7	50–150	15		3.0–3.5	50–650
7	Western Mediterranean	France	OTB	Demersal species, deep-water crustaceans		*GOC7*	30.0	2.4	15	50–150	20		3.0–3.5	50–650
7	Western Mediterranean	France	OTB	ARA, NEP			75.0	3.3–4.6	28–32	300	50		3.1	300–700
8	Western Mediterranean	France	OTB	Demersal species, deep-water crustaceans		*4FF*	40.5	3.0–5.0	25–30	50–150	20		3.0–3.5	50–650
9	Western Mediterranean	Italy	OTB	ARA, CTC, HKE, NEP	DB-2	*Volantina*	24.6–47.5	1.0	10–20	100–200	15–30	Long combination ropes	1.8–2.5	250–600
9	Western Mediterranean	Italy	OTB	ARA, ARS, DPS HKE, NEP	DB-2	*Volantina*	24.6–47.5	1.5	15–25	120–180	18–35	Long combination ropes	2.5–3.2	250–600
9	Western Mediterranean	Italy	OTB	CTC, HKE, MTS, MUT, NEP, TGS	DB-4	*Volantina*	24.6–47.5	1.5–2.0	15–23	10–80	10–25	Short combination ropes	3.0–3.6	50–350
9	Western Mediterranean	Italy	OTB	CTC, HKE, MTS, MUT, NEP, TGS	DB-4	*Volantina*	24.6–47.5	2.0–2.5	15–25	10–80	10–25	Short combination ropes	3.2–3.8	50–350
9	Western Mediterranean	Italy	OTB	CTC, HKE, NEP, MTS MUT, SBG, TGS	DB-2	*Four cables*	34.0–52.0	1.8–3.0	12–18	60–100	Absent	Two combination ropes	3.3–4.2	50–350

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9	Western Mediterranean	Italy	OTB	CTC, HKE, MTS, MUT, NEP, SBG, TGS	DB-2	*Four cables*	34.0–52.0	2.5–3.5	14–22	60–100	Absent	Two combination ropes	3.3–4.2	50–350
9	Western Mediterranean	Italy	OTB	ANE, CTC, HKE, MUT, SBG, SFS, TGS	DB-4	*Four cables*	40.0–56.0	2.5–4.0	12–18	60–100	Absent	Two combination ropes	3.3–4.2	50–350
9	Western Mediterranean	Italy	OTB	ANE, CTC, HKE, MUT, SBG, SFS, TGS	DB-4	*Four cables*	40.0–56.0	4.0–15.0	12–25	40–100	Absent	Two combination ropes	3.3–4.7	50–350
9	Western Mediterranean	Italy	OTB	HKE, MUT, DPS, MNZ	DB-4	*Americana*	43.5	2.8–3.1	15–16	Absent	97	Two combination ropes with diameter of 14–34 mm	2.9–3.0	80–230
10	Western Mediterranean	Italy	OTB	ARA, ARS, DPS, HKE, MUT, NEP	DB-2	*Volantina*		1.0	15–25	200–250	Absent	Long combination ropes	2.5–3.2	50–600
10	Western Mediterranean	Italy	OTB	ARA, ARS, DPS HKE, NEP	DB-2	*Volantina*	24.6–47.5	1.5	15–25	120–180	18–35	Long combination ropes	2.5–3.2	250–600
10	Western Mediterranean	Italy	OTB	CTC, HKE, MTS, MUT, NEP, TGS	DB-4	*Four cables*	24.6–47.5	2.0–2.5	15–25	10–80	10–25	Short combination ropes	3.2–3.8	50–350
10	Western Mediterranean	Italy	OTB	CTC, HKE, MTS, MUT, NEP, SBG, TGS	DB-2	*Tartana*		2.5–3.5	14–22	60–100	Absent	Two combination ropes	3.3–4.2	50–350
11	Western Mediterranean	Italy	OTB	HKE, MUT	DB-2		32.5						2.8	50–300
12	Central Mediterranean	Tunisia	OTB	ARA, ARS	DB-2		28.9	6.0		95	14			100–300
12	Central Mediterranean	Tunisia	OTB	DPS, JAX, MON, HKE, NEP, ARA, ARS, XKX, OCM	DB-2	*Italian fondari*	57.0–65.2			230–270	20–30	Two bridles for each wing, 4–5 m chain or gathered ropes, and 1.4 m chain	2.7–2.8	200–600
12	Central Mediterranean	Tunisia	OTB	DPS, JAX, MUT, HKE, MON, Demersal species	DB-2	*Americain*	57.0			150	12–16	Two bridles for each wing, 4–5 m chain or gathered ropes, and 1.4 m chain	2.8–3.4	200–300

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12	Central Mediterranean	Tunisia	OTB	OCC, MUT, SBP, BAS	DB-2		40.0			200	Absent	4–5 m chain or gathered ropes	1.9–2.1	50–80
12	Central Mediterranean	Tunisia	OTB	DPS, HKE, MON, MUT, NEP	DB-2	*Tangonero*	67.0			150	20	Two bridles for each wing, 4–5 m chain or gathered ropes, and 0.5 m chain	2.9–3.1	90–400
13	Central Mediterranean	Tunisia	OTB	ARA, ARS	DB-2		28.9	6.0		95	14			100–300
13	Central Mediterranean	Tunisia	OTB	DPS, JAX, MON, HKE, NEP, ARA, ARS, XKX, OCM	DB-2	*Italian Fondari*	57.0–65.2			230–270	20–30	Two bridles for each wing, 4–5 m chain or gathered ropes, and 1.4 m chain	2.7–2.8	200–600
13	Central Mediterranean	Tunisia	OTB	MUR, PAC, JAX, HKE, DEX, OCC, SQR, SBP, SRG	DB-2	*Chebbiki*	49.0			200	Absent	4 m chain or combined mixed ropes and triangle for connection with wings	3.1–3.7	50–150
13	Central Mediterranean	Tunisia	OTB	MUX, PAC, BLU, SRG, DEX, PEN, CTC, MET, QSO, Mugilidae	DB-2	*Mahdawiya*	40.0–51.0			200	15–20	4 m chain or combined mixed ropes and triangle for connection with wings	2.7–2.8	30–80
13	Central Mediterranean	Tunisia	OTB	CTC, OCC, MUX, BLU, QSO	DB-2	*Grande ouverture verticale*	40.0–50.0			200	Absent	4 m chain or combined mixed ropes and triangle for connection with wings	2.6–2.8	30–60
13	Central Mediterranean	Tunisia	OTB	PEN, MET, DPS, Demersal species	DB-4	*Americain*	57.0			15–20	12–16	Short sweeps and bridles	2.8–3.4	30–100
13	Central Mediterranean	Tunisia	OTB	HKE, MAC, PAX, MUT, OCC, CTC, RSE, MON	DB-4	*Grande ouverture verticale*		6.0						
14	Central Mediterranean	Tunisia	OTB	PEN, MPN, HKE, MUT, Sparidae, CTC, OCC	DB-4	*Chalut de fond de type crevettier*	58.0						2.8	20–56

GSA	Subregion	Country	Gear code	Main target species	Category	Local name	Headline length (m)	Vertical net opening (m)	Horizontal net opening (m)	Sweep length (m)	Bridle length (m)	Rigging	Trawling speed (kn)	Mean depth (m)
14	Central Mediterranean	Tunisia	OTB	ARA, ARS	DB-2		28.9	6.0		95	14			100–300
14	Central Mediterranean	Tunisia	OTB	PEN, OCC, CTC, MET, QSO	DB-2		40.0–49.0			120–200	Absent	4 m chain or combined mixed ropes and triangle for connection with wings	2.6–2.8	30–60
14	Central Mediterranean	Tunisia	OTB	DPS, JAX, MUT, HKE, SQR, Demersal species	DB-2		57.0			150	12–16	Two bridles for each wing, 4–5 m chain or gathered ropes, and 1.4 m chain	2.8–3.4	200-300
14	Central Mediterranean	Tunisia	OTB	HKE, MAC, PAX, MUT, OCC, CTC, RSE, MON	DB-4			6.0						
15	Central Mediterranean	Italy	OTB	ARA, ARS, DPS, HKE, MUT, NEP	DB-2	*Tartana*		1.0–1.5	15–30	200–250	Absent	Long combination ropes	2.2–3.0	80–600
15	Central Mediterranean	Italy	OTB	ARA, ARS, DPS, HKE, NEP	DB-2	*Volantina*	24.6–47.5	1.5–2.5	15–25	120–180	25–40	Long combination ropes	2.5–3.2	80–600
15	Central Mediterranean	Italy	OTB	ANE, CTC, HKE, MUT, SBG, SFS, TGS	DB-4	*Four cables*		4.0–15.0	10–22	40–100	Absent	Two combination ropes	3.3–4.7	50–350
15	Central Mediterranean	Malta	OTB	ARS, MUT, DPS	DB-2		37.0					Combined ropes with diameter of 24 mm		
15	Central Mediterranean	Malta	OTB	ARA, ARS, XKX, DPS, HKE, MON, MUT, NEP, OCM			24.0	2.4–2.6	15.6–18.7	100–150	Absent			700
15	Central Mediterranean	Malta	OTB	ARA, ARS, XKX, DPS, HKE, MON, MUT, NEP, OCM			46.0	0.6–1.3	19.6–28.8	272	Absent			700
15	Central Mediterranean	Malta	OTB	ARA, HKE, NEP	DB-2	*Rete Italiana*	35.0–47.5	1.0–1.5	10–20	200–250	Absent	Long combination ropes and chain	2.7–2.9	300–800
15	Central Mediterranean	Malta	OTB	CTC, HKE, PAX	DB-2		28.0–48.0	0.7–1.2	10–17	60	20–30	Chain	2.7–3.5	50–200

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16	Central Mediterranean	Italy	OTB	ARA, ARS, DPS, HKE, MUT, NEP	DB-2		24.0–46.0	0.5–1.5	15–30	150–250	Absent	Long combination ropes and chain	2.2–3.0	80–700
16	Central Mediterranean	Italy	OTB	ARA, ARS, DPS, HKE, NEP	DB-2		24.6–47.5	1.5–2.5	15–25	120–180	25–40	Long combination ropes	2.5–3.2	80–600
16	Central Mediterranean	Italy	OTB	ANE, CTC, HKE, MUT, SBG, SFS, TGS	DB-4	*Four cables*	40.0–56.0	4.0–15.0	10–22	40–100		Two combination ropes	3.3–4.7	50–350
16	Central Mediterranean	Italy	OTB	ANE, CTC, HKE, MUT, SBG, SFS, TGS	DB-4			4.0–15.0	10–22	40–100	Absent	Two combination ropes	3.3–4.7	50–350
16	Central Mediterranean	Italy	OTB	CTC, HKE, PAX	DB-2		28.0–48.0	0.7–1.2	10–17	60	20–30	Chain	2.7–3.5	50–200
16	Central Mediterranean	Italy	OTB	DPS, HKE, MUT	DB-2	*Volantina*	25.0	1.0–2.0	10–25	110			2.5–3.2	50–300
16	Central Mediterranean	Italy	OTB	DPS, HKE	DB-2	*Fondale*	34.0	1.0–1.5	15	144	8		2.9–3.2	120–150
16	Central Mediterranean	Italy	OTB	ARS, ARA	DB-2	*Fondalone*	36.0	1.0–1.5	20	216	48		2.4–2.8	600–800
17	Adriatic Sea	Croatia	OTB	CTC, HKE, MTS, MUT, NEP, TGS	DB-2	*Romanjola Volantina*	16.0			100		Combined ropes with diameter of 24 mm	2.5	
17	Adriatic Sea	Italy	OTB	CTC, HKE, MTS, MUT, NEP, TGS	DB-2	*Volantina*	25.0–48.0	1.0–2.0	10–25	100–200	15–30	Long combination ropes	3.0–4.0	10–200
17	Adriatic Sea	Italy	OTB	CTC, HKE, MTS, MUT, NEP, TGS,	DB-4	*Americana*	45.9–64.9	1.2–2.0	10–30	100–200	15–30	Long combined ropes	3.0–4.0	10–200
17	Adriatic Sea	Slovenia	OTB	CTC, HKE, MTS, MUT, NEP, TGS	DB-2	*Volantina*								
17	Adriatic Sea	Croatia	OTB	HKE, NEP, DPS, MUT	DB-2	*Volantina*	50.0	1.5	10–25	100–200	15–30		3.0	140–180
18	Adriatic Sea	Italy	OTB	ARA, ARS, DPS, HKE, MUT, NEP	DB-2	*Tartana*		1.0–1.5	12–22	200–250	Absent	Long combination ropes	2.2–3.2	40–600

GSA	Subregion	Country	Gear code	Main target species	Category	Local name	Headline length (m)	Vertical net opening (m)	Horizontal net opening (m)	Sweep length (m)	Bridle length (m)	Rigging	Trawling speed (kn)	Mean depth (m)
18	Adriatic Sea	Italy	OTB	ARA, ARS, HKE, NEP, DPS, MUT	DB-2	*Tartana*	24.6–47.5	1.0–2.0	10–25	100–200	15–30	Long combination ropes	3.0–4.0	40–600
18	Adriatic Sea	Italy	OTB	HKE, CTC, MTS, TGS, MUT	DB-4	*Volantina*	45.9–64.9	1.2–1.7	10–18		8–20	Long combination ropes	2.8–3.3	10–60
18	Adriatic Sea	Albania	OTB		DB-2	*Americana*	40.0–55.0	1.2–1.7	10–20	100–200	15–30	Long combination ropes	2.2–3.2	
18	Adriatic Sea	Montenegro	OTB		DB-2	*Tartana/ volantina*	30.0–45.0	1.0–1.2	8–16	100–200	Absent	Long combination ropes	2.2–2.8	
19	Central Mediterranean	Italy	OTB	ARA, ARS, XKX, DPS, HKE, MON, MUT, NEP, OCM	DB-2	*Tartana*	24.0	2.4–2.6	15.6–18.7	100–150	Absent			700
19	Central Mediterranean	Italy	OTB	ARA, ARS, XKX, DPS, HKE, MON, MUT, NEP, OCM	DB-2	*Rete Italiana*	35.0–47.5	0.6–1.5	15–25	200–250	Absent	Long combination ropes and chain	2.7–2.9	300–800
19	Central Mediterranean	Italy	OTB	CTC, HKE, PAX	DB-2		28.0–48.0	0.7–1.2	10–17	60	20–30	Chain	2.7–3.5	50–200
20	Central Mediterranean	Greece	OTB	HKE, MUT, DPS, NEP, SQR	DB-2	*Classic bottom trawl*	32.0	0.7–1.6	9–15	180–280	Absent			50–400
20	Central Mediterranean	Greece	OTB	DPS, HKE, MUT, NEP	DB-2		31.0–50.0		11–18				2.5	250–400
22	Eastern Mediterranean	Türkiye	OTB	HKE, MON, JAX	DB-2		43.2			200	6–10			85–145
22	Eastern Mediterranean	Türkiye	OTB	Demersal species	DB-2	*Kara Osman Ağı*	25.8						2.5–3.0	
22	Eastern Mediterranean	Türkiye	OTB	Demersal species	DB-2		18.6						2.5–3.0	
22	Eastern Mediterranean	Türkiye	OTB	Demersal species	DB-2	*Osmanlı Trolü*	27.1						2.5–3.0	
22	Eastern Mediterranean	Greece	OTB	DPS, HKE, MUT, NEP	DB-2		26.0–44.0		11–18				2.5–3.0	100–300
22	Eastern Mediterranean	Greece	OTB	DPS, HKE, MUT, NEP	DB-2		27.0–40.0		11–17				2.5–3.0	250–300

GSA	Subregion	Country	Gear code	Main target species	Category	Local name	Headline length (m)	Vertical net opening (m)	Horizontal net opening (m)	Sweep length (m)	Bridle length (m)	Rigging	Trawling speed (kn)	Mean depth (m)
24	Eastern Mediterranean	Türkiye	OTB	MUT, PAC, ANN	DB-2		24.0			75			2.7–3.2	25–50
24	Eastern Mediterranean	Türkiye	OTB	MUT, LIB, TGS	DB-2	*Osmanlı Trolü*	21.5						2.5–3.0	
25	Eastern Mediterranean	Cyprus	OTB	SPC, BOG, PAC, MUT, SQR, SBA, SDR, CBR, HKE, EHI	DB-2									
26	Eastern Mediterranean	Egypt	OTB	ARA, ARS, SQM, HKE, BRF	DB-4		60.0–70.0	1.0–6.0					2.5–3.0	576–722
26	Eastern Mediterranean	Egypt	OTB	MUX, PAX, JAX, SZX, CTC, PEN	DB-2		30.0	1.0	8–21	150	5–10		2.5–3.0	200–250
26	Eastern Mediterranean	Egypt	OTB	PAC, MUR, HKE, GUU, BOG	DB-2									20–225
26	Eastern Mediterranean	Egypt	OTB	PEN, MUX, LIB, SOL, JAX, BOG, THB	DB-2		41.0			90	4		2.5–3.2	20–270
26	Eastern Mediterranean	Egypt	OTB	PEN, HOM, BPI	DB-2		31.0			36			2.5	
26	Eastern Mediterranean	Egypt	OTB	ARA, ARS, HKE	DB-2		43.0			164			2.5–3.0	585–860
26	Eastern Mediterranean	Egypt	OTB	ARA, ARS, SQM, HKE, BRF	DB-2		60.0–70.0	1.0–6.0					2.5–3.0	576–722
26	Eastern Mediterranean	Egypt	OTB	PEN, MUX, PAX, JAX	DB-4		28.0–52.0	1.0		150	5–100		2.5–3.0	20–250
26	Eastern Mediterranean	Egypt	OTB	PEN, MUX, SOL, LIB	DB-4		25.0–34.0	1.0		150	40–100		2.5–3.0	9–30
26	Eastern Mediterranean	Egypt	OTB	HKE, ARA, ARS	DB-4			1.8–2.0	14					250
26	Eastern Mediterranean	Egypt	OTB	PEN, MUZ, JAX, BOG, SOL, LIB, THB	DB-4		28.0–43.6			120			3.0	50–100

GSA	Subregion	Country	Gear code	Main target species	Category	Local name	Headline length (m)	Vertical net opening (m)	Horizontal net opening (m)	Sweep length (m)	Bridle length (m)	Rigging	Trawling speed (kn)	Mean depth (m)
26	Eastern Mediterranean	Egypt	OTB	HKE, ARS, ARA, DPS, LKT	DB-4		35.0–51.0	4.5		120	15		3.0	200–800
26	Eastern Mediterranean	Egypt	OTB	ARS, ARA, DPS, LKT	DB-4		45.0	3.5	22	150	25		3.0	400–950
26	Eastern Mediterranean	Egypt	OTB	ARS, ARA, DPS	DB-4		38.0	3.5	18	120	12		3.0	400–950
27	Eastern Mediterranean	Palestine	OTB	Shrimps	DB-4	*Jar*	35	2.2	21			Sweep and bridle; two 150 kg doors		5–25
27	Eastern Mediterranean	Palestine	OTB	Demersal species	DB-4	*Jar*	30	2.3	18			Sweep and bridle; two 150 kg doors		5–25
27	Eastern Mediterranean	Palestine	OTB	Demersal species	DB-2	*Jar*	27	2.2	16			Sweep and bridle; two 150 kg doors		5–170
27	Eastern Mediterranean	Israel	OTB	PEN, MUX	DB-4									400
27	Eastern Mediterranean	Israel	OTB	PEN, MUX, COM, HKE, NNZ, PAC, SQR	DB-4			2.0	10–15	70–200				250
27	Eastern Mediterranean	Israel	OTB		DB-2		30.0–31.2	2.5		200	7	Combined ropes with diameter of 32 mm	2.6–3.4	10
27	Eastern Mediterranean	Israel	OTB		DB-2					200	6	Combined ropes with diameter of 25 mm	3.1	
28	Black Sea	Türkiye	OTB	PEN, demersal species	DB-2	*Marya*	30.0–40.0			158		30 m polypropylene and 172.5 m combined ropes with diameter of 32 mm		
29	Black Sea	Türkiye	OTB	WHG, MUT	DB-2	*Trol*	27.0	1.0– 1.2		200	5	Long combination ropes	2.5–3.0	50–120
29	Black Sea	Türkiye	OTB	WHG, MUT	DB-2	*Trol*	38.8	1.0–1.5		200	5	Long combination ropes	2.5–3.0	50–120

GSA	Subregion	Country	Gear code	Main target species	Category	Local name	Headline length (m)	Vertical net opening (m)	Horizontal net opening (m)	Sweep length (m)	Bridle length (m)	Rigging	Trawling speed (kn)	Mean depth (m)
29	Black Sea	Türkiye	OTB	WHG, MUT	DB-2	*Trol*	30.0						2.5–3.0	
29	Black Sea	Türkiye	OTB	WHG, MUT	DB-2	*Trol*	29.9			150–250		Combined ropes with diameter of 30 mm	2.5–3.0	40–80
29	Black Sea	Bulgaria	OTB	BLU, MUT, WHG			20.0–35.0	1.5–5.5	10–20		15-30	Combined ropes	3.0–4.2	10–90

Notes: OTB: single boat bottom otter trawl; ANE: *Engraulis encrasicolus*; ANN: *Diplodus annularis*; ARA: *Aristeus antennatus*; ARS: *Aristaeomorpha foliacea*; BAS: *Serranus spp*; BOY: *Bolinus brandaris*; BPI: *Spicara maena*; BRF: *Helicolenus dactylopterus*; CBR: *Serranus cabrilla*; CTC: *Sepia officinalis*; DEX: *Dentex spp*; DPS: *Parapenaeus longirostris*; EHI: *Centracanthus cirrus*; FOR: *Phycis phycis*; GUU: *Chelidonichthys lucerna*; HKE: *Merluccius merluccius*; HOM: *Trachurus trachurus*; JAX: *Trachurus spp*; LIB: *Saurida undosquamis*; MAC: *Scomber scombrus*; MAS: *Scomber japonicus*; MET: *Metapenaeus spp*; MPN: *Metapenaeus monoceros*; MNZ: *Lophius spp*; MON: *Lophius piscatorius*; MTS: *Squilla mantis*; MUR: *Mullus surmuletus*; MUT: *Mullus barbatus*; MUX: *Mullus spp*; NEP: *Nephrops norvegicus*; NNZ: *Nemipterus randalli*; OCC: *Octopus vulgaris*; OCM: *Eledone spp*; PAC: *Pagellus erythrinus*; PAX: *Pagellus spp*; PEN: *Penaeus spp*; PIL: *Sardina pilchardus*; QSO: *Portunus segnis*; RPW: *Rapana venosa*; RSE: *Scorpaena scrofa*; SBG: *Sparus aurata*; SDR: *Synodus saurus*; SFS: *Lepidopus caudatus*; SHO: *Galeus melastomus*; SJA: *Pecten jacobaeus*; SOL: *Solea solea*; SPR: *Sprattus sprattus*; SQC: *Loligo spp.*; SQR: *Loligo vulgaris*; SQM: *Illex coindetii*; SZX: *Saurida spp*; TGS: *Penaeus kerathurus*; THB: *Nemipterus spp*; WHB: *Micromesistius poutassou*; WHG: *Merlangius merlangus*; XKX: *Plesionika spp*; NNZ: *Nemipterus randalli*; JRS: *Raja asterias*. DB-2: demersal/bottom two-face trawls; DB-4: demersal/bottom four-face trawls; SP-2: semi-pelagic two-face trawls; SP-4: semi-pelagic four-face trawls; TT-2: demersal/bottom two-face twin trawls; TT-4: demersal/bottom four-face twin trawls.

Western Mediterranean

In Spain – geographical subareas (GSAs) 1, 5 and 6 – the only trawling technique allowed is the single trawl technique, while twin- or multi-rig trawls are forbidden. Spain is the Mediterranean country with the greatest variability of nets, in terms of net designs, dimensions and materials used. Polyamide and PE netting is commonly used, as in most Mediterranean countries, but in the last 10–15 years Ultra Cross knotless netting made with Dyneema fibre has also been used (Net Systems, 2023); this material, although more expensive than the others, has a higher breaking strength with the same twine diameter. Therefore, it is possible to make nets with thinner twines than traditional nets, greatly reducing towing loads and fuel consumption.

The following main types of net can be identified (Sala *et al.*, 2013).

The *cadenero* (DB-2) is generally used on sandy and muddy bottoms near the coast at about 35–60 m, especially in Catalonia by vessels of 18–22 m. Several chains are mounted to the ground rope in order to increase the bottom contact. The length of the sweep is around 150 m and the bridles are typically not used. The vertical opening is about 1 m and the horizontal opening is 15–30 m. The headrope length ranges from 47 m to 96 m.

The *huelvano* (DB-2) is mostly used on flat and muddy seabeds. This net is rigged for greater horizontal net opening (30–40 m) instead of vertical opening (1.2–1.5 m). For that purpose, bridles are not present and sweeps are very long (40 m). Headrope length ranges from 47 m to 96 m. This gear is frequently used in the Balearic Islands by vessels of 15–25 m.

The *minifalda* (DB-2) is an old type of net mostly used in middle and deep fishing grounds with muddy sediments. The net is rigged with double wings in order to achieve a high vertical opening (about 2.5 m). The length of the bridles is around 50 m, with the length of the sweep around 300 m. The headrope length ranges from 44 m to 91 m and the horizontal opening is 25–35 m. It is frequently used in the Levant by vessels of 15–25 m length.

The *pescado fondo duro* (DB-2) is a small trawl type (vertical opening about 1.5 m; horizontal opening 15–25 m) mostly used in coastal areas on sandy and rocky bottoms between 50–100 m depth. The target species are gastropods, cephalopods, crustaceans and demersal fishes in general. Both sweeps and bridles are present in the rigging. The headrope length ranges from 23 m to 48 m and the horizontal opening is between 15 m and 25 m. It is frequently used in the Balearic Islands by vessels of 15–25 m length.

The name of the *cuadrado pescado* (DB-4) refers to the demersal fish that represent the main target for this gear. For that purpose, a high vertical opening (up to about 3.5 m) is obtained by long bridles (up to 50 m) and sweeps (up to 200 m), while the towing speed is around 3.5 knots. It is used from the continental shelf to the beginning of the continental slope on muddy bottoms. The headrope length ranges from 41 m to 84 m and the horizontal opening is between 15 m and 25 m. It is used in central Catalonia and Andalusia.

The *cuadrado gamba* (DB-4) has geometry similar to the *cuadrado pescado*, but the target species are deep-water shrimps (at greater than 500 m depth). The trawling speed is around 3 knots. This net is used at highly variable sea depths on muddy bottoms, and so as to control the net during trawling, sweeps are not used. The vertical opening is obtained by using long bridles. The headrope length ranges from 38 m to 85 m and the horizontal opening is between 15 m and 25 m. It is used in central-northern Catalonia.

The *dos bocas* net has two chains from the wings to the middle of the lower bosom that give this net strong bottom contact and a high horizontal opening. The length of the bridles is around 50 m, while the length of the sweep is around 200 m. The headrope length ranges from 44 m to 91 m, and the horizontal opening is between 20 m and 35 m. It is used in Catalonia and the Levant from the continental shelf to the beginning of the continental slope.

The *espada* (DB-4) trawl is towed at 4.2 knots on muddy bottoms in shallow waters (60–70 m). It is characterized by a high vertical opening (up to 1.5 m) due to the small bridles (10 m of spreading wire named *vientos*) and a reduced number of chains. The headrope length ranges from 55 m to 114 m, and the horizontal opening is between 15 m and 30 m. It is used in southern Catalonia from the continental shelf to the beginning of the continental slope, by vessels of 18–22 m length.

The *semitangonero* (DB-4) is a hybrid between the *huelvano* and *cuadrado*. It is characterized by the presence of large mesh in the wings and the first section of the belly; it is rigged to catch mixed deep-sea fish species and shrimps as well. For this reason, long sweeps (300 m) and bridles (50 m) are present, and the trawling speed is around 3 knots. In the Alboran area, this net is rigged to obtain a vertical opening of about 4 m and since the bottom is irregular, the sweeps are not used. It is used at the beginning of the continental slope on irregular seabed topography by vessels of 15–25 m length. It is also used in Andalusia and in the Balearic Islands. The headrope length ranges from 38 m to 94 m and the horizontal opening is 25–35 m long.

The *tangonero* (DB-4) net is towed in deep waters (about 250 m) to catch mixed species (fish, shrimp and cephalopods). The length of the bridle is 45 m and the trawling speed is about 2.5 knots. It is used in northern Catalonia on muddy bottoms of the continental slope by vessels of 20–25 m length. The headrope length ranges from 46 m to 96 m, and the horizontal opening is between 15 m and 32 m long.

The *tangonero clasico* (DB-4) net is characterized by long wings, the presence of a danleno and sweeps without bridles. The net is similar to the *huelvano* used in the Balearic Islands. The length of the heavy sweep is around 180 m. A towing speed of 3–3.2 knots is maintained to avoid stacking due to the mud. It is used in Andalusia (Alboran waters) by vessels of 15–25 m length. The headrope length ranges from 60 m to 124 m, and the horizontal opening is between 45 m and 50 m long.

The *tangonero cuchilla* (DB-4) net is characterized by the presence of two danlenos made of netting, joined with two spreading wires or *vientos* (6 m long). The presence of the *vientos* is important for providing a high vertical opening and thus a good catch efficiency for European hake. It is used in the Alboran waters on the muddy bottoms at the beginning of the continental slope by vessels of 15–25 m length. The length of the sweep is around 180 m. The headrope length ranges from 55 m to 115 m, and the horizontal opening is between 45 m and 50 m long.

In Morocco (GSA 3), the most commonly used trawl net is the so-called *atomique* (Roullot and Fahfouhi, 1984). It is a two-face trawl and has a headline length ranging from 46 m to 51 m. It is deployed at depths ranging from 60 m to 360 m to catch demersal species, such as European hake, deep-sea shrimp and red mullet, among others.

The trawl nets employed in Algeria (GSA 4) derive from net typologies used in other countries of the western Mediterranean (Laid, Lamri and Kadri, 2001), such as the Italian *tartana* and the Spanish *huelvano* (locally called *valvano*) and *minifalda* (locally called *minifalta*). Over time and through experience, some fishers have modified the Spanish and Italian type trawls by transforming the ends of the trawl wings. By using bridles and light PE netting, the fishers have increased the vertical openings of the nets, thus reaching a better profitability. As a result, the danlenos placed directly on the wings of the trawl have tended to disappear.

The *valvano* is a two-face trawl characterized by a vertical opening of 2.5–3 m and by a significant length of the wings, between 23 m and 26 m. It is used for demersal fish and especially for shrimp fishing. The netting used for catching fish is usually PA, but when shrimps are the main target species, the upper part is made of PE except for the extension and the codend, which are made of PA. The rigging involves the use of bridles (*entremises*) connected to the danleno. Sweeps are made of mixed rope with a diameter of 26 mm to 32 mm, and a length of 100 m to 200 m (depending on the working depth of the trawl). They are connected to rectangular- or oval-shaped iron doors.

The *minifalda* is a two-face trawl characterized by a vertical opening of around 2.5–3 m and by a wing length between 20 m and 24 m. This type of net is used for demersal fish and especially for shrimps. Likewise, in this case, most of the nets are made of PA; in the case of shrimp trawling, the upper side of the trawl body and wings may be made of PE. The rigging used for this type of trawl incorporates long sweeps, called *calamine*, made of a mixed rope with a diameter of 26 mm to 32 mm and a length of 100 m to 200 m (depending on the working depth of the trawl). They are connected to rectangular- or oval-shaped doors.

The French type *charleston* trawl is a bottom trawl with sides, which differs from the classic bottom trawl without sides. It is characterized by a vertical opening of 3–4 m and by a length of the upper and lower wings of 20 m and 26 m, respectively, and is used for demersal fish, especially in the centre of Algerian waters. The rigging used for this type of trawl incorporates sweeps (*calamine*) made of a mixed rope with a diameter of 26 mm to 32 mm and a length of 100 m to 150 m, connecting the trawl door and the wing (depending on the working depth of the trawl).

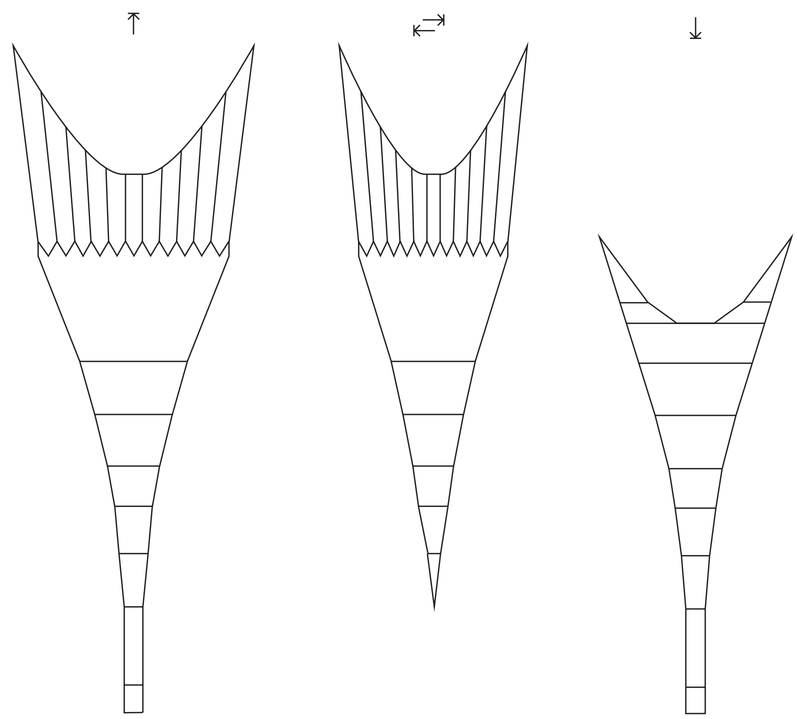
The Italian type *maglioutch* trawl (*maglioutch* is the danleno) is a two-face trawl formerly used by Italian fishers who came to work in Algeria. This is practically a *tartana* net, used in Italy, with a short vertical opening (usually less than 1 m). The rigging of this type of trawl uses long sweeps connecting the trawl wings and the doors by means of a danleno (*maglioutch*).

The four-face trawl with a high vertical opening between 10 m and 12 m is also used, with upper and lower wings having a mesh size of 400 mm on each side. The length of the wings is 33 m and 44.7 m for the upper and lower sections, respectively. The rigging used for this type of trawl involves forks with a length of 18.5 m (lower and upper fork) and an upper steel cable with a diameter of 8 mm to 10 mm and a length of 60 m to 80 m, as well as a lower cable of mixed rope with a diameter of 24 mm to 26 mm and a length of 60 m to 80 m. A short chain (called *matsat*) of 2–3 m length is also added to the lower cable.

In France, the trawler fleet is composed of vessels working exclusively in the Gulf of Lion (GSA 7). However, small vessels (operating with the *ganguis à panneaux* described below; Sacchi, Le Corre and Mortreux, 2010) are included in the category of small-scale fishing fleets and work exclusively in the coastal waters off Provence (GSA 7) with a few bottom trawlers in the eastern coastal waters of Corsica (GSA 8). Two types of bottom trawl nets are identified: those with low vertical openings and those with high vertical openings. The first category, two-face nets, are used less frequently and are being replaced by twin trawls (*chaluts jumeaux*) for the continental shelf fishery. Most of the trawlers use the second category, which are four-face trawls with a vertical opening between 2 m and 6 m. Their design and size (in particular, the net surface) are fitted to the maximum pulling power of the vessel. The headline is smaller than the groundrope (around 20 percent shorter). Two types of rigging are used: with sweeps and bridles (*bras et entremises*), essentially for the low vertical opening trawls; and with forks (*fourches*), for the high vertical opening trawls. As these types of gear must be in contact with the bottom, they are rigged with a mixed groundrope with chains and sometimes a small rubber disk. The length of the sweeps (or low fork for the high vertical openings) are chosen according to its maximum working depth (i.e. around 100 m to 120 m for the continental shelf of the Gulf of Lion). The otterboards are mainly made of steel and, according to the effective power tractions, can weigh 600 kg and cover 4 m^2 each. The bottom trawls used in Corsica (GSA 8) are normally two-face trawls with low vertical openings targeting demersal fish, small pelagic fish, and shrimp – deep-water rose shrimp, giant red shrimp, and blue and red shrimp (*Aristeus antennatus*) (Sacchi, 2007).

To catch more demersal fish that migrate in the water column (e.g. mackerel, hake, seabream), larger trawls with high vertical openings are employed (Figure 18). They have their anterior section and wings made of large mesh for the forepart of the nets (800 mm to 1 600 mm mesh size) or of long ropes (*juge à cordes*) in order to reduce the net drag and fuel consumption.

FIGURE 18
Four-face bottom trawl with high vertical opening (*juge à cordes*) used in France



Source: redrawn from **Sala, A., Brčić, J., Conides, A., De Carlo, F., Klaoudatos, D., Grech, D., Lucchetti, A. *et al.*** 2013. *Final project report. Technical specifications of Mediterranean trawl gears (myGears).* Specific project Nr. 5 – Framework service contract Mediterranean Halieutic Resources Evaluation and Advice (MAREA). Bari, Italy, COISPA, Rome, CNR, Attiki, Greece, HCMR, Livorno, Italy, CIBM, Peñiscola, Spain, SUMASPE, Guilvinec, France, SIMRAD.

Peculiar bottom trawl nets are used in coastal areas in derogation to the Council Regulation (EC) No 1967/2006 (Council of the European Union, 2006). These are known as *gangui à panneaux* with otterboards. This trawl has a traditional Mediterranean design and a short headline (around 15 m), a horizontal opening of about 6–10 m and a vertical opening of 1–2 m. As such, these nets are rigged with short sweeps (15–35 m) and are towed at low speeds (between 1.5 knots and 3 knots) by single vessels less than 12 m long within 3 nautical miles of the coast (Sacchi, Le Corre and Mortreux, 2010). Most of the vessels are registered in the maritime quarters of Toulon and Marseille and can be used on both soft and hard bottoms. The main targets of this fishery are the mixed demersal species intended for the preparation of soups.

Different types of *ganguis* with otterboards are employed and they are adapted to different uses (Sacchi, Le Corre and Mortreux, 2010).

The hard bottom *ganguis* with a vertical opening of 1 m, horizontal opening of 6 m and panels of 50–60 kg are employed all year round (125 days/year on average), at depths of 12–30 m, inside the seagrass meadows. The towing speed is 1.5 knots and the duration is about 1 hour. This type of *ganguis* has a metal roll about 1 m long with a diametre of 70 mm in the middle of the bulge, called *daïe*, which is intended to lay the green leaves of seagrass and avoid harvesting too many dead leaves.

The soft bottom *ganguis* with a vertical opening of 2 m, horizontal opening of 8 m and iron panels of about 90 kg are employed all year round (80 days/year on average) at depths of 28–100 m, that is, deeper than seagrass meadows. The towing speed is 2–3 knots.

The *ganguis* targeting violet (*Microcosmus sabatieri*) built of wood with an iron frame and with panels of 50–60 kg are employed from September to April at depths of 40–70 m.

In Italy, in the northern, central and southern Tyrrhenian Sea (GSAs 9 and 10), demersal/bottom two-face trawls (*volantina* and *tartana*) are widely used (Sala *et al.*, 2013). In GSA 9, vessels operating on the continental shelf with traditional trawls usually catch red mullet, cuttlefish (*Sepia officinalis*), mantis shrimp (*Squilla mantis*), common octopus (*Octopus vulgaris*) and European hake in coastal fishing grounds (depths less than 50 m), and catch European hake, horned octopus (*Eledone cirrhosa*), rays (*Raja* spp.) and poor cod (*Trisopterus minutus capelanus*) in deeper waters. Vessels operating on the continental shelf with high vertical opening trawls usually catch European hake, red mullet, cuttlefish, mantis shrimp and octopus in coastal fishing grounds (depths less than 50 m), and European hake, horned octopus, rays, lesser spotted dogfish (*Scyliorhinus canicula*), poor cod and octopus in deeper waters. Vessels operating on the continental slope target Norway lobster and deep-water rose shrimp on the fishing grounds to the south of Elba Island using *tartana* and *volantina* nets. Vessels operating in deep waters target giant red shrimp and blue and red shrimp using *tartana* and *volantina* nets.

The main bottom trawls used in the Tyrrhenian Sea can be summarized as follows (Sala *et al.*, 2013).

The two-face *volantina* trawl (DB-2) is used in the Ligurian Sea on sandy–muddy bottoms at the beginning of the continental slope, at depths of 250–600 m to catch Norway lobster, European hake, and blue and red shrimp. The headrope length ranges from 25 m to 48 m, and the horizontal opening is between 10 m and 20 m. Long sweeps (100–200 m) and bridles (15–30 m) are used to create short vertical openings (around 1 m). Similar nets are used in the Tyrrhenian Sea at the same depths; they have a vertical opening of around 1.5 m and a horizontal opening of 15–25 m, with a headrope of around 30–52 m.

The two-face *tartana* trawl (DB-2) is used in the southern Tyrrhenian Sea from shallow to deep waters (bottom depths from 50 m to 600 m) to catch both coastal and deep-water species, such as giant red shrimp and blue and red shrimp. The rigging incorporates the use of long sweeps (200–250 m) without bridles; this rigging is responsible for the short vertical opening (1 m). The horizontal opening ranges from 15 m to 25 m.

The four-face *Americana* trawl (DB-4) is used in the Ligurian Sea on sandy–muddy bottoms of the continental shelf, at depths of 50–350 m. The horizontal opening ranges between 15 m and 23 m. Short sweeps (10–80 m) and bridles (10–25 m) are used to create higher vertical openings (around 2 m). Similar nets are used in the Tyrrhenian Sea at the same depths; they have a vertical opening of around 2–2.5 m and a horizontal opening of 15–25 m, with a headrope length of around 27–46 m.

The two-face four-cable trawl (DB-2) is towed with four cables and is designed to catch both off-bottom species, such as European hake, red mullet, gilthead seabream (*Sparus aurata*) and cuttlefish, which are generally close to the seabed but exhibit an upward migration, and bottom species such as Norway lobster and mantis shrimp. The volume swept by the relatively large meshes (120–1 600 mm) is what determines the capture efficiency. It is typically constructed without bridles but the rigging with four cables guarantees a higher vertical opening (around 2–3.5 m). The two-face trawl with a high vertical opening is used on sandy–muddy bottoms of the continental shelf at depths of 50–350 m. The headrope length ranges from 34 m to 52 m and the horizontal opening is between 12 m and 18 m. These nets are used in the Ligurian Sea to catch both coastal species and deep-water species, such as Norway lobster and European hake. Similar nets are used in the Tyrrhenian Sea with vertical openings of 2.5–3.5 m and horizontal openings of around 14–22 m.

The four-face four-cable trawl (DB-4) is towed with four cables and is designed to catch the same species as the two-face four-cable trawl. The four-face trawl is used on sandy–muddy bottoms of the continental shelf at depths of 50–350 m. Bridles are not used, but the rigging with four cables and four faces guarantees a higher vertical opening (around 4 m). The headrope length ranges from 40 m to 56 m, and the horizontal opening is between 12 m and 18 m. These nets are used in the Ligurian Sea to catch both coastal species and deep-water species, such as Norway lobster and European hake. Similar nets are used in the northern and central Tyrrhenian Sea with vertical openings of 4–15 m and horizontal openings of around 15–25 m (headrope length of around 34–52 m). Sometimes these nets are also used to catch anchovies.

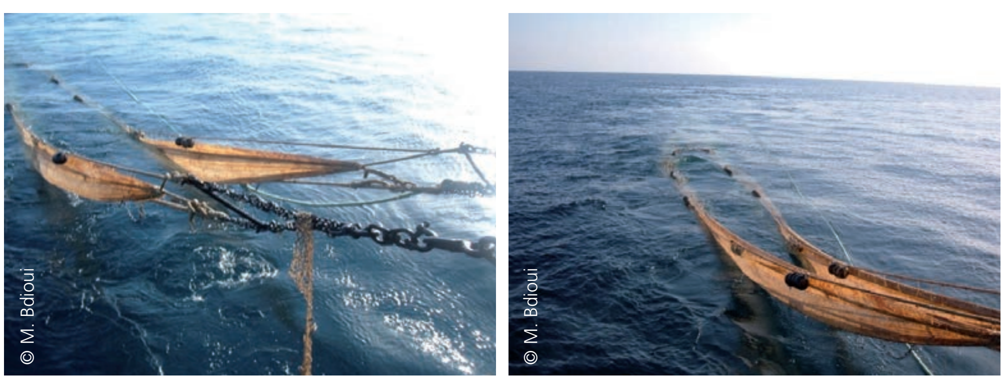
In Sardinia (GSA 11), trawlers operate in the shallow waters of the continental shelf with *tartana* nets (low vertical openings), targeting mixed species, such as common octopus, horned octopus, red mullet, cuttlefish and rays. The vessels operating on the continental slope and in deep waters usually target red shrimps, Norway lobster, deep-water rose shrimp and European hake using *tartana* nets.

Central Mediterranean

In Tunisia (GSAs 12, 13 and 14), several trawl types are used. The majority are two-face trawl nets (Plate 3). In shallow waters, especially in the Gulf of Gabès (GSA 14) from 30 m to 60 m and in the Gulf of Hammamet (GSA 13) from 50 m to 70 m, the shrimp trawl is used to target the caramote shrimp (*Penaeus kerathurus*), other non-indigenous shrimps such as the speckled shrimp (*Metapenaeus monoceros*) and the northern brown shrimp (*Penaeus aztecus*), and other demersal fish species. The entire trawl net has a small size made of PA knotless netting panels that have generally small mesh sizes, i.e. about 60 mm in the wing and 52 mm in the other sections. The net is rigged without sweeps and with two bridles (Plate 4). The use of metallic chains is often observed just before the wings (up to 6 m in length).

PLATE 3
***Fondale* two-face bottom trawl with cut-wings used in Tunisia**

PLATE 4
Shallow water shrimp trawl net wings (left) and healine (right) used in Tunisia



Moreover, a similar trawl but made of knotted PE and with larger wings, the so-called *chebbiki*, is used to target demersal fish species on rocky ground. The trawl can have two codends, with the lower one dedicated to the rocks and the upper one to catching fish.

Furthermore, the high vertical opening trawl net called the *grande ouverture verticale*, but also *Mahdaouia* or other commercial names such as American and Mexican, among others, has vertical openings up to 6 m high and is employed to catch demersal species such as European hake and red mullet (Bdioui, M'rabet and Ben Naceur, 2003). In terms of dimensions, the trawl generally has two small lateral sides (faces), in addition to the upper and lower panels. The trawl is generally rigged with two to three sweeps and one bridle on each side (according to the netting material used, rigging and target species).

In deep-water bottom trawl shrimp fisheries, the trawl nets specifically targeting red shrimps and the pink shrimps are similar to the *fondale* net (also locally known as the Italian net) and could be both *tartana* and *volantina*, with some small modifications and adaptations such as the use of short ropes at the end of wings (Plate 5) to increase the trawl dimensions and openings without increasing the towing force (engine power). They are mostly used where the continental slope begins, at depths ranging from 200 m to 800 m. The footrope generally ranges from 58 m to 65 m, according to the vessel engine power (from 700 hp to 900 hp). It is generally made of mixed cable (from 32 mm to 50 mm) or gathered ropes (PE or PA) with a diameter up to 70 mm. The upper side of the trawl is made generally of PE or a mixture of PE and PA netting panels with a mesh bar of 26–30 mm in the wings. The lower side netting panels generally range from a 40–50 mm PA mesh bar (4–5 mm twine thickness) to a 26 mm PA mesh bar (2.5 mm twine thickness) next to the codend. The trawl is usually rigged with two bridles each, which are 20–30 m long (Plate 6). However, some vessels still use the old system by rigging the trawl without bridles.

A limited number of vessels use four-face nets (DB-4), such as the *tangonero* trawl (characterized by very long wings and the presence of a danleno and sweeps without bridles), the *Americana* trawl (locally called *Americain*) or the *Mexicana* trawl.

PLATE 5
Trawl net ropes used for red and pink shrimps in Tunisia

PLATE 6
Trawl net with two bridles used in Tunisia


© M. Bdioui

In Malta (GSA 15), the bottom otter trawl fleet can be divided into two subfleets: one composed of vessels that are authorized to fish both within the 25-nautical mile fisheries management zone and the high seas and a second subfleet of vessels that are legally restricted to operating on the high seas only. The nets are mostly made of two panels and the headline length ranges from 24 m to 48 m. The vertical net opening is variable according to the net type (0.6–1.5 m or 2.4–2.6 m). In depths ranging from 300 m to 800 m, the main target species are red shrimps, but European hake, Norway lobster and deep-water rose shrimp are also caught. These nets have long combination ropes (100–200 m) and a chain; the sweeps are 200–250 m long and the bridles are absent; they are towed at speeds of 2.7–2.9 knots. In shallower waters (50–200 m), the main target species are European hake, cuttlefish and red mullet (*Mullus* spp.). These nets have 60 m long sweeps and 20–30 m long bridles; a chain is used and the towing speed is up to 3.5 knots.

In Italy, the trawlers operating in the Strait of Sicily (GSA 16) mainly use the demersal two-face trawl (*volantina* and *tartana* types) and, to a lesser extent, the demersal four-face trawl, even if it is not common (Sala *et al.*, 2013). The dimensions of the headrope range between 24 m and 56 m depending mainly on the vessel's engine power and although there are some differences in material between the nets used in shallow water (*banco* net) and in deeper water (*fondale* net), the demersal two-face trawl is characterized by a low vertical opening (usually less than 2 m). Inshore trawling mainly targets mixed species – *Mullus* spp., European hake, seabream (*Pagellus* spp.), *Trachinus* spp., octopus, cuttlefish, musky octopuses (*Eledone* spp.), monkfish (*Lophius* spp.), deep-water rose shrimp, Norway lobster, broadtail shortfin squid (*Illex coindetii*), lesser flying squid (*Todaropsis eblanae*), John dory (*Zeus faber*), *Raja* spp. – on the continental shelf, with trawlers usually carrying out two hauls 4–5 hours long per day. Offshore and deep trawling is conducted by large trawlers (generally between 24 m and 33 m in length) belonging to the Mazara del Vallo harbour. This fleet operates with large nets (headrope upwards of 55 m in length on average and horizontal opening of around 25–30 m) in international waters, working both on the continental shelf and slope up to 700–800 m depth. These vessels undertake long fishing trips (15–30 days) and exploit areas in other GSAs inside the Strait of Sicily (i.e. GSAs 12, 13, 14, 15, 16 and 21). The key target species of this fishery are giant red shrimp and blue and red shrimp, but deep-water rose shrimp is also caught. With the *tartana* trawl, long sweeps are used (200–250 m) without bridles; therefore, the vertical opening is usually less than 1.5 m and the horizontal opening ranges from 15 m to 30 m. With the two-face *volantina*, short sweeps (around 120–180 m) and bridles (25–40 m) are used so that the vertical opening slightly increases to 2.5 m. The four-face trawl with four cables and high vertical opening is rarely used in the shallow waters of the continental shelf (50–350 m depth) to catch coastal species (red mullet, European hake, cuttlefish, caramote shrimp, among others) and sometimes anchovies. These nets have a horizontal opening of around 10–22 m and a vertical opening ranging from 4 m to 15 m.

In Greece (GSA 20), the most widely used trawl design is the two-face trawl (DB-2). According to Adamidou (2007), the netting is made of multifilament twine, knotted and knotless, with diamond meshes. This type of trawl gear is relatively the same irrespective of the target species; minor modifications, made to the gear by the fishers, are associated with the fishing grounds, though usually these nets are used in sandy–muddy bottoms at depths ranging from 250 m to 400 m by vessels of 14–20 m length. The entire length of the trawl net is usually 58 m and the mouth's stretched circumference is about 61 m. The wings are made of two half sections that consist of 1–4 pieces of net each and are about 11–12 m long, and the netting's stretched mesh size is usually 90 mm. The main body is comprised of an equal number (usually 4–6) of rectangular pieces of netting, each 100 meshes wide, placed at the right and left side of the central triangle located on the upper (*tselo*) and lower (*boukos*) part of the trawl body, respectively. The length of the main body is about 20 m and the netting's stretched mesh size ranges from 40 mm to 70 mm. The extension piece consists of 5–7 pieces of net of 100 meshes wide each; it is about 19 m long and the netting's stretched mesh size is usually 40 mm. The codend consists of 1–6 pieces of net and is about 7 m long with an overall width of 300 meshes. It is usually covered by a strengthening piece of netting. A single rope of PA is tied around the codend to close it. The headline is 18–28 mm thick and is mainly made of PA or Manila fibre; its length usually ranges between 25 m and 55 m. The footrope is about 48 m long, 40 mm thick and is made of PA plus iron or polypropylene and iron. The sweeps are made of PA plus iron or Manila fibre plus iron; their length ranges from 180 m to 280 m and their thickness from 24 mm to 50 mm. The otterboards of the traditional trawl are oval or rectangular and weigh 200–400 kg depending on their material (Adamidou, 2007). Nets are towed at a mean speed of around 2.5 knots to mainly catch deep-water rose shrimp, European hake, red mullet and Norway lobster. The horizontal opening usually ranges between 11 m and 18 m. The vertical opening ranges from 0.7 m to 1.5 m, even if the high vertical opening net can be used. No deep-water fishery tradition exists and red shrimps have started to be exploited only in recent years; therefore, trawl nets are constructed following the characteristics of the Italian trawl (Mytilineou *et al.*, 2006).

Adriatic Sea

The Adriatic area is one of the most exploited areas in the Mediterranean by bottom trawlers (Colloca, Scarcella and Libralato, 2017).

In Italy (GSAs 17 and 18), European hake represents the most-landed demersal species by single boat bottom otter trawl vessels in the Adriatic Sea and also the one with the highest commercial value (Mannini and Sabatella, 2015). European hake is caught with other important commercial species such as red mullet, deep-water rose shrimp, broadtail shortfin squid, musky octopuses, monkfish, seabream and Norway lobster. The fishing areas are located on the soft bottoms of the continental shelf and along the upper part of the continental slope. Trawl catch occurs in a depth range of 20–70 m (mainly in GSA 17) and down to 500 m (in GSA 18). Both demersal two-face trawls (DB-2) and four-face trawls (DB-4) are employed. The DB-2 category uses two faces with different dimensions. The upper face is shorter than the lower face, and this asymmetry allows the towing to be mainly exercised on the headrope, thus to keep the net open. Moreover, the low tension on the lower panel and on the footrope, which is longer than the headrope, allows the net to better adhere to the bottom, with a consequent higher catch efficiency for demersal species. The nets in this category are often made entirely of knotless PA netting and have a wide opening of the wings attached to long sweeps and bridles, coupled with a narrow vertical opening (1–1.5 m). The target species of this category include European hake, red mullet, whiting (*Merlangius merlangus*), poor cod, monkfish and Norway lobster. The DB-4 category presents four faces, the upper and lower panel and two side panels, which are usually made entirely of knotless PE netting, though sometimes a portion of knotless PA netting may appear in the lower panel. It is also called a box trawl or *Americana* because the upper and lower panels have the same dimensions as the two side panels, and consequently the net will naturally take up a more open cross-sectional shape compared to a two-face net. In fact, the vertical openings of these trawls can reach up to 2–4 m in height, increased by a couple of bridles whose length can reach 10–15 m. This gear category mainly targets crustaceans such as deep-water rose shrimp, giant red shrimp and Norway lobster.

To summarize, the Italian Adriatic trawlers employ two types of DB-2, called *tartana* and *volantina*, and one type of DB-4, called *Americana*.

The *tartana* (DB-2) is the most traditional Italian trawl net; it is used across a wide depth range, from shallow coastal waters to deep fishing grounds. The target species are mixed demersal species such as shrimps, fishes and cephalopods that live in contact with muddy bottoms. The net is equipped with long and heavy sweeps ranging from 100–250 m depending on the bottom depth, and without bridles. With this rigging, the vertical opening is usually less than 1 m and the horizontal opening varies according to net dimensions (15–25 m).

The *volantina* (DB-2) is usually made of PA and is commonly used on the Italian side, especially in the northern Adriatic Sea, where it is also towed with the twin trawl method. During the last ten years, the upper side of these nets has also been made of PE netting. The net guarantees a larger vertical opening (about 1.5 m) than the *tartana*, thus allowing the capture of species that are not always in close contact with the seabed, while at the same time maintaining contact with the bottom. It has longer sweeps (100–200 m) and bridles (15–30 m), and a larger wingend spread. The horizontal opening varies according to net dimensions (15–25 m).

The *Americana* (DB-4) is the name given by Italian fishers to this type of net. The net is manufactured mostly with knotted PE netting, and it is usually characterized by having two very short bridles (10–15 m) directly connected to the otterboards, while the sweeps are not used. The attack angles of the otterboards (40–45°) are higher compared to those of the *volantina* (19–20°), in order to increase the vertical opening, which can be around 2–4 m. Moreover, for the same vessel size, the horizontal net opening of the *Americana* trawl, ranging from 15 m to 22 m, is generally higher than typical of other *volantina* trawls (Lucchetti and Sala, 2012). The footrope is often equipped with a fishing line and a tickler chain in order to catch mixed demersal species. In the middle Adriatic (GSA 17), it is common to rig two twin nets with a central clump weight (twin trawl method). During the last 15 years, several trawlers have switched their activity from the traditional *tartana* and *volantina* trawls to the *Americana* configuration (Sala and Lucchetti, 2011; Lucchetti and Sala, 2012).

In Croatia (GSA 17), there is one type of demersal two-face trawl (DB-2), called *romanjola* (Sala *et al.*, 2013). The *romanjola* is the traditional Croatian trawl net. It is similar to the *tartana* and used to target the same species. Although the net is made of two panels, the wings are made of one single panel. The footrope is commonly rigged with protection bobbins and with additional load for higher catch efficiency. Moreover, the catch efficiency is sometimes increased through the use of an additional tickler chain in front of the net mouth. The small trawl nets called *strasin* and *kogol*, described by Matić-Skoko *et al.* (2011), that were used in coastal waters (from 5 m to 20 m depth) to mainly target picarel (*Spicara smaris*) are no longer legal.

In Slovenia (GSA 17), the nets employed belong to the DB-2 category and have the same technical properties as the Italian *volantina*. They are used to catch the same target species (European hake and red mullet, among others).

In Albania (GSA 18), trawlers usually employ Italian nets, such as the *tartana* and *volantina*. The mean headline length is 40–55 m, and the net openings during fishing are 1.2–1.7 m (vertical) and 10–20 m (horizontal). The main target species are European hake, red mullet and deep-water rose shrimp.

In Montenegro (GSA 18), the net used by trawlers is identical to the Italian *tartana*, with 30–45 m of headline length, 1–1.2 m of vertical opening and 8–16 m of horizontal opening. The main target species are European hake, red mullet and deep-water rose shrimp.

Eastern Mediterranean

In Greece (GSA 22), the most widely used trawl design is the two-face trawl (DB-2). These nets are used in sandy–muddy bottoms at depths ranging from 100 m to 300 m by vessels of 20–25 m in length. Their technical characteristics follow the description given for the Greek nets used in the central Mediterranean (Adamidou, 2007). Nets are towed at a mean speed of around 2.5–3.0 knots to mainly target deep-water rose shrimp, European hake, red mullet and Norway lobster. The horizontal opening varies from 11 m to 17 m. The length of the headline usually ranges between 26 m and 44 m. In Crete (GSA 23), there are only a few vessels operating, mainly along the northern coast due to the very narrow continental shelf.

In the Turkish part of the Mediterranean Sea (GSAs 22 and 24), the most abundant trawl typology is the demersal/bottom two-face trawl category with the most commonly used being 900 meshes at the footrope level (e.g. in the Aegean Sea; Tosunoğlu and Aydın, 2007). The size of the nets varies based on engine power and vessel size. Larger vessels with bigger engines use a greater trawl size between 1 200 and 1 500 meshes at the footrope level to catch certain fish species like goldband goatfish (*Upeneus moluccensis*), chub mackerel (*Scomber japonicus*), horse mackerel, bogue (*Boops boops*) and sardine. The fishing strategy is the same for all fishing grounds, as fishers want to catch all commercial species. Therefore, in shrimp or demersal fish areas, the same trawl gear is used, but the weight of the footrope and groundrope, the groundrope number (double or single) and the number of chain rigs are different.

In Egypt (GSA 26), bottom trawling is the most important fishing sector in terms of the number of vessels. Lucchetti *et al.* (2016) described the most commonly used net, which is a modified Italian trawl. It consists of an asymmetric two-face trawl (top versus bottom faces, similar to the Italian *tartana*) with long groundrope, large wingend spread (i.e. horizontal net opening) and a low vertical opening (about 1 m). The trawl net is usually made of knotless PA or knotted PE, mainly in the upper part of the belly, and is equipped with a 30 m footrope (on average), comprising a 38 mm combined rope weighted with about 80 kg of leads along its length. The wire ropes have a diameter of 12–20 mm, usually 16 mm. The total net length (from the wings to the codend) ranges from 14 m to 69 m, with an average length of 44 m. The different codends have a mean length of 5.4 m, ranging from 3 m to 7 m. Trawl rigging includes 150 m sweeps and Italian traditional otterboards (150 kg each). These trawls are commonly used in coastal waters to target mixed demersal species such as shrimp (*Penaeus* spp.), mullet (*Mullus* spp., goldband goatfish), cuttlefish and lizard fish (*Saurida* spp.). Larger nets are used for deep-sea trawling (up to 950 m) to target giant red shrimp and blue and red shrimp. This fishery is relatively new to the country, which has developed in recent years, and trawlers are using both two-face nets (e.g. Italian designed nets 60–70 m long and 8 m wide, with a height of 1–6 m, 30–40 m long wings, 40 mm codend mesh size and 300–350 kg otterboards; Ibrahim *et al.*, 2011) and four-face nets (Sabrah *et al.*, 2022).

In Israel (GSA 27), bottom trawling involves the use of two-face trawls and, on rare occasions, four-face trawls. Long sweeps (200 m) and short bridles (6–7 m) are commonly used to target coastal species. The vertical openings range between 1 m (two-face trawls) and 2.5 m (four-face trawls). Small trawl nets are commonly used, with a headrope length of around 30 m. The main target species are red mullet, European hake, caramote shrimp, common squid (*Loligo vulgaris*), common pandora (*Pagellus erythrinus*) and also the Lessepsian migrant Randall's threadfin bream (*Nemipterus randalli*).

In Palestine (GSA 27), trawlers use two types of bottom trawls (jar or gar). One is used to catch demersal and benthic fish, while the other is used to target shrimps mainly at night (Ali, 2002; Abudaya *et al.*, 2013). The trawlers operate continuously for 24 hours and return once in the morning, to land the catch, get supplies and change crews.

Black Sea

In Türkiye (GSA 29), the two-face trawl is used to mainly target whiting and red mullet (Erdem *et al.*, 2019). These are usually small nets towed at 2.5–3 knots, with a headline length between 30 m and 40 m and a vertical opening usually less than 1.2 m. In particular, the size of the demersal trawl gear in the Black Sea ranges from 500 meshes to 1 000 meshes of 40 mm around the mouth, and a trawl gear of 800 meshes is commonly used in the region. According to Turkish fishing legislations, the smallest mesh size that can legally be used in the bottom trawls of the Black Sea is 40 mm (diamond).

In Bulgaria, Romania and Ukraine, bottom trawling is not allowed.

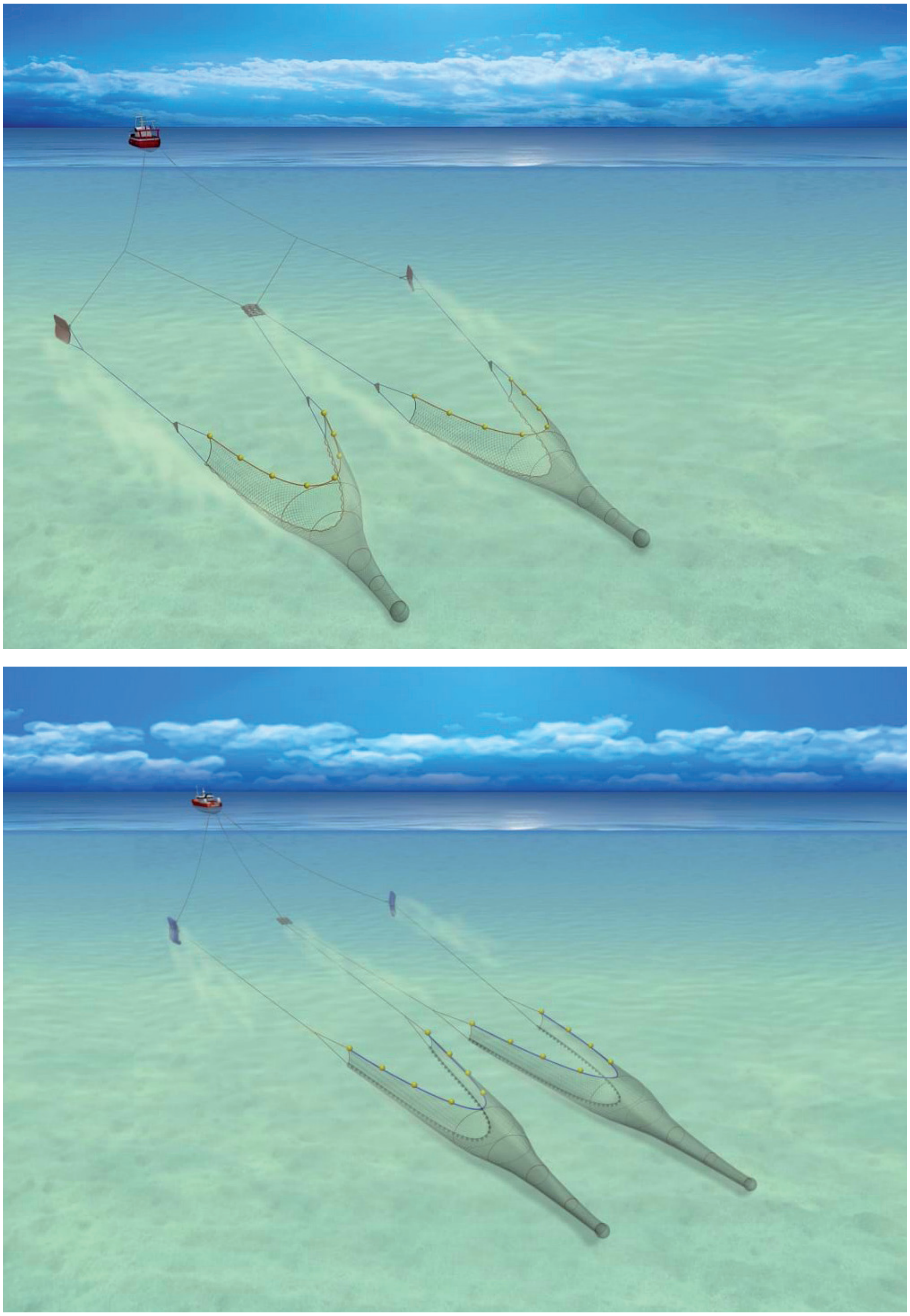
1.2.2 Twin bottom otter trawls

In this trawling technique, two identical otter trawls (twin) are towed side by side by one vessel (twin bottom otter trawls) (Box 2). The nets can be rigged in two different ways: a) a two-warp system using a bridle arrangement; or b) a three-warp system (Figure 19). In both riggings, the horizontal opening of the two nets is guaranteed by standard trawl doors with a clump weight in the centre. Subregional variations of this trawl are shown in Table 5.

The main benefit from using this technique is the ability to increase the horizontal opening at the wingends of the trawl deployed, without proportionally enlarging the main body of the trawl, which would cause an inconvenient increase of drag resistance. The increase in horizontal opening is achieved by deploying two juxtaposed smaller trawls rather than a larger single trawl. The twin trawls enable wingend spread to be increased by approximately one-third, without also increasing vertical opening and towing resistance (Sala *et al.*, 2009). Therefore, the nets used in the twin-trawl technique are usually smaller than an equivalent single net but are designed to sweep a wider area of seabed using less fuel.

This technique is most useful in trawl fisheries targeting species closely associated with the bottom, which are not necessarily herded by the sweeps and, due to their sedentary behaviour, are not liable to escape over the headrope of the trawl. Species such as shrimps, Norway lobster and *Lophius* spp. fall into this category (Sangster and Breen, 1998). The multi-rig trawl technique (one vessel–more than two nets; multiple bottom otter trawls) is not common in the Mediterranean.

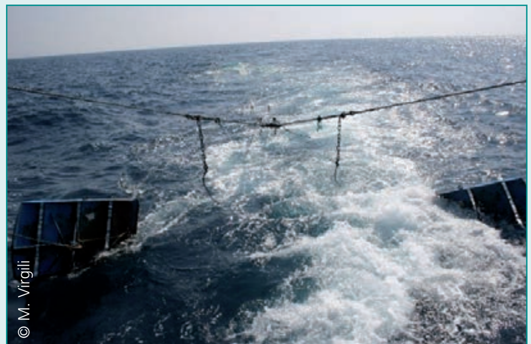
FIGURE 19
Twin bottom otter trawl with two-warp rigging (top) and a three-warp system (bottom)



Source: **Seafish.** 2023. Fishing gear database. In: *Seafish.* Cited 23 May 2023. Edinburgh. www.seafish.org/responsible-sourcing/fishing-gear-database/?t=docGear/

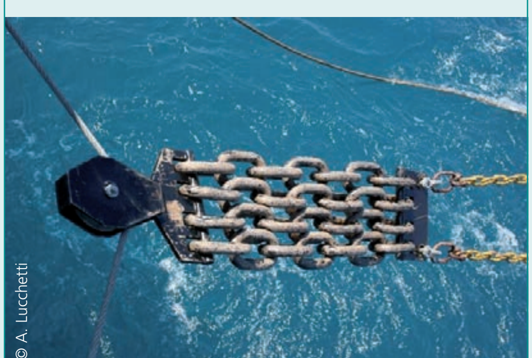
Box 2
Details of a twin bottom otter trawl operation

Two nets are towed together simultaneously.



Trawl doors being deployed to initiate the haul, with the central clump visible in the middle.

Chain rigged to the groundrope to enhance bottom contact and catch efficiency.



Central clump weight used to balance the towing force of the two nets.

The two codends hauled at the same time.

Table 5

Technical parameters of twin trawl nets used in the Mediterranean Sea

GSA	Subregion	Country	Gear code	Main target species	Category	Local name	Headline length (m)	Vertical net opening (m)	Horizontal net opening (m)	Sweep length (m)	Bridle length (m)	Rigging	Trawling speed (kn)	Mean depth (m)
7	Western Mediterranean	France	OTT	Demersal species	BTT-2		31.0–42.0	1.5–2.5	21–30	100	15		4.0–4.3	20–50
17	Adriatic Sea	Italy	OTT	CTC, HKE, MTS, MUT, NEP, TGS	BTT-2	*Volantina*	24.6–47.5	1.0–2.0	20–30	30–70	10–15	Short combination ropes	2.8–3.2	10–60
17	Adriatic Sea	Italy	OTT	CTC, HKE, MTS, MUT, NEP, TGS	BTT-4	*Americane*	45.9–64.9	1.0–2.0	15–35	30–70	10–15	Short combination ropes	3.2–3.7	10–120
17	Adriatic Sea	Italy	OTT	GUU, HKE, MNZ, MUT, NEP,	BTT-4	*Americana*	33.2	0.7–1.3	16–18				2.7–3.6	30–80

Notes: OTT: twin bottom otter trawl; CTC: *Sepia officinalis*; GUU: *Chelidonychthys lucernus*; HKE: *Merluccius merluccius*; MNZ: *Lophius* spp.; MTS: *Squilla mantis*; MUT: *Mullus barbatus*; NEP: *Nephrops norvegicus*; TGS: *Penaeus kerathurus*.

Western Mediterranean

In the French Gulf of Lion (GSA 7), two-face twin trawls called *chaluts jumeaux* are employed to catch demersal species at depths ranging from 20 m to 50 m (Plate 7). The headline length ranges from 31 m to 42 m and the horizontal net opening is 21–30 m, while the vertical net opening is around 1.5–2.5 m. The mean trawling speed is higher than in the Adriatic Sea (4.0–4.3 knots).

PLATE 7
Twin trawl used in France

Central Mediterranean

No twin trawls are reported from this region.

Adriatic Sea

In Italy (GSAs 17 and 18), both two-face *volantina* and four-face *Americana* nets are used, although the majority of vessels commonly use *Americana* nets made of PE with short bridles. A central clump weight is used to balance the towing force of the two nets. The groundrope is often equipped with a fishing line and a tickler chain in order to catch mixed demersal species. This gear is used by large (more than 25 m length) or small vessels (less than 15 m length), especially in the northwestern Adriatic.

Eastern Mediterranean

No twin trawls are reported from this region.

Black Sea

No twin trawls are reported from this region.

1.2.3 Beam trawls

A beam trawl is a trawl whose horizontal and vertical openings are maintained by a rigid frame made of iron. Two or more iron sledges facilitate the sliding of the gear along the bottom. The net usually consists of a cone-shaped net ending in a bag or codend that retains the catch. No hydrodynamic forces are needed to keep a beam trawl open.

Different types of beam trawls are used in the Mediterranean. They are generally used in shallow waters by small units within some small-scale fisheries. Some of these beam trawls operate more like dredges and are often considered as such at the national level. The Provençal *gangui* (from the southeast of France), Catalan *ganguils* (from northwest Spain), Greek *kankava* for sponges and Italian *gangamo* for prawns and sea urchins (from Sicily) are the most common examples. In the Provençal French fishery using *gangui*, the target species are Scorpaenidae, red mullet and other high value species used in traditional dishes. In Italy, large bottom trawlers off the Adriatic coast use a kind of beam trawl, the so-called *rapido* trawl, to catch scallops (*Pecten jacobeus*) and queen scallops (*Aequipecten opercularis*) on sandy or detritic bottoms at 40–50 m depth at some distance from the coast, as well as common sole (*Solea solea*) in muddy inshore areas.

The classification of beam trawls in the Mediterranean is not always homogeneous, because in some cases the same gear is considered as a dredge in one country and as a beam trawl in another country (Table 6).

Subregional variations

Table 6

Technical parameters of beam trawl nets used in the Mediterranean and the Black Sea

GSA	Subregion	Country	Gear code	Main target species	Headline length(m)	Vertical net opening (m)	Horizontal net opening (m)	Sweep length (m)	Rigging	Trawling speed (kn)	Mean depth (m)
6	Western Mediterranean	Spain	TBB	Gastropods	3.0				One or two gear		
7	Western Mediterranean	France	TBB	BBS, SRK, CBR, Labridae							
7	Western Mediterranean	France	TBB	Demersal species	0.7–4.0	0.7–1.0	2.5–4.0	15–35		1.0–1.5	12–30
8	Western Mediterranean	France	TBB	Demersal species	0.7–4.0	0.7–1.0	2.5–4.0	15–35		1.0–1.5	12–30
9	Western Mediterranean	Italy	TBB	JRS, CTC, SOL	3.0	0.3–0.4			Two gear – teeth	6.0–7.0	10–20
11	Western Mediterranean	Italy	TBB	Shrimps, crabs and demersal fish	4.0–5.0	1.0	4.0–5.0		Single gear – chains		
16	Central Mediterranean	Italy	TBB	Shrimps, crabs, demersal fish, sea urchins	1.0–1.5	0.3–0.35	1.0–1.5		One or two gear – chain or blade		
17	Adriatic Sea	Croatia	TBB	CTC, BOY, SJA, SOL, TGS	2.0–4.2	0.3–0.4			Two to four gear – teeth	5.0–7.0	10–60
17	Adriatic Sea	Croatia	TBB	CTC, SOL, OYF, SJA	1.8	0.5	1.8		Two gear – teeth	5.0–5.2	30–40
17	Adriatic Sea	Italy	TBB	CTC, BOY, SJA, SOL, TGS, OCM	2.0–4.2	0.3–0.4			Two to four gears – teeth	5.0–7.0	10–60
28	Black Sea	Türkiye	TBB	DPS, PEN	3.5	0.5	3.5	4.3		1.5–2.0	
28	Black Sea	Türkiye	TBB	DPS, PEN	5.0	0.5	5.0				
29	Black Sea	Türkiye	TBB	RPW	2.5–2.7	0.18–0.22	2.5–3.0		One or two gear – steel wire or chains (up to three chains)	1.5–3.0	5–35
29	Black Sea	Bulgaria	TBB	RPW		0.5	5.0–6.0			2.8–3.6	13–38
29	Black Sea	Romania	TBB	RPW	3.0–5.0	0.3–0.4			Two gear	2.0–3.5	15–35
29	Black sea	Bulgaria	TBB	RPN	1.5–5.0	0.5–0.7			One or two gear – chains plus net combined	2.0–3.0	10–56

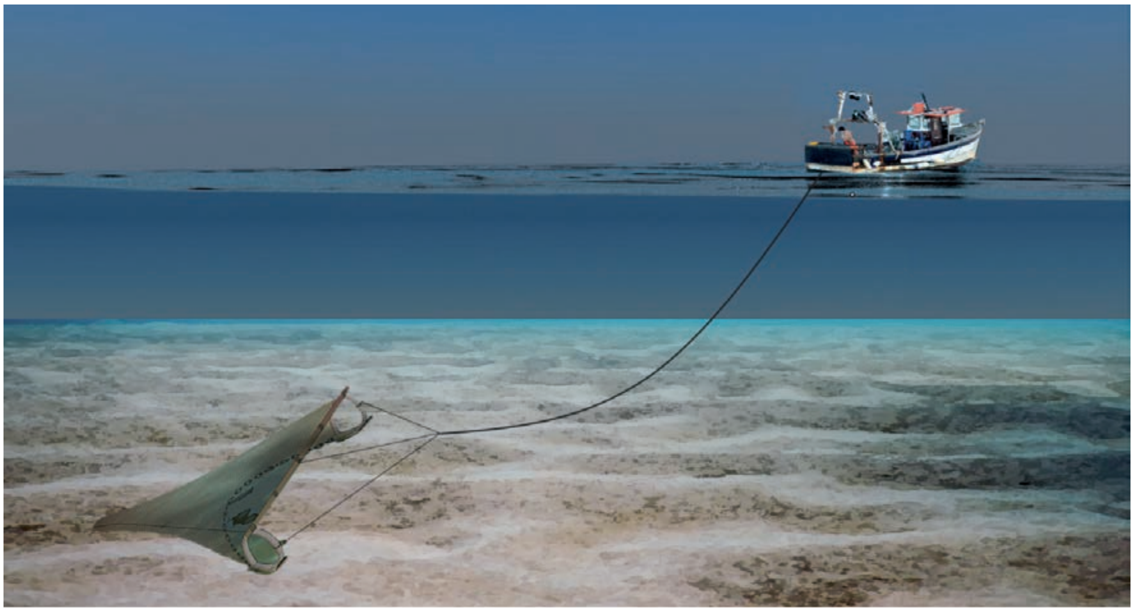
Notes: TBB: beam trawl; BBS: *Scorpaena porcus*; BOY: *Bolinus brandaris*; CBR: *Serranus cabrilla*; CTC: *Sepia officinalis*; DPS: *Parapenaeus longirostris*; JRS: *Raja asterias*; OCM: *Eledone* spp.; OYF: *Ostrea edulis*; PEN: *Penaeus* spp.; RPN: *Rapana spp.*; RPW: *Rapana venosa*; SJA: *Pecten jacobaeus*; SOL: *Solea solea*; SRK: *Serranus scriba*; TGS: *Penaeus kerathurus*; TUR: *Scophthalmus maximus.*

Western Mediterranean

In the Catalonia area of Spain (GSA 6), Mediterranean bottom beam trawl typology that targets gastropods is employed (Sala *et al.*, 2013). Such Spanish beam trawls can have a maximum width of 3 m and are permitted only on vessels with an overall length less than 12 m. Each vessel can tow a maximum of two beam trawls rigged in series and not in parallel; they are not permitted on vessels with trawling licences.

In the Provençal French Riviera (GSA 7), a very ancient beam trawl is still employed and its local name is *ganguì* (another type of *gangui* with trawl doors has been already described in the section on bottom trawls; Sacchi, Le Corre and Mortreux, 2010). It is a small coastal fishing gear towed at low speeds (between 1.5 and 3 knots) by single vessels with an overall length less than 12 m within 3 nautical miles of the coast (Figure 20; Plate 8), through a derogation from Council Regulation (EC) No 1967/2006. This type of beam trawl has been adapted to different coastal habitats, such as seagrass meadows (*Posidonia oceanica*) and soft bottoms. The target species belong to the Scorpaenidae family, red mullet and other highly valuable species that are used in traditional dishes such as *soupe de roche* and *bouillabaisse*. The fixed-frame *ganguis* are categorized by dimensions. The *petits ganguis* are from 1.5 m to 2.5 m wide and 70 cm high and are used from November to March on the seagrass meadows to target fish for rock soup, sea urchins or shrimps. They are used for 50–100 days per year, and the fishing activity consists of 4–5 hauls of one hour each per day, with a towing speed of 1.5 knots. The *ganguis à patins* are larger in size, with frame dimensions of 4–5 m, and they are employed all year round on the seagrass meadows. The 13 most common species caught are: black scorpionfish (*Scorpaena porcus*), East Atlantic peacock wrasse (*Symphodus tinca*), annular seabream (*Diplodus annularis*), common octopus, cuttlefish, European conger (*Conger conger*), rainbow wrasse (*Coris julis*), common two-banded seabream (*Diplodus vulgaris*), striped red mullet (*Mullus surmuletus*), red scorpionfish (*Scorpaena scofra*), painted comber (*Serranus scriba*), blotched picarel (*Spicara maena*) and picarel. These species represented 60 percent of the catch, which included 60 total species.

FIGURE 20
***Gangui* bottom beam trawl used in France**



Source: illustrated by A. Lucchetti.

PLATE 8
Hauling of *Gangui* bottom beam trawl used in France

In Italy (central-northern Tyrrhenian Sea, GSA 9), the *rapido* trawls are very similar to those used in the northern Adriatic Sea (as described below) as far as the technical features, but they have smaller dimensions, being only 3 m wide (Sala *et al.*, 2013). Furthermore, in this case they are provided with four sledges, each 12 cm wide and 70 cm long. The wooden board (300 cm × 32 cm × 2.4 cm) is placed above the upper side of the iron frame at an angle of about 30° to the ground. Thirty-three iron teeth are fixed to the lower side of the *rapido* mouth at a distance of 7 cm from each other; they have a diameter of 12 mm and extend 0.5–1.0 cm behind the tooth bar. Two *rapido* trawls are usually towed at once at a speed of around 5 knots and each haul lasts between two and three hours. The fishing activity is practised from early morning (about 1 a.m.) to dusk by carrying out multiple hauls without stopping for 16–18 hours. About 6–8 hauls are performed each fishing day. The trawl is 4.8 m long and consists of two panels. In the upper panel, there are two nettings: the first one is tied to the *rapido* mouth and has a mesh size of around 45 mm; the second netting is the codend, with a mesh size of around 40 mm. The lower panel of the net is protected by a reinforced rubber diamond-mesh matting (stretched mesh size 24 cm × 30 cm). Normally, each gear has a total weight of about 150 kg. The species accounting for the highest percentage of landings are Mediterranean starry ray (*Raja asterias*), cuttlefish, common sole, and a mix of other fishes and crustaceans.

In Italy (Sardinia, GSA 11), the *ganghero* or *gangamo* is a kind of rudimentary beam trawl consisting of a metal beam (about 4–5 m wide, 1 m high) rigged with a chain along the lower leading edge and a net bag to collect the catch (Plate 9). This gear is used in Sardinia to catch shrimps, crabs and demersal fish. The net, made of PA, consists of two panels, the upper and the lower panel being 20 m long. The codend has a length of about 2 m. The *ganghero* is used during winter and in the night by small vessels, and each vessel can tow just one gear. However, this type of gear has almost disappeared (Sala *et al.*, 2013).

PLATE 9
Commercial *ganghero* single trawl used in Sardinia

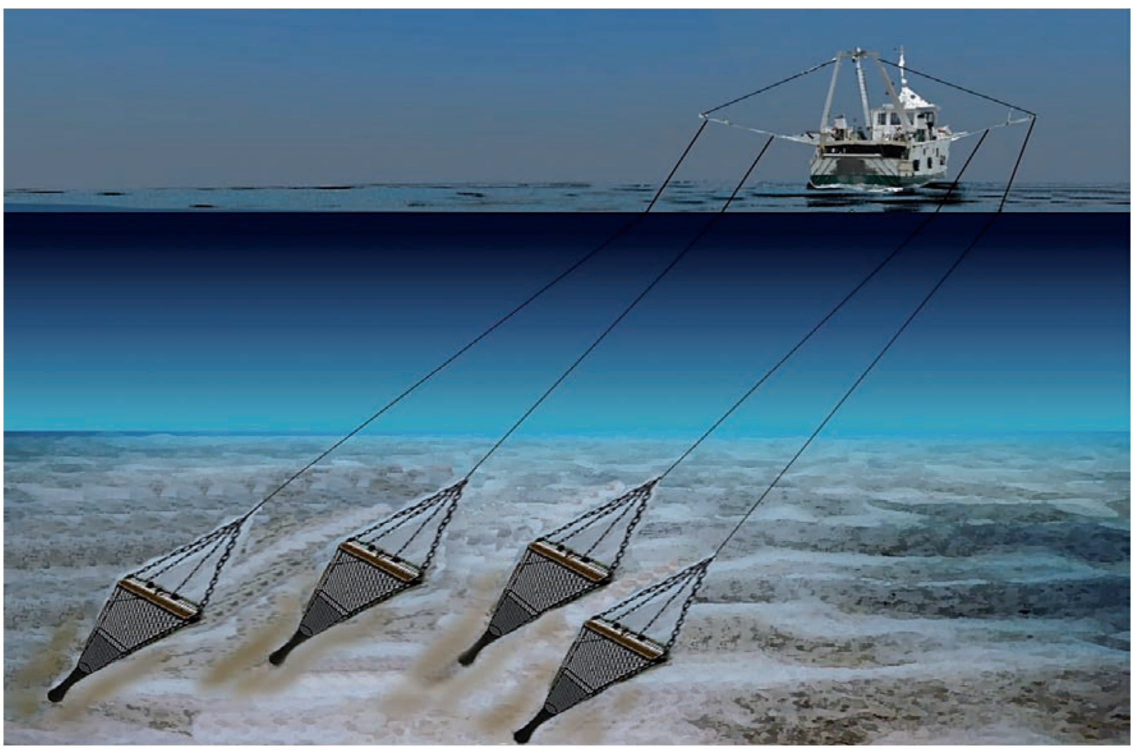
Central Mediterranean

In Greece (GSA 20), this fishing method is not practised (SGMED, 2004).

Adriatic Sea

In the Italian central-northern Adriatic Sea (GSA 17), *rapido* trawlers (Figure 21; Plate 10) commonly target the common sole, while flatfish such as turbot (*Scophthalmus maximus*) and brill (*Scophthalmus rhombus*) are important bycatch species in muddy inshore areas; in the sandy offshore areas of the northern Adriatic, great Mediterranean scallops (*Pecten jacobaeus*) are also targeted.

FIGURE 21
***Rapido* trawl**

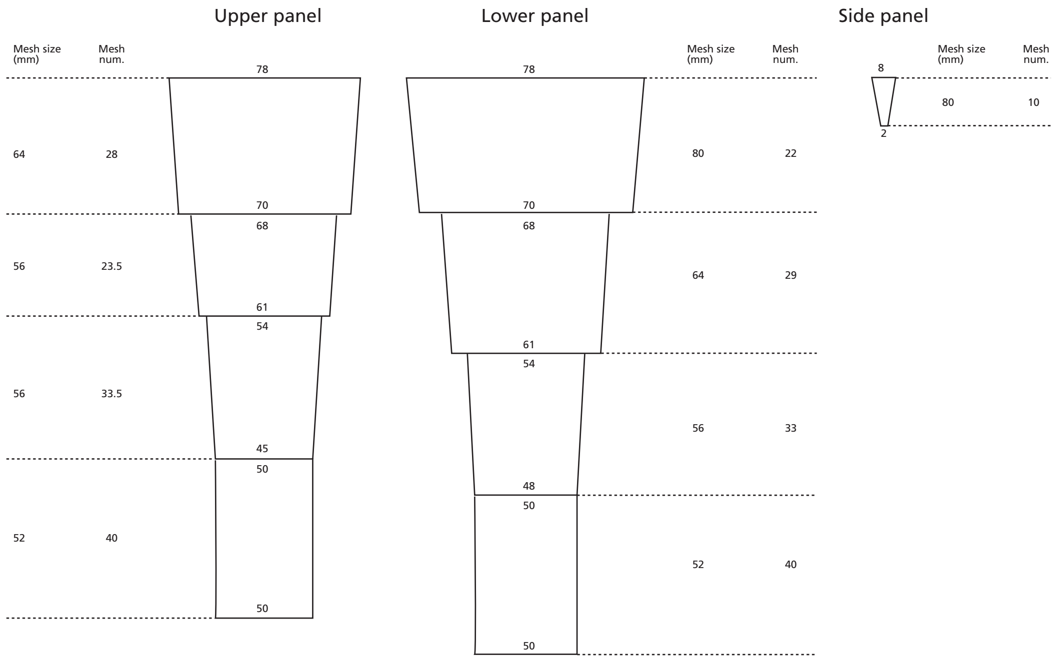


Source: illustrated by A. Lucchetti.

PLATE 10
***Rapido* trawl during fishing operations in the central-northern Adriatic Sea**

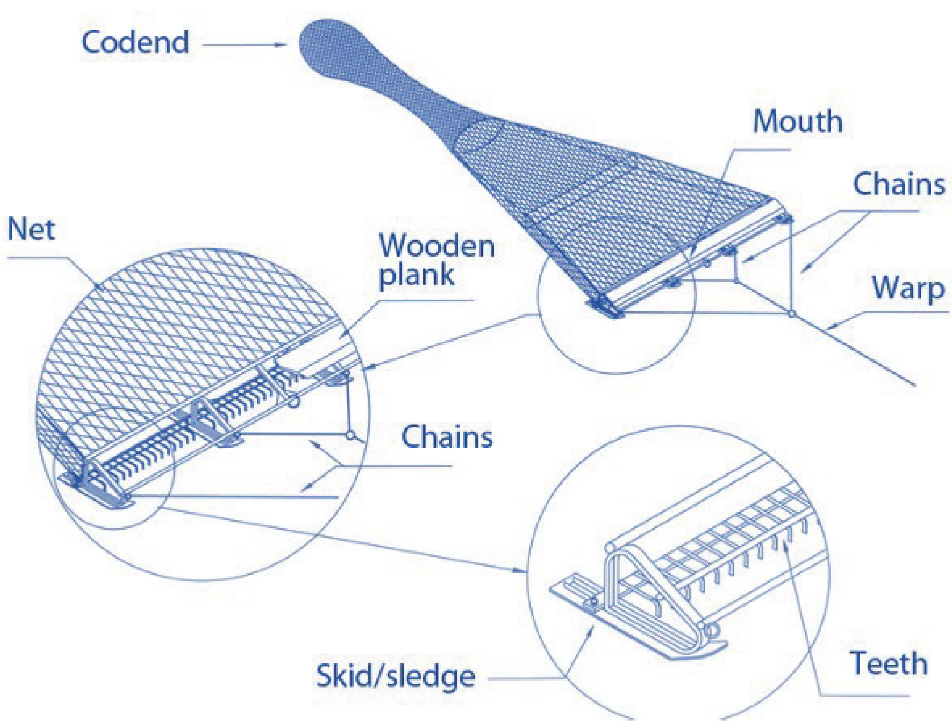
A modern *rapido* resembles a toothed dredge. The *rapido* trawl consists of a box dredge (about 4 m wide weighing 200 kg) rigged with 5–7 cm teeth along the lower leading edge and a net bag to collect the catch (Giovanardi, Pranovi and Franceschini, 1998; Sala *et al.*, 2013). There are usually around forty-four iron teeth at a distance of 6–7 m from each other, with a diameter of 13 mm and extending 0.5–1.0 m behind the tooth bar. The gear is equipped with four sledges, each 12 cm wide and 70 cm long (Plate 11). An inclined wooden board (400 cm × 30 cm × 2.4 cm), at an angle of about 30°, is fitted to the front of the metallic frame to act as a depressor, to keep the gear in contact with the seabed and, moreover, to press it on to the bottom to facilitate the penetration of the teeth into the soft sediment (Lucchetti and Sala, 2012). The net, made of PA, consists of two panels: an upper panel having a length of around 7.3 m and a slightly longer lower panel (Figure 22, Figure 23). The former has smaller meshes, gradually increasing from 48 mm (stretched mesh size) in the codend to 60 mm close to the *rapido* mouth, while the latter has meshes ranging from 52 mm (codend) to 80 mm (*rapido* mouth; Plate 11). The latter netting is protected by a reinforced rubber diamond-mesh matting (stretched mesh size 24 × 30 cm). A commercial vessel typically tows simultaneously four sets of gear. During fishing, the gear is towed at high speed (13–15 km/hour) and each haul lasts about one hour. The fishing activity is carried out day and night for about 24 hours without stopping and a total of 15–18 hauls per fishing day are performed. Considering these properties (weight of the gear, presence of a rake, high towing speed, gear dimensions), the *rapido* trawl has a considerable physical impact on the bottom; Lucchetti and Sala (2012) quantified that *rapido* trawls used in muddy areas make furrows up to 10–13 cm deep when digging into the sediment.

FIGURE 22
Technical specifications of a beam trawl



Source: redrawn from A. Lucchetti.

FIGURE 23
Typical Italian *rapido* trawl

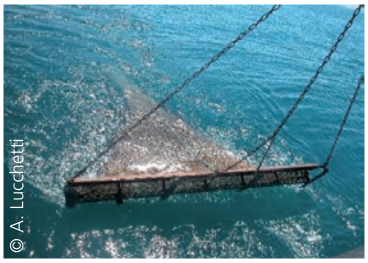


Source: **Lucchetti, A. & Sala, A.** 2012. Impact and performance of Mediterranean fishing gear by side-scan sonar technology. *Canadian Journal of Fisheries and Aquatic Sciences*, 69(11): 1806–1816.

PLATE 11
Bottom rake and sledges (left), inclined wooden board and lateral sledges (centre) and hauling (right) of the commercial *rapido* trawl used in the central-northern Adriatic Sea

Bottom rake and sledges

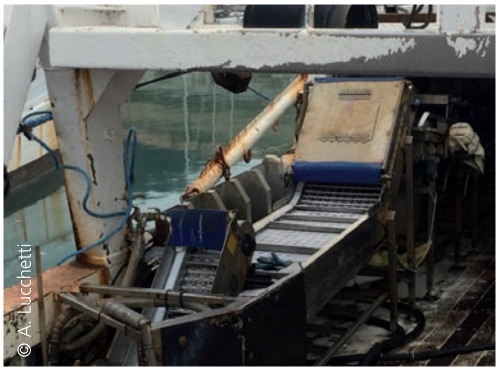
Inclined wooden board and lateral sledges



Rapido trawl hauling

Nowadays, some modern vessels are equipped with automatic sifting systems that allow the catch to be lifted from the stern and have thus greatly improved working conditions (Plate 12). These systems are mainly used for sorting molluscs, such as muricids (*Bolinus brandaris*).

PLATE 12
Sifting system on board a modern beam trawl vessel used in the Italian Adriatic Sea



In Croatia (GSAs 17 and 18), an entirely similar fishing gear is used and is known by the name *rampon*, which is classified as a dredge (see Chapter 3; Ezgeta-Balić *et al.*, 2021). Its main target species are the great Mediterranean scallop and European flat oyster (*Ostrea edulis*) (Official Gazette 12/2016[1]; Official Gazette 48/2015[2]). However, there are other commercially important species caught as bycatch, such as the common sole, cuttlefish, musky octopus (*Eledone moschata*), smooth scallop (*Flexopecten glaber*), queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*), as well as muricid gastropod species including banded dye muex (*Hexaplex trunculus*) and purple dye murex (*Bolinus brandaris*). A typical commercial fishing vessel tows two beam trawls (frame dimensions 180 cm × 50 cm, equipped with a toothed bar with teeth 9 cm apart and 10 cm long); the beam trawl net is fitted out with a 4 m long diamond mesh with 40 mm knot-to-knot mesh size (80 mm stretched mesh size; Ezgeta-Balić *et al.*, 2021).

[1] https://www.fao.org/faolex/results/details/en/c/LEX-FAOC158933/
[2] https://www.fao.org/faolex/results/details/en/c/LEX-FAOC158723/

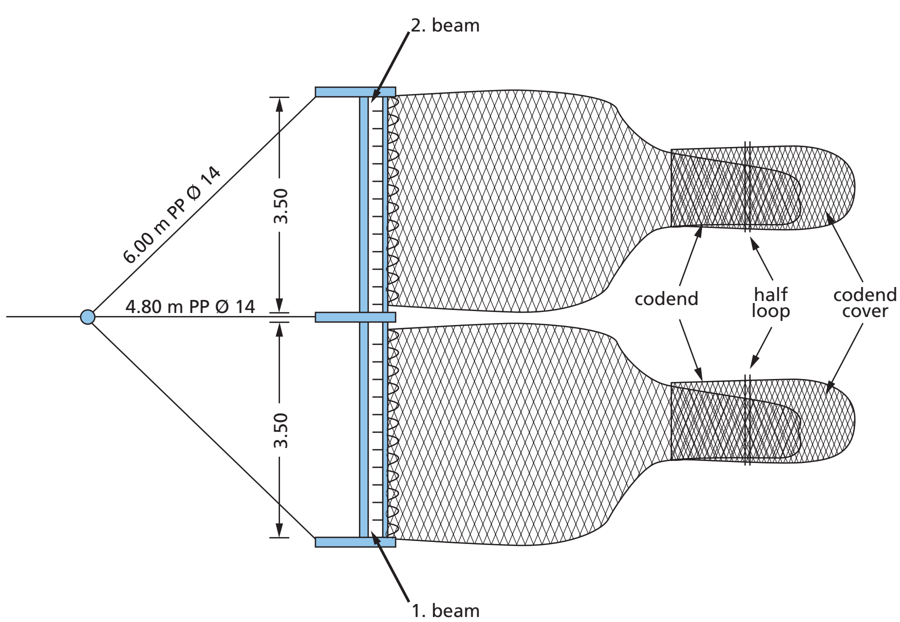
Eastern Mediterranean

In Greece, according to their legislation, beam trawls are forbidden (Sala *et al.*, 2013)

Black Sea

In Türkiye, the beam trawl method (Figure 24) is used in deep-water rose shrimp fisheries, but it is only allowed in certain parts of the Marmara Sea (GSA 28) in the coastal zone (40–150 m; Deval *et al.*, 2006; Zengin and Akyol, 2009; Demirel and Gül, 2016). The lengths and engine power of the beam trawl boats vary from 7 m to 13 m and from 9 hp to 160 hp, respectively (Zengin *et al.*, 2004). The beam trawl used in this fishery has two identical nets rigged side-by-side on the same beam (twin-beam trawl). A typical twin-beam trawl is 5–6 m wide and 50–60 cm high, and according to Turkish fisheries legislation, the maximum height of the beam should be 50 cm. The codend is made from PA with chafer (80 mm mesh size, made of polypropylene, with a 2.5 mm rope thickness) to protect the codend against chafing on the seabed. According to Turkish fishery legislations, the beam trawl (mostly used in the Marmara Sea) is allowed to be used to catch deep-water rose shrimp in waters deeper than 50 m, with a maximum codend length of 11 m and a minimum mesh size of 32 mm. A thick chain beneath the beam scrapes the bottom of the sea in order to frighten shrimp out of the sand and into the net. With this aim, two twin rigged beam trawls are towed with a 50 m longitudinal distance between them. The beam trawlers are equipped with two special booms, one on each side, to handle two sets of gear. Every fishing vessel is allowed to tow twin-beam trawls with two codends and a maximum beam length of 15 m, or three beam trawls each with a maximum beam length of 5 m (Bök, Goktürk and Kahraman, 2011). The towing speed usually varies from 1.5 knots to 2.0 knots and the towing duration can reach five hours.

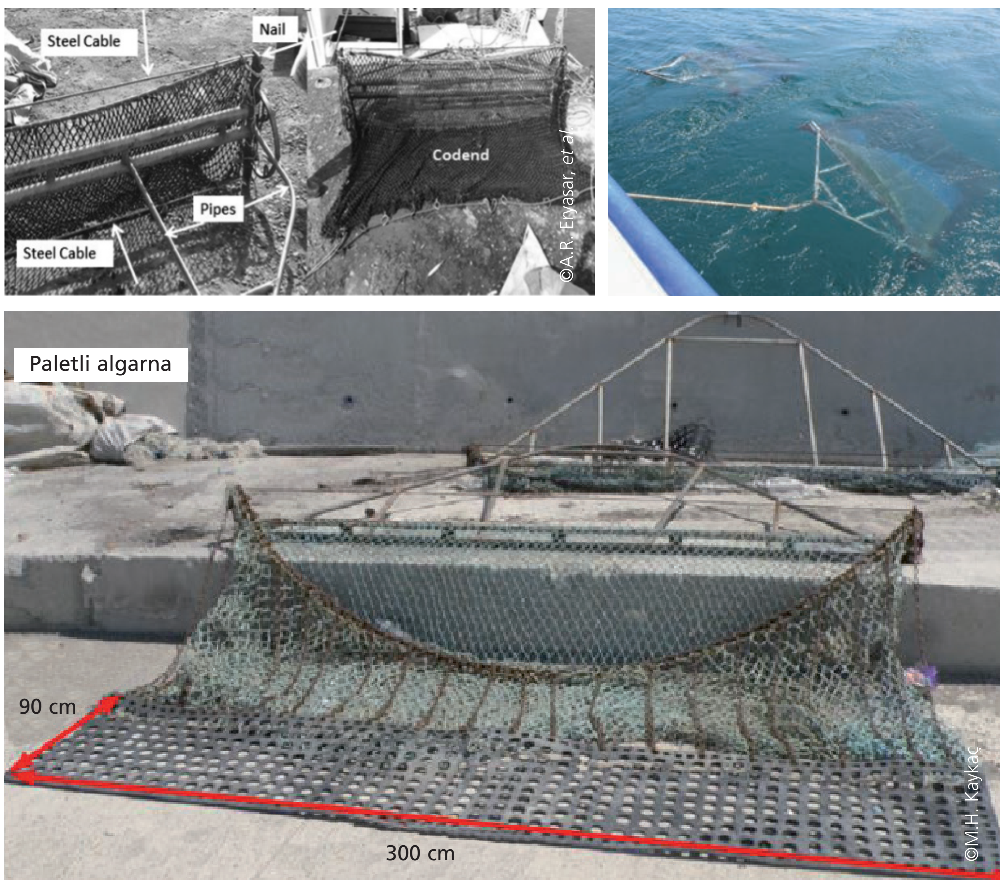
FIGURE 24
Technical specifications of the twin rigged shrimp beam trawl used in the Marmara Sea



Source: redrawn from **Deval, C.M., Bök, T., Ates, A. & Özbilgin, H.** 2006. Selectivity of PE and PA material codends for rose shrimp (*Parapenaus longirostris*) in Turkish twin rigged beam trawl fishery. *Fisheries Research*, 81(1): 72–79.

In Bulgaria, Türkiye, Ukraine and Russia, rapa whelk (*Rapana venosa*) beam trawl fisheries are actively carried out (Eryasar *et al.*, 2018). The largest yields are obtained in the eastern Black Sea region. In Türkiye, the traditional beam trawls (locally known as *algarna*) have a frame made of 50–60 mm diameter iron pipes, that is 40–45 cm high and 2.40–2.55 m wide (Plate 13; Kaykaç *et al.*, 2014). According to Turkish fisheries legislation, the maximum height of the beam should be 40 cm and the length of the codend should be a maximum of 4 m for this fishery. The gear weight is around 22–60 kg. Steel cables, of 5–8 mm in diameter, placed on the upper and lower parts of the frame have dual functions. Primarily, they detach rapa whelk individuals from their substrate by scraping and secondarily, they stir the ground surface to facilitate dragging of the net (Kaykaç *et al.*, 2014). Both ends of the steel cable are mounted to the legs, which are located towards the ground side of the frame and referred to as "nails" (5–6 cm deep, 0.5–1 cm thick) by the local fishers (Eryasar *et al.*, 2018). The codend is made of 72 mm PA diamond mesh with a twine thickness of 4–5 mm and the codend length is around 1 m. The number of meshes on the codend circumference in beam trawls is 140–220. The towing speed is 1.4–2.7 knots.

PLATE 13
Beam trawl for rapa whelk (*Rapana venosa*) in the Black Sea



Sources: **Eryasar, A.R., Ceylan, Y., Dalgic, G. & Yesilcicek, T.** 2018. By-catch in the commercial beam trawl fishery for rapa whelk in the Black Sea. *Mediterranean Marine Science*, 19(1): 69–78; **Kaykaç, M.H., Zengin, M., Özcan-Akpınar, İ. & Tosunoğlu, Z.** 2014. Structural characteristics of towed fishing gears used in the Samsun Coast (Black Sea). (In Turkish). *Ege Journal of Fisheries and Aquatic Sciences*, 31(2): 87–96.

In Romania, rapa whelk harvesting is done using beam trawls, mainly on the northern part of the coast, between Mamaia Bay and Sfantu Gheorghe, at depths ranging between 17–30 m (Danilov *et al.*, 2018).

In Bulgaria, the beam trawls used in this fishery are reported to be usually 5 m wide (Plate 14).

PLATE 14
Beam trawl used in Bulgaria (left) and detail of bottom rake and sledges (right)

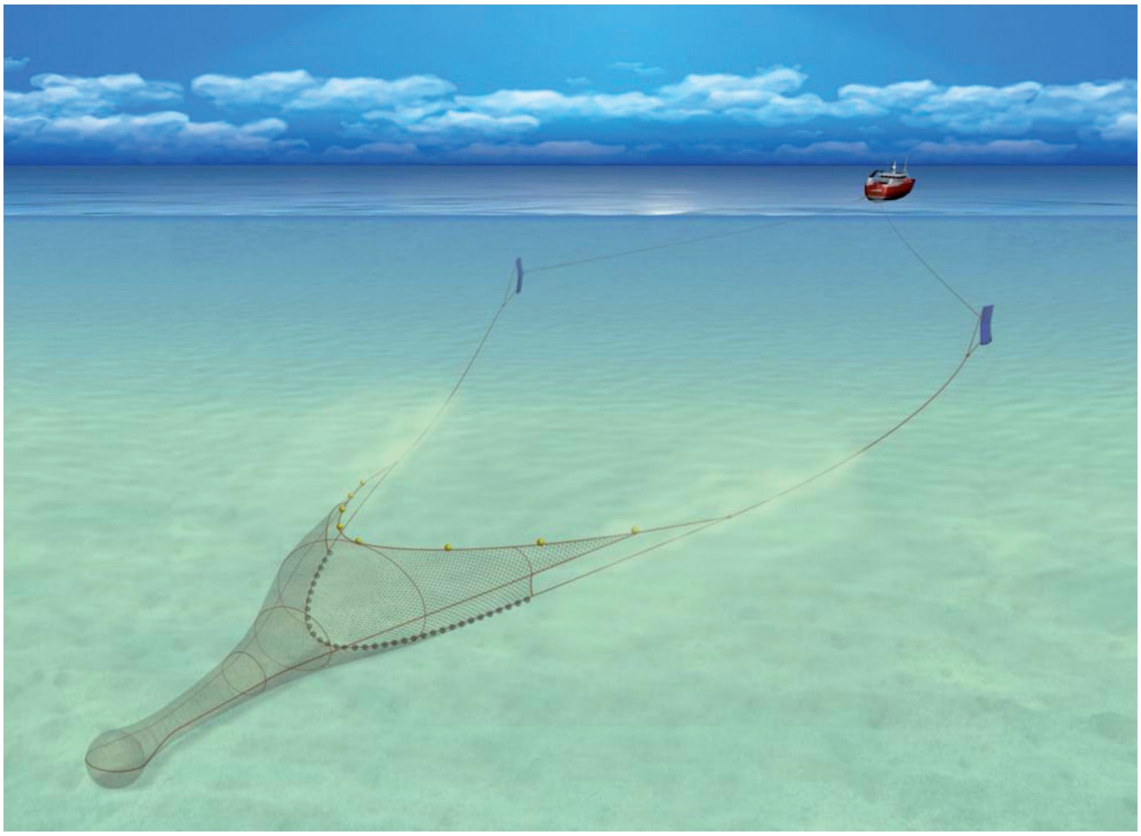
1.2.4 Semi-pelagic trawls

A semi-pelagic trawl is a hybrid trawling system between a single boat mid-water trawl and a bottom trawl. This group of nets is rather difficult to classify, as it is not always easy to categorize them unequivocally from other trawl types. Indeed, in the Mediterranean, some nets with a high vertical opening are equipped to skim the seabed by lightening the weight of the groundgear (leadrope and chains) so that they gently touch the bottom or are towed slightly off the seabed, while the otterboards are on the bottom. Since it is not always evident how much and whether these nets rise from the seabed, it is preferred here to leave them in the bottom trawl group (Figure 25).

Therefore, in the Mediterranean and the Black Sea, the only trawl nets that can be identified as semi-pelagic according to the FAO gear classification (He *et al.*, 2021) are the ones used in Spain, where the net is towed on the bottom but with the doors throughout the water column; high vertical profile trawl doors are used for this purpose.

In this catalogue, since these nets are used in the Mediterranean and the Black Sea on the bottom, even if sometimes in a very light manner, it has been decided to place them in the group of trawl nets towed on the bottom.

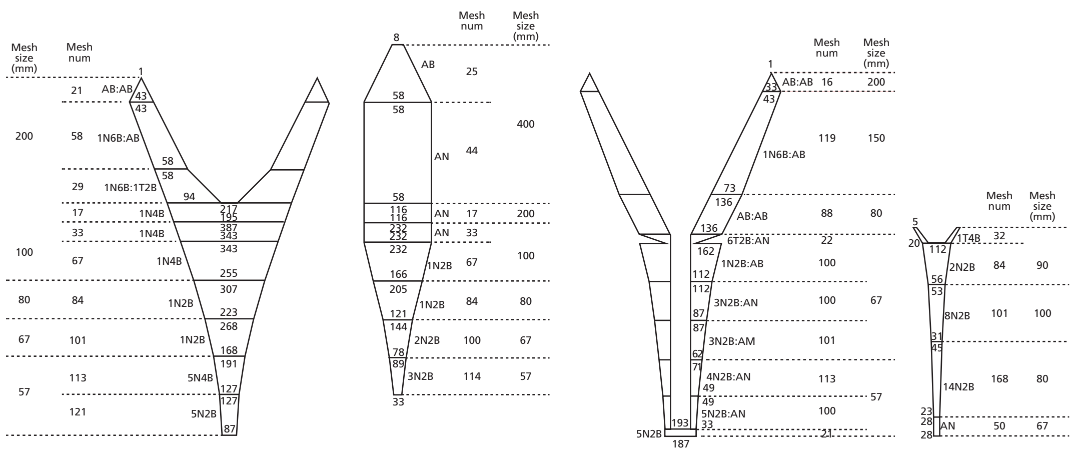
FIGURE 25
Semi-pelagic trawl technique



Source: **Seafish.** 2023. Fishing gear database. In: *Seafish*. Cited 23 May 2023. Edinburgh. www.seafish.org/responsible-sourcing/fishing-gear-database/?t=docGear/

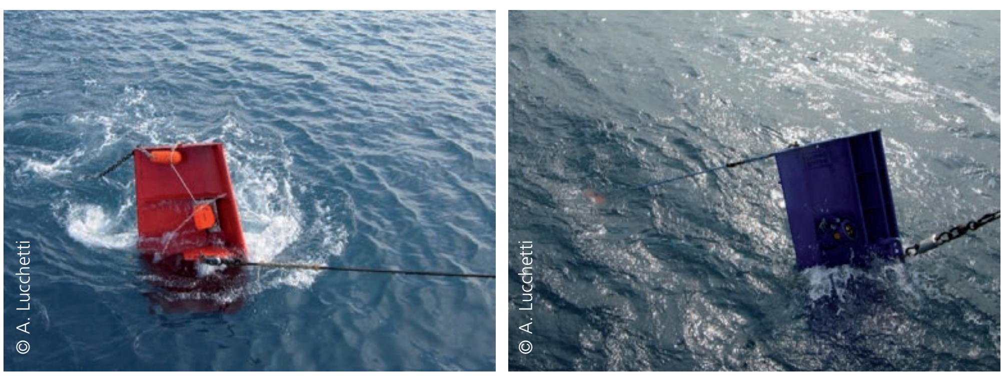
In Spain, semi-pelagic four-face trawls with trawl doors off the bottom are used (Figure 26). Vessels are equipped with acoustic sensors to control the position of the pelagic doors (Plate 15). The butterfly (SP-4) is a semi-pelagic trawl rigged for high vertical opening (about 5 m) to catch red shrimps in deep waters. The main characteristics are the presence of three bridles about 60 m long and the absence of sweeps. The headrope length ranges from 54 m to 114 m, and the horizontal opening is between 20 m and 30 m. It is used in northern Catalonia and the southern Levant Sea by vessels 15–25 m in length.

FIGURE 26
Technical specifications of a semi-pelagic four-face trawl



Source: redrawn from **Sala, A., Brčić, J., Conides, A., De Carlo, F., Klaoudatos, D., Grech, D., Lucchetti, A. *et al.*** 2013. *Final project report. Technical specifications of Mediterranean trawl gears (myGears)*. Specific project Nr. 5 – Framework service contract Mediterranean Halieutic Resources Evaluation and Advice (MAREA). Bari, Italy, COISPA, Rome, CNR, Attiki, Greece, HCMR, Livorno, Italy, CIBM, Peñiscola, Spain, SUMASPE, Guilvinec, France, SIMRAD.

PLATE 15
Pelagic otterboards used in the Mediterranean Sea



1.3 Mid-water trawls

Pelagic or mid-water trawl nets are towed by one or two vessels (pair trawling) and rigged to operate in mid-water to target large schools of small pelagic species such as anchovy and sardine and, to a lesser extent, other pelagic fish such as horse mackerel and mackerel. This is the reason why these nets have higher vertical openings than bottom trawlers and have low or no contact with the seabed. Pelagic trawl nets derive their name from the fact that they do not have strong contact with the bottom but simply touch it, being towed either on the surface, in mid-water or near the bottom. In practice, however, these nets are used exclusively near the bottom in relation to the behaviour of the target species (anchovy and sardine), which, during the dark hours, are scattered throughout the water column and cannot be caught in appreciable quantities with these nets, while during the day they swim near the bottom where they form large schools.

Mid-water trawls are generally much larger than bottom trawls. The net is made up of four panels of netting: an upper panel, a lower panel and two side panels. Two lateral wings extending forward from the opening are generally made of large meshes or long rope to progressively lead fish schools towards the posterior part of the nets with smaller meshes. These nets have a cone-shaped body ending in a codend that holds the catch. The codend mesh size is about 20 mm in stretched length. Floats on the headrope and weights on the groundline often maintain the vertical opening. Modern large mid-water trawls, however, are rigged in such a way that floats are not required, relying on downward forces from weights to keep the vertical opening maintained during fishing. Two weights or sinkers are joined to the ends of lower wings in order to quickly sink the footrope.

Pelagic trawls are towed at the appropriate level in the water column to intercept target shoals, with the gear depth controlled by altering the towing speed and/or the warp length. The use of electronic equipment such as the eco-sounder is actually quite common and is an essential tool to detect fish concentrations ahead of the net; hence, the trawl direction and depth setting of the net can be adjusted according to the position of the schools detected. In modern vessels, sonar is sometimes used to identify small pelagic schools at great distances from the boat. Trawl winches installed on deck control the trawling wires and store them. Net drums are common tools to handle mid-water trawls on board vessels. The towing speed commonly used is about 4 knots or even more. The dimensions of boats used in trawling vary from small inshore boats up to large deep-sea trawlers, with the size of gear scaled on the basis of the boat dimensions. Pelagic trawls are mainly used in the Gulf of Lion (France), in the northern Adriatic by the Italian fleet (*volante*) and in Türkiye. See Table 7 for the different pelagic trawl net types used in the Mediterranean and the Black Sea.

Table 7

Technical parameters of pelagic trawl nets used in the Mediterranean and the Black Sea

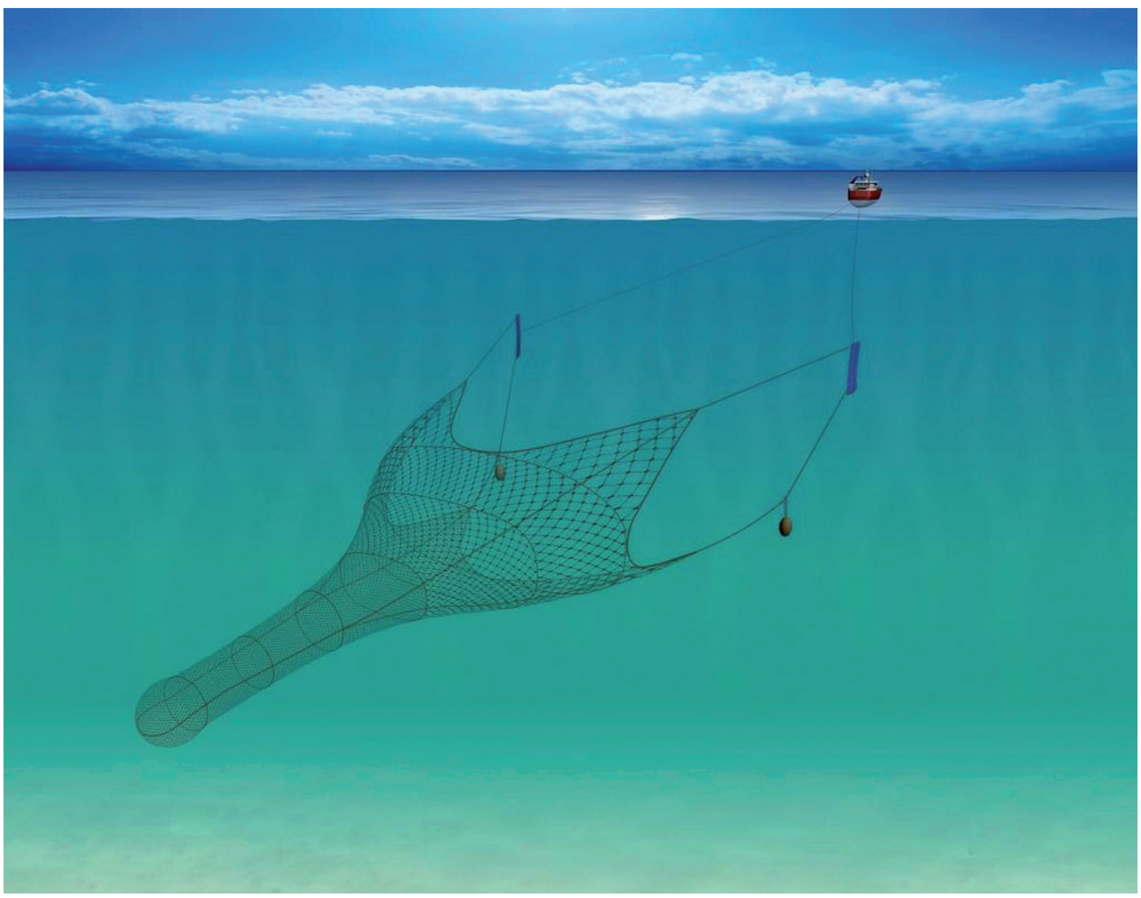
GSA	Subregion	Country	Gear code	Main target species	Category	Headline length (m)	Vertical net opening (m)	Horizontal net opening (m)	Sweep length (m)	Bridle length (m)	Rigging	Trawling speed (kn)	Mean depth (m)
4	Western Mediterranean	Algeria	OTM	ANE, PIL, MAC, HOM, SAA	M-4	33		10–26					
7	Western Mediterranean	France	OTM	ANE, PIL, MAC	M-4	52–80	27–42	31–48	80–100	80–100	Four doors	4.0–5.0	
7	Western Mediterranean	France	OTM	ANE, PIL, MAC	M-4	92–110	24–30	40–55	100	100	Four doors	4.0	
7	Western Mediterranean	France	OTM	ANE, PIL, MAC	M-4	98–122			100	100	Pelagic		
12	Central Mediterranean	Tunisia	OTM	MAC, HOM	M-2	68							
13	Central Mediterranean	Tunisia	OTM	MAC, HOM	M-2	68							
14	Central Mediterranean	Tunisia	OTM	MAC, HOM	M-2	68							
17	Adriatic Sea	Italy	PTM	ANE, PIL, MAC	M-4	25–74	7–12	30–45	20–40		Short combined ropes	4.0–5.0	10–120
18	Adriatic Sea	Italy	PTM	ANE, PIL, MAC	M-4	25–74	7–12	20–30	20–40		Short combined ropes	4.0–5.0	10–250
29	Black Sea	Türkiye	PTM	ANE, SPR	M-4	32–42	2–3		40		40 m polypropylene ropes	3.0–3.5	24–120
29	Black Sea	Romania	OTM	SPR, ANE, HOM	M-2	59–74	11–14	20–22				3.2–3.4	> 20
29	Black Sea	Bulgaria	OTM	SPR, ANE, HOM	M-2	59–74	11–14	20–22				3.2–3.4	> 20
29	Black Sea	Romania	OTM	ANE, SPR, BLU, HMM	M-2	20–30	4–8	15–25	10–20		Short combined ropes	2.5–3.5	20–100
29	Black sea	Bulgaria	OTM	SPR, ANE, HMM	M-2	18–45	4–8	25–35	15–25	Short	Combined ropes	3.1–4.2	10–90
29	Black Sea	Ukraine	OTM	SPR, ANE, CLA, GAR		30–35	≥ 8	12.6	≥ 15	150–250		3.0	20–85
30	Black Sea	Ukraine	OTM	CLA, ANE, SOY		≥ 38			100	24		3.2	5

Notes: OTM: mid-water otter trawls; PTM: mid-water pair trawls; M-2: two-panel trawl; M-4: four-panel trawl; ANE: *Engraulis encrasicolus*; BLU: *Pomatomus saltator*; CLA: *Clupeonella cultriventris*; GAR: *Belone belone*; HMM: *Trachurus mediterraneus*; HOM: *Trachurus trachurus*; MAC: *Scomber scombrus*; PIL: *Sardina pilchardus*; SAA: *Sardinella aurita*; SOY: *Liza haematocheilus*; SPR: *Sprattus sprattus*.

1.3.1 Single boat mid-water otter trawls

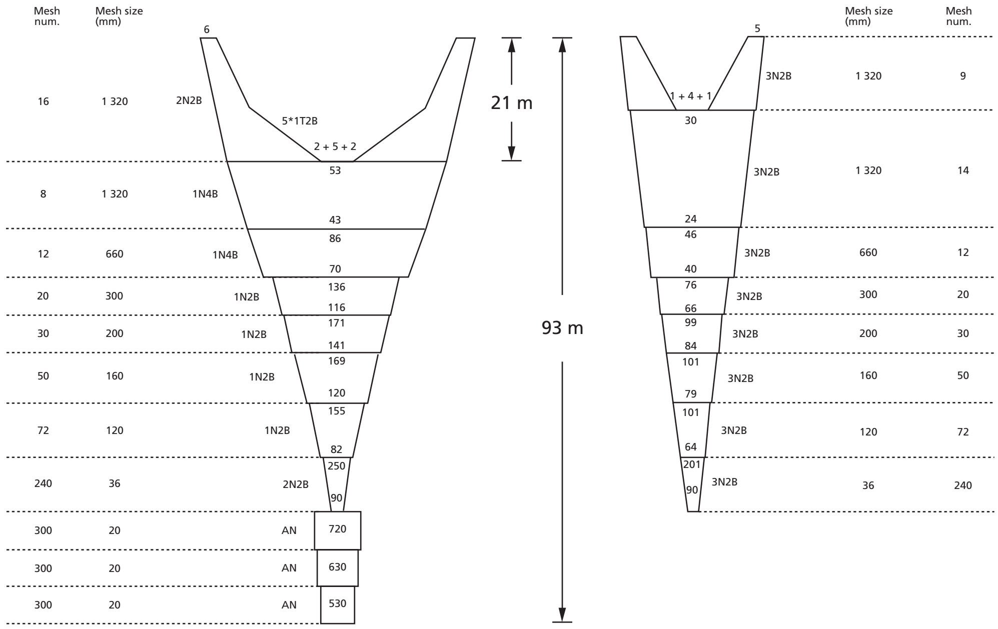
The single boat pelagic trawl technique (single boat mid-water otter trawl) is used to target small pelagic species (anchovies and sardines), mainly in France. The front part is usually rigged with ropes, which herd the targeted fish inwards. In a single boat pelagic trawl, the horizontal opening is maintained by spreading the two wings by means of two or four doors (Figure 27) – two small pelagic and two traditional bottom doors (Figure 28 and Figure 29). The pelagic trawl is towed at the appropriate level in the water column to intercept the target shoal, with the gear depth being controlled by altering the towing speed and/or warp length. Electronic equipment is useful in this fishing technique to enhance catch efficiency and has greatly improved its precision; echo-sounders enable the depths at which fish concentrate to be detected, with sonar enhancing the probability of detecting schools of fish, while net sensors help to control the net performance and modify the length of the trawl warps and the net rigging accordingly. As for traditional semi-pelagic pair-trawling, the towing speed commonly used is around 4 knots.

FIGURE 27
Single boat pelagic trawl with two-door rigging



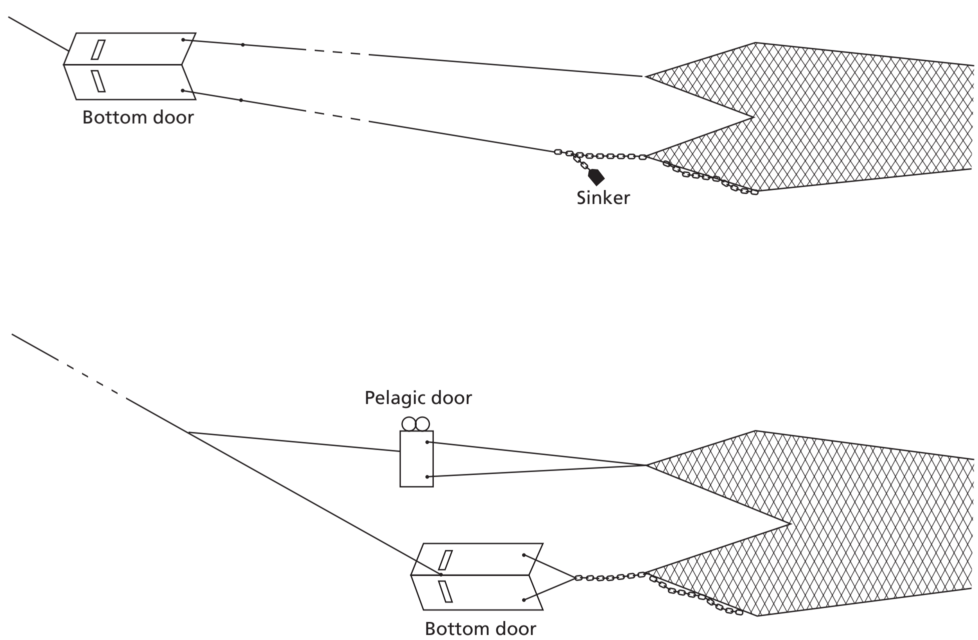
Source: **Seafish.** 2023. Fishing gear database. In: *Seafish.* Cited 23 May 2023. Edinburgh. www.seafish.org/responsible-sourcing/fishing-gear-database/?t=docGear/

FIGURE 28
Technical specifications of a single boat mid-water trawl



Source: redrawn from G. Buglioni.

FIGURE 29
Single boat mid-water trawl with two-door rigging (top) and four-door rigging (bottom)



Source: redrawn from G. Buglioni.

Subregional variations

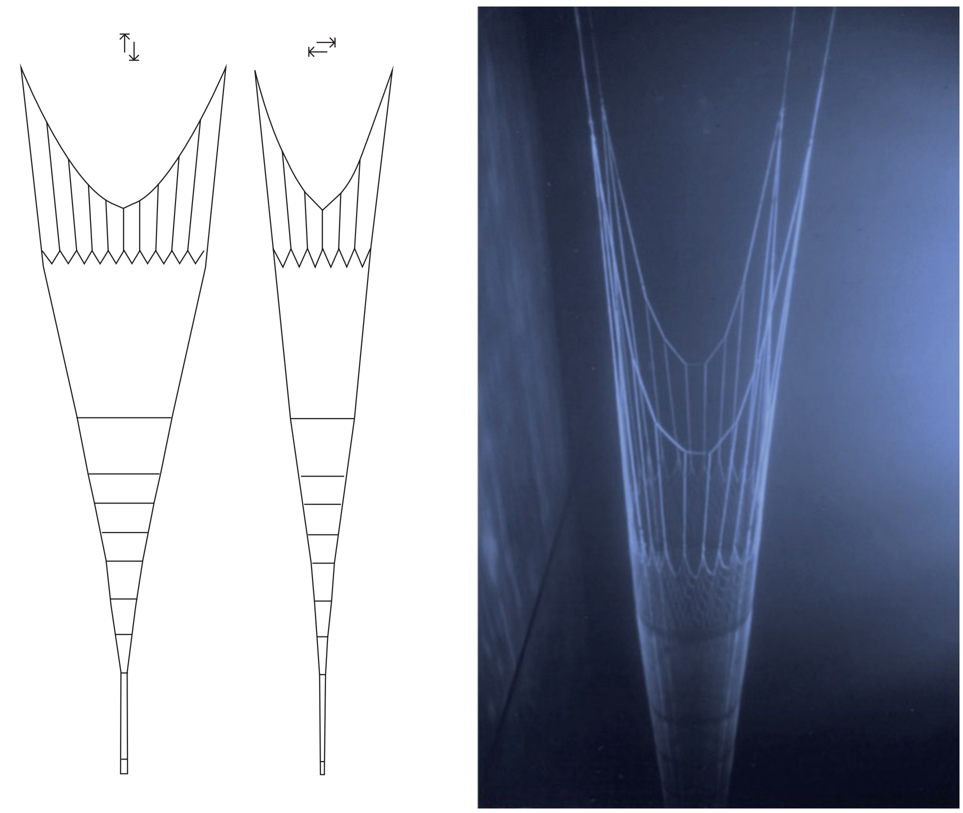
Western Mediterranean

In Algeria (GSA 4), a single boat pelagic four-face trawl is used, which is characterized by a very large vertical opening ranging from 20 m to 26 m with rope meshes (Laid, Lamri and Kadri, 2001). The rigging for this type of trawl uses forks with an upper steel cable of a diameter of 8 mm to 10 mm and a length of 60 m to 80 m and a lower cable of mixed rope with a diameter of 24 mm to 26 mm and a length of 60 m to 80 m. A short chain (*matsat*) of 2–3 m is also added to the lower cable. In Algeria, the four-face pelagic trawl is also used, with a vertical opening of 12–26 m. The mesh of the wings ranges from 400 mm to 800 mm for a normal trawl, and from 1 600 mm to 5 200 mm for a pelagic trawl, called *à cordes*. The rigging used for this type of trawl has two cables ranging from 60 m to 100 m long; the lower cable being extended by a piece of chain called an extension or difference, which has a length ranging from 2.5 m to 3 m and is connected to the groundrope of the trawl. A sinker is placed at the junction of the lower cable and chain, made of a group of chains weighing around 0.5 kg/hp. High profile trawl doors are used.

In France (GSA 7), as pair-trawling is prohibited by the national legislation (JORF, 2013), pelagic trawling is practised exclusively with single trawls. It is used to catch sardine, mackerel and anchovies on the continental shelf of the Gulf of Lion; only less than 20 percent of demersal species, such as hake and seabream, are authorized. All single boat mid-water otter trawls consist of four panels with the front part made of either long ropes (50 m, the longest) or large mesh (1 600–3 200 mm stretched mesh).

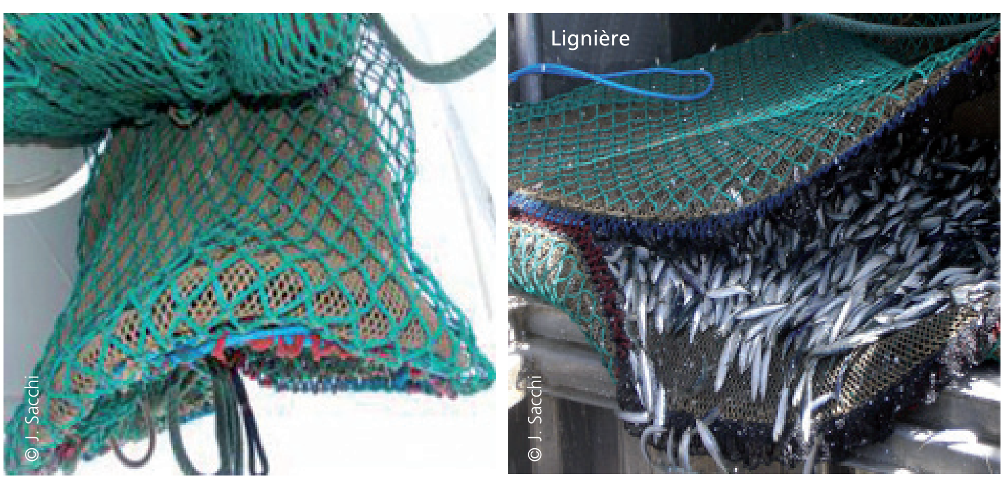
In particular, the *pelagic à cordes* net reflects the typical symmetrical design of a pelagic trawl, with an absence of slack between the upper, lower and side panels. All panels have the same overall length and the roped forepart permits a significant herding effect to be achieved, while avoiding high net drag at the same time. These properties are necessary for exploiting shoals of pelagic fish like anchovies and sardines in the water column (Figure 30). In contrast to bottom trawls, the headline has the same length as the bottom line and ranges from 52 m to 128 m. The horizontal net opening is 31–60 m and the vertical net opening is very large (28–42 m). The hauls are short (less than one hour), with towing speeds maintained at 4–5 knots. The codend mesh size used is 20 mm, according to the legislation. The rigging usually involves either classical pelagic rigging with large pelagic doors and weights or four doors – two bottom doors, which are fixed at the wings of the lower panel and are similar to the bottom trawling doors, and two small pelagic doors (of about 50 kg each) fixed to the end of the upper panel wings. These pelagic doors help keep the net vertically open, whereas the bottom doors maintain the trawl close to the bottom. Vessels are equipped with sonar and acoustic sensors to control the position of the pelagic doors. The codend closing system is peculiar, since the codend is closed by lacing the last meshes to preserve as much space as possible for the catch (Plate 16).

FIGURE 30
***Pélagique à cordes* net**



Source: redrawn from J. Sacchi.

PLATE 16
Codend closing system with two wire cables (*lignières*) used in France



In Italy, in the central Tyrrhenian Sea, some nets of this type are reported to be used to catch pelagic species such as anchovies.

Central Mediterranean

In Tunisia (GSAs 12, 13 and 14), the single boat mid-water otter trawls employed are locally called *pélagique à cordes* due to the presence of long ropes in the front part of the net, such as in French nets (Romdhane *et al.*, 2014). They mainly target mackerel and horse mackerel; the headline is around 60–70 m long.

Adriatic Sea

No single boat mid-water otter trawls are reported from this region.

Eastern Mediterranean

No single boat mid-water otter trawls are reported from this region.

Black Sea

In Ukraine, Bulgaria and Romania, mid-water otter trawls are used to target small pelagic fish (sprat, anchovy, shad, horse mackerel, bluefish and bonito). The typical vessel size operating this gear in the area is 18–24 m. The trawl net deployed has an otter door spread of 34–60 m (45 m on average). Typically, the trawls are towed at 3.2 knots for 2.5 hours (STECF-SGMED, 2008).

In Bulgaria (GSA 29), trawling activities with single boat mid-water trawls are performed especially in the southern area (Burgas, Sozopol, Nessebar, Cape Emine and Cape Maslen) on the continental shelf at 40–100 m depth. European sprat (*Sprattus sprattus*) is the most important target species (especially from February to November) along with some seasonal species (horse mackerel, red mullet, anchovy, among others; Erdem *et al.*, 2019). Mid-water trawlers with a length of 15–25 m use nets with horizontal openings of 20–24 m and vertical net openings of around 6–8 m. Sometimes, large rope-trawls are used with net lengths up to 68.5 m. The mesh size at the codend (mesh length) is around 12–16 mm.

In Romania (GSA 29), a few single boat mid-water trawls are also used to catch sprat between April and November, with headlines ranging from 59 m to 74 m. The vertical and the horizontal openings are around 11–14 m and 20–22 m, respectively, while the towing speed is around 3.2–3.4 knots. The codend mesh size varies according to the target species: 16 mm for sprat, 20 mm for anchovy, 28 mm for horse mackerel (STECF-SGMED, 2008).

In Ukraine, mid-water trawls are also used.

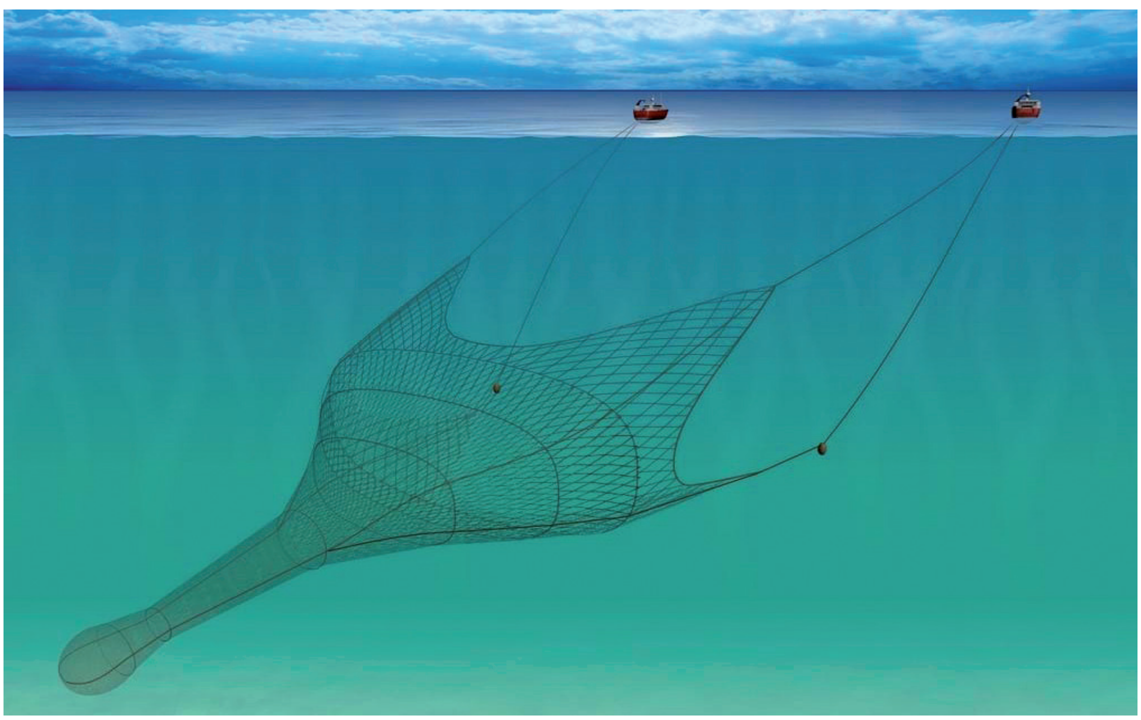
1.3.2 Mid-water pair trawls

The mid-water pair trawling technique, i.e. two vessels towing one net, is used primarily to increase the swept area and thus the catchability of dense shoals of pelagic species (e.g. anchovies and sardines). In pair trawls, the horizontal opening is maintained by the distance between the two boats during the towing operation (Figure 31). In fact, the distance between the two vessels is monitored by radar. Sometimes, a rope joining the two vessels is used to keep a fixed distance. Floats on the headrope and weights on the groundrope often maintain the vertical opening. Modern large mid-water trawls, however, are rigged in such a way that floats are not required and rely on downward forces from weights to keep the vertical opening maintained during fishing. Two weights or sinkers (about 300 kg each) are mounted onto the ends of the lower wings to quickly sink the groundrope.

The net used in the pair trawling technique has four panels of netting: an upper panel, a lower panel and two side panels (Figure 32). These nets are designed to catch shoaling pelagic fish that are off the bottom, such as anchovies, sardine, mackerel and horse mackerel. Sometimes, they also catch large schools of grey mullet. Pair trawl nets are generally large trawls (e.g. Italian *volante*), with high vertical (11–15 m) and horizontal (25–40 m) net openings. They are constructed with very big mesh (600–1 400 mm mesh opening) or ropes in the forward part of the trawl that herd fish towards the centre of the body of the trawl, which is made of a much smaller mesh size. The codend has small mesh (around 20 mm) to gather the catch. The rigging is as shown in Figure 33. The procedures for the fishing operation are summarized in Figure 34 and Box 3. Once the small pelagic school has been detected, the first vessel deploys the net into the sea. Meanwhile, the second vessel approaches the first one to receive one of the net wings from the first vessel. The two vessels start lowering trawl warps and the winch is blocked, with the haul normally lasting less than one hour. When the haul ends, the operations repeat in reverse. Generally, given the amount of the catch, the net is hauled alternately from one of the two boats, so that the catch can also be sorted in turn by the two crews. In fact, if the net catches a school of large fish, this can comprise more than 10 tonnes. In these cases, the hauling phase is complicated and, to prevent the weight of the catch from breaking the net, the codend is provided with a strengthening bag. In cases of abundant catch, the catch is hauled on board a little at a time.

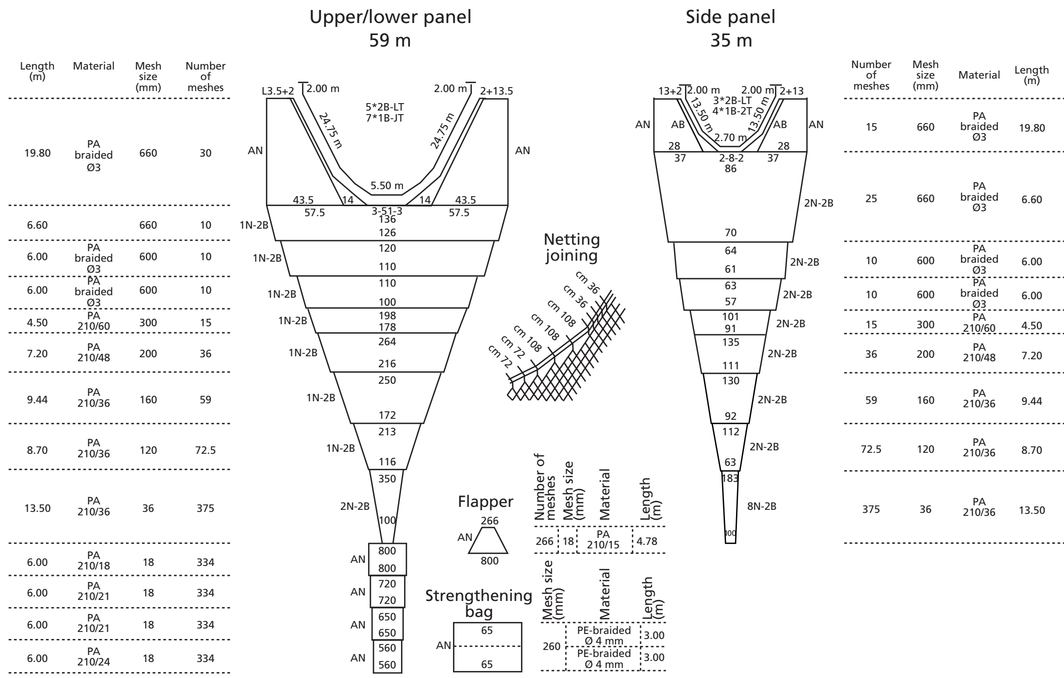
The sorting operations of the commercial catch can be optimized using a mechanical selector (or sieve). This equipment is frequently used by vessels operating in the Italian Adriatic Sea (GSA 17). The mechanical selector consists of a stainless-steel frame on which adjustable vertical bar gratings are installed on three inclined planes. Once put into operation, the catch is loaded from the boxes containing water and ice to the sieve. The vibrating action of the sieve and the adjustable distance of the bars allow the different sizes of commercial products and discard undersized fish to be quickly selected. Plastic tubes are placed in the lateral and terminal parts of the sieve to store the fish in crates (usually in polystyrene for anchovies and in wood for sardines). Once filled with fish, each crate is moved to the storage area and replaced with a new one. This operation is repeated until all of the catch is in the boxes.

FIGURE 31
Mid-water pair trawl rigging



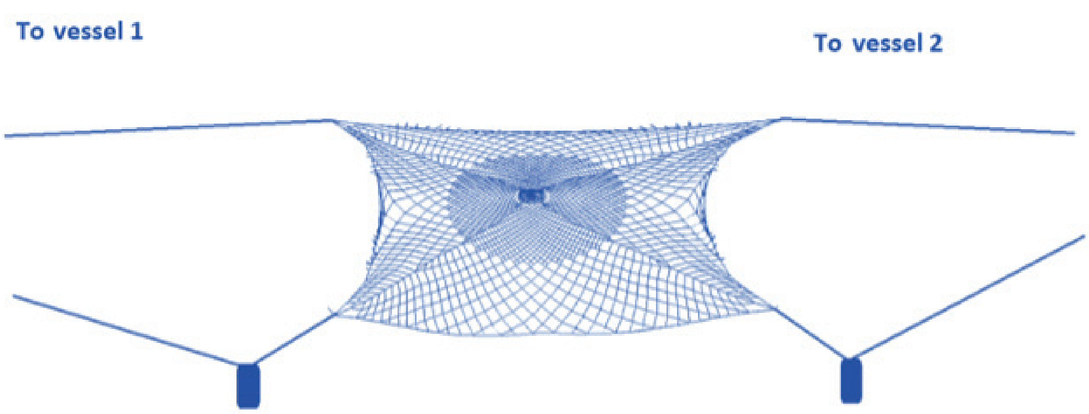
Source: **Seafish.** 2023. Fishing gear database. In: *Seafish*. Cited 23 May 2023. Edinburgh. www.seafish.org/responsible-sourcing/fishing-gear-database/?t=docGear/

FIGURE 32
Technical specifications of a mid-water pair trawl (four-face trawl)



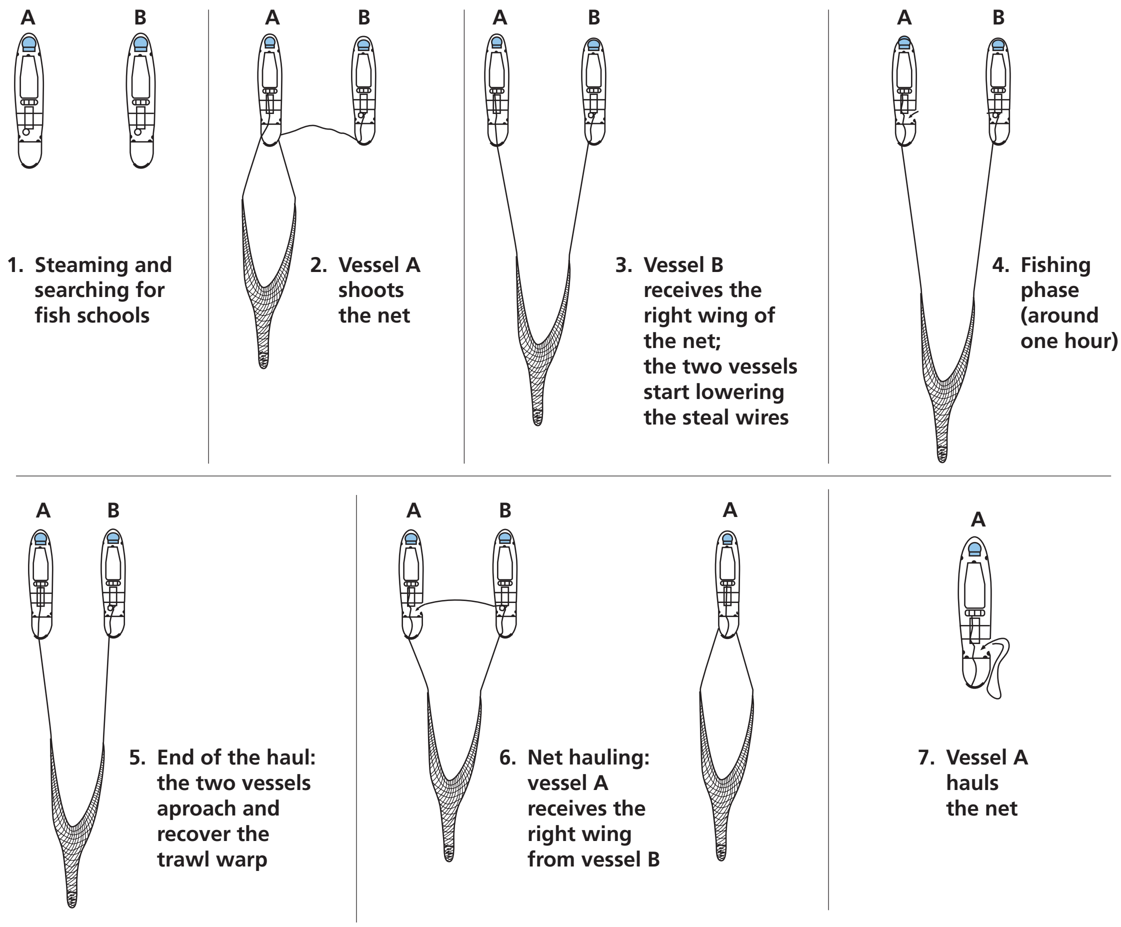
Source: redrawn **Sala, A., Brčić, J., Conides, A., De Carlo, F., Klaoudatos, D., Grech, D., Lucchetti, A.** ***et al.*** 2013. Final *project report. Technical specifications of Mediterranean trawl gears (myGears).* Specific project Nr. 5 – Framework service contract Mediterranean Halieutic Resources Evaluation and Advice (MAREA). Bari, Italy, COISPA, Rome, CNR, Attiki, Greece, HCMR, Livorno, Italy, CIBM, Peñiscola, Spain, SUMASPE, Guilvinec, France, SIMRAD.

FIGURE 33
Details of a pair trawl and rigging



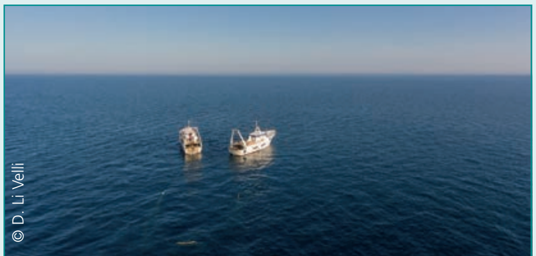
Source: **Eigaard, O.R., Rihan, D., Graham, N., Sala, A. & Zachariassen, K.** 2011. Improving fishing effort descriptors: Modelling engine power and gear-size relations of five European trawl fleets. *Fisheries Research*, 110: 39–46.

FIGURE 34
Details of fishing operations carried out with a mid-water pair trawl



Source: redrawn from A. Lucchetti and F. De Carlo.

Box 3
Details of a mid-water pair trawl operation



Partner boat approaching the boat that is lowering the net before the two vessels deploy the towing warps.

Side-by-side vessels towing the nets.

Codend haul in Italy.

Codend used in Türkiye (it is possible to observe the strengthening bag).

Deployment of the sinker, which is mounted on the ends of the lower wing and allows the groundrope to sink quickly.

Codend haul in Italy.

Mechanical selector sometimes used on board to divide catch into different sizes and species, such as sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*).

Subregional variations

Western Mediterranean

In Spain (GSAs 1, 5 and 6), pelagic trawls (PTM-4) are forbidden.

Central Mediterranean

In Italy, pair trawlers are active in Sicily (GSA 16). The nets have technical properties similar to those used in the Adriatic Sea (see the following section on the Adriatic Sea).

Adriatic Sea

On the Italian side (GSAs 17 and 18), mid-water pair trawls are quite common.

In Croatia, Albania and Montenegro (GSAs 17 and 18), mid-water pair trawls are only occasionally used.

The target species are mainly anchovy and sardine, as well as sprat in the northern part, with a preference for anchovy in Italy and sardine in the eastern side of the Adriatic Sea. These are the largest towed nets in the Adriatic Sea, with headropes ranging from 25 m to 74 m, horizontal net openings from 20 m to 45 m and vertical openings from 7 m to 12 m. The boats are usually equipped with advanced systems for the identification of fish schools and for immediate refrigeration of the catch. Large mesh is used on the wings (more than 600 mm mesh opening), while the codend has a mesh size with or without knots of around 20 mm. Two large weights of more than 200 kg each are normally used to sink the net.

Eastern Mediterranean

According to Greek legislation, pelagic trawls are forbidden.

In Egypt (GSA 26), fishers use bottom trawl nets to catch small pelagic species like anchovy, sardine and horse mackerel. In fact, at the end of the haul, they leave the net on the surface and increase the speed of the vessel for 10–15 minutes to specifically catch these small pelagic species.

Black Sea

Turkish trawlers use mid-water pair trawls mainly in shallower waters (20–60 m) off the Samsun region in the southern Black Sea (the drainage basin of the rivers Yesilirmak-Kizilirmak; STECF-SGMED, 2008). The mesh size at the codend is 12 mm. The total number of fishing vessels operating for sprat is about 40–50, while the mean length of vessels is 20–25 m.

In Ukraine (GSA 30), pair trawls are used to catch whiting and sprat.

2. Seiners

2.1 General characteristics

Surrounding nets are large nets constructed mostly from rectangular sections of netting, framed by a headline with large floats on top and a weighted footrope with leads at the bottom, used to surround schools of fish both from the sides and from underneath, thus preventing them from escaping by diving downwards.

Surrounding nets can be divided into two main types of nets: surrounding nets with purse lines and surrounding nets without purse lines (Table 8). According to the type of surrounding net gear, specific equipment may be required, as large nets require some facilities on board in order to be handled and manoeuvred. The net generally involves the use of small mesh to minimize fish becoming enmeshed and damaged (spoiled, skinned, beheaded, etc.).

Table 8

Classification of surrounding nets according to the International Standard Statistical Classification of Fishing Gear

Gear categories (first tier)	Subcategories (second tier)	Standard abbreviations	ISSCFG code
Surrounding nets			1
	Purse seines	PS	1.1
	Surrounding nets without purse lines	LA	1.2
	Surrounding nets (nei)	SUX	1.9

Source: FAO. 2016. *International Standard Statistical Classification of Fishing Gear. Handbook on Fisheries Statistics*. Rome.

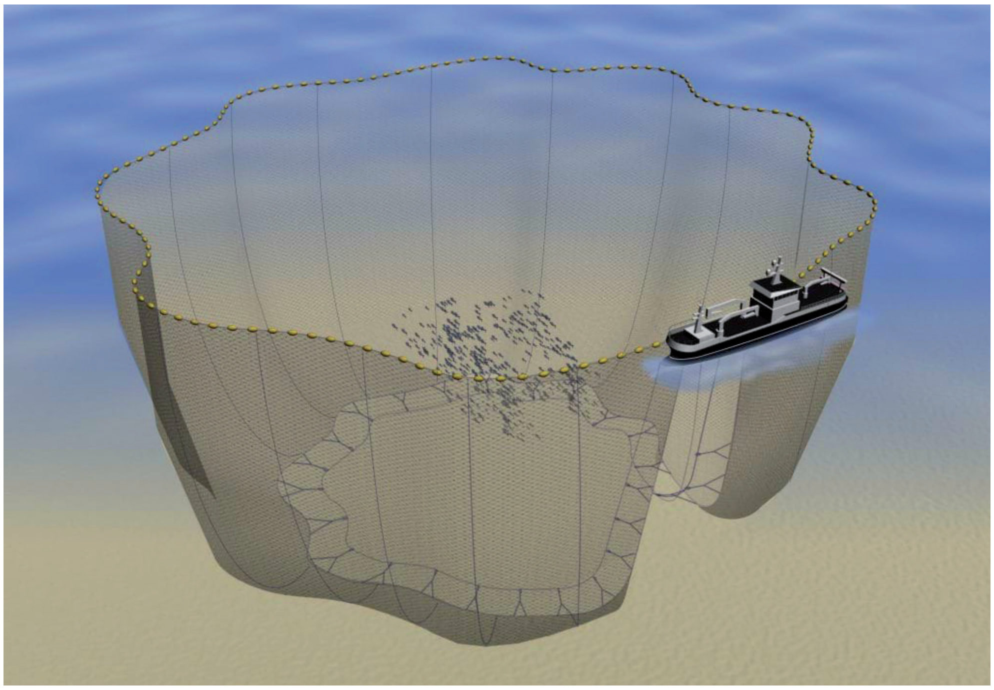
2.2 Purse seines

Purse seines are large netting walls framed by a floatline at the top and a leadline at the bottom, set to surround schools of fish, both from the sides and from underneath, thus preventing them from escaping by diving downwards. The bottom of a purse seine is characterized by the presence of a purse line, which runs through steel rings attached by means of short bridles to the lower edge of the net (Figure 35). The purse line, which is normally a wire made of steel, once recovered by means of winches, enables the net to be closed from the bottom like a purse, and thus to retain all the fish encircled. The footrope of a purse seine can be weighted with leads or with a chain to increase the sinking velocity of the net in order to prevent fish from escaping horizontally.

Generally, the net design involves three main netting compartments: a single net wing, the main netting body, and the bunt or bag, which is mounted on the side of the net. Sometimes, purse seines have a symmetrical net design: two lateral net wings with the same dimensions and characteristics, the main netting body and a bunt, positioned in the middle for the collection of the catch. The central sections are deepest and gradually taper towards the wing and the bunt, where fish finally accumulate; this is the part of the net where the catch is gathered at the end of the haul and has small mesh and thicker netting material compared to the netting of the main body. For easy and safe operations on board, the net is stored at the stern of the boat, with the headline on one side and the leadline on the other. The purse rings are stowed around a metal bar close to the leadline (Plate 17).

Purse seines are considered to be the most important surrounding nets from a commercial point of view, since they can be used in the Mediterranean and the Black Sea to catch small pelagic species – anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*) – and large pelagic species – mainly bluefin tuna (*Thunnus thynnus*) and albacore (*Thunnus alalunga*) (Table 9). Surrounding nets can be used by a large range of vessel sizes, from open small boats to large industrial vessels. Existing studies on the Mediterranean purse seine fisheries suggest that the discard ratio is rather low (Kelleher, 2005; Santojanni *et al.*, 2005; Tsagarakis *et al.*, 2012) because vessels mainly target small pelagic fish with a low diversity of species and sizes.

FIGURE 35
Purse seine



Source: **Seafish.** 2023. Fishing gear database. In: *Seafish.* Cited 23 May 2023. Edinburgh. www.seafish.org/responsible-sourcing/fishing-gear-database/?t=docGear/

PLATE 17
Purse seine on the stern of a boat with visible purse rings attached to the leadline

Table 9

Technical parameters of surrounding nets used in the Mediterranean and the Black Sea

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Titre	Twin diameter (mm)	Headline length (m)	Mean depth (m)
3	Western Mediterranean	Morocco	PS	ANE, PIL	18.0		158.0	210/4	0.33		
3	Western Mediterranean	Morocco	PS	ANE, PIL, HOM, BOG	18.0	9 000	164.0		0.4	620	
3	Western Mediterranean	Morocco	PS	ANE, PIL, HOM, BOG	16.0	2 700	53.0		0.5	376	
3	Western Mediterranean	Morocco	PS	ANE, PIL	16.0	2 000	41.0		0.3	223	
3	Western Mediterranean	Morocco	PS	ANE, PIL	18.0–22.0		32–70			300–650	
4	Western Mediterranean	Algeria	PS	ANE, PIL, BON, MAS	18.0–90.0	1 500–8 000					
6	Western Mediterranean	Spain	PS	ZGX, FIM	16.0		35.0			100	6–16
7	Western Mediterranean	France	PS	BFT	140.0–240.0	974	70.0–250.0			1 900–2 000	
7	Western Mediterranean	France	PS	PIL, MAZ	20.0–24.0	6 000	70.0–250.0			300–600	20–40
7	Western Mediterranean	France	PS	SBG, BSS, Mugilidae, mid-water species	60.0–70.0	1 145	80.0			400	20
8	Western Mediterranean	France	PS	PIL, MAZ	20.0–24.0	6 000	70.0–250.0			300–600	20–40
10	Western Mediterranean	Italy	PS	BFT	140.0–150.0		200.0–300.0		5	1 600–2 000	
10	Western Mediterranean	Italy	LA	DOL aggregated with FAD	30–40	800–1 200		210/4	0.35	100–120	>100
10	Western Mediterranean	Italy	PS	ANE, PIL	20	6 000–8 000		210/6	0.44	425–460	25–50
11	Western Mediterranean	Italy	PS	ANE, PIL	14.5	8 000	125.0			370	

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Titre	Twin diameter (mm)	Headline length (m)	Mean depth (m)
11	Western Mediterranean	Italy	PS	AMB			80.0			340	
12	Central Mediterranean	Tunisia	PS	Small pelagics	20.0–24.0	2 040	30.0–32.0		0.6	816	20–100
12	Central Mediterranean	Tunisia	PS	Small pelagics	20.0–24.0	2 040	38.0–40.0		0.6	980–1 160	20–100
12	Central Mediterranean	Tunisia	PS	Small pelagics	20.0–24.0	5 040–1 040	80.0–160.0		0.6	2 400	20–200
12	Central Mediterranean	Tunisia	LA	AMB, DOL aggregated with FAD	32.0–60.0	580–1 380			0.4-0.6	280–600	20–1 200
13	Central Mediterranean	Tunisia	PS	Small pelagics	20.0–24.0	2 040	30.0–32.0		0.6	816	20–100
13	Central Mediterranean	Tunisia	PS	Small pelagics	20.0–24.0	2 040	38.0–40.0		0.6	980–1 160	20–100
13	Central Mediterranean	Tunisia	PS	Small pelagics	20.0–24.0	5 040–1 040	80.0–160.0		0.6	2 400	20–200
13	Central Mediterranean	Tunisia	PS	BFT, Tunnidae	100.0–400.0	1 000–2 500	100.0–250.0		1.6	2 000	
13	Central Mediterranean	Tunisia	LA	AMB, DOL aggregated with FAD	32.0–60.0	580–1 380			0.4–0.6	280–600	20–1 200
14	Central Mediterranean	Tunisia	PS	Small pelagics	20.0–24.0	2 040	30.0–32.0		0.6	816	20–100
14	Central Mediterranean	Tunisia	PS	Small pelagics	20.0–24.0	2 040	38.0–40.0		0.6	980–1 160	20–100
14	Central Mediterranean	Tunisia	PS	Small pelagics	20.0–24.0	5 040–1 040	80.0–160.0		0.6	2 400	20–200
14	Central Mediterranean	Tunisia	PS	BFT, Tunnidae	100.0–400.0	1 000–2 500			1.6	2 000	
14	Central Mediterranean	Tunisia	LA	AMB, DOL aggregated with FAD	32.0–60.0	580–1 380			0.4–0.6	280–600	20–1 200
15	Central Mediterranean	Malta	PS	BOG, MAS, MAC, PIL, ANE, JAX	23.0		105.0				35–44

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Titre	Twin diameter (mm)	Headline length (m)	Mean depth (m)
15	Central Mediterranean	Malta	LA	AMB, DOL aggregated with FAD	32.0–60.0	580–1 380			0.4–0.6	280–600	20–1 200
16	Central Mediterranean	Italy	LA	AMB, DOL aggregated with FAD	32.0–60.0	580–1 380			0.4–0.6	280–600	20–1 200
16	Central Mediterranean	Italy	PS	ANE, PIL	22.0	7 272	160.0				
16	Western Mediterranean	Italy	PS	ANE, PIL	20	6 000–8 000		210/6	0.44	425–460	25–50
16	Central Mediterranean	Italy	PS	PIL	27.5	5 000	90.0				
17	Adriatic Sea	Italy	PS	ANE, PIL	18.0	11 000	198.0	210/2	0.24	500	84–150
17	Adriatic Sea	Italy	PS	ANE, PIL	18.0	10 000	180.0	210/2	0.24	446	84–150
17	Adriatic Sea	Croatia	PS	ANE, PIL	16.0–18.0	11 665	194.0–231.4	210/2	0.24	510–600	62–79
17	Adriatic Sea	Italy	PS	ANE, PIL	16.5	4 033–5 000	66.6–85.6	210/2	0.24	180–240	10–25
17	Adriatic Sea	Slovenia	PS	ANE, PIL	16.0	5 000	82.7	210/2	0.24	240	10–25
17	Adriatic Sea	Slovenia	PS	SSB, SBG, PAX, SQR, Mugilidae	16.0	4 368	71.4	210/2	0.24	193	10–25
17	Adriatic Sea	Italy	PS	SSB, SBG, PAX, SQR, Mugilidae	53.0	1 132	64.2	210/2	0.24	204	10–25
17	Adriatic Sea	Italy	PS	BFT	120.0		200.0–350.0		4.00	1 200–2 100	
18	Adriatic Sea	Italy	PS	ANE, PIL	18.6	9 500	176.7	210/2	0.24	400	20–100
18	Adriatic Sea	Italy	PS	ANE, PIL	18.4	10 000	184.0	210/2	0.24	432	20–100
18	Adriatic Sea	Italy	PS	ANE, PIL	18.0	11 000	198.0	210/2	0.24	500	84–150
18	Adriatic Sea	Italy	PS	ANE, PIL	18.0	10 000	180.0	210/2	0.24	446	84–150
20	Eastern Mediterranean	Greece	PS	ANE, PIL, JAX, BOG, MAS	14.0–40.0		80.0–120.0	210/3–210/12	0.3–0.6	450–760	80–120

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Titre	Twin diameter (mm)	Headline length (m)	Mean depth (m)
21	Central Mediterranean	Libya	LA	AMB, DOL aggregated with FAD	54					273	18–110
21	Central Mediterranean	Libya	PS	BFT	140	990	250.0			1 900–2 000	
21	Central Mediterranean	Libya	PS	ANE, PIL						277	40–93
21	Central Mediterranean	Libya	PS	SBR, JAX, BAR						222–259	9–45
22	Eastern Mediterranean	Greece	PS	PIL, HOM, BOG	14.0–28.0		80.0–120.0			450–760	
22	Eastern Mediterranean	Greece	PS	BON, LTA, BLT, MGR, BOP	40.0		120.0			800	
22	Eastern Mediterranean	Türkiye	PS	ANE, PIL	18.0	8 383	157.1	210/24	0.92	850	
22	Eastern Mediterranean	Türkiye	PS	ANE, PIL	18.0	10 224	197.5	210/24	0.92	900	
22	Eastern Mediterranean	Türkiye	PS	ANE, PIL	14.0	9 721	195.6			800	
22	Eastern Mediterranean	Türkiye	PS	Small pelagics	14.0	3 393	68.2			500	
24	Eastern Mediterranean	Türkiye	PS	PIL, SAA, MAS, UPM	24.0	6 510	155.7	210/36–210/42	1.1–1.2	965	
25	Eastern Mediterranean	Cyprus	PS	PIL, BOG, RRH, VMA, JAX							
26	Eastern Mediterranean	Egypt	PS	BOG, HOM	18.0					220–260	35–75
26	Eastern Mediterranean	Egypt	PS	PIL, RAS, SAA, MUF, MGC	16.0–18.0		40.0			160	16
27	Eastern Mediterranean	Syrian Arab Republic	PS	BOG, SBZ, SBG, BRB, HOM, POP	10.0–12.0					250–400	40–50
27	Eastern Mediterranean	Syrian Arab Republic	PS	BOG, HOM, MAS, BLT, YRS	10.0–20.0		25.0–100.0			1 000	25–100

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Titre	Twin diameter (mm)	Headline length (m)	Mean depth (m)
27	Eastern Mediterranean	Lebanon	PS	ANE, PIL, SAA, MAS	5.0		40.0			170	
27	Eastern Mediterranean	Palestine	PS	SAA, COM, LTA, LZZ, JAX	17.0–22.0			210/3	0.3	180–220	
27	Eastern Mediterranean	Palestine	PS	SAA, COM	20			210/3	0.3	200–300	
27	Eastern Mediterranean	Palestine	PS	SAA, HOM, MAC	17–22		50.0	210/3–210/12	0.3–0.6	200–450	
27	Eastern Mediterranean	Palestine	PS	RMM	45–70						
28	Black Sea	Türkiye	PS	ANE	9.0–15.0	6 750–9 074	108.0–156.2	210/18–210/21	2.3–2.4	870–1 080	
28	Black Sea	Türkiye	PS	BON	22.0–54.0	5 176	381.7	210/12	0.6	2 145	
28	Black Sea	Türkiye	PS	PIL	14.0–20.0	6 141–12 000	153.0–180.0	210/18–210/27	2.80–2.85	870–1 080	
28	Black Sea	Türkiye	PS	PIL, HOM, BLU, BON, MAS	12.0–16.0	6 280–7 500	136.8–180.0	210/18–210/27	2.30–2.85	1 000–1 260	
29	Black Sea	Türkiye	PS	ANE	12.0	16 430	209.0	210/15	2.00	1 300	
29	Black Sea	Türkiye	PS	BON	32.0	4 150	140.0	210/18	2.80	950	
29	Black Sea	Bulgaria	PS	BLU, HMM	14.0	10 000	25.0	210/6	0.43	500	20–25
30	Black Sea	Ukraine	PS	ANE, CLA	13.0						5–7

Notes: PS: purse seines (with purse line); LA: lampara (without purse line); FAD: fish aggregating devices; AMB: *Seriola dumerili*; ANE: *Engraulis encrasicolus*; AVX: *Atherina spp*; BAR: *Sphyraena spp.*; BFT: *Thunnus thynnus*; BLT: *Auxis rochei*; BLU: *Pomatomus saltatrix*; BOG: *Boops boops*; BON: *Sarda sarda*; BOP: *Orcynopsis unicolor*; BRB: *Spondyliosoma cantharus*; BSS: *Dicentrarchus labrax*; CLA: *Clupeonella cultriventris*; COM: *Scomberomorus commerson*; DOL: *Coryphaena hippurus*; FIM: *Aphia minuta*; HOM: *Trachurus trachurus*; HMM: *Trachurus mediterraneus*; JAX: *Trachurus spp.*; LTA: *Euthynnus alletteratus*; LZZ: *Liza spp.*; MAC: *Scomber scombrus*; MAS: *Scomber japonicus*; MAZ: *Scomber spp.*; MGC: *Liza ramada*; MGR: *Argyrosomus regius*; MUF: *Mugil cephalus*; MUT: *Mullus barbatus*; PAC: *Pagellus erythrinus*; PAX: *Pagellus spp.*; PIL: *Sardina pilchardus*; POP: *Trachinotus ovatus*; RAS: *Dussumieria acuta*; RRH: *Etrumeus teres*; RMM: *Mobula mobular*; SAA: *Sardinella aurita*; SBG: *Sparus aurata*; SBZ: *Diplodus cervinus*; SLM: *Sarpa salpa*; SQR: *Loligo vulgaris*; SPC: *Spicara smaris*; SSB: *Lithognathus mormyrus*; UPM: *Upeneus moluccensis*; VMA: *Scomber colias*; YRS: *Sphyraena sphyraena*; ZGX: *Gymnammodytes spp.*

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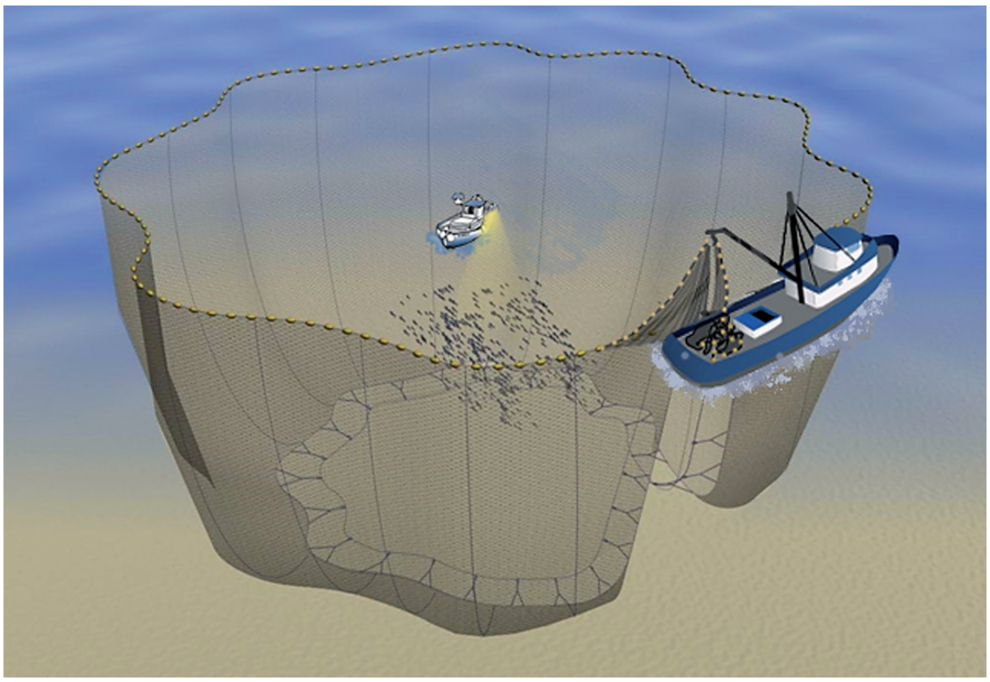
2.2.1 Purse seines for small pelagic species

Purse seines are used to target small pelagic species, namely anchovy and sardine, though the catch of mackerel (*Scomber* spp.) has local importance. This fishery represents a highly relevant fishing sector in the Mediterranean and the Black Sea from an economic, as well as a social, perspective. Purse seine fisheries exhibit great variation from one area to another, not only depending on the different biological and environmental conditions, but also on the social, economic and historical context in which the fishers live, as well as their traditions. Normally, the netting panels used to trap the fish (16 mm mesh) are stretched on the headline, so that the length of the netting is around 1.15 times longer than the headline. In this way, the mesh of the fishing net is always well open.

Purse seines targeting small pelagic species are normally operated by means of skiffs (usually 1–3 small boats) that carry out the aggregation of the schooling fish during the night by means of lights mounted on small tenders (Figure 36; Plate 18). Hydroacoustic instruments like the echo-sounder are important tools for locating fish aggregations. Optionally, the lamps used to attract the fish school can be mounted directly on the main vessel (Plate 19). Lights seem to attract the target species directly or indirectly by attracting and illuminating prey organisms. When a fish school has been located (with an echo-sounder) and aggregated (by means of lights), the net deployment starts by lowering the net wing into the sea (the net wing is kept on board the boat skiff); gradually the main body of netting and the bunt are deployed into the sea, encircling the school of aggregated fish. Usually, the entire purse seine is set and the circle is closed in less than 10 minutes. Once the net has completely encircled the school, the main boat comes back to the wing. When the setting is completed, the net is closed by hauling in the purse line and fish can no longer escape (Plate 20). From this stage, the main vessel starts to haul in the net by using a power block (a kind of mechanized net winch) or a traditional net winch, and the catch is slowly herded into the bunt. In shallow waters (< 30 m), this operation can be carried out completely by hand. During the hauling phase, due to the surface currents and the positioning of the purse seine vessel, the net is inflated outwards creating an upward movement of the net; therefore, the real net height while the net is being operated is almost half the stretched net height. When most of the purse seine has been retrieved, the fish are grouped within a restricted area along the port side of the vessel. Then, the fish are harvested from the purse seine using a large scoopnet. The fish caught by means of this gear remain alive within the net and are transferred into large tanks with water and ice. In recent years, modern vessels have been using fish pumps to directly suck fish from the net and bring them on board.

Small purse seines (headrope length around 200 m, stretched net height around 80 m) usually have a symmetrical net design: two lateral net wings with same dimensions and characteristics, along with the main netting body and a bunt or bag positioned in the middle of the net for the collection of the catch (Figure 37). The bunt has small meshes and thicker netting material compared with the main body netting. This is the section of the purse seine where the schooled fish are gathered at the end of the hauling process. The main net is usually made up of polyamide netting panels with 14–20 mm mesh size. Moreover, one, two or three horizontal netting panels made of larger meshes and thick twine are joined to the headrope and leadrope to strengthen the net during hauling (Figure 37 and Plate 21). The deployment of the net around a detected school of fish starts from one of the two wings held by the skiff. Then the purse seiner sets the net around the school and comes back to the skiff. This operation usually lasts less than 5 minutes. The last netting panel lowered into the water is the second wing. Once all the net is set, the net hauling starts immediately by recovering the purse line before the net touches the bottom; in this phase, the two net wings are recovered simultaneously. Considering the relatively small size of the nets used, the hauling operation, except for the purse line, is often carried out completely by hand, until the catch is aggregated in the middle of the net (the bunt). Furthermore, in order to facilitate the hauling operation, the boat is positioned downstream, with the current gradually helping to drive the net towards the boat (Figure 38). The hauling procedures normally last less than one hour.

FIGURE 36
Purse seine for small pelagic species



Source: **Seafish.** 2023. Fishing gear database. In: *Seafish.* Cited 23 May 2023. Edinburgh. www.seafish.org/responsible-sourcing/fishing-gear-database/?t=docGear/

PLATE 18
Tenders equipped with lamps

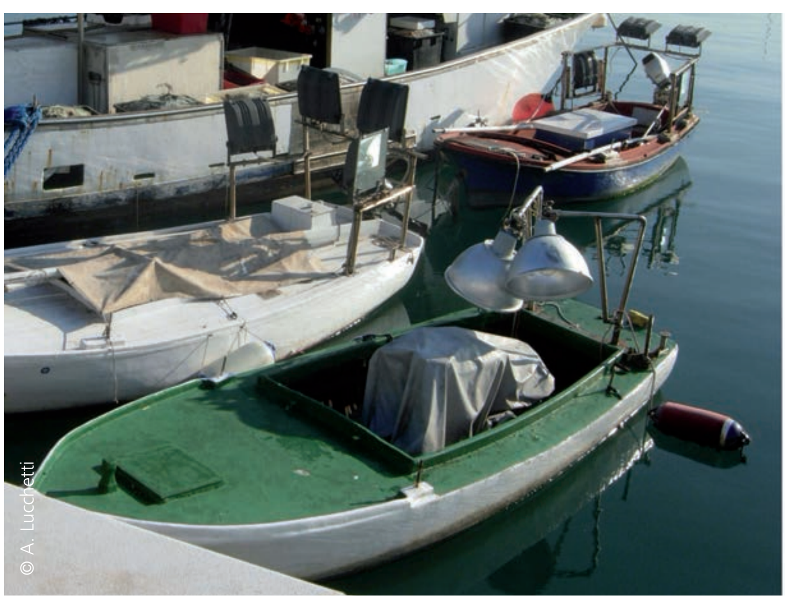
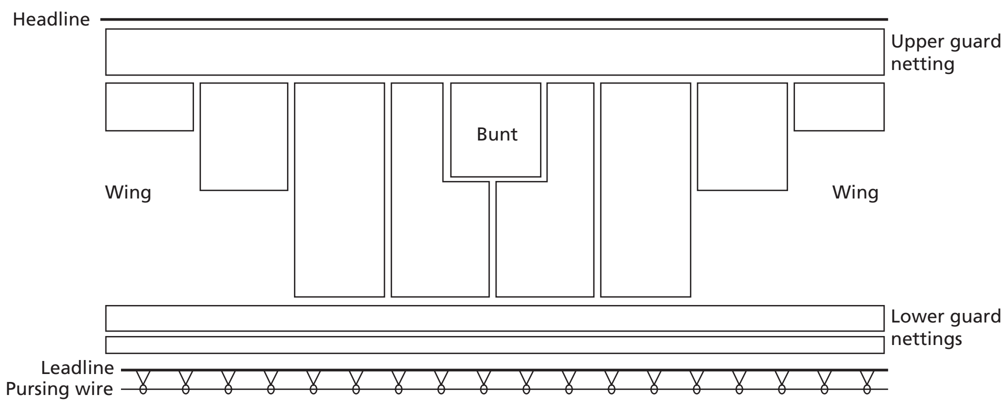


PLATE 19
Purse seiner and adjacent skiff equipped with lamps

PLATE 20
Recovery of the purse line during hauling

FIGURE 37
Technical specifications of a typical purse seine with the bunt in the centre of the net



Source: redrawn from A. Lucchetti and F. De Carlo.

PLATE 21
Rigging of a purse seine for small pelagic species with reinforcement nets mounted on the headline and leadline

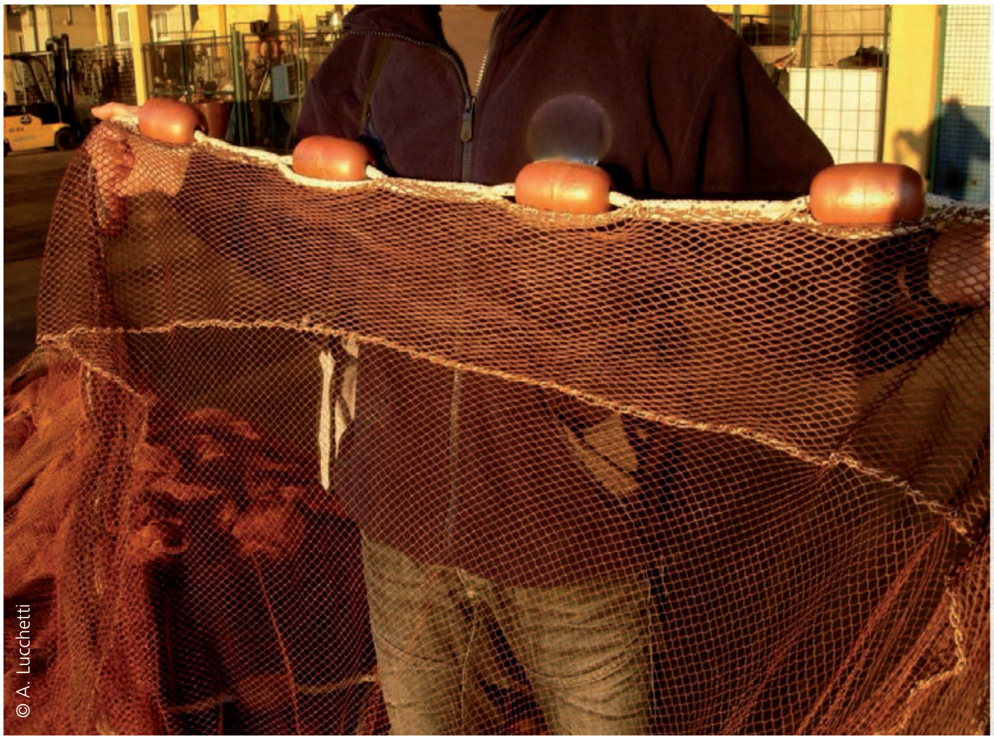
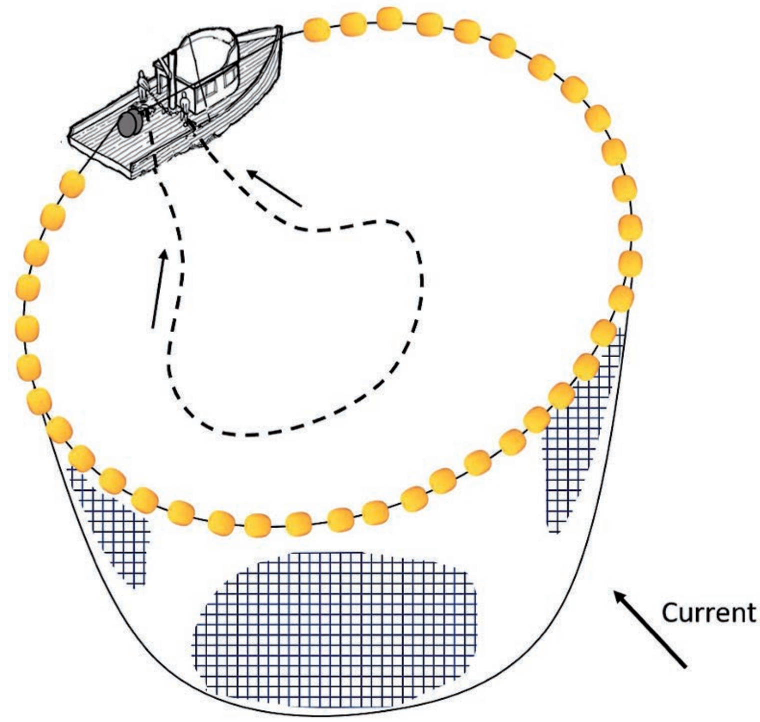


FIGURE 38
Operation of a small purse seine using the sea current to facilitate hauling

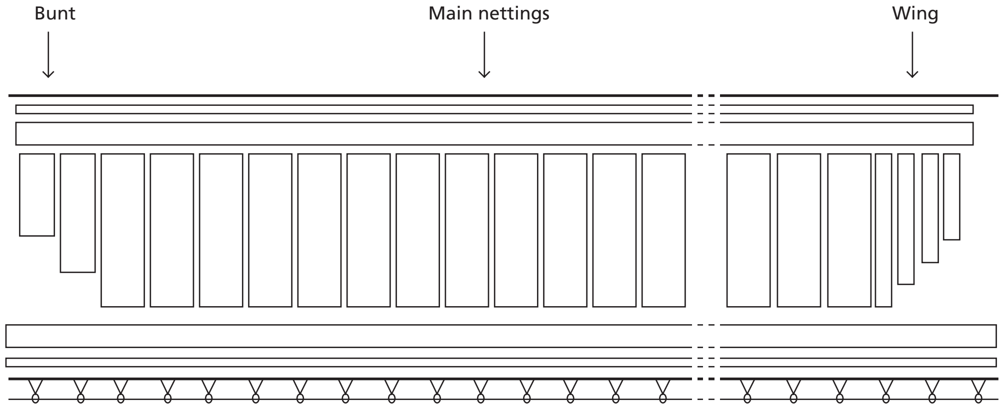


Source: illustrated by A. Lucchetti.

In larger purse seines (headrope length of 400 m or more, stretched net height around 180 m or more), the net design usually involves three main netting compartments: a single net wing, the main netting body, and the bunt, which is normally mounted on a side of the net (Figure 39). With these nets, fishers take advantage of the current flow to give the net a proper round shape. The deployment of the net starts by lowering the wing into the sea (the net wing is kept on board the skiff); gradually, even the main body of netting and the bunt are shot into the sea, encircling the school of fish aggregated by means of lights. Once the net has completely encircled the school, the main boat comes back to the wing already lowered into the sea at the beginning of the haul; from then on, the main boat starts to haul in the purse line by means of winches and the net using a power block. Thus, the catch is slowly herded into the bunt. In summary, the net hauling starts by recovering the net wing and ends with the bunt. The pursing phase normally lasts less than 5 minutes. The purse line recovery then starts within 5–10 minutes, depending on the fishing depth and experience of fishers performing the operation. The complete purse line recovery normally requires 5 minutes. On average, the fishing operations, from net deployment to purse wire closure, last between 13 minutes and 23 minutes. These data are also confirmed by the sensors mounted on the purse seine leadline. Thus, a mechanized power block is used for the net hauling; this phase normally lasts less than one hour.

The size of vessels (from 10 m up to more than 25 m) and the technology on board (such as power blocks, acoustic devices to detect the presence of schools, etc.) strongly influence the number of fishers on board, ranging from 3 to 20.

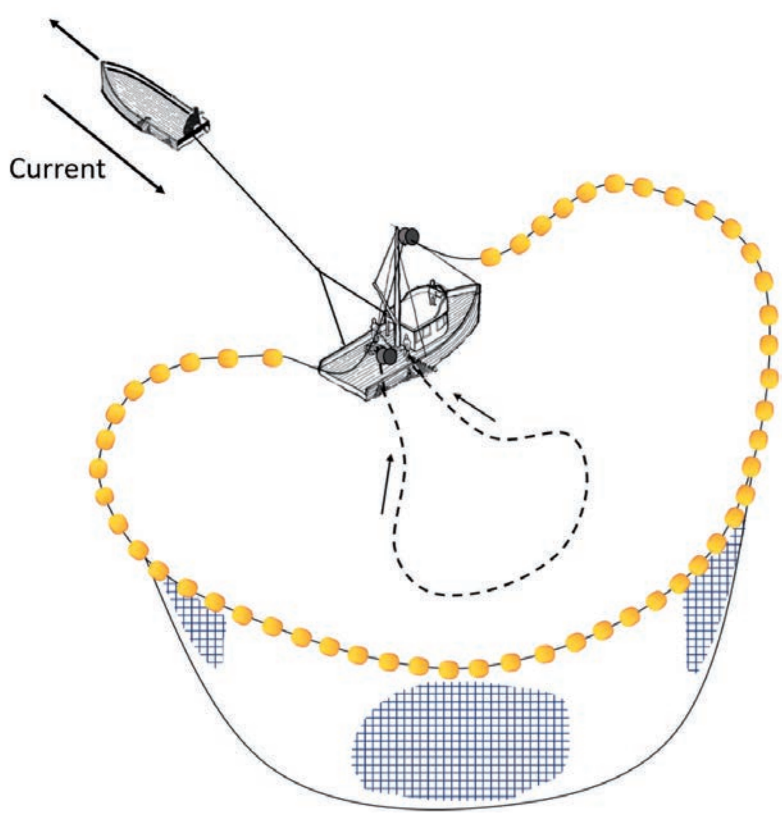
FIGURE 39
Technical specifications of a typical purse seine with the bunt on the side of the net



Source: redrawn from A. Lucchetti and F. De Carlo.

In the cases where the round shape of the net is achieved with help from the current flow, the boat is positioned upstream during the hauling operation and a small work boat can be used to keep the main boat in position or to avoid the current pushing the boat onto the net (Figure 40).

FIGURE 40
Operation of a large purse seine using a work boat to facilitate hauling



Source: illustrated by A. Lucchetti.

Subregional variations

Western Mediterranean

In Morocco (GSA 3), purse seines targeting small pelagics (sardine, anchovy and mackerel) are widespread (Darasi, 2014). They are locally called *lartie* and are used by boats (called *chebak*) longer than 8 m. The mesh length at the bunt is around 18–20 mm and the stretched net height is around 130–160 m, while the operational depth is 20–40 m. From 8 to 12 fishers are required on each boat.

In Algeria (GSA 4), purse seines are used all year round to catch small pelagics (sardines, anchovies, mackerel), especially in the Tipasa area (Sahi and Bouaicha, 2003). They are used by boats about 7.8 m long with 45 hp engines in depths ranging from 10 m to 50 m. The purse seines have a length of 220 m to 700 m with 1 500 to 8 000 meshes in height (around 30–150 m). The bunt has a mesh length of about 18 mm (Laid, Lamri and Kadri, 2001).

In Spain (GSA 6), the purse seine fishery is carried out by vessels of a medium length of 16 m (SGMED, 2004). The target species are anchovy, and other small pelagic species like sardine, horse mackerel (*Trachurus* spp.) or mackerel. Occasionally, round sardinella (*Sardinella aurita*) is fished to be used as bait for the longline fleet or as food to fatten tuna. Less important is the purse seine fishery in the Balearic Islands (GSA 5), where boats have a medium length of 11.2 m (SGMED, 2004).

In Italy (GSAs 9, 10 and 11), purse seines are very common and used all year round to catch small pelagics (sardines, anchovies; Plate 22). The net has an average length of around 400 m and height of 120 m, with a mesh size at the bunt of 15–16 mm and a twine diameter of around 0.24 mm (210/2 titre).

In Sardinia (GSA 11), purse seines are used in spring–summer to target anchovy and sardine; the net used is 350–400 m long, the last 50 m of which make up the bunt (*pezzale*); the maximum height at the centre is around 120–130 m (8 000 meshes), and 80 m at the *pezzale* (5 500–6 000 meshes). From late summer to autumn, purse seines are also used to catch greater amberjack (*Seriola dumerili*); in this case, the nets are slightly smaller.

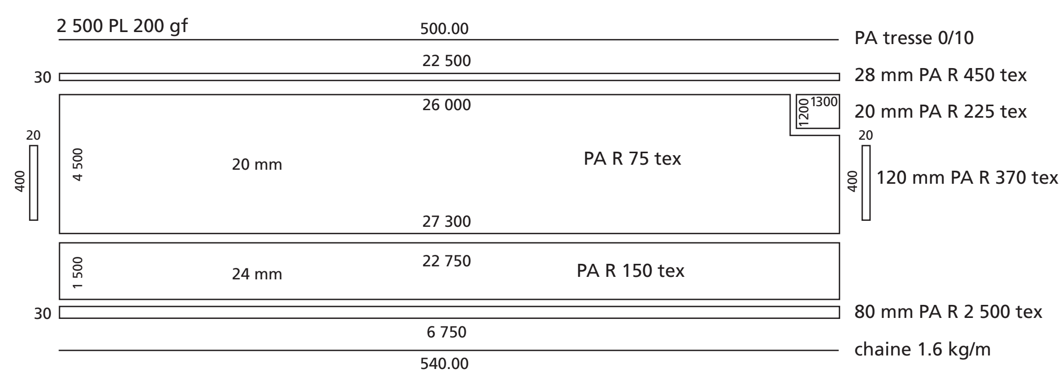
In France (GSA 7), small purse seines consist of two types: a) the purse seine for vessels between 12 m and 24 m long, whether or not they use a light device (*lamparos*; Figure 41); and b) the purse seine known as *allatchare* (Figure 42) for vessels less than 12 m long. The sardine is the main target species of larger purse seiners. A standard purse seine for small pelagic fish has a net length of around 300–600 m and a stretched

PLATE 22
Traditional purse seiner used in the Tyrrhenian Sea for small pelagic species (left) and details of the lamps used on board the skiff (right)

net height of around 70–150 m, with the bunt placed at one end; the mesh opening at the bunt is 20–24 mm in T90 orientation (SGMED, 2004; Le Gall, 2004). The buoyancy of the seine is ensured by a series of polyvinyl chloride (PVC) floats mounted on a braided polyamide (PA) rope at a rate of 1 g/m, while a chain or leaded rope of 1.5 kg/m provides ballast for the whole. On the other hand, on the lower part of the seine, a series of steel rings 20 cm in diameter are mounted every 7–8 m using 1.5 m ropes and through which a purse line with reinforced polypropylene (*mixte*) is threaded.

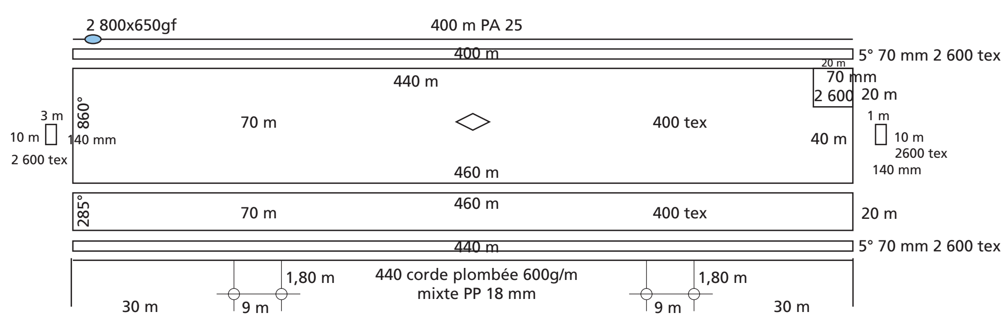
The *allatchare* is a small purse seine of the same shape design as the *lamparo*. It is about 300 m to 400 m long, with a net height of 50–70 m and a 70 mm mesh size. The chain is replaced by a leaded rope of 35 mm diameter. This gear is used essentially in daylight to catch round sardinella, but it was adapted to target demersal and mid-water species – mainly round sardinella, Mugilidae, European seabass (*Dicentrarchus labrax*) – in shallow waters. Generally, the traditional technique still used by some vessels of about 20 m in length begins by first attracting a school of sardines to the surface using a strong lamp powered by a generator placed on a small boat (*porte-feu* or *lamparo*). A second boat, which holds the ends of the seine and the purse line, is then launched. The main boat then encircles the *porte-feu* and the school of fish to close the net with the purse line. Then, the net is hauled by a power block mounted on a crane to concentrate the catch in the bag with bunt, before the catch is hastily removed with a scoopnet (*salabarde*). For the vessels shorter than 10 m, the purse seine is set without the help of a skiff, the end of the net and the slide being simply supported by a flag buoy that the vessel retrieves at the end of the encircling phase.

FIGURE 41
Technical specifications of a *lamparo* purse seine used in France



Source: redrawn from J. Sacchi.

FIGURE 42
Technical specifications of an *allatchare* or *latchare* purse seine used in France

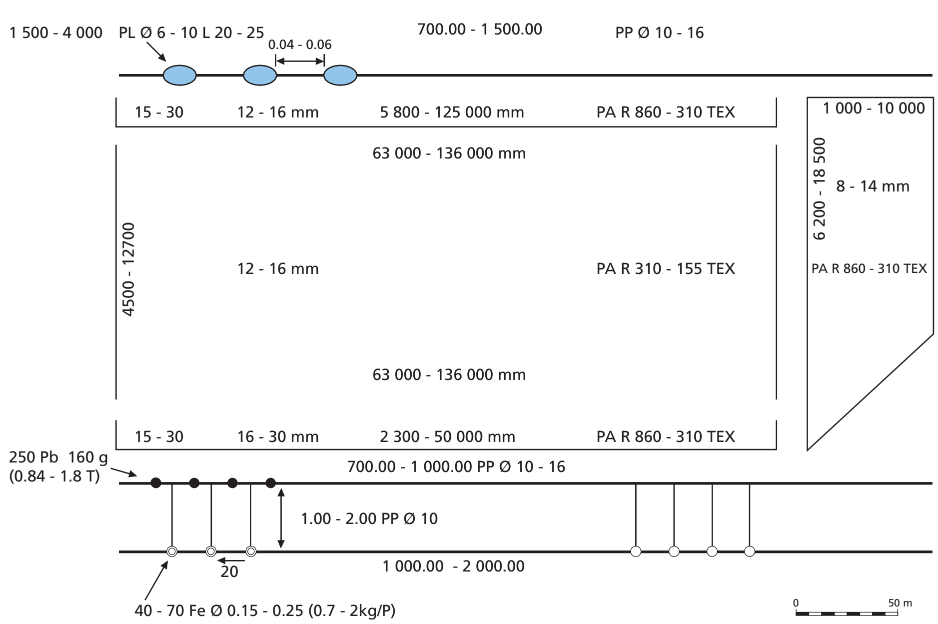


Source: redrawn from J. Sacchi.

Central Mediterranean

In Tunisia (GSAs 12, 13 and 14), the purse seine (called *chenchoul*) is made of several rectangular netting panels with small meshes (12–16 mm mesh bar) that form wings at the ends (Figure 43). The length of the seine varies between 200 m and 800 m, according to the size of the vessel, and the mesh bar of the bunt varies from 9 mm to 14 mm. Purse seines used on the northern and central coasts of Tunisia are characterized by a significant height (80 m or more). This is related to the topography of the seabed, as the continental shelf is very small. In addition, the reinforcement netting panels used next to the floatline and leadline have a relatively significant height, reaching 2.5 m. Similarly, the mesh size of the reinforcement netting panels is bigger than that used further south. In the Gabès region, an additional reinforcement netting panel is used on the leadline. Rings and a purse line are fixed between the two reinforcement netting panels to minimize siltation and facilitate the fishing manoeuvers in shallow depths on muddy bottoms. The fishing operation is carried out at night after attracting fish to the light. Once the fish are encircled, the retrieval operations begin; these operations can be manual or, in large vessels, mechanical using winches. The target species are sardine and anchovy, but also mackerel, horse mackerel and bogue (*Boops boops*; Romdhane *et al.*, 2014). Sometimes, purse seine fishing is practised during the day without the generated light. In this case, the search for schools of fish is carried out by using vertical sounders, sonar and visually, as well as following the behaviour of seabirds or small pelagics on the surface.

FIGURE 43
Technical specifications of a *chenchoul* purse seine used in Tunisia



Source: redrawn from **Romdhane, M.S., Mrabet, R., Rais, C., Dhouib, S. & Kheriji, A.** 2014. *Engins de pêche de Tunisie. Projet pour une pêche durable en Tunisie.* Gland, Switzerland, WWF, Tunis, INAT, Tunis, INSTM and Geneva, Switzerland, Fondation Oak.

In Malta (GSA 15), the main target species of purse seines operating with lamps (*lampara*) include chub mackerel (*Scomber japonicus*) and round sardinella, but also anchovy, bogue and sardine (De Leiva *et al.*, 1998). Two or three small boats (tenders) use strong lights to attract the fish. The length of the nets used ranges from 160 m to 750 m (370 m on average), while the height ranges from 26 m to 120 m (89 m on average). The mesh size of the bunt varies from 17 mm to 27 mm.

In Italy, especially in Sicily (GSA 16), the purse seines targeting anchovies and sardines are similar to those described for the western Mediterranean. The mesh size at the bunt is 20 mm, and the number of vertical meshes ranges from 6 000 to 8 000. The headline length ranges from 425 m to 460 m, depending on the fishing grounds, whose depths range from 25 m to 50 m or more.

In Greece (GSA 20), the purse seines mainly target anchovies and sardines (see later section on the eastern Mediterranean for a description).

In Libya (GSA 21), according to the target species, there are two main important fishing strategies used in purse seine fisheries.

The first is the small pelagic purse seining that occurs during the night-time using artificial lights for fish aggregation. It is a seasonal activity called *lambara* and practised from March to October to target sardine and mackerel locally. Fishing takes place generally during dark nights (notably moonless nights). Up to three vessels can be used: the *mator* – the main fishing vessel, with a length overall (LOA) ranging from 7 m to 18 m ensures the fishing operation, as it carries the net and sometimes uses lighting. Two *flukas* (3–7 m LOA) are used for lighting. The gear is about 270 m in length and can reach 82 m in height. Fishing operations take place generally from 35 m to 90 m depth (Zgozi *et al.*, 2020).

The second type is the purse seine that targets aggregated fish in schools. It is locally called *mar*w and the targeted species are salema (*Sarpa salpa*), horse mackerel and barracuda (*Sphyraena* spp.) (Zgozi *et al.*, 2020). In this case, only one vessel is used during the fishing operation. Fishing takes place generally during the night-time and is practised throughout the year. The operation begins by seeking the schools of fish using the echo sounder and by following the behaviour of fish or seabirds. Floating, intermittent lighting is placed in the located fish school, which is then surrounded by the purse seine. The gear is from 220 m to 260 m in length and is used from a depth of 55 m to 65 m.

Adriatic Sea

Purse seine fisheries targeting small pelagics, mainly anchovy and sardine, in the Adriatic Sea have a major economic and social role. This métier involves night fishing that is mostly carried out in spring and summer in favourable sea and weather conditions. Purse seines are commonly operated from skiffs (usually one or two) equipped with strong lamps to attract schooling fish.

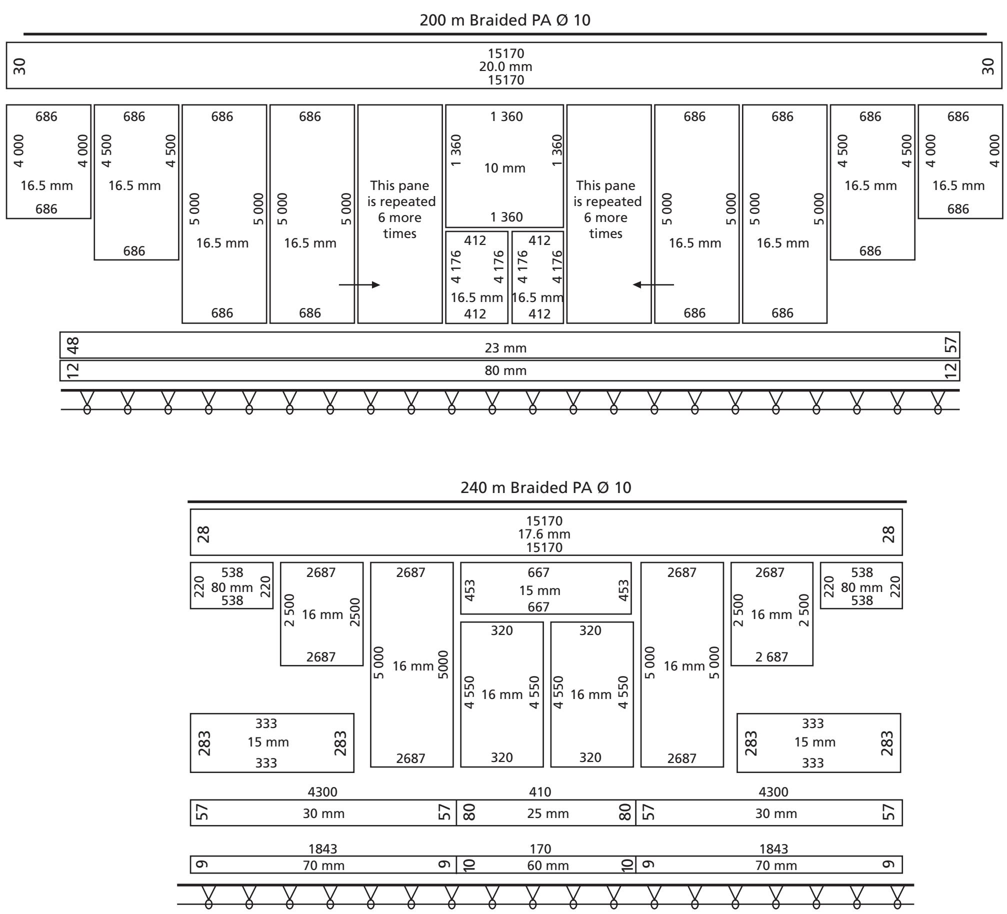
Italy, Croatia, and Slovenia are the three countries most involved in purse seine fisheries in the Adriatic Sea targeting small pelagics. Croatia has the largest purse seine fleet in the Adriatic Sea, followed by Italy.

The bottom depths of fishing grounds, vessel size (and hence net size) and gear rigging are major variables in the fishing operations.

Two main types of purse seine fisheries can be identified in the Adriatic Sea (Lucchetti *et al.*, 2018): small purse seines and large purse seines.

Small purse seines are used in the shallow waters of the northern Adriatic Sea (Gulf of Trieste and along the western coast of northern Istria) and operated at depths less than 25–30 m by small vessels with low tonnage (Figure 44). These vessels use purse seine nets of small dimensions and target anchovies, sardines and, rarely, sparids – gilthead seabream (*Sparus aurata*), pandora (*Pagellus* spp.), sand steenbras (*Lithognathus mormyrus*) – as well as squid (*Loligo vulgaris*), grey mullet (*Mugilidae*) and horse mackerel. In the Gulf of Trieste and in the northernmost part of the basin, where the bottom depth is less than 25–30 m, small purse seine pelagic fisheries employ small vessels with a LOA less than 14 m. The purse seines used in this area have a symmetric design, with two lateral net wings of the same size and characteristics, the main netting body, and a bunt or bag in the middle of the net. The deployment of the net around a school of fish begins with one of the two wings held by the skiff. Then, the net is set around the school. The last netting panel to be lowered into the water is the second wing. Hauling starts immediately after the net has been set, with recovery of the two net wings occurring simultaneously before the net touches the bottom. Given the relatively small size of the nets in this area, hauling, though not purse line recovery, is often performed by hand until the catch has been concentrated in the bunt. To facilitate hauling, the boat is positioned downstream so that the current contributes to driving the net towards the boat. In this area, the lamps used to attract the fish school are mounted on a skiff and directly on the main vessel. The mean length of the headline is around 216 m and the mean stretched net height is around 85 m (5 000 meshes). The stretched net height is around 34–48 percent of the headline length. Shooting and the encircling operation usually takes less than 5 minutes. Hauling usually takes less than one hour. The leadline usually reaches the bottom in 2–3 minutes.

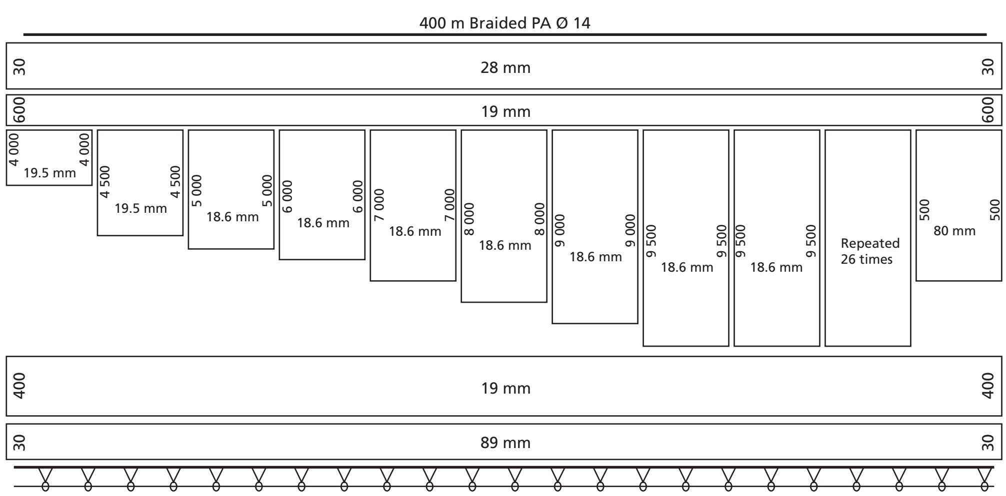
FIGURE 44
Technical specifications of a purse seine used in the Gulf of Trieste in Italy (top) and in Slovenia (bottom)



Source: redrawn from A. Lucchetti and F. De Carlo.

Large purse seines used in the rest of the Adriatic Sea (bottom depth varies from 30–200 m, though is usually deeper than 50 m), mostly from Croatia and Italy, only target small pelagic species (except occasional hauls targeting other pelagic species; Figure 45). Purse seines are generally larger than those used in the northern Adriatic Sea. They consist of a single net wing, with the main netting body and the bunt mounted on one side of the net. The wing is deployed first from the skiff; then the main body and the bunt are also gradually lowered into the water to surround the fish attracted by the lamps. When the school has completely been encircled, the main boat doubles back to the net wing and begins to draw the purse line (with winches) and to haul the net (with a power block), thus slowly herding the catch into the bunt. During hauling, the boat is positioned upstream; a small tender or skiff can be used to keep the main boat in position or to prevent the current from driving the boat into the net. The headline length of the Italian purse seines ranges from 400 m to 500 m, while the Croatian (*srdelara*) purse seine is longer, ranging from 510 m to 600 m. In Italy, the stretched net height ranges from 170 m to around 200 m (around 10 000 meshes) and is about 42 percent of the headline length. In Croatia, the stretched net height varies between 160 m and 230 m and is about 39 percent of the headline length. The large net heights have many purposes: to keep the net at a reasonable distance from the school; to avoid alarming the fish; to provide a scoop in which fish are surrounded and then enclosed from all sides; to avoid entanglements; and to preserve the quality of fish. In the fleet operating in the central Adriatic Sea, pursing takes less than 5 minutes and is performed after 5–10 minutes of deployment, depending on the fishing depth and fisher's expertise. The purse seine and rigging (e.g. buoyancy, weight of leadline) are designed for fast sinking after deployment (the sinking speed is about 10–12 m/min), in order to prevent the school from escaping. In the last few years, Croatian purse seiners have started to use fish pumps to suck fish directly from the net, so as to ensure better fish quality.

FIGURE 45
Technical specifications of a large purse seine used in the Adriatic Sea



Source: redrawn from A. Lucchetti and F. De Carlo.

In Croatia (GSAs 17 and 18), other types of purse seines are used (STECF, 2012):

- The *igličara* is a purse seine net targeting garfish (*Belone belone*), with a minimum mesh size of 20 mm.
- The *ciplara* is a purse seine net targeting grey mullet, with a minimum mesh size of 52 mm.
- The *oližnica* purse seine net targeting sand smelt (*Atherina boyeri*) with a minimum mesh size of 14 mm.
- The *lokardara* is a purse seine net targeting chub mackerel with a minimum mesh size of 20 mm.

Generally, these small purse seiners are allowed at distances less than 300 m from the coastline, regardless of the sea depth, which means that these types of fishing gear are exempt from some general provisions of Council Regulation (EC) No 1967/2006 for European Union countries (Council of the European Union, 2006; Zorica *et al*., 2020).

In Montenegro and Albania, purse seines are also used with technical properties similar to those described for Italy and Croatia.

Eastern Mediterranean

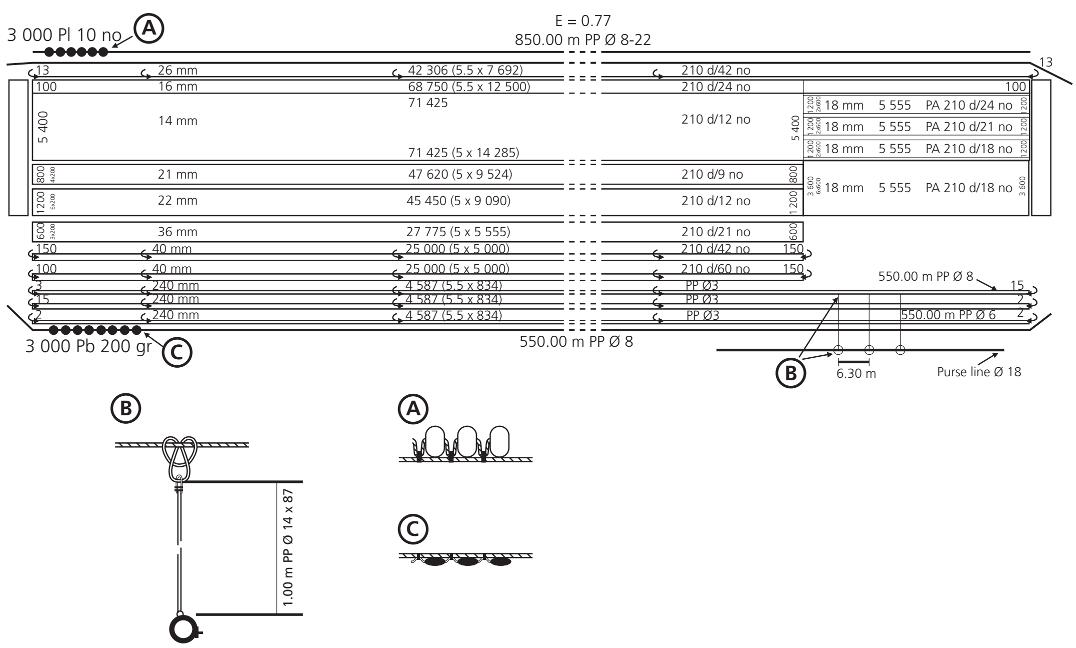
In Greece (GSAs 22 and 23), the main portion of the fleet operating with purse seines is in the Aegean Sea. The main species landed are anchovy, sardine, horse mackerel, bogue, picarels (*Spicara* spp.), round sardinella, chub mackerel and Atlantic mackerel (*Scomber scombrus*). Purse seines are classified into two major types: those operating during the day and those operating during the night using lights, which is the most common activity. There are no significant differences between the two types as far as equipment and vessel construction are concerned. The most important difference is related to the mesh size of the net (14–28 mm for the night and 40 mm for the day, with a full mesh for both; SGMED, 2004; Adamidou, 2007). Concerning the night purse seine, the main body of the netting consists of 8–20 rectangular pieces of net (sections), 400 meshes wide each, joined one below the other. The mesh size of the main net body is 14–28 mm (full mesh) and the twine thickness is 210/3 to 210/12 denier. The upper and lower two sections are made of thicker twine (210/12–210/60 denier) and usually have a bigger mesh size (32 mm to 90 mm full mesh). They are narrower compared to the sections of the main body, with the first and the last section being 20 meshes wide, and the second section of the top and of the bottom being 100–200 meshes wide. The bunt consists of 4–19 sections and is placed sometimes in the centre of the netting and other times in the side. It is made of thicker twine compared with the main net body (210/9–210/21 denier). The length of the gear ranges from 450 m to 760 m and the depth from 80 m to 120 m. The net is composed of 14–19 net sheets each with a length of 500–800 m, a height of around 40 m each and a diamond mesh of 16 mm. The leadline is usually 5–15 percent longer than the headline. There are 60–135 rings according to the length of the gear. The headline and the leadline are usually of PA with a diameter of 10–16 mm. Attracting the school of fish can also be helped by numerous floating light sources (i.e. lamp rafts), which are positioned at sea and do not require direct human control, but are recovered at the end of the haul (Plate 23). At the same time, a small tender with one crew member is lowered close to the floating lamps to check if the fish school has remained in the area (using a fish finder device).

Limited information exists for the day purse seine. It is usually longer and less wide compared to the night purse seine. The mesh size is bigger (40 mm full mesh) and the netting is thicker (210/12–210/15 denier). The operation of the daytime purse seine is the same as the night-time purse seine, without the use of lamp rafts. The main catch consists of species such as: Atlantic bonito (*Sarda sarda*), little tunny (*Euthynnus alletteratus*), skipjack tuna (*Katsuwonus pelamis*), bullet tuna (*Auxis rochei*), plain bonito (*Orcynopsis unicolor*), bluefish (*Pomatomus saltatrix*), greater amberjack, meagre (*Argyrosomus regius*) and common dolphinfish (*Coryphaena hippurus*).

PLATE 23
Lamp raft used in Greece

In Türkiye (GSA 22), purse seines are mainly used to target sardines and anchovies (Figure 46).

FIGURE 46
Technical specifications of a purse seine used in Türkiye



Source: redrawn from **Tokaç, A., Ünal, V., Tosunoğlu, Z., Akyol, O., Özbilgin, H. & Gökçe, G.** 2010. *Ege Denizi Balıkçılığı* [Aegean Sea fisheries]. İzmir, Türkiye, IMEAK Chamber of Shipping İzmir branch.

In the Syrian Arab Republic (GSA 27), seines are employed to catch a great variety of small fish such as bogue, Atlantic horse mackerel (*Trachurus Trachurus*) and pompano (*Trachinotus ovatus*) at 25–100 m depth, using small mesh lengths (10–20 mm; Ibrahim, Hassan and Mtawei, 2012).

In Egypt (GSA 26), purse seines have revolutionized the sardine fishery because of their efficiency in catching schools (El-Haweet, 2001). The sardines (*Sardina pilchardus*, *Dussumieria acuta* and *Sardinella aurita*) are usually caught in shallow waters (16 m). The purse seine described by El-Haweet (2001) has a floatline about 160 m long with approximately 300 buoys (one buoy every 50 cm) and a leadline of about 140 m with a weight of 125 g every 30 cm. The purse rings have a special line attached to the leadline with a ring every 4 m. The maximum height of the net (stretched net depth) is about 40 m in the central part with the stretched mesh size varying between 16 mm and 18 mm. The net dimensions are proportional to the boat size. About 12–17 fishers usually carry out the hauling of the net manually within 20 minutes, with the help of a power block used to collect the purse line only. This gear is commonly used on dark nights with artificial lights to attract fish, which are carried on two or three small boats. One main vessel is used to release and collect the net.

In Lebanon (GSA 27), the purse seiners (locally known as *shinsholas*, derived from the Italian word *cinciola*) that target anchovies and sardines play an important role in terms of total landings (Plate 24; Sacchi and Dimech, 2011; Bariche, Alwan and El-Fadel, 2006). This gear is used by both small (< 10 m) and large vessels (> 20 m), which also own small, motorized skiffs and one or two boats or rafts with lamps. The net has a very small mesh length (5 mm) and a stretched net height of 40 m. Purse seiners can make several hauls during one night with the help of 9 or 10 fishers. Small purse seines (from 50 m to 170 m of headline length) can be operated entirely by hand. However, bigger nets need power blocks and capstans and consequently a hydraulic system. The mesh sizes and the twine mainly used in Lebanon are the same for *lampara* and purse seine fisheries. The nets are made up of PA multifilament of 210/2 titre to 210/6 titre and 10–14 mm mesh sizes. This gear mainly targets common pelagic species, such as the sand smelt (Atherinidae) and sardine, Madeiran sardinella (*Sardinella maderensis*) and anchovy, as well as the Lessepsian spotback herring (*Herklotsichthys punctatus*).

PLATE 24
Purse seiners (top) and tender with lamps (bottom) used in Lebanon

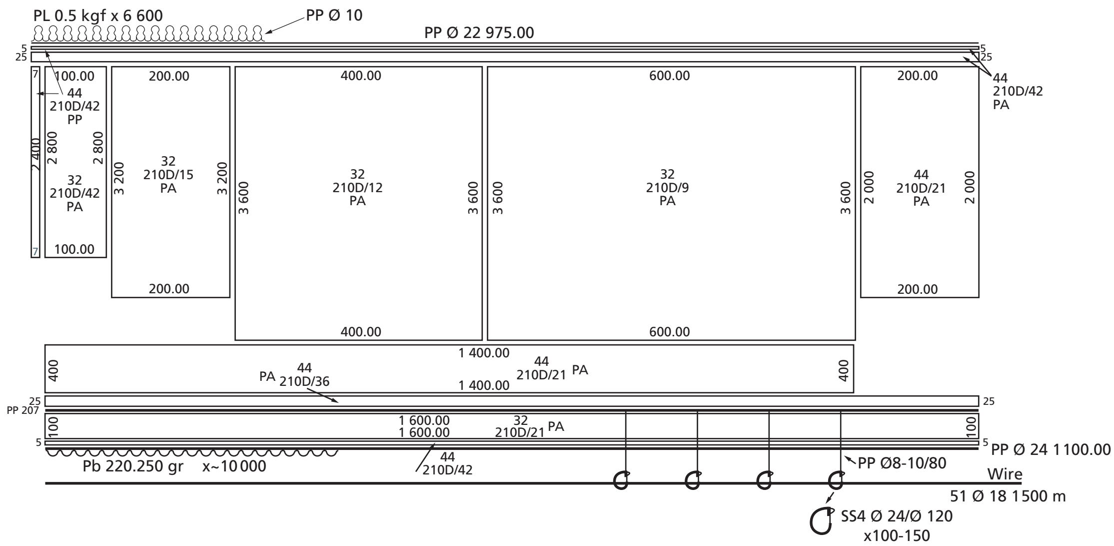
In Palestine (GSA 27), different purse seines are used (El-Haweet *et al.*, 2004). The *shanshulla* used in the Gaza Strip are purse seines with a 200–450 m headline and a depth of about 50 m; they are made of green nylon of 210/3, 210/6 and 210/12 twine sizes and of 17 mm and 22 mm mesh size. Two other types of purse seiners operate in the Gaza Strip. The first is a purse seine launch 14–18 m long with 85–100 hp engines, and the second is a smaller open boat (*hassaka* type), 6–8 m long, made of fibreglass with 40 hp outboard engines. The larger ones are equipped with several lights fixed all around the roof and powered either by solar energy or by diesel-based engines to attract pelagic fish. In general, larger purse seiners carry two seines of different dimensions (one for daytime activities and the other for night-time) used according to the season and the fish targeted. Fishing at night is carried out with four *feloukas* (5–8 m long boats with oars), with three gas lamps on each to aggregate the sardines before setting the purse seine. A *hassaka* with an outboard engine can also be used as a *lampara* net. Likewise, a *hassaka* is also useful for transshipment, as the tender stays at anchor if the weather is good. Most launch purse seines (*shanshulla*) have another second, much stronger purse seine than sardine nets with a mesh size of 45–70 mm to catch migrating giant devil rays (*Mobula mobular*), locally known as sea watwat, when they pass by the Gaza Strip during their migration season from March to April. The fishing season for sardines, which provide the main annual income for fishers in the Gaza Strip, is limited to only 2–3 months in spring and autumn, respectively. Sometimes, horse mackerel, shrimp and Atlantic mackerel form part of the catch. Squid are also a small but valuable bycatch of the light attraction process. Daytime catch includes rays, flying fish (Exocoetidae) and bullet tuna.

Black Sea

The Black Sea purse seine fisheries mainly target small pelagic species consisting primarily of anchovy and sprat (*Sprattus sprattus*), but also Atlantic bonito and bluefish.

Türkiye (GSAs 28 and 29) has the largest fleet and is responsible for the majority of landings. Purse seines are actively employed to catch anchovy, sprat and sardine; they have a 9–20 mm mesh length and a stretched net height of around 150 m to 200 m (sometimes smaller purse seines have 80 m net height; Figure 47). The average reported headline length for this fishing activity is around 600 m (with a range of 100–1 500 m). Some purse seines are also used to catch Atlantic Bonito, using larger mesh sizes (22–54 mm) and net heights (140–382 m). The average reported headline length is around 600 m (with a range of 100–1 200 m; Doyuk, 2006; Erdem *et al.*, 2019).

FIGURE 47
Technical specifications of a purse seine used in the Black Sea for small pelagic species



Source: redrawn from **Erdem, Y., Özdemir, S., Özsandikçi, U. & Büyükdeveci, F.** 2019. Technical features of nets used in industrial fisheries in the western Black Sea (Sinop Province)/Batı Karadeniz'de (Sinop ili) endüstriyel balıkçılıkta kullanılan ağlar ve teknik özellikleri. *Turkish Journal of Maritime and Marine Sciences*, 5(2): 74–87.

In Ukraine (GSAs 29 and 30), purse seines are used to catch Black Sea anchovy (*Engraulis encrasicolus ponticus*), so-iuy mullet (*Planiliza haematocheilus*) Atlantic bonito, Atlantic mackerel and bluefish.

2.2.2 Purse seines for tuna

Tuna purse seines usually have very large dimensions, measuring 1 500 m to 2 000 m in length and 120 m to 250 m in drop. Presently, the purse seine is the most widely used fishing technique to catch bluefin tuna. Fish caught by means of this gear remain alive within the net and most of the live fish caught are transferred to a transport cage for tuna farming. Most of the Mediterranean bluefin tuna purse seine fishing vessels use a standard net measuring 1 500 m long by 250–270 m deep (Plate 25). More efficient, larger and faster sinking nets (more than 2 000 m in length and 300 m in height) are designed to secure bigger live bluefin tuna schools before their transfer into gravity transport cages.

The fishing operations carried out by a purse seiner first of all involve the identification of the school of fish. Large pelagic species can be located through sightings on the sea surface (e.g. concentrations of seabirds, disturbance of the water surface and presence of groups of dolphins). In the case of large vessels targeting bluefin tuna, sonar can be used to locate the school. In the past, tuna were located by aerial sightings (small aeroplanes, helicopters). This practice is currently forbidden in European Union countries. When a school is located, one end of the net is kept by the skiff (Plate 26), while the main vessel encircles the school at maximum speed. Usually, all the purse seine is set and the circle is closed within a few minutes. In the Mediterranean, purse seiners targeting bluefin tuna often do not deploy the entire net and instead close the circle with only a portion of the seine. This is mainly because tuna can change their direction and escape before the circle is closed. Once the school is surrounded, the end of the net that stays attached to the skiff is transferred aboard the purse seiner and the two extremities of the purse line cable are hauled with the winch (rarely by hand) as quickly as possible in order to close the net at its bottom. In fact, the fish can escape below the net until the purse seine is closed. The net is then pulled aboard the purse seiner with a hydraulic power block (Plate 27) or, on rare occasions, by hand. When most of the purse seine has been retrieved, the fish are grouped within a restricted area along the port side of the vessel. Then, the fish are harvested from the purse seine using a large scoopnet. Deployment lasts about 5 minutes, while pursing is longer and takes between 15 minutes and 25 minutes depending on the efficiency of the boat. Net hauling takes between 60 minutes and 90 minutes. Besides the deck equipment needed, 8–12 fishers are required for these operations. The transfer of the fish to the tuna transport cages (Plate 28) lasts 1–2 hours, depending on the number of fish caught.

PLATE 25
Purse seine used in the Mediterranean on board a fishing vessel

PLATE 26
Skiff on the ramp of a tuna purse seiner used in France

PLATE 27
Purse seiner during hauling (top) and details of the power block (bottom)

PLATE 28
Tuna transport cage

The most relevant spawning areas for bluefin tuna, and therefore the most important fishing areas for tuna seiners, are reported from: the Balearic Islands (GSA 5); the central and southern Tyrrhenian Sea (GSA 10); the central Mediterranean Sea, south and southwest of Malta (GSAs 13, 15 and 16); the central Mediterranean Sea, north of

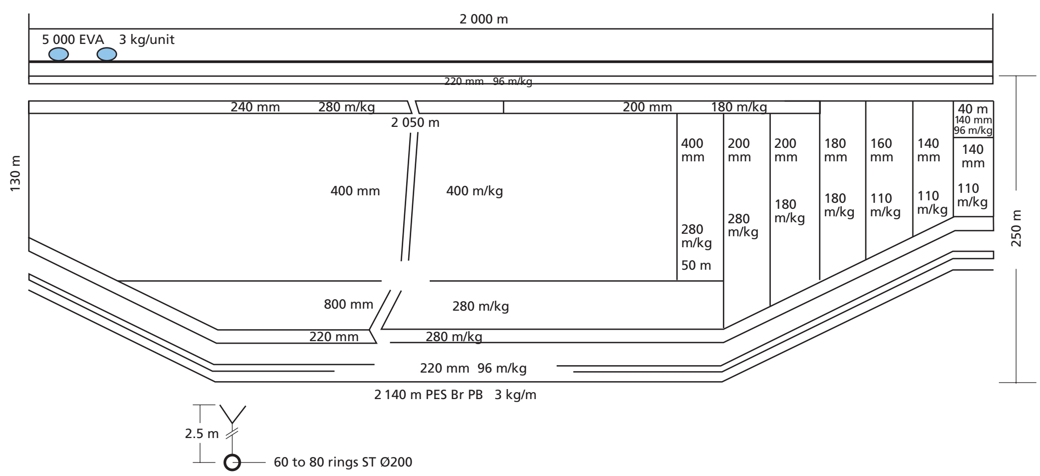
Libya (GSAs 14 and 21); the eastern Mediterranean, southern Aegean Sea (GSAs 22 and 23); the eastern Mediterranean, Levant Sea (GSAs 24, 25 and 27); and the eastern Mediterranean Sea, north of Egypt (GSA 26). Fishing operations take place during the bluefin tuna spawning peaks, which, depending on climate and oceanographic conditions, take place during the months of June and July.

Subregional variations

Western Mediterranean

In France, the tuna purse seiner fleet targets bluefin tuna off Malta or the Balearic Islands for one month until the quota is exhausted (Plate 29). The majority of their purse seines have a mesh length from 80 mm to 180–240 mm, a 1 900–2 000 m headline and a stretched net height reaching about 250 m. A buoyancy of 8 to around 10 kg/m is achieved with a series of about 5 000–8 000 ethylene vinyl acetate (EVA) floats; the purse seine is weighted either by a chain or a leadline of 2.5–3 kg/m (Figure 48). With a sinking speed of about 12 m/minute, the pursing can start 5–6 minutes after shooting, as soon as the rings reach a depth of 60 m (SGMED, 2004; Le Gall, 2004). Just before the bunt, an opening can be created to allow the transfer at sea of live tuna from the seine to the floating cages, which will then be towed to the fattening farms for the sashimi market.

FIGURE 48
Technical specifications of a purse seine used in France for tuna



Source: redrawn from J. Sacchi.

PLATE 29
Tuna purse seiner used in France

In Campania, Italy (GSA 10), the tuna purse seine (called *tonnara volante*) has a headline 1 600–2 000 m long, depending on the length of the vessel. The maximum stretched net height is 200–300 m, while the bunt (called *pezzale*) has a measured mesh size of 140–150 mm (knotted PA, 5 mm in diameter, black or brown colour).

Central Mediterranean

In Tunisia (GSAs 13 and 14), the length of a tuna purse seine varies between 1 000 m and 4 000 m. It has a mesh length ranging from at least 100 mm to 400 mm and a thick twine diameter (1.6 mm). The vertical number of meshes is 1 000–2 500, for a height ranging from 100 m to 250 m.

In Libya (GSA 21), the tuna purse seiners have a 140 mm mesh length and 990 meshes in a vertical position, resulting in 250 m of stretched net height. The leadline length is 1 900–2 000 m (J. Sacchi, personal communication, 2023).

Adriatic Sea

In the Italian Adriatic Sea (GSAs 17 and 18), purse seines for tuna are known as *tonnara volante*. These nets are about 1 200–2 100 m long and 200–350 m high, with a mesh size of more than 120 mm stretched. They can weigh several tonnes and be up to 2 km long. The yarn used for the mesh has a high diameter (approximately 4 mm) to make it extremely resistant to shocks and breaking. Despite its size and weight, this net is lowered and hauled aboard like the smallest purse seine (with purse line) for anchovies, sardines and mackerel. Given the size of the net, about one hour is needed to haul the net in and to be ready to lower it again. Usually, a fishing boat catches tuna several times during the fishing season, and the quantity depends on the size of shoals, with 100 tonnes of catch having been recorded during one haul (SGMED, 2004).

In Croatia (GSAs 17 and18), a purse seine called a *tunara* is used to fish bluefin tuna, as well as to catch other large pelagic species. The minimum mesh opening of this purse seine is 40 mm. Another type of purse seine, the so-called *palamidara,* is used for Atlantic bonito, bullet tuna, little tunny and greater amberjack. The minimum mesh size of the Atlantic bonito purse seine is 34 mm.

Eastern Mediterranean

In Greece (GSA 22), seiners are employed to target tuna species such as Atlantic bonito, bullet tuna and little tunny, using a mesh length of 40 mm and a net height of 120 m (Adamidou, 2007).

In Turkish seas (GSAs 22 and 24), purse seiners began catching bluefin tuna in the 1950s. In 2003 – the year in which Türkiye became a contracting party of the International Commission for the Conservation of Atlantic Tunas (ICCAT) – Turkish purse seiners involved in the bluefin tuna fishery ranged from 30 m to 62 m in length and from 24 gross register tonnage (GRT) to 694 GRT, with 1 000–4 710 hp (Oray and Karakulak, 2004). The tuna seine nets are 2 000–2 430 m in length and 252–324 m in height.

Black Sea

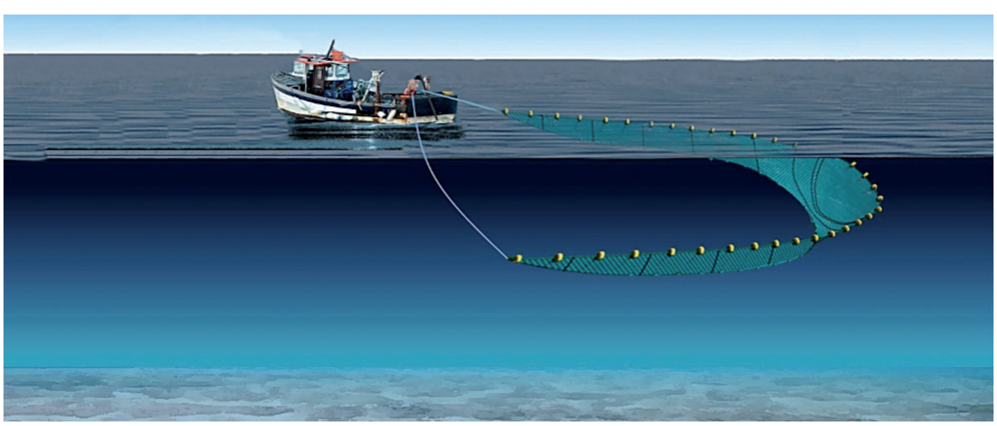
No tuna seiners are reported for the Black Sea.

2.3 Surrounding nets without purse lines

Quite similar to the boat seine, the surrounding net without purse lines is a long wall of netting constructed mostly from rectangular sections, framed by a headline on the top and a leadline on the bottom, that is designed to surround fish at the surface or in shallow water and is hauled without the use of a purse line (Box 4). This type of net is deployed to surround a school of fish and is hauled to immediately recover the leadline. In fact, in this type of net the leadline is shorter than the headline so that when the net is retrieved, the tension in the leadline pulls the wall of netting ahead of the headrope to prevent fish from escaping downwards. The gear can be operated by one or two boats. These nets are used by artisanal fisheries (mostly polyvalent vessels) to catch demersal and pelagic species. Surrounding nets without purse lines are sometimes used by small vessels to catch surface schooling pelagic fish such as common dolphinfish, greater amberjack and blackspot seabream (*Pagellus bogaraveo*) clustering around fish aggregating devices (FADs). A typical surrounding net without a purse line is the *lampara* net (Figure 49); it has a central bunt or bag with smaller meshes and two long wings. Hauling starts by recovering the two ropes attached to the wings. *Lampara* nets are often used at night with the assistance of light to attract and concentrate small pelagic fish so that they can be easily surrounded by the net.

The only limitation to the use of surrounding nets is very shallow waters, where the water depth is less than the height of the surrounding net during fishing operations, potentially risking damage to the fishing gear.

FIGURE 49
***Lampara* surrounding net without purse lines**



Source: illustrated by A. Lucchetti.

Box 4

Details of surrounding nets without purse lines

Surrounding nets without purse lines

In this type of net, the buoyancy of the headline is predominant compared to the weight exerted by the leadline, so the net always operates with the headline on the surface. In fact, the number of floats is much higher than in a boat seine.

Net wings are recovered during hauling operations both by winches and by hand.

Surrounding net without purse lines during net hauling operations.

Details of floats of a surrounding net without purse lines.

Subregional variations

Western Mediterranean

In Spain (GSA 5, Balearic Islands), the surrounding nets without purse lines called *llampuguera* are used in the common dolphinfish fishery in association with FADs, locally called *capcer* (described in Section 6.1), from the second quarter of August to December. It is a very old type of gear and has undergone very few modifications over time. These nets have a length of around 110–180 m, a height of around 15 m and are made up of several pieces of net (called *regala, banda* and *fisca*) and a codend or moridor in its central part or in the lateral part where the fish are collected during hauling operations.

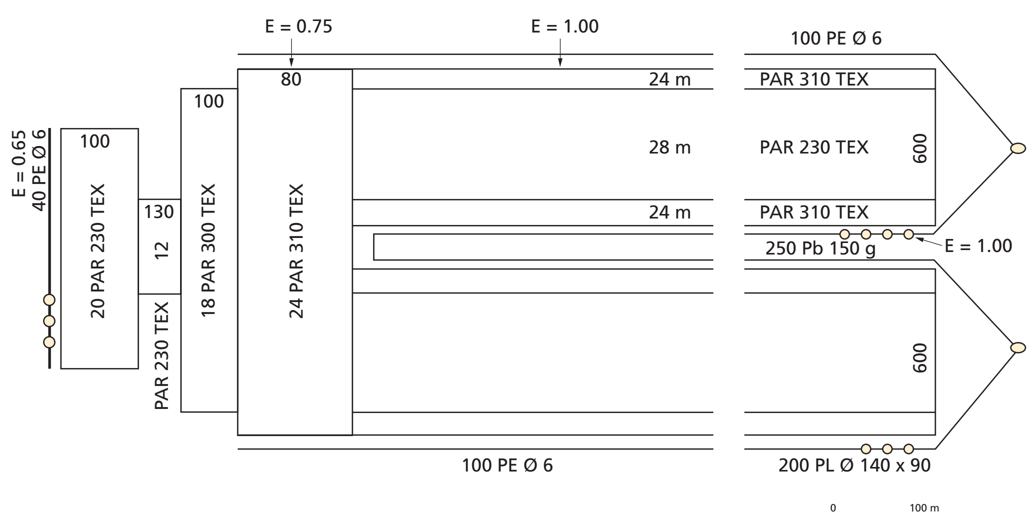
In Italy, the use of surrounding nets without purse lines is limited to the southern and central Tyrrhenian Sea (GSA 10). In fact, this is a manual fishing system that cannot compete, in terms of yield, with large purse seine nets. However, due to the different regulations to which these two types of gear are subject and due to local traditions, these nets are still often used in coastal areas to catch fish with FADs called *canizzati*, or to fish Mediterranean sand eel (*Gymnammodytes cicerelus*) and other small fish (in the past they were used to catch juveniles of anchovy and sardine). Generally, these nets are used by small boats in certain periods of the year. They are locally known as *pulica, fonticella, ragostina* or *raustina, tartanone, napoletana* and *lampara*, mainly in Sicily and Calabria. Surrounding nets without purse lines have a headrope of around 100–180 m and an operational height of 10–15 m. The mesh size of the bunt ranges from 5 mm to 15 mm, depending on the target species. The mesh opening of the wings ranges from 50 mm to 180 mm. Short ropes of 15–30 m are used during shooting and hauling operations. Another type of purse seine without purse lines is employed to catch common dolphinfish, with a 30–40 mm mesh opening in the bunt, 800–1 200 meshes in the vertical position and a headline length of 100–120 m (depending on the vessel size). This gear is used in hundreds of metres of depth, around the FADs.

Central Mediterranean

In Italy (Sicily, GSAs 16 and 19), the use of surrounding nets without purse lines is limited. The technical characteristics of these nets are similar to the nets described for the western Mediterranean, with a headline length up to 260 m, mesh size of the bunt around 10–15 mm, mesh size of the wings around 80 mm on average and an operational height around 15 m. This net is used to catch pelagic species (sardine, mackerel, bogue, horse mackerel) and sometimes Atlantic saury (*Scomberesox saurus*), especially in the Strait of Sicily. In addition, the purse seines targeting common dolphinfish, as described for the western Mediterranean, are used in this area.

In Tunisia (GSAs 12, 13 and 14), surrounding nets without purse lines are used in coastal areas to catch sardine, mackerel, bogue and horse mackerel (Figure 50).

FIGURE 50
Technical specifications of a purse seine without purse lines used in Tunisia



Source: redrawn from **Romdhane, M.S., Mrabet, R., Rais, C., Dhouib, S. & Kheriji, A.** 2014. *Engins de pêche de Tunisie. Projet pour une pêche durable en Tunisie.* Gland, Switzerland, WWF, Tunis, INAT, Tunis, INSTM and Geneva, Switzerland, Fondation Oak.

Adriatic Sea

No surrounding nets without purse lines are reported in this subregion.

Eastern Mediterranean

In Lebanon (GSA 27), a surrounding net without purse lines, locally known as *massis*, is made up of a PA multifilament panel of 10 mm to 14 mm stretched meshes and comprises two lateral wings framing a central bunt, made of the smallest meshes and thickest twine, where the fish are collected. The leadline is generally shorter than the headline. The total length does not exceed 200 m and the height is not more than 25 m. Fishing is conducted using a single vessel and consists of attracting pelagic and mid-water fish with raft lights (four lamps of 500 W each). The net then encircles the fish school and is hauled by pulling the two wings on board by hand or with the help of a net hauler. The two halves of the leadline come together before the wings are drawn. To prevent fish from escaping, the leadline of the net is maintained in contact with the ground throughout the net hauling process. The strongest part of the net, the bunt, is in the upper part of the middle of the net (Sacchi and Dimech, 2011).

3. Dredgers

3.1 General characteristics

A dredge is a rigid structure (a metal cage or a metal frame with a netting bag attached to it) equipped with a scraper blade, teeth or chain on its lower part, towed to dislodge animals out of the substrate and lift them into the cage or bag.

Dredges are an active type of gear that are dragged along the bottom to catch bivalves (mussels, oysters, scallops, clams) and are occasionally also used for crustaceans, finfish, gastropods, sponges or sea urchins. Dredges can be towed by a fishing vessel or completely controlled manually (hand dredges). Dredges operated from a vessel can be either dragged by the main boat engine (towed dredge) or hauled by a motorized winch from an anchored vessel (mechanized dredge). Finally, there are dredges towed by vessels equipped with hydraulic systems capable of conveying pressurized water to the gear (hydraulic dredges). Dredges are numerous and diversified, locally designed and adapted to target different species and bottom properties. As such, dredges usually consist of a metal frame or rod of variable size and shape that delimits the mouth of the gear. A net ending in a bag can be mounted on the frame (flexible dredge), or, alternatively, the dredge can take the form of a cage and be made entirely of metal (rigid dredge). In this case, the five sides of the cage (the mouth is clearly open) can be made up of metal netting, perforated sheet metal or metal rods. The dredge can be mounted on two (or more) lateral sledge runners to prevent it from digging into the substratum.

The catching principle of all dredges is that the gear digs into the marine sediments to remove the organisms inside before the catch is guided into a netting bag or cage that allows the sediment to be filtered. Four basic types of dredges can be identified by the way they dig into the first few centimetres of sediment:

- dredges with a scraper blade mounted on the lower part of the frame, which sifts the first few centimetres of the seabed;
- dredges with a toothed rake forming the lower part of the frame;
- dredges with an upper metal frame and a chain digging the bottom; and
- dredges without a blade, teeth or chain, which are the most rudimentary of the dredges and have only a metal frame to which a net bag is laced.

The average daily and annual production of dredges greatly varies between zones and from one year to the next, as this depends on the state of the resource, environmental conditions, number of fishing vessels and number of fishing days. All dredges operate in shallow waters (generally less than 15 m) because at these depths it is possible to find the bivalve molluscs that burrow into the sediment. The most important from a commercial point of view are hydraulic dredges and dredges towed by vessels, as they allow for the most abundant catch.

The International Standard Statistical Classification of Fishing Gear (FAO, 2016) classifies dredges as in Table 10.

Table 10
Classification of dredges according to the International Standard Statistical Classification of Fishing Gear

Gear categories (first tier)	Subcategories (second tier)	Standard abbreviations	ISSCFG code
Dredges			4
	Towed dredges	DRB	4.1
	Hand dredges	DRH	4.2
	Mechanized dredges	DRM	4.3
	Dredges (nei)	DRX	4.9

Source: **FAO.** 2016. *International Standard Statistical Classification of Fishing Gear. Handbook on Fisheries Statistics.* Rome. www.fao.org/3/bt988e/bt988e.pdf

3.2 Main dredge gear

The technical properties of dredges used in the Mediterranean and the Black Sea are summarized in Table 11.

Table 11

Technical parameters of dredges used in the Mediterranean and the Black Sea

GSA	Subregion	Country	Gear code	Main Target species	Dredge width (m)	Dredge height (cm)	Dredge type	Rod spacing or mesh length (mm)	Digging gear	Rake teeth length (cm)	Towing speed (kn)	Mean depth (m)
1	Western Mediterranean	Spain	DRB	DXL, SVE, KTT	1.0		Metal frame and net bag	17–20	Rake	10–15	0.3	1–15
1	Western Mediterranean	Spain	DRB	KLK	1.0		Metal frame and net bag	30–40	Rake	24	0.3	5–30
3	Western Mediterranean	Morocco	DRH	DXL	0.5	25	Metal frame and net bag	18	Rake or blade			0.5–1.5
3	Western Mediterranean	Morocco	DRB	KTT, SVE	0.7	40	Metal frame and net bag	30	Rake	5.5		2–8
3	Western Mediterranean	Morocco	DRB	KTT, SVE	0.7	60	Metal frame and net bag	50	Rake	1.4		4–8
4	Western Mediterranean	Algeria	DRH	DON	0.5–0.6	25	Metal frame and net bag	18	Blade			1
5	Western Mediterranean	Spain	DRB	DXL, SVE, KTT, KLK	0.6–1.0	58	Metal frame and net bag	17–20	Rake	10–15	0.2–0.5	1–15
6	Western Mediterranean	Spain	DRB	DXL, SVE, KTT, KLK	0.6–1.0	58	Metal frame and net bag	17–20	Rake	10–15	0.2–0.5	1–15
2	Western Mediterranean	Spain	DRB	DXL	0.6–0.7	50–55	Metal cage	11–19	Rake	10–20	1.0–2.0	
6	Western Mediterranean	Spain	DRB	SVE, BOY	2.0	40	Metal frame and net bag	60–70	Frame		1.0–2.0	
6	Western Mediterranean	Spain	DRB	Worms, KLK	0.7	53	Metal cage	39	Rake		3.0–6.0	1.5–7.0
6	Western Mediterranean	Spain	DRB	KLK, DOV, GKL	0.7	53	Metal frame and net bag	12	Rake		1.0–1.2	5–30
7	Western Mediterranean	France	DRB	OYF, BOY	1.45–3.00	90	Metal frame and net bag	55	Blade			
7	Western Mediterranean	France	DRB	MSM	1.25		Metal frame and net bag	75	Blade			
9	Western Mediterranean	Italy	DRH	CLJ	0.5–1.0	20–30	Metal frame and net bag	20–22	Rake or blade	7	0.2	1–2

GSA	Subregion	Country	Gear code	Main Target species	Dredge width (m)	Dredge height (cm)	Dredge type	Rod spacing or mesh length (mm)	Digging gear	Rake teeth length (cm)	Towing speed (kn)	Mean depth (m)
9	Western Mediterranean	Italy	DRB	EQI, RAE, DON	2.5–3.0	40	Metal cage	7–8	Blade		1.0	2–6
9	Western Mediterranean	Italy	DRB	DXL	1.2–1.3	60	Metal frame and net bag	20	Rake	30	0.2–0.3	0–4
9	Western Mediterranean	Italy	DRB	DXL	0.6–0.7	20	Metal cage	20	Rake	7–10	0.2–0.3	0–4
10	Western Mediterranean	Italy	DRB	EQI, RAE, DON	2.5–3.0	40	Metal cage	7-8	Blade		1.0	2–6
10	Western Mediterranean	Italy	DRB	DXL	1.2–1.3	60	Metal frame and net bag	20	Rake	30	0.2–0.3	0–4
10	Western Mediterranean	Italy	DRB	DXL	0.6–0.7	20	Metal cage	20	Rake	7–10	0.2–0.3	0-4
17	Adriatic Sea	Italy	DRM	SVE, VNA, KFX, NSQ, KTT	2.8–3.0	40	Metal cage	12	Blade		1.8–2.0	5–15
17	Adriatic Sea	Italy	DRH	DXL	0.5–1.0	20–30	Metal frame and net bag	20–22	Rake	7	0.2	1–2
17	Adriatic Sea	Italy	DRH	CLJ	0.55	30	Metal cage		Blade		0.2	1–2
17	Adriatic Sea	Italy	DRM	EQI, RAE, DON	2.5–3.0	40	Metal cage	7–8	Blade		1.0	2–6
17	Adriatic Sea	Italy	DRM	KLK	2.5–3.0	40	Metal cage	25	Blade			10–30
17	Adriatic Sea	Croatia	DRB	Pectinidae	4		Metal frame and net bag		Rake			
18	Adriatic Sea	Italy	DRB	Pectinidae, DJB	1.5	20–30	Metal frame and net bag	50	Rake	5–7		
18	Adriatic Sea	Albania	DRM	SVE, KTT, KLK			Metal cage		Blade			
22	Eastern Mediterranean	Greece	DRB	Sponges	0.9	30	Metal frame and net bag	150				
22	Eastern Mediterranean	Greece	DRB	Sponges	2.0	50	Metal frame and net bag	300–340	Chain		2.0	10–50

GSA	Subregion	Country	Gear code	Main Target species	Dredge width (m)	Dredge height (cm)	Dredge type	Rod spacing or mesh length (mm)	Digging gear	Rake teeth length (cm)	Towing speed (kn)	Mean depth (m)
22	Eastern Mediterranean	Greece	DRB	Shellfish	1.2	25	Metal frame and net bag	70	Rake (or frame)	3	0.2	1–20
28	Black Sea	Türkiye	DRB	MSM	1.2	60	Metal frame and net bag	15	Rake	5		
29	Black Sea	Türkiye	DRM	SVE	2–3	35–55	Metal cage	7–10	Blade			5–20
29	Black Sea	Bulgaria	DRB	SVE, DON	0.8	18	Metal cage	10	Rake	30		2–6
29	Black Sea	Romania	DRM	MSM	3.5	45	Metal cage	10–12	Blade		1.5–2.0	20
29	Black Sea	Romania	DRB	SVE, MSM	0.7	24	Metal frame and net bag	15-30	Blade		0.8	0.5–1.5
29	Black Sea	Romania	DRH	SVE, MSM	0.45	25	Metal frame and net bag	15	Blade		0.3	1.5–20.0
29	Black Sea	Romania	DRH	SVE, MSM	0.4	20	Metal frame and net bag	7	Blade		0.3	0.5–1.5
29	Black Sea	Ukraine	DRB	RPW, MSM								
29	Black Sea	Ukraine	DRB	RPW								
29	Black Sea	Ukraine	DRB	RPW, MSM	< 2	< 70	Metal cage		Blade		3	10
30	Black Sea	Ukraine	DRM/ DRB/ DRH	GPA	< 45	< 200			Chain		1.5–2.0	2–7

Notes: DRB: boat dredges; DRH: hand dredges; DRM: mechanised dredges; BOY: Bolinus brandaris; CLJ: Ruditapes philippinarum; DJB: Modiolus barbatus; DON: Donax spp.; DOV: Donax variegatus; DXL: Donax trunculus; EQI: Ensis (siliqua) minor; GKL: Glycymeris glycymeris; GPA: Gobiidae; KFX: Cardium spp.; KLK: Callista chione; KTT: Acanthocardia tuberculata; MSM: Mytilus galloprovincialis; NSQ: Nassarius mutabilis; OYF: Ostrea edulis; RAE: Solen marginatus; RPW: Rapana venosa; SVE: Chamelea gallina; VNA: Polytitapes aurea.

3.2.1 Towed dredges

Towed dredges are dredges actively towed by the main boat engine or by a motorized winch from an anchored vessel. As such, towed dredges have a quite simple design; the gear usually has a robust metal frame (rectangular or triangular shape) with a width no greater than 1–1.5 m and a weight less than 30 kg. The lower leading edge of the frame that touches the seabed can be equipped with a toothed rake (with teeth around 5–7 cm long) or chain. Sometimes, wooden depressors are mounted on the front of the metallic frame to increase contact with the seabed and to facilitate the digging of the teeth into the soft sediment. A net, usually made of polyamide (PA) or polyethylene (PE), is mounted directly on the frame and consists of two panels: the upper and the lower panel. Depending on the power and size of the vessel and the fishing depth, the number of dredges can vary from a single dredge towed behind the boat to two dredges towed on each side of the stern. This type of gear is commonly used to target bivalves such as the Pectinidae – variegated scallop (*Mimachlamys varia*) and smooth scallop (*Flexopexten glaber*) – the bearded horse mussel (*Modiolus barbatus*), oysters and rapa whelk (*Rapana venosa*); these species are strongly attached to the seabed so the fishing practice requires more than one single passage along the same track to scrape the mussels from the bottom. Each vessel can tow more than one dredge, but usually no more than two.

Subregional variations

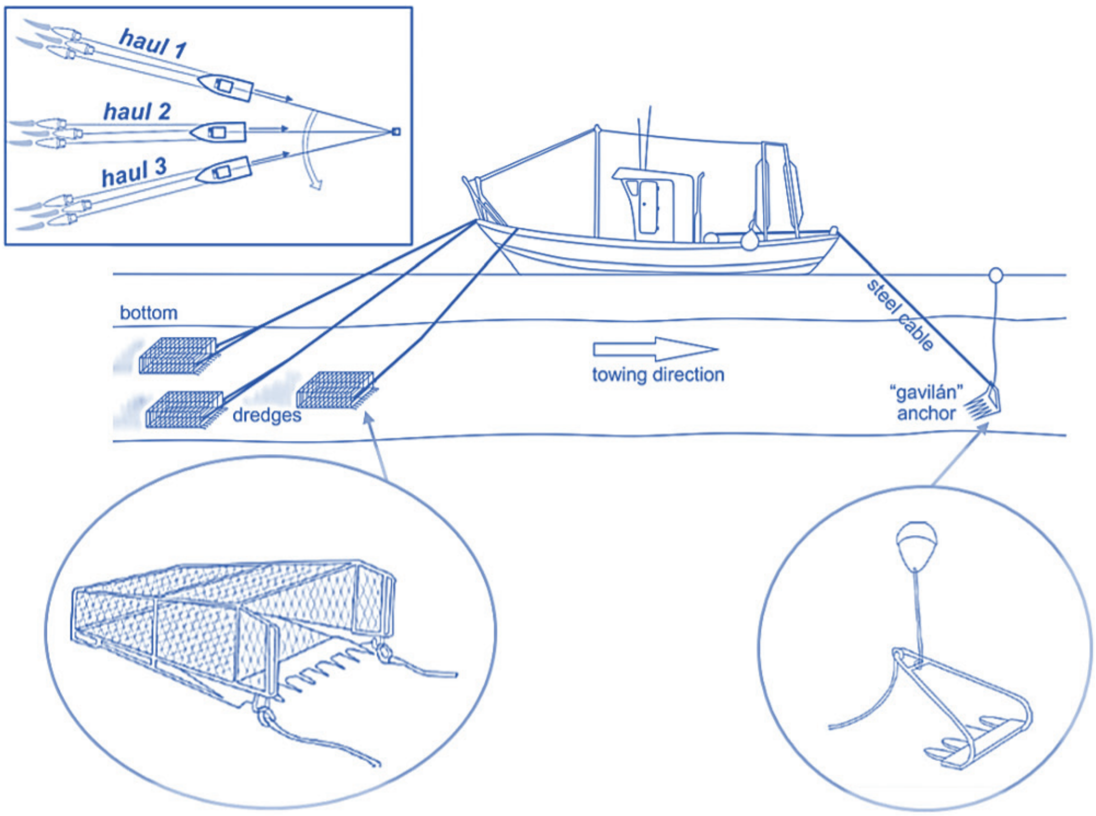
Western Mediterranean

In Morocco (GSA 3), boat-operated dredges are used to catch the striped venus clam (*Chamelea gallina*) and rough cockle (*Acanthocardia tuberculata*). This type of gear is made of a metal cage and a net bag with variable mesh lengths depending on the target species and on the mean depth where it is used (from 2 m to 8 m; Roullot and Fahfouhi, 1984).

In Spain, vessels of 7 m to 11 m in length are involved in the towed dredging fishery in the northern Alboran Sea (GSA 1), in Catalonia (GSA 6) and in the Balearic Islands (GSA 5) as part of a multitarget artisanal shellfish fleet (Urra *et al.*, 2019, 2021). This fleet mainly targets bivalves, such as the wedge clam (*Donax trunculus*), striped venus clam, smooth clam (*Callista chione*) and rough cockle. These vessels can also target other species with different types of gear in certain seasons. In Catalonia, the dredge is usually made of a rigid iron frame (around 1 m wide) with 40–50 round iron teeth (length: 10–15 cm; width: 8–10 mm) that scrape the seabed. The frame is covered by a plastic or metallic grid (mesh size: 17–20 mm) to hold the catch. Other types of dredges have a net bag (mesh size: 22 mm) and a lower number of iron teeth (around 20) that are set further apart (up to 20 mm). The size of the meshes of the metal netting covering the frame is regulated to avoid the capture of immature specimens. Baeta, Rubio and Breton (2021) reported boats that simultaneously tow four clam dredges (frame mouth width 60 cm; height 58 cm; depth 87 cm) at a towing speed of 0.2–0.5 knots.

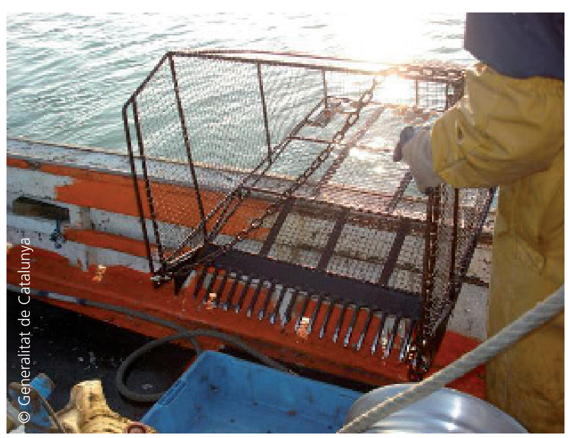
Each fishing operation takes about 20–40 minutes (including dredging at about 10 m/minute, sorting the catch and discarding) and is repeated several times in a circle around the anchor used at the stern, locally called *rastellot* (Figure 51). The dredge is named a *gàbia* (Generalitat de Catalunya, 2015) (Plate 30). The maximum number of dredges per boat is four units. When the vessel reaches the fishing area, the anchor is thrown from the stern of the boat and around 200–400 m of steel cable are lowered, depending on the depth of fishing in relation to the habitat of the target species. The anchor is marked on the surface by means of a buoy that denotes its position for the other vessels. Once the anchor is set, the four cages (Plate 31) are thrown into the sea by the bow of the boat (two per port and two per starboard) and are attached to it by a cable of about 10 m in length. Therefore, the anchor cable is hauled by a hydraulic winch. The towing operation of a set takes approximately 25 minutes during which about 170 m of the seabed are dragged, and then the cages are hauled in. The catch is sorted on board through a sieve and species of illegal size and non-commercial ones are returned to the sea immediately. The maximum operating depth is around 15 m. Each boat usually performs between 15–20 tows per day (Baeta, Rubio and Breton, 2021).

FIGURE 51
Operation of a *gabias* mechanized dredge used in Spain



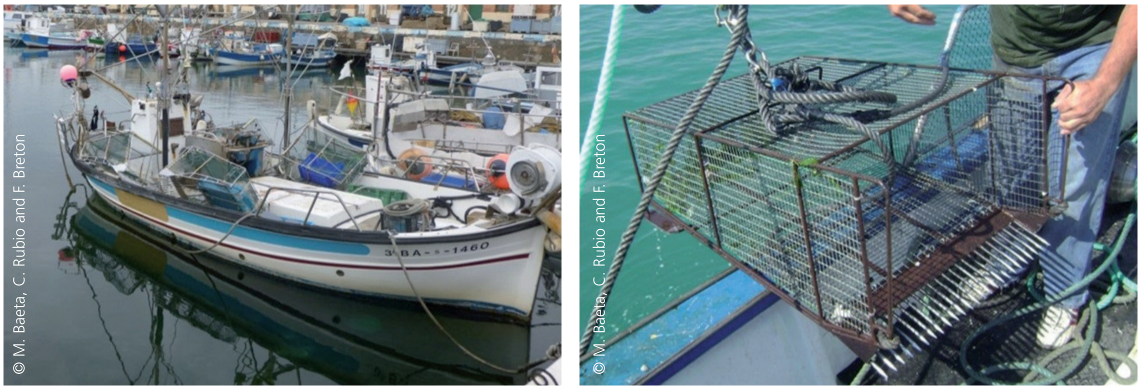
Source: **Generalitat de Catalunya.** 2015. *Plan de gestión de la modalidad de dragas mecanizadas (PGDM) de Calalunya.* Departament d'Agricultura, Ramaderia, Pesca, Alimentació i Medi Naturali. Barcelona, Spain.

PLATE 30
Dredges used for smooth clams (*Callista chione*) and wedge clams (*Donax* spp.)



Source: **Generalitat de Catalunya.** 2015. *Plan de gestión de la modalidad de dragas mecanizadas (PGDM) de Calalunya*. Departament d'Agricultura, Ramaderia, Pesca, Alimentació i Medi Naturali. Barcelona, Spain.

PLATE 31
Clam dredges on board a small-scale boat (left) and the traditional clam dredge used on the northeastern coast of Spain (right)



Source: **Baeta, M., Rubio, C. & Breton, F.** 2021. Impact of mechanized clam dredging on the discarded megabenthic fauna on the Catalan coast (NW Mediterranean). *Journal of the Marine Biological Association of the United Kingdom*, 101(3): 545–553.

The Ebro Delta (GSA 6) was likely one of the first areas to see the establishment of a striped venus clam fishery in the western Mediterranean region (Baeta *et al.*, 2021). This fishery has evolved from the 1950s to today. In the mid-1970s, "the modern clam dredge fisheries" (i.e. the mechanized clam dredge fisheries) replaced the "ancient clam dredge fisheries". Currently, only three fishing vessels use this modern method, mainly targeting other species and only occasionally harvesting clams. Fishing is carried out by dragging four clam dredges along the bottom (Plate 32). Usually, tows are performed parallel to the shore, at a towing speed of 1–2 knots and for a duration of 15–20 minutes. Dredges of approximately 30 kg consist of a metallic frame, a toothed lower bar and a rectangular metallic grid box (width 60–70 cm; height 50–55 cm; depth 120–140 cm; mesh size 11 mm × 11 mm/19 mm × 19 mm) closed at the back. The toothed lower bar has between 18 and 25 teeth with a length of 10–20 cm and a diameter of 20 mm. There are also two metal bars welded to the dredge mouth where the towing cable is attached.

A slightly modified dredge design is used to target worms, which are sold as live bait to recreational fishers (Baeta, Navarrete and Ballesteros, 2019). These dredges are rigged with metallic teeth along the lower leading edge. They include several structures to retain worms, but are open at the back. The mesh size of the dredges on the top, bottom and both sides is a constant 29 × 29 mm, which is the same mesh size used to target smooth clams. In the mid-1980s, another new and more efficient clam fishery began using new technology and more powerful engines, leading to "the towed dredge fisheries". The towed dredge fleet targets not only the striped venus clam, but also the purple dye murex (*Bolinus brandaris*). Currently, the towed dredge fleet is responsible for over 95 percent of striped venus clam landings in the Ebro Delta area (2000–2019). Fishing is carried out by dragging two gear units (dredges) side by side from the stem. Usually, tows are performed parallel to the shore, at a towing speed of 1–2 knots and for a duration of 5–10 minutes to target striped venus clams or 1–1.5 hours to target purple dye murex. The dredges (Plate 32) have three parts: the mouth, the main body and the codend. The total length of the gear varies between 6 m and 8 m. The mouth is a rectangular or semi-oval metal frame, with a 2 m maximum horizontal aperture and a 40 cm vertical aperture. The upper part of the bag consists of netting and the lower part of 13–16 tickler chains. The codend (60–70 mm mesh size) measures 1.5–3 m. The lower part of the bag is made of thicker and more resistant mesh, while the material in the upper part is lighter to keep the net open during the trawl.

PLATE 32
Clam dredges used by mechanized clam dredge fisheries (left) and by towed dredge fisheries (right) in the Ebro Delta

Source: **Baeta, M., Solís, M.A., Ballesteros, M. & Defeo, O.** 2021. Long-term trends in striped venus clam (*Chamelea gallina*) fisheries in the western Mediterranean Sea: The case of Ebro Delta (NE Spain). *Marine Policy*, 134: 104798.

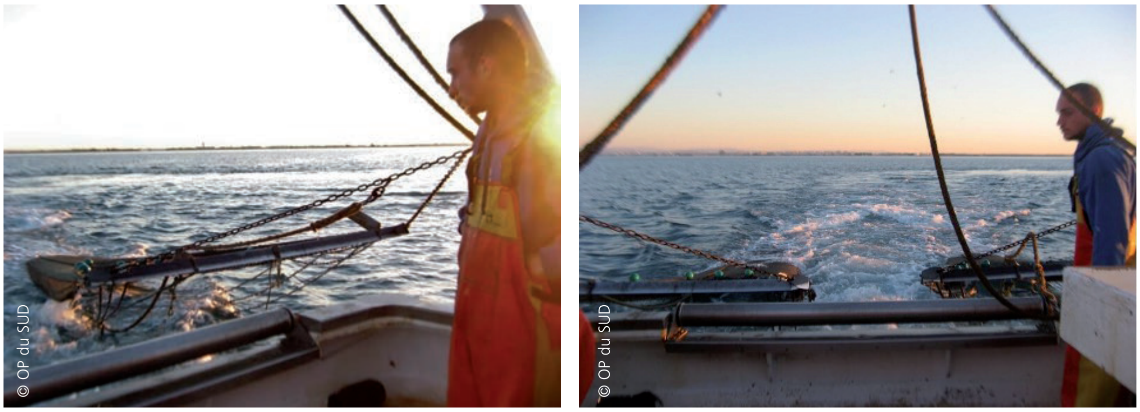
In France (GSA 7), dredges must be used only for sea snails, clams, oysters, sea urchins and grooved sea squirt (*Microcosmus vulgaris*). Towed dredging activity is carried out with a dredge composed of a netting bag or a metal basket mounted on a rigid frame or a bar of variable size and shape for the purpose of catching bivalves, gastropods and sea urchins. Two types of towed dredges are used.

The seashell dredges and sea snail dredges (Figure 52; Plate 33), called *drague barre* (bar dredge), are used exclusively at sea and mainly target purple dye murex. The lower part of the metal frame consists of a non-cutting flat bar not exceeding 3 m and 90 kg, without teeth and sledges. In addition, one or more chains are attached to both ends of the bar to increase contact with the bottom. The total weight of the metal frame of the gear does not exceed 90 kg. The minimum mesh size of the netting bag is 55 mm and the maximum width of the bar is 3 m (Sacchi, 2008; PGM, 2014).

FIGURE 52
***Drague barre* dredge used in France**

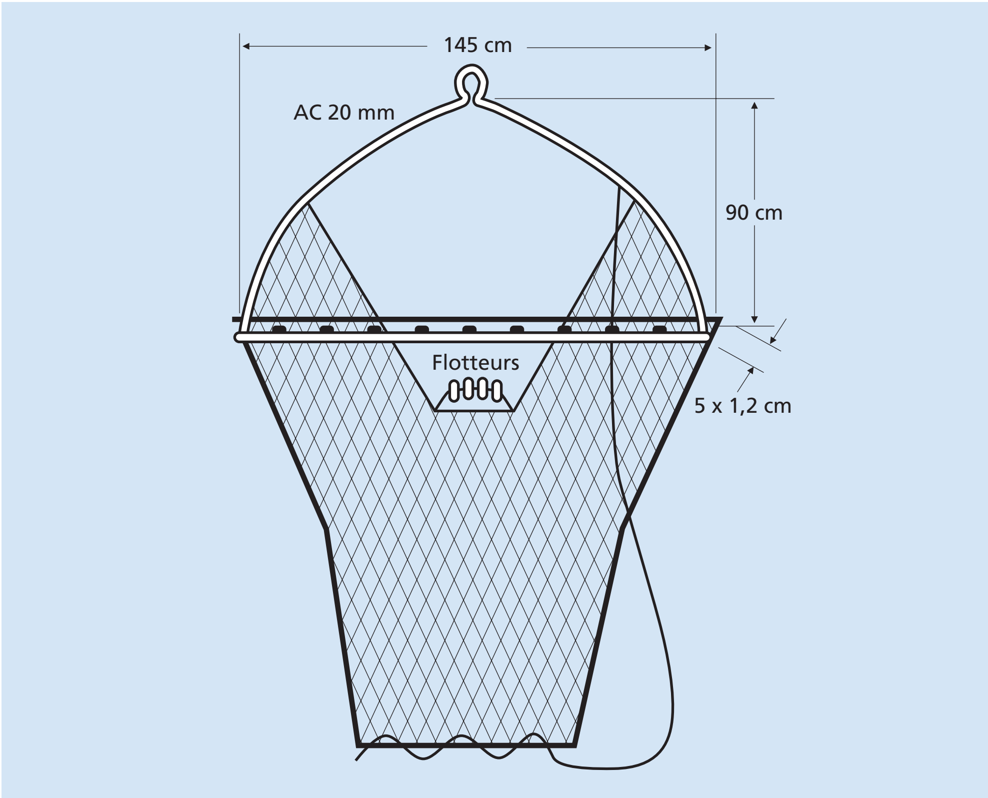
Source: illustrated by A. Lucchetti.

PLATE 33
***Drague barre* dredge used in France**



In addition, some vessels are currently involved in dredging for oysters, mainly in the Gulf of Lion (Figure 52), but also in some bays along the coast of Provence. This technique is practised around eight months per year; the characteristics of the oyster dredge are defined by national legislation. The bottom part of the dredge (cutter) is limited to a maximum length of 2.5 m and must not be sharp nor have teeth. The total weight with its chains must not exceed 50 kg. The minimum mesh size for the codend must not be less than 80 mm.

FIGURE 53
Towed dredge used in the Gulf of Lion

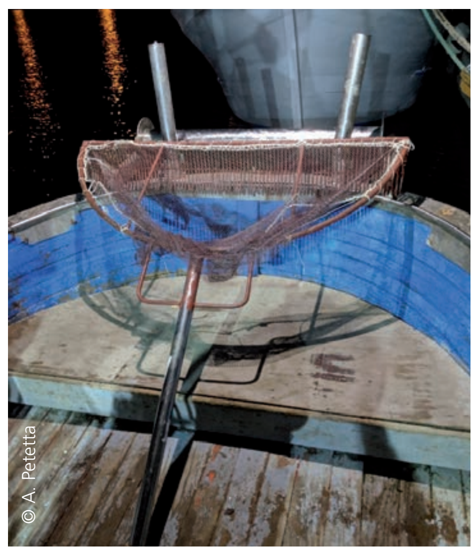


Source: redrawn from J. Sacchi and Le Musée Ethnographique de l'Étang de Thau.

In Italy (GSAs 9 and 10), in the central Tyrrhenian Sea (off Tuscany, Lazio and Campania), a mechanized dredge or rake towed by an anchored vessel, through the use of the anchor cable, is employed to catch wedge clams. The rakes are dredges made up of a stainless-steel frame that delimits the entrance or mouth of the gear. The upper part is often a semicircle, of which the lower part is the diameter, where long, sharp iron teeth are fixed close together. A net bag with a very small mesh made of PA netting is mounted on the mouth for the collection of small clams, like the wedge clam. Alternatively, the mechanized dredge can be a cage entirely made of metal, with a rake in the lower part of the mouth and all sides covered with a netting made of metal as well. Two lateral slides placed in the lower lateral part of the dredger facilitate sliding on the bottom.

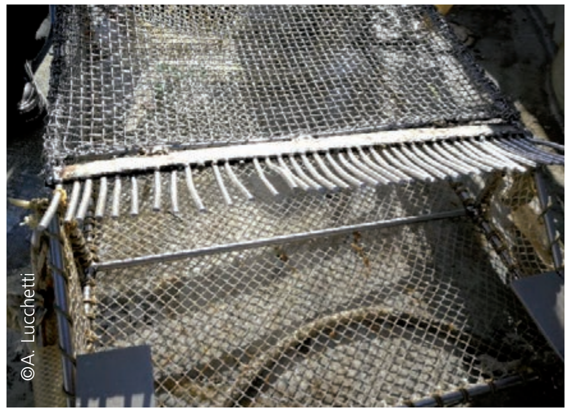
The most widely used boat rake along the central Tyrrhenian Sea (off the regions of Campania and Lazio) is the *napoletano* rake (Plate 34): the lower part of the metal frame is armed with very long iron teeth (about 30 cm), sharp and close to each other, so that the wedge clams cannot escape. The mesh size of the collecting bag is 20 mm and the opening of the rake frame is about 120–130 cm (Petetta *et al.*, 2019).

PLATE 34
***Napoletano* rake mechanized dredge**



The rake most used along the Tuscan coast (northern Tyrrhenian Sea) is the so-called *viareggino* rake (Plate 35). It has teeth of only 7–10 cm in length, a width of about 50–60 cm and a maximum height of 20 cm.

PLATE 35
***Viareggino* rake mechanized dredge**



Both models are used in very shallow waters (bathymetries never more than 4 m), so they are equipped with a short handle (1–3 m), or a short rope, which regulates the inclination of the teeth during towing and are shaken during the recovery phase to release the sediment. The methods of fixing the handle to the tow cable allow the inclination of the teeth to be adjusted with respect to the bottom. Small boats (3–8 m in size) are used to tow the dredge, and very often the crew is composed of only one or two people. The fishing action is carried out by lowering the anchor and then unwinding the anchor cable by leading the boat with the engine in reverse. Once the cable has been unrolled to the desired length (50–100 m), the fisher releases the rake into the sea and begins to retrieve the anchor through the winch. Once the recovery of the anchor cable is completed (this operation allows the rake to be towed on the bottom), the dredge is hauled and the net bag is emptied on board. Each vessel can tow a maximum of two rakes, each with a cable attached to the handle and hauled on both sides of the boat. The selection of marketable sizes (greater than 20 mm) is carried out through cylindrical metal baskets manually operated by the onboard staff or through the use of hand-vibrating sieves (Plate 36). In both cases, the mesh openings of the sieves are around 20 mm (Petetta *et al.*, 2019).

PLATE 36
Manual sieve used on board to sort commercial clams

Central Mediterranean

In Sicily (GSA 16), a towed dredge, the so-called *ganghero* or *gangamu*, has been used; it comprises a 1–1.5 m wide metal beam and a vertical net opening of 0.4 m, mounted on two lateral sledge runners (30–35 cm high) to prevent it from digging into the substratum (Plate 37). A cutting blade is mounted on the lower side of the gear to scrape the surface of the substratum and dig into it. This gear is nowadays quite rare, though it was commonly used at low depths to catch sea urchins. The net, made of PA and PE, consists of two panels: the upper and lower panel 6–7 m long. It is employed at around 15 m depth to catch shrimps, crabs, demersal fish and sea urchins. This gear appears to be no longer in use at the time of writing.

The classification of this tool is controversial, as it could also be included in the beam trawl group (Sala *et al.*, 2013).

PLATE 37
Commercial *ganghero* (twin-gear) that was used in Sicily

Adriatic Sea

In the Italian southern Adriatic Sea (GSA 18), the *rampone* trawl is used (Sala *et al.*, 2013). The gear consists of a box dredge about 1.5 m wide, weighing 30 kg, rigged with 5–7 cm teeth along the lower leading edge and a net bag to collect the catch. Two inclined wooden boards (150 × 30 × 2.4 cm) are fitted to the front of the metallic frame to act as a depressor, in order to keep the gear in contact with the seabed and, moreover, to press it on to the bottom to facilitate the penetration of the teeth into the soft sediment (Plate 38). The gear is equipped with four skids that enable the sliding of the gear on the seabed. The net, made of PA and PE, consists of two panels: the upper and the lower panel at 4 m long. This type of gear is commonly used to target bivalves in the Pectinidae, such as the variegated scallop, and in the Mytilidae, such as the bearded horse mussel; these species are strongly attached to the seabed, and therefore this fishing technique requires more than one traverse of the gear in the same area. The *rampone* is classified by Italian legislation as a mechanized dredge as it mainly catches bivalves. Therefore, Italian Ministerial Decree 22/12/2000 (Ministero dell'Interno, 2000) has fixed for this gear the following technical measures:

- The width of the beam should be no more than 1.6 m.
- The minimum mesh opening of the net should be 50 mm.
- The length between perpendiculars of the fishing vessel should be no more than 10 m, the engine power should be at most 150 hp and the gross tonnage should be at most 10 tonnes.

PLATE 38
Commercial *rampone* trawl used in the southern Adriatic Sea

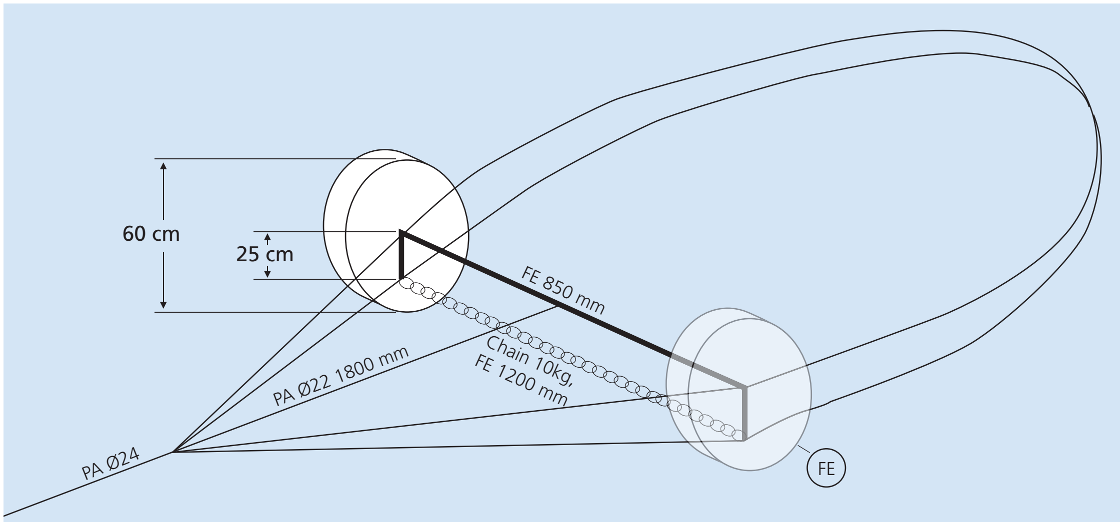
In Croatia (GSA 17), a dredge quite similar to the *rapido* trawl is locally known as a *rampon*, which is classified by the national regulation as a dredge. This gear is allowed only in the northern Adriatic Sea and the maximum mouth width is set at 4 m. The main target species is the great Mediterranean scallop (*Pecten jacobaeus*), which mostly occurs on sandy or sandy–muddy seabeds along the coast of the Istrian Peninsula at depths less than 70 m (Cetinić and Soldo, 1999a, 1999b; Ezgeta-Balić *et al.*, 2021).

Eastern Mediterranean

In Greece (GSA 22), there are two different types of solid frame gear: the *gagkava* targeting sponges and the *argaleios* targeting shellfish (Sala *et al.*, 2013).

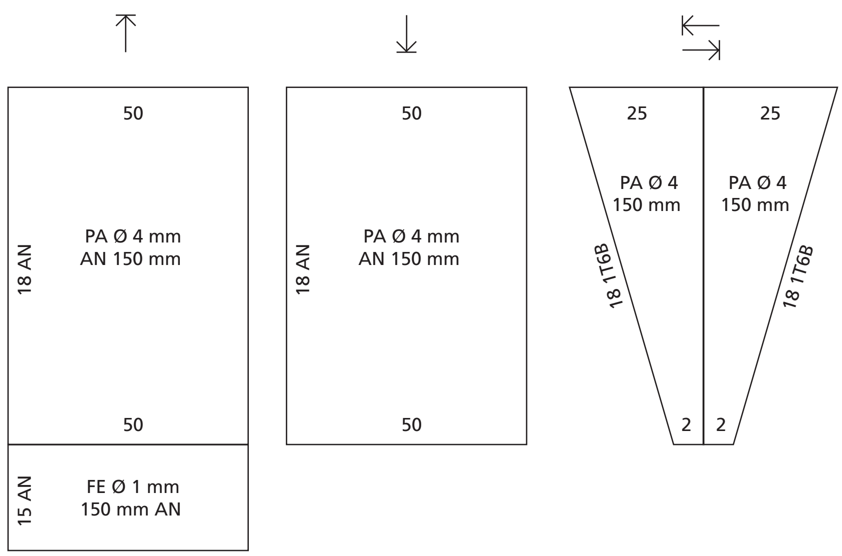
The *gagkava* or *gagava* was used mainly in the southeastern Aegean Sea (Dodecanese area; Figure 54 and Figure 55). Currently, it is no longer used due to the damage it caused on the sea bottom, even though no regulations prohibit them. This dredge has a rectangular frame made of wood or metal rods, to which a netting bag is attached. The frame is about 2 m wide, 0.5 m high and 2.5–3 cm thick. The netting bag has a length of 4 m to 8 m and the mesh size is 300–340 mm (stretched mesh). It is tied directly to the upper and side part of the frame while, at the lower part, a chain of 2.5–2.6 m is connected and the bag is attached to the chain. The bag is emptied either by loosening the end line or by lifting it from the rear to drop the catch from the mouth. The overall weight of the gear reaches up to 50–60 kg. The *gagava* is dragged along the seabed by a towing wire that is linked to the frame by three ropes (two at the lower and one at the upper part of the frame) using a motorized winch with a towing speed of 2 knots. It is used mainly in sponge fishing at depths from 10–50 m on an even seabed.

FIGURE 54
G*agkava* dredge used in Greece



Source: redrawn from **Adamidou, A.** 2007. Commercial fishing gears and methods used in Hellas. In: Papaconstantinou C., Zenetos A., Vassilopoulou C. & Tserpes G., eds. *State of Hellenic Fisheries*, pp. 118–181. Athens, Greece, Hellenic Centre for Marine Research and Institute of Marine Biological Resources;

FIGURE 55
Technical specifications of the *gagkava* dredge net used in Greece



Source: redrawn from **Sala, A., Brčić, J., Conides, A., De Carlo, F., Klaoudatos, D., Grech, D., Lucchetti, A.** *et al.* 2013. *Final project report. Technical specifications of Mediterranean trawl gears (myGears).* Specific project Nr. 5 – Framework service contract Mediterranean Halieutic Resources Evaluation and Advice (MAREA). Bari, Italy, COISPA, Rome, CNR, Attiki, Greece, HCMR, Livorno, Italy, CIBM, Peñiscola, Spain, SUMASPE, Guilvinec, France, SIMRAD.

The *argaleios* (Plate 39) is used in several areas around Greece and is a triangular metal frame up to 0.2 cm thick with sidebars curved at the end. The lower side of the frame touching the sea bottom is up to 1.2 m long and can be equipped with a rake. In this case, the teeth of the rake cannot be more than 3 cm in length and less than 1.5 cm apart. A netting bag, which is up to 1.5 m long with a mesh size over 70 mm (stretched mesh), is attached to the frame to collect the catch. The overall weight of the gear is less than 12 kg. The *argaleios* can be towed either by hand or from a vessel using a towing rope tied to the eyelet at the top of the triangular frame. It is used on even seabeds at depths from 1 m to 20 m, and the target species are the smooth scallop, the smooth clam and the bearded horse mussel. The gear is mainly used in the Thermaikos Gulf and to a lesser extent in the Saronic Gulf and the Pagasetic Gulf.

PLATE 39
***Argaleios* gear used in Greece**

Source: **Adamidou, A.** 2007. Commercial fishing gears and methods used in Hellas. In: Papaconstantinou C., Zenetos A., Vassilopoulou C. & Tserpes G., eds. *State of Hellenic Fisheries*, pp. 118–181. Athens, Hellenic Centre for Marine Research and Institute of Marine Biological Resources.

Black Sea

In Türkiye (GSA 28), a boat dredge targeting the Mediterranean mussel (*Mytilus galloprovincialis*) is reported (locally called *midye dreci*). It is made of a metal frame with teeth 5 cm long and 15 mm spacing, and a net bag 2.5 m long (Doyuk, 2006).

In Bulgaria (GSA 29), a boat dredge targeting both wedge clams (*Donax* spp.) and striped venus clams is reported. It is a small type of gear, having a metal frame 0.8 m wide and 60 cm long with a mouth 18 cm high and a rake for digging with long teeth (30 cm) spaced 0.8 cm apart. The mesh size of the netting bag is 10 mm. It is towed at depths of 2–6 m (Gumus, Todorova and Panayotova, 2020).

In Romania (GSA 29), the boat dredge reported by Niță *et al.* (2021) is made of a metal cage (0.7 m wide, 24 cm high) with a net bag (meshes of 15–30 mm mesh length) and a blade for digging into the sediment. It is towed at a speed of 0.8 knots at depths of 0.5–1.5 m. The main target species are striped venus clams and mussels.

For the Ukrainian fishery (GSA 29), rapa whelk is a target species. Previously, this species was targeted by divers, but over 2016–2018, some vessels started to use mechanized dredges (Khizhyak's dredge) and beam trawls. Thus, the landings of rapa whelk have increased dramatically. Mechanized dredges are also used to catch the Mediterranean mussel (FAO REU, 2016).

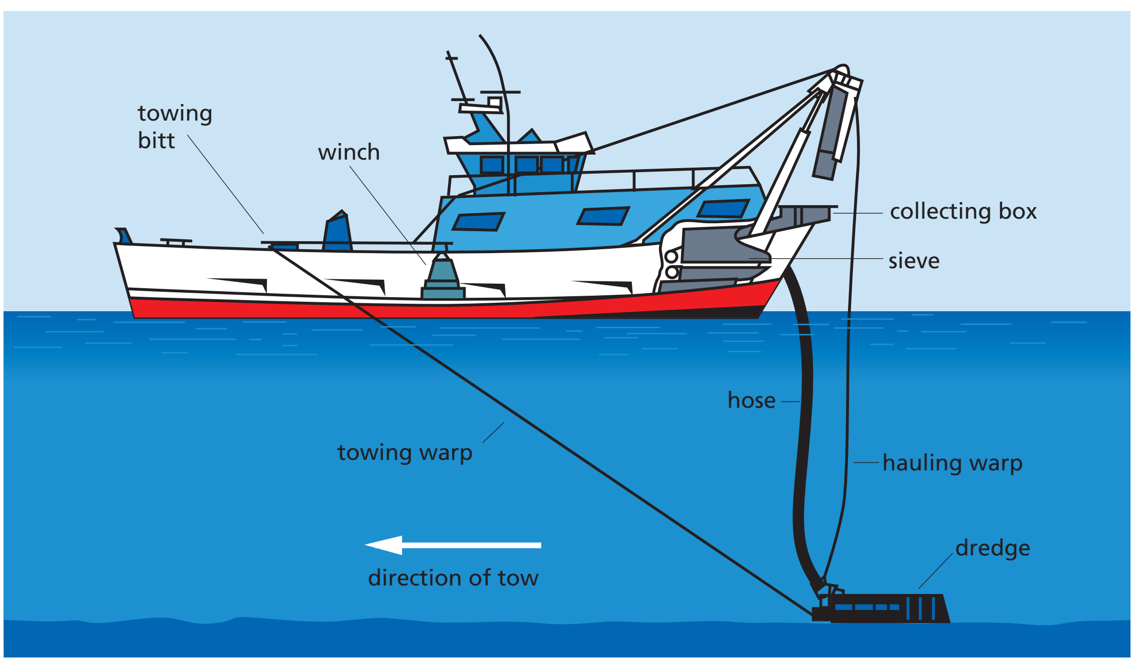
3.2.2 Mechanized (hydraulic) dredges

The mechanized or hydraulic dredge consists of a metal cage-like structure towed by means of vessel propeller or anchor. Its functioning relies on high-pressure water jets used to remove the target species from the sediment and to facilitate their capture (Figure 56 and Figure 57). The main target species in the Mediterranean and the Black Sea are striped venus clams, razor clams (*Ensis minor, Solen marginatus*) and smooth clams. The hydraulic dredge consists of a metal cage (2.5–3 m wide), whose bottom part is made of metal rods; the cage is mounted on two sledge runner skids to prevent it from digging into the sediment (Plate 40). The front lower part of the cage is fitted with a scraper blade. The front of the cage is connected by a hose to a centrifugal water pump that ejects water under pressure from a series of 2–3 nozzles mounted at the mouth of the dredge and inside the cage (Plate 41). The water pressure is used to drive out the marine organisms living within the bottom sediments, so as to facilitate their catch and to wash the cage of sand and mud.

Once suitable fishing grounds are reached, the dredge is lowered from the bow of the vessel. Due to its weight, the cage immediately sinks to the bottom and the vessel moves in reverse at low speed (around 1 knot) for a variable distance. At the end of the tow, the cage is hauled in and its contents are tipped into a collecting box (Lucchetti and Sala, 2012). The catch is finally sorted into different commercial classes by means of a mechanical vibrating sieve, sometimes composed of multiple sieving grids (Plate 42). The unwanted material and undersized bivalves are directly thrown back into the sea. The selection of the product is carried out either on the seabed, by the dredge itself, or on board, using the sieve grids. The towing of hydraulic dredges can also take place using a motorized winch from an anchored vessel (Plate 43). Fishing operations take place as follows: at the stern of the boat, the anchor is thrown and then 200–300 m of cable are lowered. At that point, the dredger is lowered and once it touches the bottom, winches begin to retrieve the anchor cable. In this phase, the dredger digs into the seabed, capturing bivalve molluscs living in the sediment.

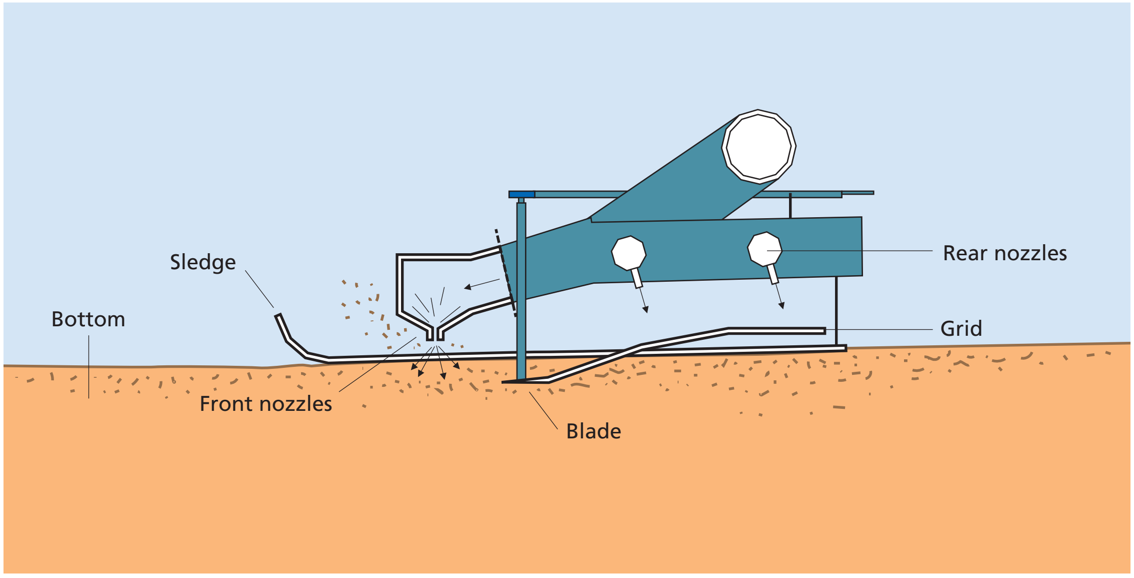
The catching efficiency of these types of gear strongly depends on the dimensions of the dredge and towing speed. Meanwhile, the selectivity is mainly affected by the characteristics of the dredge and the sieves, the space between the rods, the mesh side of the grid (if a grid is used as a sieve) and the diameter of the holes (if a metal sheet is used to sort the catch). An average of two crew members usually works on a vessel.

FIGURE 56
Operation of a hydraulic dredge



Source: redrawn by Koen Ivens from **Lucchetti, A. & Sala, A.** 2012. Impact and performance of Mediterranean fishing gear by side-scan sonar technology. *Canadian Journal of Fisheries and Aquatic Sciences*, 69(11): 1806–1816.

FIGURE 57
Hydraulic dredge



Source: redrawn by Koen Ivens from **Ferretti, M., Tarulli, E. & Palladino, S.** 2002. *Classificazione e descrizione degli attrezzi da pesca in uso nelle marinerie italiane con particolare riferimento al loro impatto ambientale.* Rome, ICRAM.

PLATE 40
Hydraulic dredge equipment

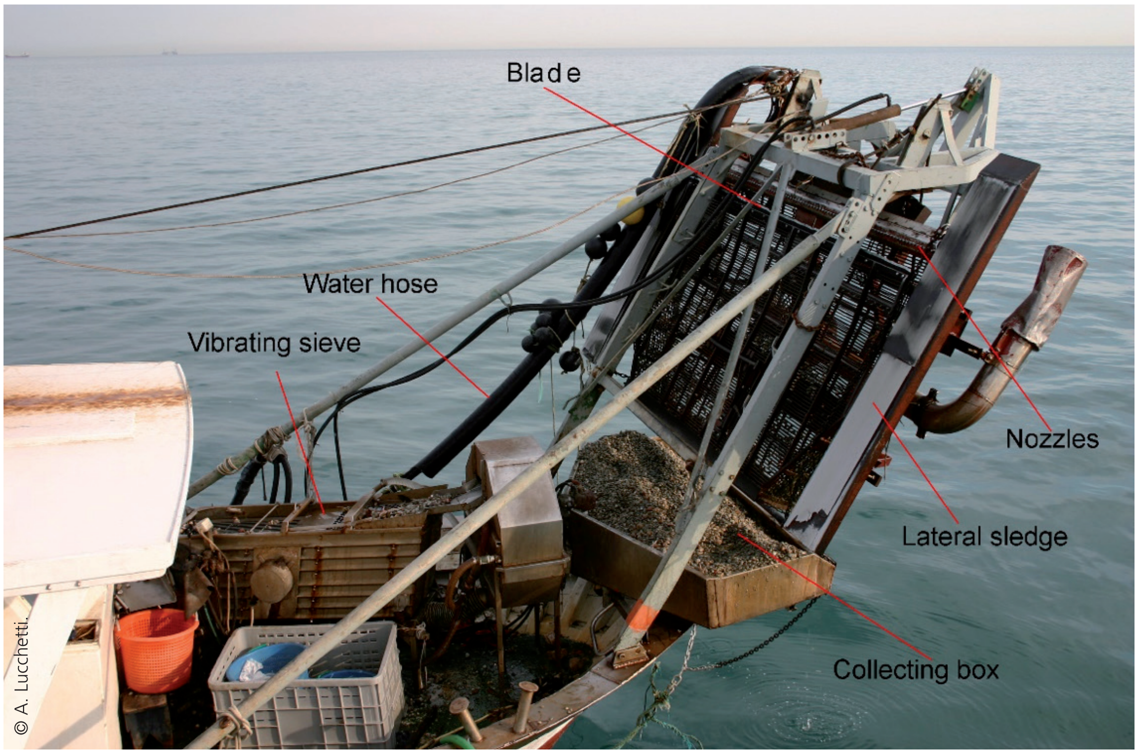


PLATE 41
Lower side of a hydraulic dredge cage with nozzles ejecting water under pressure

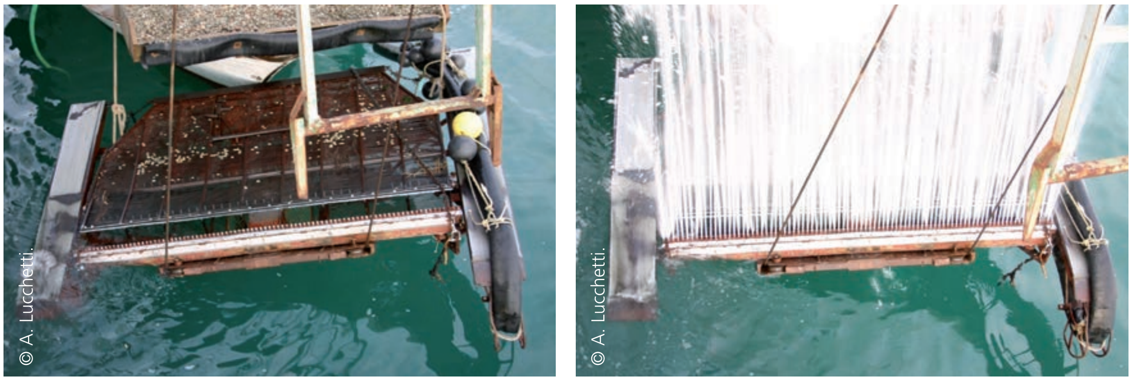


PLATE 42
Vibrating sieve (left) sorting clams into different sizes (right)

PLATE 43
Dredge (top) equipped with an anchor (bottom) for towing the cage

Subregional variations

Western Mediterranean

In Spain, the fleet targeting the striped venus clam in the Gulf of Cadiz, Andalucia (southwest Spain) uses hydraulic blade dredges, whereas the fleet targeting this species in the Alboran Sea (GSA 1) and along the Algarve coast uses mechanized dredges. These dredges are on average 2.75 m wide, 2 m deep and 0.45 m high. The towing of these dredges can take place in two ways: with the anchor cable (200–300 m) or directly with the propeller. The towing is performed at 2.5 knots maximum, while fishing operations are repeated several times and the course changes five degrees each time (Scarcella and Cabanelas, 2016).

In Italy (GSAs 9 and 10), the hydraulic dredges operating in the Tyrrhenian Sea (Campania and Lazio Regions) mainly target razor clams (Vasapollo *et al.*, 2020). This species inhabits sandy seafloors at a depth of around 2–6 m. Therefore, the fishing vessels targeting the razor clam operate at a distance usually less than 0.3 nautical miles from the coast and never go beyond 8 m depth, on account of the ecology of this species. The dredge consists of a metal cage, inside which pressurized water is injected through nozzles (hence the term "hydraulic") to both penetrate the sea bottom and dissolve the sediment, and to clear the cage of materials such as sand, mud and debris that often clog it. One or two centrifugal water pumps are placed on board the fishing vessel and they direct the water to the cage by a rubber tube. The minimum bar spacing of the cage is set at 7 mm by the Italian national regulation. A metal blade is positioned at the front of the cage and is in contact with the bottom, protruding under the two small skid-sledge runners; this blade enables the cage to dig target organisms out of the sediment, in conjunction with the nozzles. The dredge rests on the bottom due to two small lateral slides on the front of the cage. Towing is carried out by recovering the anchor cable in reverse. The dredge is always placed at the bow of the vessel; at the end of the tow the cage is hauled on board and the collected material is conveyed to a tank. The selection of commercial sizes of *Ensis minor* is carried out manually.

Central Mediterranean

No hydraulic dredges are reported for this subregion.

Adriatic Sea

Along the Italian Adriatic coast (GSA 17), the majority of vessels operating with hydraulic dredges target striped venus clams and are locally called *vongolare*. The carpet shell clams (*Polytitapes aurea*) and cockles (*Acanthocardia* spp. and *Cardium* spp.) are other commercial species bycaught by this fishery, whose most important production centres are in the Marche and Veneto regions. Other vessels in the same GSA target smooth clams, locally called *fasolare,* and razor clams, locally called *cannellare*.

The hydraulic dredger for clam fisheries has blade dredge gear (i.e. on the lower part in contact with the seabed, there is a sharp metal blade that protrudes a few centimetres under the sledge runners; 4–6 cm for the *vongolare* dredger) favouring the removal of the top part of the sediment, which is conveyed into the gear along with the bivalves that are in the sediment. The dredge consists of a sort of parallel pipe-shaped metal cage ranging from 2.8 m to 3.0 m in width, the lower, upper and rear parts being made of metal rods. This part of the gear makes the first selection of the molluscs by size (Petetta *et al.*, 2021b). According to Italian legislation, hydraulic dredges are stipulated to have the following characteristics: i) maximum cage width of 3 m; ii) maximum pressure on the nozzles of 1.8 bar; and iii) maximum gear weight of 600 kg. Venus clam dredges are also subject to the following limitations: the distance between the metal rods in the bottom part of the cage must be at least 12 mm, according to national regulation; instead of rods, square-mesh metal nets with a minimum mesh size of 17 mm, or

12 × 25 mm rectangular mesh, or a perforated sheet with round holes of a diameter of at least 21 mm and full/empty ratio below 0.5 mm must be used. The product harvested by the dredge must be sorted using sieves, with the mesh having the same characteristics as the aforementioned cage. In the case of dredges targeting the smooth clam (*fasolare*), the space between the rods of the cage and sieve is 25 mm. In contrast, in the case of dredges targeting the razor clam (*cannellare*), the space between the rods of the cage is 7 mm. The use of sieves on board is not permitted.

The cage rests on two skid-sledge runners that facilitate the sliding motion on the seabed; different types of nozzles are mounted on the dredge, arranged in parallel rows, which inject water under pressure. There are further nozzles at the mouth of the dredge that spray water downwards in order to dissolve the sediment in such a way so as to expose the bivalves while at the same time assisting the movement of the dredge in the substrate. Further back, there are washing nozzles that clear the cage of materials such as sand, mud and debris that could otherwise clog it. The pressurized water pump is almost always located on board the vessel and the water is conveyed into the cage via a rubber hose.

In Albania (GSA 18), similar dredges are also used to catch striped venus clams (Lucchetti *et al.*, 2022), as well as European prickly cockles (*Acanthocardia* spp.) and smooth clams.

Eastern Mediterranean

No hydraulic dredges are reported for this subregion.

Black Sea

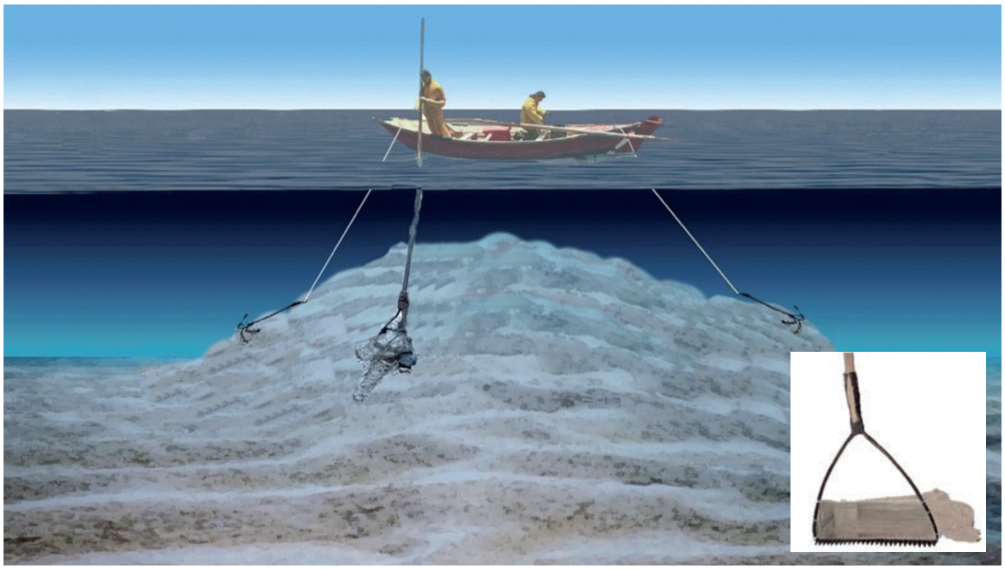
In Türkiye (GSA 29), hydraulic dredges of different sizes are used in shallow water at depths of 5–20 m, depending on the size of the boat, in the striped venus clam fishery (Doyuk, 2006). Hydraulic dredges and automatic sieve systems are located at the stern of the boat. The dredge is used with pressurized water and the towing speed is around 1.5–2 knots. In addition, the hydraulic dredge has the following characteristics: cage width 2–3 m long; cage height 35–55 cm; and sieve size 7–10 mm.

In Romania (GSA 29), a mechanized dredge design is also used to catch the striped venus clam. The characteristics include a metal cage (3.5 m wide and 45 cm high) and a blade as digging gear. The mean operating depth is 20 m (Niță *et al.*, 2021).

3.2.3 Hand dredges

These are hand-towed dredges used in shallow waters on foot or handled from a small, anchored vessel to catch bivalves and gastropods (Figure 60). Hand dredges usually consist of a metal frame or a small cage of different sizes and shapes covered with wire mesh or metal rods and a netting bag made of synthetic netting or wire mesh mounted on the frame (or cage), whose lower part may be a scraper blade or a toothed rake. The dredge may or may not be mounted on two lateral sledge runners to prevent it from digging into the substratum. A handle made of metal or wood is moved back and forth to move the sediments with the dredge in order to dislodge the target species from the seabed.

FIGURE 58
Hand dredge operated from a vessel



Source: illustrated by A. Lucchetti.

Subregional variations

Western Mediterranean

In Spain, hand dredges are used to catch wedge clams and striped venus clams, especially in the Gulf of Cadiz (Atlantic), but also in the northern Alboran Sea (GSA 1). The hand dredge consists of a wooden beam 45 cm wide and 15 cm high with an even cutting edge, a mesh sieve size of 14 mm and a length of 58 cm, with a rear net bag of 200 cm length and mesh size of 10 mm. The gear digs deeply into the sediment, up to 10 cm.

In Morocco (GSA 3), two types of rakes are used along the Mediterranean coast to catch bivalve species: the hand rake for wedge clams (*Donax* spp.) and rakes used from boats for other clam species (Darasi, 2014; Darasi, Awadh and Aksissou, 2019). The rakes currently used consist of a metal frame (which differs according to the technique used) and a metal bar in the form of a comb supporting teeth that vary in number and length (Plate 44). A netting bag is attached to the metal frame whose role is to accumulate and store the catch. Rakes on board are used to collect clams all year round at depths not exceeding 25 m. This technique is highly profitable and practised mainly by fishers from the Kaa Asras area. The hand dredges targeting wedge clams are small types of gear made of a metal cage and a net bag with small meshes (18 mm mesh length), which are used in very shallow waters (0.5–1.5 m).

PLATE 44
Hand dredge rake used in Morocco

Source: **Darasi, F., Awadh, H. & Aksissou, M.** 2019. Des engins de pêche artisanale utilisés en partie ouest Méditerranée marocaine. *International Journal of Innovation and Scientific Research*, 40(2): 276–286.

In Algeria (GSA 4), a hand-operated dredge design similar to the ones described for Morocco is employed (Laid, Lamri and Kadri, 2001), targeting wedge clams (*Donax* spp.). Typically, hand dredges are manually operated by using a wooden handle in shallow depths where the seabed is sandy or muddy. It comprises a kind of funnel-shaped iron basket whose mouth has a diameter of 50 cm to 60 cm, formed out of a straight flat iron on the bottom side (which scratches the bottom sediments) and curved on the other side with a wooden handle 5 cm in diameter and 1.5 m long in the middle. The metal cage has a length of 70 cm and is covered in metal netting with small meshes. The rearmost part of this cage, which has a diameter of 10 cm, is joined to a netting bag at the end that is 90 cm long with a mesh length of around 18 mm.

In France (GSA 7), the *arselière* or *clovissière* is a fishing technique that is now falling into disuse; the gear is similar to a large steel rake, with the shape of a horseshoe, weighing about 10 kg, equipped with a handle 7–8 m long and comprising at its end a bag with meshes from 36 mm to 38 mm. This type of gear is held around the waist of the fisher who manoeuvers it while standing on the boat by scraping the bottom, mainly targeting the grooved carpet shell (*Ruditapes decussatus*), but also the peanut worm (*Sipunculus nudus*) or sea worms (Nereididae family). The dredge for catching clams is light and small, measuring 1 m × 1.2 m in size. It is handled manually in very shallow waters (less than 2 m) from the shore or from a small boat. The mesh size must not be less than 60 mm according to national regulation, and these dredges are used in the Gulf of Lion. In particular, fishing for the wedge clam using a dredge-rake (*le tellinier*) is practised almost all year round, in shallow waters, especially near river mouths where the sea comes into contact with fresh water. The *tellinier* weighs between 10 kg and 15 kg and consists of a blade welded to a small wire cage extended by a nylon bag 4 m long with 20 mm stretched meshes; for handling, the cage has three wooden or metal handles placed on top, which are about 1.5 m long and joined together in a triangle. According to the regulations, a *tellinier* cannot have an opening greater than 1 m.

To operate, the *tellinier* is hung by a harness around the waist of the fisher who pulls back the dredge by making continuous back-and-forth movements with his arms, so that its blade is planted in the sand for the duration of the tow (*tire*) for about 500 m (Figure 59). Each tow catch is emptied into a bag attached to a circular buoy, usually a large tyre inner tube. In Camargue, fishing is limited to 1 kg per person per day (Plate 45). The wedge clams are then sieved on the beach in order to collect only those of a commercial size (> 25 mm), with the smallest, known as seed, being thrown back into the sea (BIOTOPE, P2A Développement, 2007).

FIGURE 59
Hand dredge used for catching clams in shallow waters with back-and-forth movements

Source: illustated by Koen Ivens based on a photo by A. Lucchetti.

PLATE 45
***Tellinier* dredge rake used in France**

In Italy (GSAs 9 and 10), hand dredges are used in the Tyrrhenian Sea to catch wedge clams; the only difference from the hand dredge used in the Adriatic Sea is the frame (i.e. space between the rods) and the smaller mesh size of the netting bag. Hand dredges are also used by recreational fishers. Nevertheless, hand dredges operated from boats to catch wedge clams are only seldom used (Plate 46). These dredges have a metal frame, of which the lower part is a rake, and a PA netting bag with small meshes of about 2 m in length. A long wooden pole (up to 5–6 m) is used from the vessel to move the dredge and dig into the sediment to catch the bivalves. This gear is used when the fishing depth is more than 1 m. Handling this type of dredge from the boat can be difficult as the gear can lose contact with the bottom, thus becoming less effective.

PLATE 46
Hand dredges operated from a vessel in Italy

Central Mediterranean

In Tunisia, all kinds of dredges are prohibited by law. In Libya, no dredges are used.

Adriatic Sea

In Italy (GSA 17), hand dredges operated on foot in shallow waters (around 1–1.5 m) or in lagoons are made of a metal frame (iron or stainless steel) 0.5–1 m wide, formed by rods spaced 2 cm apart. The front and underside of the frame is a rake with long teeth (around 7 cm) set at 2.5–3 cm apart. A short wooden or metal handle (around 1.5 m long) is mounted on the top side and moved back and forth to facilitate penetration of the rake into the sediment. A netting bag of about 2 m (mesh size 20–22 mm) collects the clams. For this type of gear, the vessel is only used to move it from the harbour to the fishing ground and vice versa. In Italy, these dredges were used in the northern Adriatic Sea to catch Manila clams (*Ruditapes philippinarum*). This type of gear was used by hundreds of fishers in semi-natural areas; it is therefore a semi-intensive farming activity. Due to the extremely heavy working conditions, this gear has been gradually replaced over the last five years by a more modern type, the so-called *idrorasca*. The *idrorasca* is a hybrid gear between a hand dredge and a hydraulic dredge (Plate 47). As such, the *idrorasca* is 55 cm wide and mounted on two lateral sledges. It is equipped at the front with a blade to scrape the sediment and with a double row of nozzles placed perpendicular to the line of the advancing dredge; the first, which is external, is used to create a furrow in the seabed, while the second, more internal, has the function of washing and facilitating the entry of the clams into the netting bag placed at the rear, as in the hand dredge. The water jets are produced by a pump driven by a motor placed on board the vessel. The dredge is towed by means of a short handle in shallow waters (1–1.5 m) and with a longer handle in deeper waters. Alternatively, the dredge can be towed by the boat winch. For this gear, the force required by the operator to tow this dredge is much less than that required to tow the fully manual dredge. Therefore, the *idrorasca* can be considered as a hybrid type of gear, between a manual and a hydraulic dredge (Maio *et al.*, 2015).

PLATE 47
***Idrorasca* dredge used in the northern Adriatic Sea**

Eastern Mediterranean

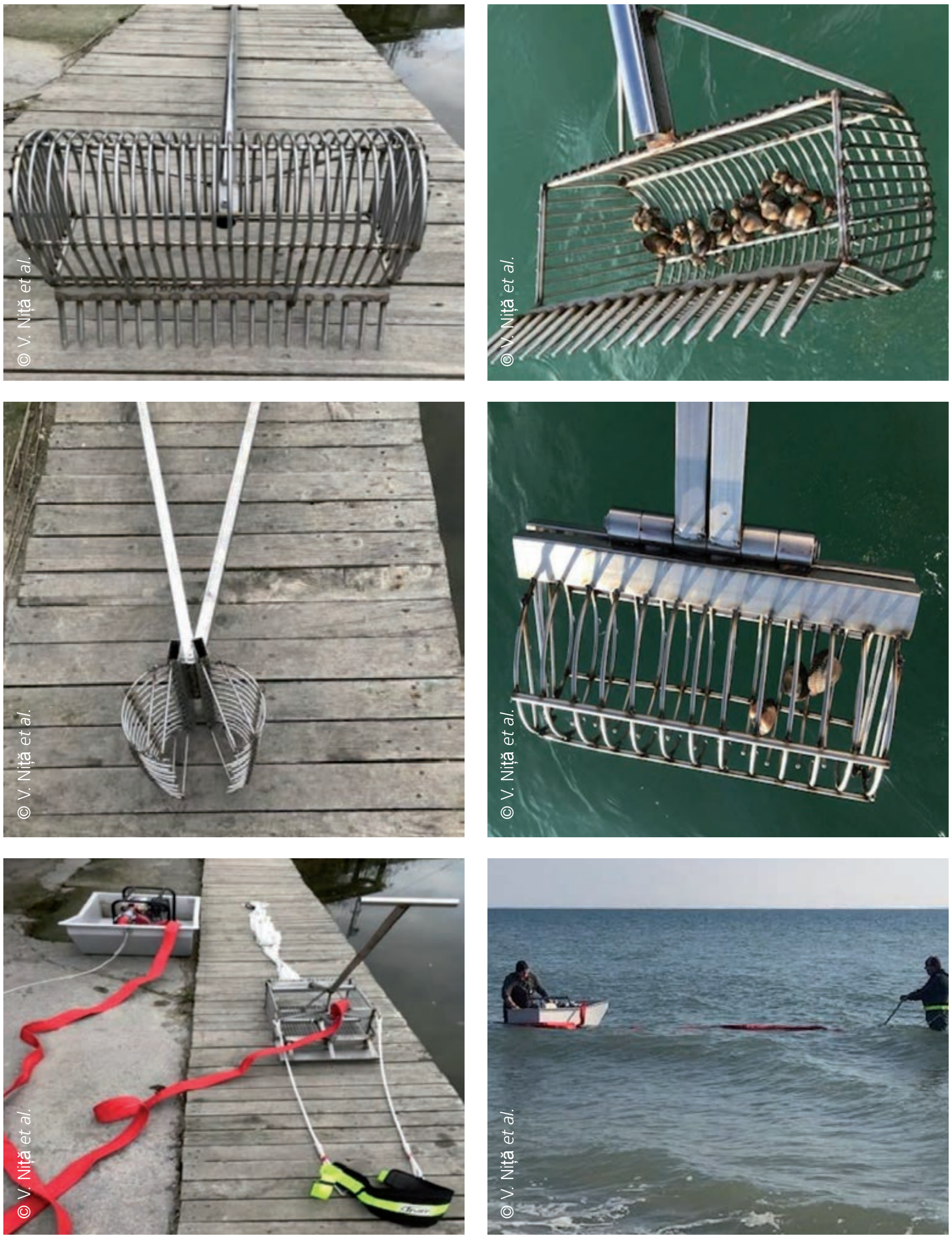
No hand dredges are reported for the eastern Mediterranean.

Black Sea

In Türkiye, a mechanical dredge targeting the striped venus clam is generally used in coastal areas at depths of 3–20 m in the Marmara Sea and the western Black Sea (GSA 29). The main structure of this dredge comprises a sieve with teeth at the end, a 1–2 m long net bag at the back and skids (wheels) on the lower sides of the dredge to slide it on the ground. The dredge is towed by human power or engine power, depending on its capacity and size. The technical features of this gear are the following: cage width of 60–90 cm, cage height of 35–55 cm, sieve size of 8–10 mm and 25–45 teeth (Çolakoğlu and Tokaç, 2017).

In Romania (GSA 29), different hand dredge types are used that target both Mediterranean mussels and striped venus clams. They are made of a metal frame (0.4–0.45 m wide and 20–25 cm high) and a net bag (7–15 mm mesh length) and towed at low speed (0.3 knots) in depths ranging from 0.5 m to 30 m. Moreover, experimental hand dredges are being tested, such as the *hidrorascheta* (similar to the Italian *idrorasca*) and different types of rakes to harvest rapa whelk and other bivalve species (Plate 48; Niță *et al.*, 2021).

PLATE 48
Hand dredges being tested on the Romanian Black Sea coast to harvest bivalve species



Source: **Niță, V., Nenciu, M., Cristea, M.G., Buhai, D., Ivănică, M. & Buhai, D.** 2021. *Ghid de bune practici pentru zona costieră românească în ceea ce privește pescuitul de moluște*. Tulcea, European Commission.

4. Polyvalent

4.1 General characteristics

The group "polyvalent" includes all fishing vessels using more than one type of gear, sometimes with a combination of both passive and active gear types, none of which's use exceeds more than 50 percent of the time at sea during the reference year.

4.2 Main polyvalent gear

4.2.1 Gillnets and entangling nets

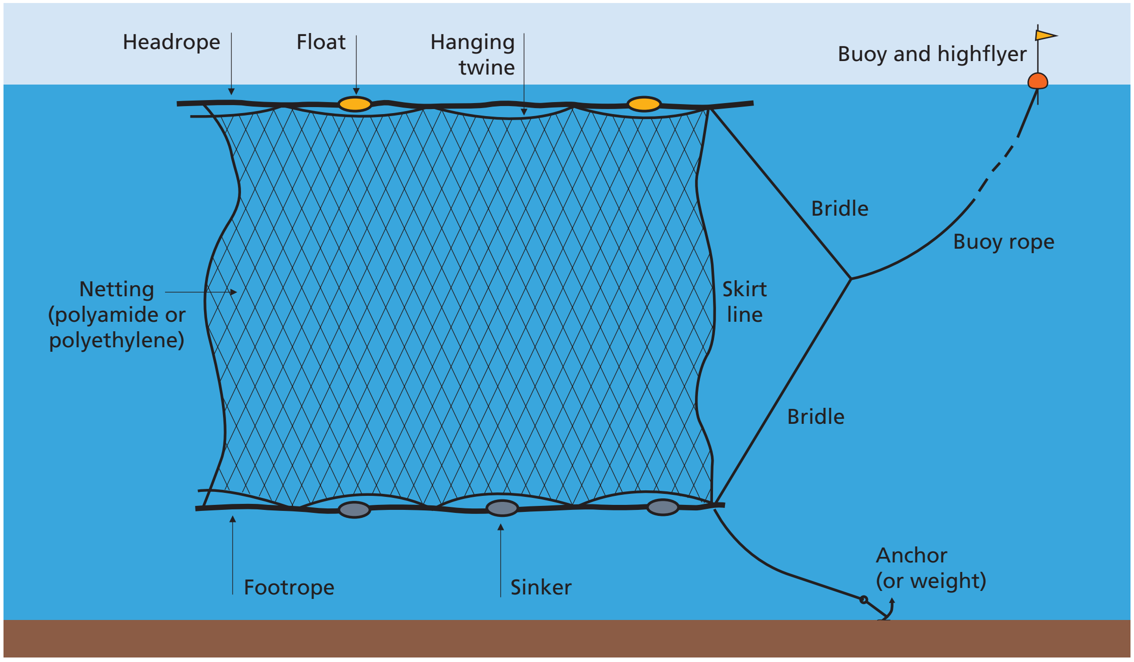
The category "gillnets and entangling nets" (passive nets) includes fixed nets (anchored to the bottom) and driftnets (drifting with the currents). The category "fixed gillnets on stakes" are particular gillnets used in estuaries, lagoons and shallow waters and will be described in Chapter 7.

Gillnets, trammel nets, combined nets and small driftnets are currently among the most important passive nets used along Mediterranean and Black Sea coasts for catching a great number of demersal, benthic and pelagic species. These are known as fixed nets (Box 5) because each end of the net is connected to an anchor, a weight or a stone to prevent the net from moving with the current, and usually both ends are marked with a buoy (Figure 60). The gillnet consists of a single netting wall, generally made of monofilament or multifilament twisted nylon netting twine. The trammel net is made of three panels of nets, with the inner panel being made either of twisted or monofilament nylon, while the outer panels have a larger mesh size than the inner one and are generally made of twisted nylon filament. The combined net is usually a bottom-set gillnet combined with a trammel net that constitutes the lower part. The driftnet is made of a single netting panel; therefore, it is a kind of gillnet. However, the driftnet is left free to drift with the current, usually near the surface or not far below it. Set nets may be set as single nets, but most often several nets are tied together to be placed in a line, in order to form a fleet (or gang) of nets.

These nets are kept vertical by a floatline (upper line, headline or headrope) and a weighted footrope (lower line or leadline). The netting panels of fixed nets are usually made of polyamide (PA) monofilament or twisted multifilament, while the floatline is usually made of braided polypropylene (PP), PA or polyethylene (PE). In addition, small solid floats, usually made of polyvinyl chloride (PVC), ethylene vinyl acetate (EVA), polyester or cork and comprised of different shapes (spherical, cylindrical, egg-shaped, or disk-shaped) are attached to the headrope. A recent innovation involves the replacement of large numbers of floats with swimming or floating lines, that is headlines made of PP or PE braided with small floats integrated into the line. The leadline is usually made of braided PP, PA or PE. Lead weights are evenly distributed along the rope, but the lower line can also be made of lead core line (PP or PE braided ropes with a string of lead weights in the centre), which does not need additional weight. The two ends of a gang of nets are fixed to the sea bottom by means of weights or anchors that keep the gear in place. According to the target species, the type of gear can be designed to fish either close to the bottom or, more rarely, in the water column. Each weight or anchor is joined to a marker buoy or flag on the surface.

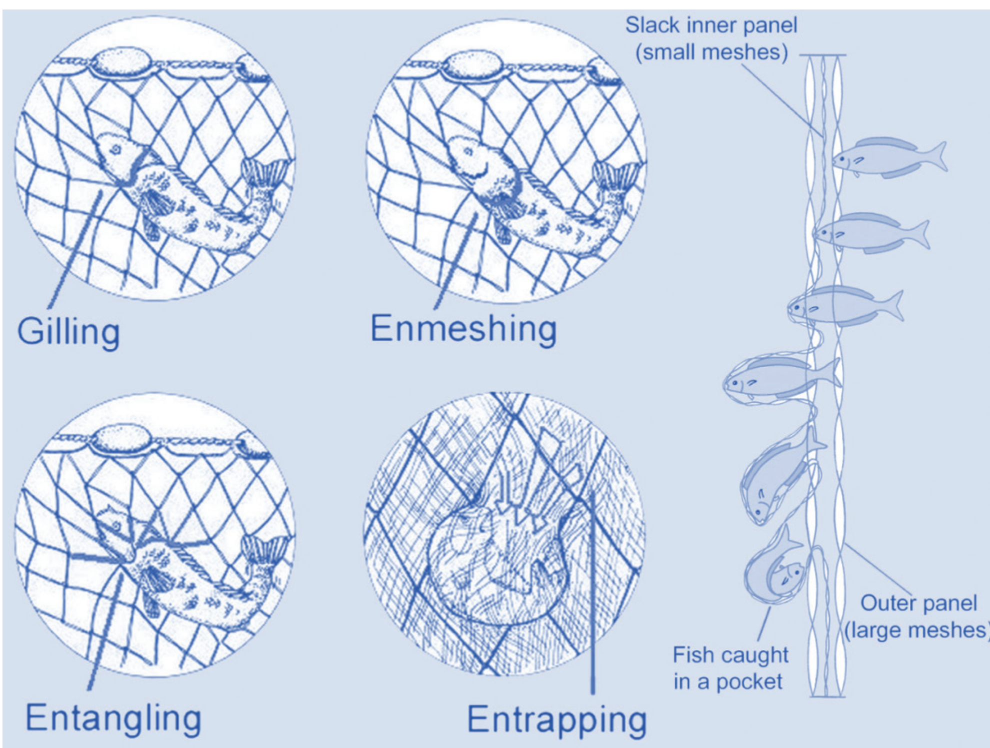
Fixed nets can be hauled by hand from shallow or moderate depths, but automatic net haulers are very common today. Fish can be caught in the netting in three ways: gilled, entangled or enmeshed (Figure 61). As such, gilling and entangling are two different principles for catching fish:

FIGURE 60
Technical elements of a fixed net



Source: redrawn from **He, P., Chopin, F., Suuronen, P., Ferro, R.S.T & Lansley, J.** 2021. *Classification and illustrated definition of fishing gears.* FAO Fisheries and Aquaculture Technical Paper No. 672. Rome, FAO. https://doi.org/10.4060/cb4966en

FIGURE 61
Methods of catching using passive nets (left) and trammel nets (right)

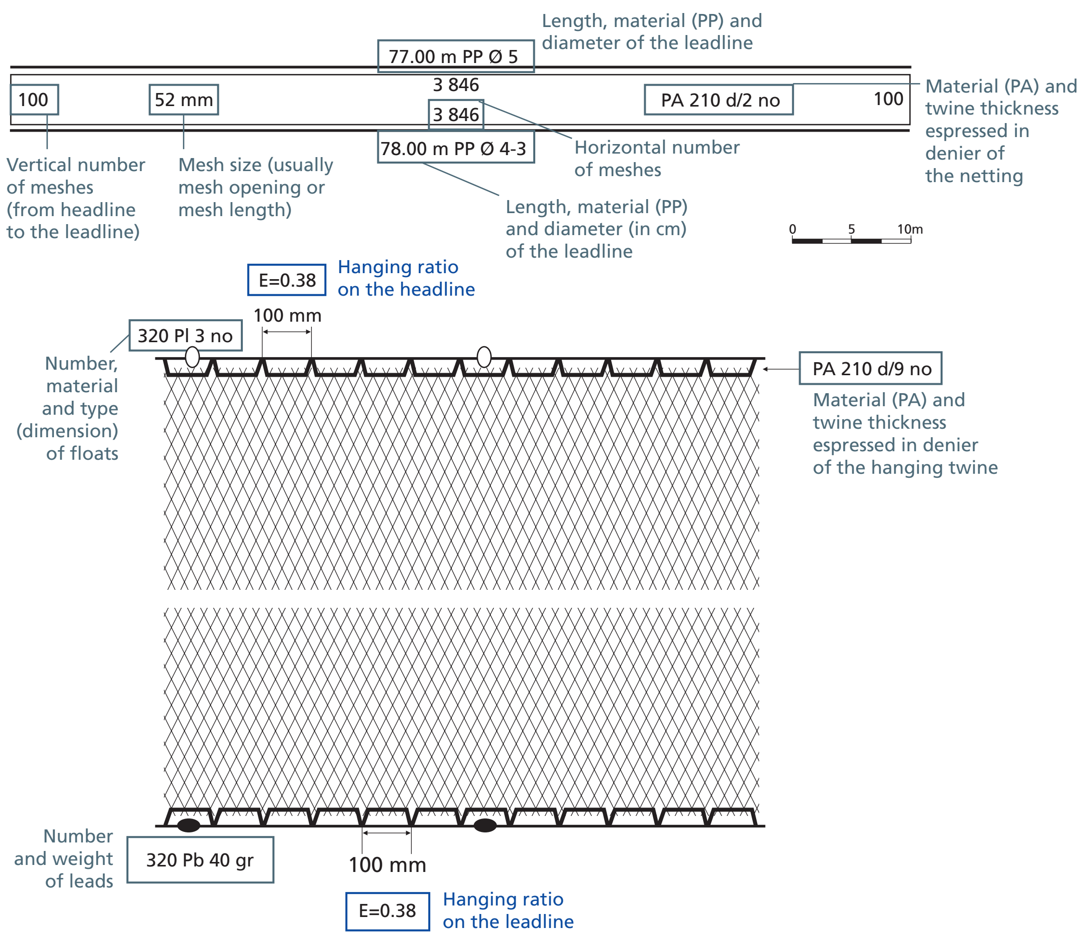


Source: redrawn from **Clark, G.H.** 1930. *The California Halibut (*Paralichthys californicus*) and an analysis of the boat catches.* Fish Bulletin No. 32. Sacramento, USA, Division of Fish and Game of California.

- Gilling occurs when the fish is meshed just behind the gill cover.
- Wedging occurs when the fish is meshed around the body somewhere behind the gill cover (normally the largest part of the body as far as the dorsal fin) and is hardly distinguishable from gilling when the maximum girth is close to the gill cover.
- Snagging occurs when the fish is attached to the netting at its head region. It is most common for species with a protruding maxilla or preopercle. The fish is caught by its mouth or teeth or maxillaries or other parts of the head region without necessarily penetrating the mesh.
- Entanglement occurs when the fish becomes trapped in the net by its spines, fins or other body protrusions. Fish already caught by other catching processes may subsequently become entangled as they struggle to free themselves.
- Entrapping occurs when the fish is entrapped in bags or pockets of the netting. This is the typical catching method of a trammel net.

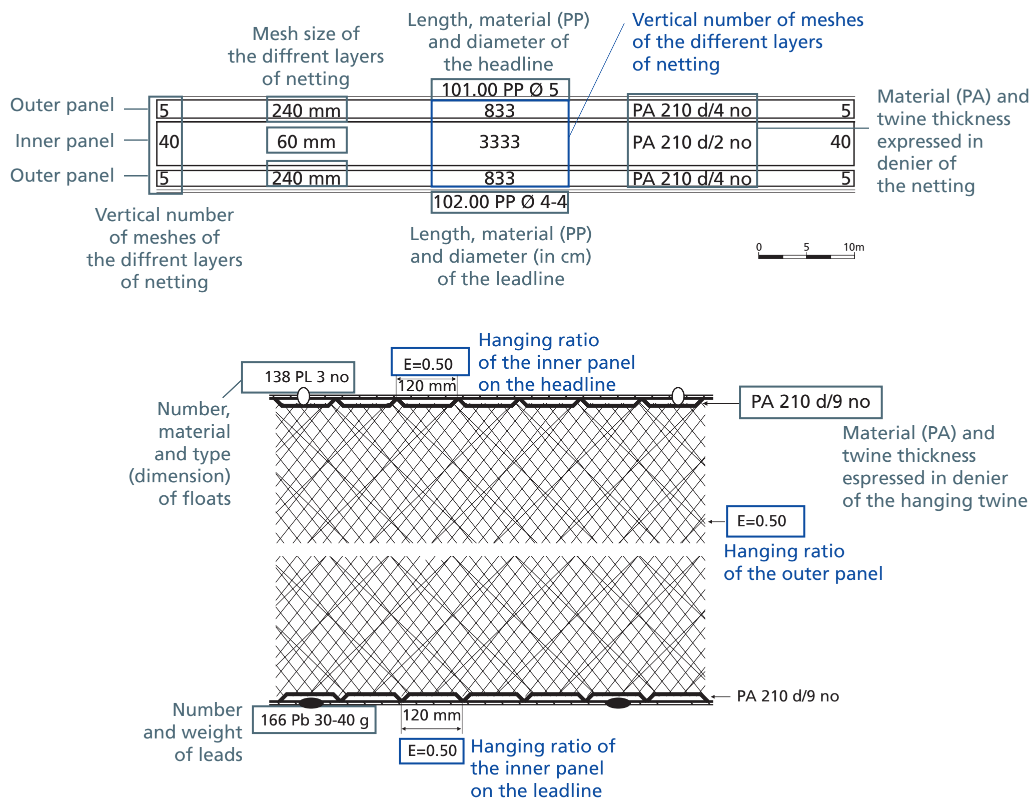
The catching method strongly depends on the gear properties. The main elements of a gillnet are explained in Figure 62, and the main elements of a trammel net are shown in Figure 63.

FIGURE 62
Main technical elements of a gillnet



Source: redrawn from **Tokaç, A., Ünal, V., Tosunoğlu, Z., Akyol, O., Özbilgin, H. & Gökçe, G.** 2010. *Ege Denizi Balıkçılığı* [Aegean Sea fisheries]. İzmir, Türkiye, IMEAK Chamber of Shipping İzmir branch.

FIGURE 63
Main technical elements of a trammel net

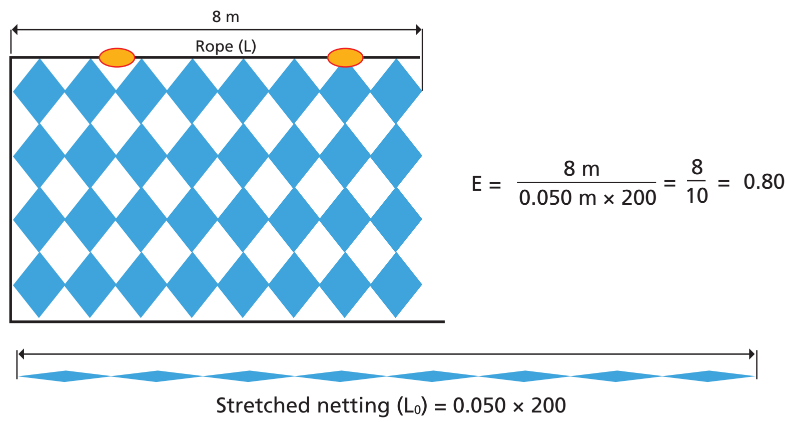


Source: redrawn from **Tokaç, A., Ünal, V., Tosunoğlu, Z., Akyol, O., Özbilgin, H. & Gökçe, G.** 2010. *Ege Denizi Balıkçılığı* [Aegean Sea fisheries]. İzmir, Türkiye, IMEAK Chamber of Shipping İzmir branch.

Additional elements of fixed nets include:

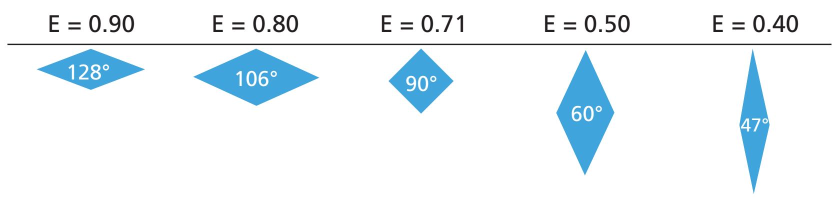
- There are three main types of static nets anchored to the bottom: trammel nets, gillnets and combined nets. The International Standard Statistical Classification of Fishing Gear (ISSCFG) classifies gillnets and entangling nets as shown in Table 12.
- Stretched net height is a theoretical net height calculated as mesh length multiplied by the number of meshes (from headline to the leadline).
- Real net height is the height of the nets while fishing is in progress (the net is set on the bottom). It depends on the stretched net height, hanging ratio, buoyancy (due to the headline) and other environmental factors such as catch and water dynamics (tides, currents, etc.).
- Vertical slackness is the ratio between the real and the stretched net height. The amount of slackness facilitates the entanglement of a fish. Slackness can be modified in various ways, such as: reducing the floatability of the headline (e.g. reducing the number of floats); reducing the hanging ratio (i.e. reducing the horizontal tension on the net); or employing vertical ropes for tie-down gillnets by using materials that increase the netting flexibility. In the case of trammel nets, the vertical slack is the ratio between the height of the external panel and that of the internal netting panel. The slack produced is able to form pockets, which is trammel nets' typical catching method.
- Hanging ratio is a rough indicator of how much the net is stretched in the water. The hanging ratio is commonly defined as $E = L/L_0$, where L is the length of the rope on which a net panel is mounted, and L_0 is the length of stretched netting hung on the rope. An example is shown in Figure 64. Nets with low ranging ratios, i.e. under 0.4, will present a notable slack (Figure 65).

FIGURE 64
Hanging ratio calculation



Source: redrawn from **Lucchetti, A.** 2012. *MAREA Specific Contract n° 3 – Estimation of maximum net length of trammel nets, gillnets and combined bottom set nets by using the volume or the mass of the net (ARCHIMEDES).* Final report. Rome, CNR-IAMC, Bari, Italy, COISPA Tecnologia & Ricerca, Attiki, Greece, HCMR, Livorno, CIBM, Athens, LAMANS, Tirana, LAPD.

FIGURE 65
Effect of hanging ratio on mesh geometry



Source: redrawn from **Lucchetti, A.** 2012. *MAREA Specific Contract n° 3 – Estimation of maximum net length of trammel nets, gillnets and combined bottom set nets by using the volume or the mass of the net (ARCHIMEDES).* Final report. Rome, CNR-IAMC, Bari, Italy, COISPA Tecnologia & Ricerca, Attiki, Greece, HCMR, Livorno, CIBM, Athens, LAMANS, Tirana, LAPD.

- Twine materials used in the Mediterranean and the Black Sea include the synthetic PA, PE and PP. Of these, PA (globally known as nylon) is the most used synthetic material.
- Yarn types most commonly used in passive nets in the Mediterranean and the Black Sea are multifilament twisted (especially used in trammel nets), monofilament single yarn (especially used in gillnets) and, on rare occasions, multimonofilament.
- Twine thickness/size of yarn is expressed in mm or denier (den). The international system is based on the weight per unit of length measured in denier. A denier is the weight in grams of a 9 000 m length of twine. The most widely used in passive nets is the 210 den; this means that a 9 000 m length of this twine weighs 210 g. When a measurement such as 210 × 3 or 210d/3 is reported, this means that the weight is 210 g and the netting yarn is made of three strands. Twine material and thickness strongly affect the flexibility of the netting panel. The twine thickness of a monofilament single yarn is usually expressed in mm, while the multifilament twisted is expressed in denier.
- Twine colour can be transparent, black, red, blue, yellow or another colour and affects the catching efficiency.

Table 12

Classification of gillnets and entangling nets according to the International Standard Statistical Classification of Fishing Gear

Gear categories (first tier)	Subcategories (second tier)	Standard abbreviations	ISSCFG code
Gillnets and entangling nets			7
	Set gillnets (anchored)	GNS	7.1
	Drift gillnets	GND	7.2
	Encircling gillnets	GNC	7.3
	Fixed gillnets (on stakes)	GNF	7.4
	Trammel nets	GTR	7.5
	Combined gillnets–trammel nets	GTN	7.6
	Gillnets and entangling nets (nei)	GEN	7.9

Source: **FAO.** 2016. *International Standard Statistical Classification of Fishing Gear. Handbook on Fisheries Statistics.* Rome. fao.org/3/bt988e/bt988e.pdf

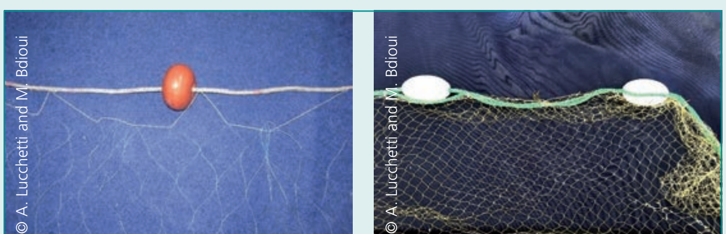
Box 5

Details of fixed nets

Headline

The headline is equipped with a series of floats to guarantee the vertical net opening. The number, material, dimensions and shape of floats strongly depend on the gear type (trammel net, gillnet, combined net), depth setting, tradition, market availability and target species. In the new types of passive nets, floats can also be integrated into the centre of the rope; alternatively, a floating rope made of a flexible foam core and braided over with strands of monofilament polypropylene is used in some fisheries, thus eliminating the need for additional floats.

Examples of headlines used for fixed nets in the Mediterranean and the Black Sea



Standard headlines with floats

Floating line with internal foam floats

Leadline

The leadline is usually made of lead weights attached externally to the rope or rigged inside a braided synthetic sleeve. The leadline may be strengthened by a supporting rope to increase the strength and prevent breakage. The type of leadline and its weight depend on the gear type (trammel net, gillnet, combined net), depth setting, tradition, market availability and target species. Passive nets set at depths greater than 50 m, such as gillnets used to catch European hake (*Merluccius merluccius*), are usually equipped with heavier leadlines.

Examples of footropes used for bottom trawl nets in the Mediterranean Sea

Leadlines with external lead weights

Leadline with internal lead weights

Netting twine

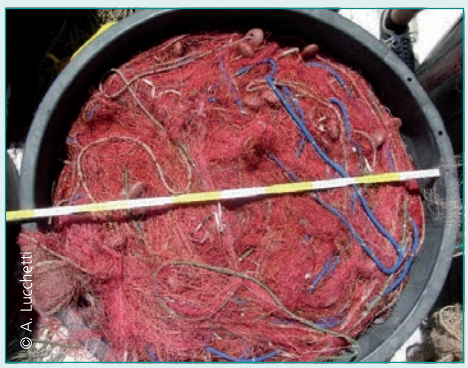
Passive nets are usually made of polyamide monofilament or polyamide multifilament twisted twine; polyamide multimonofilament twines are rarely used. Most nets have a twine diameter ranging from 0.18 mm to 0.22 mm or 210d/2–210d/4. When large species are targeted, a thicker material is used.

Netting colour greatly varies, from white to transparent (monofilament), black, brown, yellow, blue or red, according to local traditions, availability and personal preferences, among other factors.

Mesh openings vary according to the species targeted.

Examples of netting used for fixed nets in the Mediterranean and the Black Sea

White netting



Red netting

Transparent (monofilament)

Brown netting

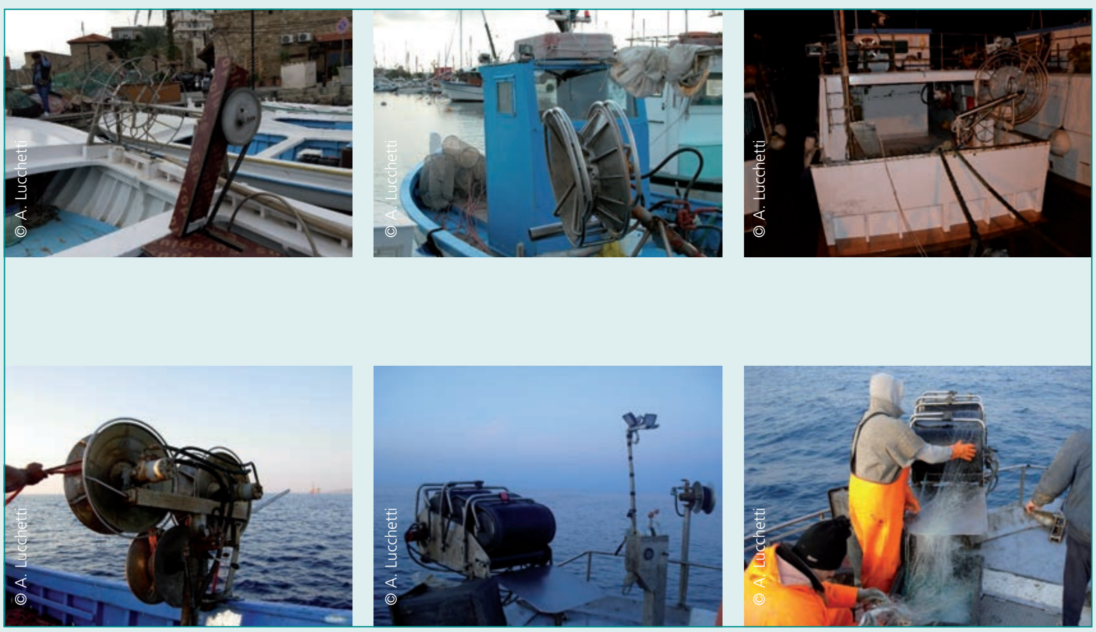
Yellow netting

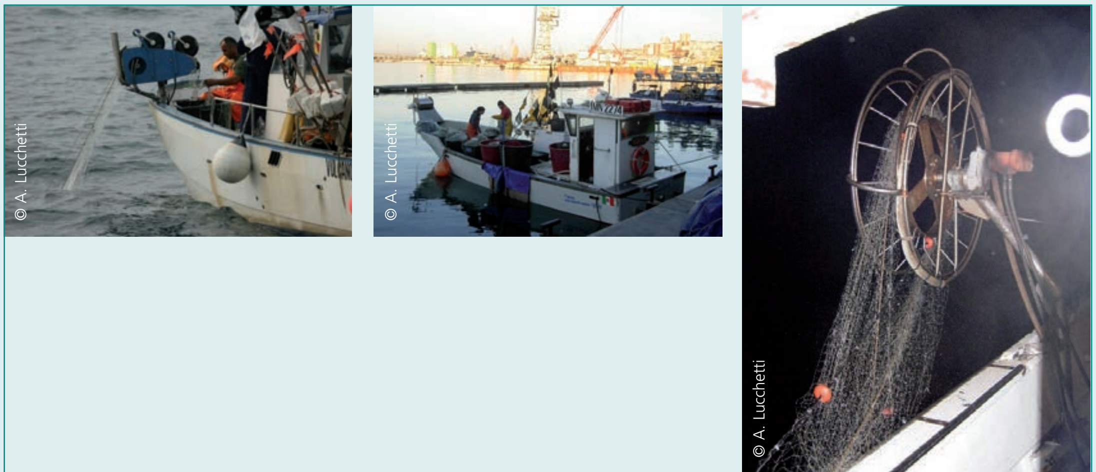
Blue netting

Net hauler

Different types of net haulers powered by hydraulic motors are used for pulling passive nets. Net haulers used in different areas vary according to traditions, bottom depths, types of fishing gear employed (i.e. the same hauler can be used to retrieve both passive nets and pots) and economic constraints.

Examples of net haulers used for fixed nets in the Mediterranean and the Black Sea





Types of net haulers used in the Mediterranean and the Black Sea.

Set gillnets (anchored)

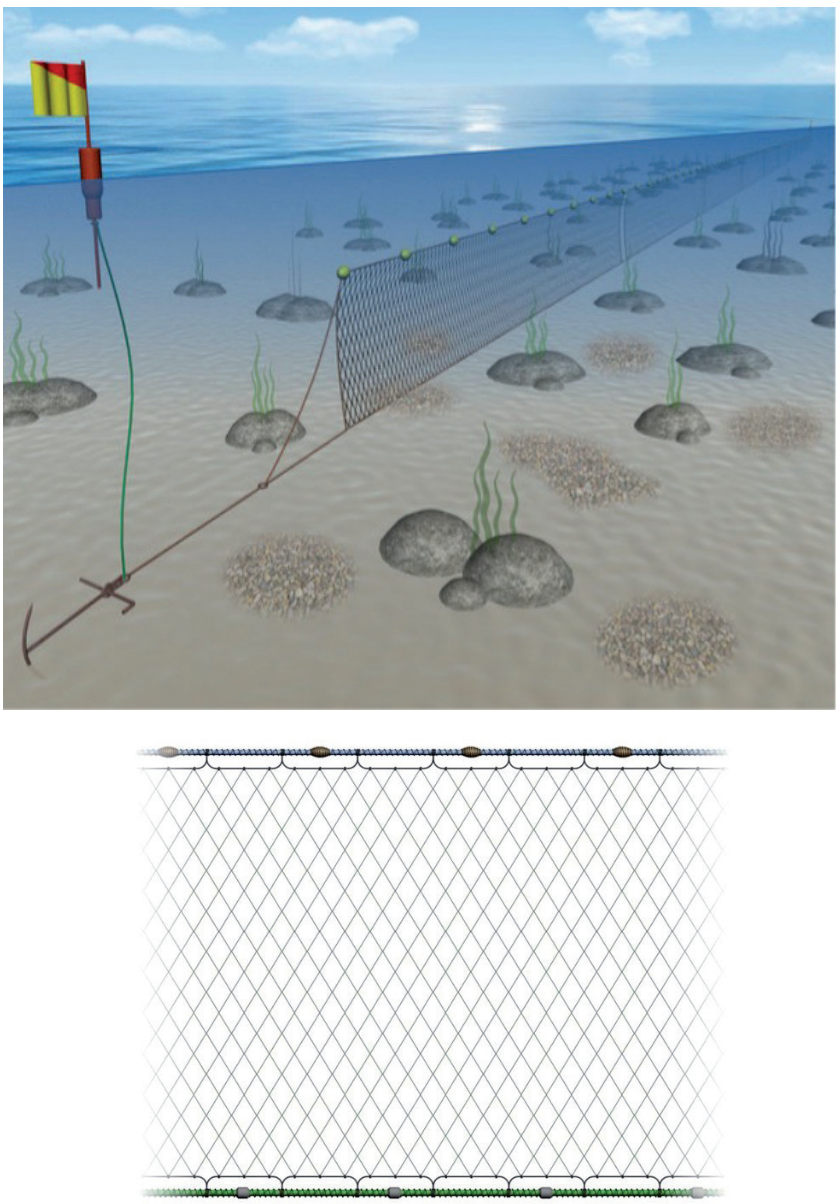
Set gillnets (anchored), or simply gillnets, are strings of single netting walls held vertically in the water by floats on the headline and weights on the leadline (Figure 66). Fish can be caught gilled, entangled (by their spines, teeth, etc.) and enmeshed in the netting. Gillnets are a quite selective type of gear and the mesh size is usually decided according to the main target species. According to their design, ballasting and buoyancy, these nets may be used to fish on the surface, in mid-water or on the bottom. Gillnets are rectangular shaped nets, made of very fine, barely visible yarn, and moored vertically in the water. The net panels are held taut between the floats on the headrope and the weights on the footrope. As such, the mesh size is calculated to retain the fish by the head or the front of the body. The colour and thickness of the yarn, the height (drop) and hanging mode must be adapted to the fishing conditions and target species. Gillnets come in many varieties in the artisanal fisheries of the Mediterranean and the Black Sea. The main characteristics are the size of the netting panels, the number of panels constituting the gear (hence the overall dimensions), the mesh size (adapted to the target species), the filament used (commonly nylon or a similar plastic, normally as monofilament) and its thread diameter, thus its visibility in the water and its resistance to a fish's effort to escape from the net. Panels may also differ in their construction in order to catch more than one target species according to their habitual depth in the water column.

The nets are generally lowered over the stern and lifted over the bow or side, at about one-third of the length, to facilitate manoeuvring of the boat. Normally, nets remain in the water for a few hours or more (usually 12 hours at night). They are lifted with the aid of a net hauler or by hand in the case of small vessels. The nets are stored in plastic containers or directly on the deck of the vessel. This method involves lengthy operations, especially to free the fish and clean the nets.

Catch composition is variable and depends on the type of net. For low nets, the catch is composed of benthic species such as edible crab (*Cancer pagurus*), spiny lobster, sole and mantis shrimp. For high nets, the catch is composed of semi-demersal species such as red mullets (*Mullus* spp.), hake, sparids, cuttlefish and shark.

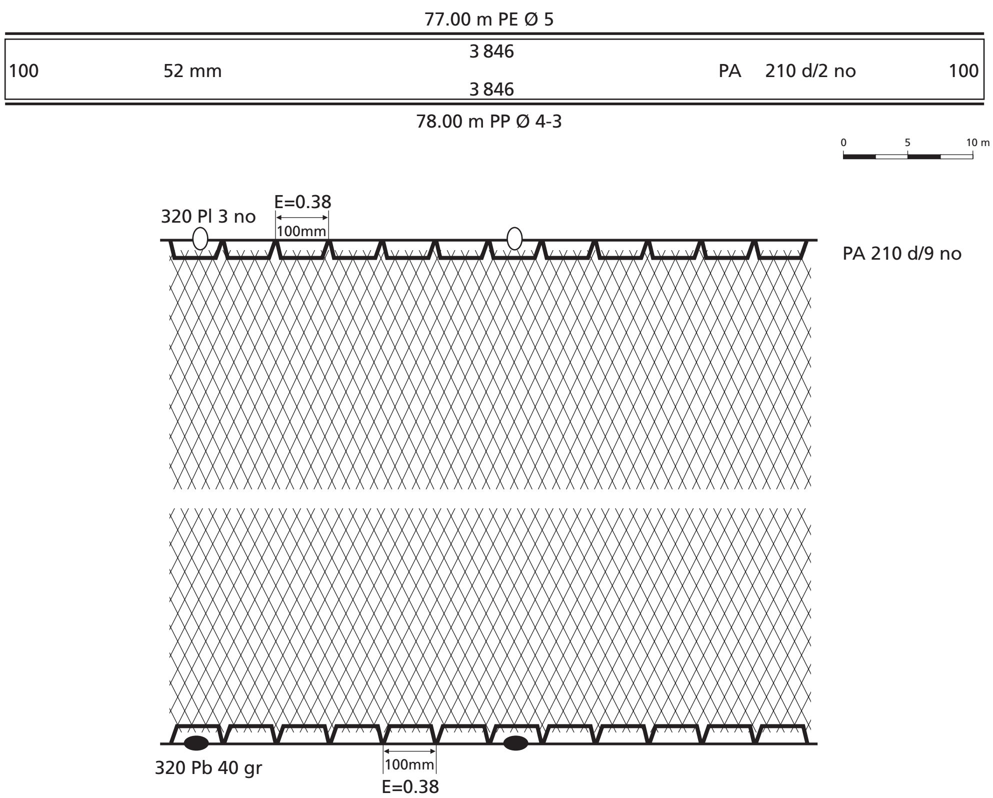
Efficiency is good when catch conditions are favourable (i.e. darkness, turbid waters, weak currents, few debris or undesirable animals likely to tangle the nets, absence of predators liable to damage captured fish such as dolphins, etc.). Numerous factors, such as the rigging of the net (especially slackness) and vertical and horizontal hanging ratios, can affect its selectivity. Nevertheless, under suitable conditions (particularly, regarding mesh size), the size selectivity within a certain species can be satisfactory. This gear is widely used in all the countries of the Mediterranean and the Black Sea, with variations according to target species and local fishing conditions.

FIGURE 66
Gillnet



Source: **Seafish.** 2023. Fishing gear database. In: *Seafish.* Cited 23 May 2023. Edinburgh. www.seafish.org/responsible-sourcing/fishing-gear-database/?t=docGear/

FIGURE 67
Technical specifications of a gillnet



Source: redrawn from **Tokaç, A., Ünal, V., Tosunoğlu, Z., Akyol, O., Özbilgin, H. & Gökçe, G.** 2010. *Ege Denizi Balıkçılığı* [Aegean Sea fisheries]. İzmir, Türkiye, IMEAK Chamber of Shipping İzmir branch.

Gillnets are used for a large number of target species, with the most important including members of the Sparidae family, such as gilthead seabream (*Sparus aurata*), bogue (*Boops boops*), sand steenbras (*Lithognathus mormyrus*) and common dentex (*Dentex dentex*), as well as other species including common sole (*Solea solea*), red mullet (*Mullus barbatus*), striped red mullet (*Mullus surmuletus*), European hake (*Merluccius merluccius*) and members of the Triglidae family like tub gurnard (*Chelidonichthys lucerna*) (Table 13).

Gillnets are used by small fishing vessels with 0.5–9 gross tonnage (GT), 4–13 m length overall (LOA) and 7.4–500 kW. The gillnets are generally used in fishing grounds ranging from 4 m to 200 m depths. In some areas (i.e. in the Ligurian Sea and northern Tyrrhenian Sea), gillnets are used also at greater depths (100–500 m), in particular to catch European hake, silver scabbardfish (*Lepidopus caudatus*) and triglids such as the tub gunard.

Depending on vessel dimensions, the length of gillnets ranges from 100 m to about 11 000 m, though the majority of nets range from 4 000 m to 6 000 m. The gillnet technical properties recorded, such as mesh size, net drop, twine thickness, twine colour and hanging ratio, vary according to the different métier. Figure 68 summarizes the main technical characteristics of the single panels of nets. In general, the height of gillnets ranges between 2 m and 6 m. In some areas, gillnets up to 10 m stretched height or more are used to catch sparids and bonitos. The real net height can be modified to enhance the vertical slackness by either reducing the number of floats, reducing the hanging ratio or using vertical ropes to tie-down the headline. For example, these solutions are often applied to catch common sole.

Different mesh sizes are employed according to the different species targeted: 17–40 mm for small pelagic fish, such as anchovy (*Engraulis encrasicolus*), sardine (*Sardina pilchardus*) and horse mackerel (*Trachurus* spp.); and 60 mm to 80–100 mm for demersal species, such as European hake, red mullet, common sole, tub gunard and sparids. Larger meshes (160–400 mm) are used to catch species such as turbot (*Scophthalmus maximus*), John dory (*Zeus faber*), common dentex, European seabass (*Dicentrarchus labrax*), smooth-hound sharks (*Mustelus* spp.) and piked dogfish (*Squalus acanthias*).

Regarding the characteristics of the floatline and the leadline, PP and PA are the materials mainly used in the Mediterranean and the Black Sea. On the floatline, floats of different material, size and shape can be used, depending on the fishing depth. In the last 5–10 years, floats have been replaced by a floating headline in some areas; this technical solution has made it possible to reduce working times, as the potential for net entanglement during hauling operations was reduced. Similarly, leadlines with lead weights integrated into the rope have been used since the 1980–1990s.

Five main types of gillnets can be identified in the Mediterranean and the Black Sea:
- gillnets targeting common sole, with a mesh size of about 70 mm and a height of about 1–3 m;
- gillnets targeting demersal species such as European seabass and brown meagre (*Sciaena umbra*) with a mesh size of about 120 mm and a height of about 3–6 m;
- gillnets targeting mullet with a mesh size of about 44 mm and a height of about 2 m;
- gillnets targeting European hake with a mesh size of about 55–80 mm and a height of about 5–6 m; and
- gillnets targeting horse mackerel, red mullet and sparids with a mesh size of about 55–70 mm and a height ranging from 3 m to 5 m.

Subregional variations

Table 13

Technical parameters (in mean values) of gillnets (GNS) used in the Mediterranean and the Black Sea

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Twine diameter (mm)	Horizontal hanging ratio	Weight of the leadline (g/m)	Mean depth (m)
3	Western Mediterranean	Morocco	GNS	*Boops boops*	40	75	3.0	0.51	0.50		17
3	Western Mediterranean	Morocco	GNS	*Exocoetus* spp.	50						
3	Western Mediterranean	Morocco	GNS	*Lichia amia*	260	15	3.9	1.20	0.62		33
3	Western Mediterranean	Morocco	GNS	*Mullus barbatus*	50	100	5.0	0.43	0.56		25
3	Western Mediterranean	Morocco	GNS	Sparidae	60						50
3	Western Mediterranean	Morocco	GNS	*Argyrosomus regius*	200	18	3.6	1.34	0.58		23
4	Western Mediterranean	Algeria	GNS	*Boops boops*	63	100	6.3	0.30	0.74	200	
4	Western Mediterranean	Algeria	GNS	*Diplodus* spp.	90						18
4	Western Mediterranean	Algeria	GNS	*Merluccius merluccius*	60						49
4	Western Mediterranean	Algeria	GNS	*Mullus barbatus*	46	80	3.6	0.20	0.63	140	
4	Western Mediterranean	Algeria	GNS	*Pagellus acarne*	60						226
5	Western Mediterranean	Spain	GNS	*Mullus surmuletus*	51	22	1.1				175
6	Western Mediterranean	Spain	GNS	*Atherina boyeri*	24	648	15.0	0.15	0.50	380	
6	Western Mediterranean	Spain	GNS	*Diplodus* spp.	101	105	10.9	0.50	0.51		40
6	Western Mediterranean	Spain	GNS	*Epinephelus* spp.	91	80	7.3	0.50	0.52		25
6	Western Mediterranean	Spain	GNS	*Merluccius merluccius*	72	70	5.0	0.30	0.44	120	40
6	Western Mediterranean	Spain	GNS	*Phycis phycis*	91	80	7.3	0.50	0.52		25
6	Western Mediterranean	Spain	GNS	*Sarda sarda*	60						
6	Western Mediterranean	Spain	GNS	Scorpaenidae	91	80	7.3	0.50	0.52		25

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Twine diameter (mm)	Horizontal hanging ratio	Weight of the leadline (g/m)	Mean depth (m)
7	Western Mediterranean	France	GNS	*Dicentrarchus labrax*	95	43	4.0	0.30	0.48	120	14
7	Western Mediterranean	France	GNS	*Diplodus* spp.	101	104	9.8	0.31	0.47		14
7	Western Mediterranean	France	GNS	*Merluccius merluccius*	80	68	5.5	0.37	0.52	174	220
7	Western Mediterranean	France	GNS	Mugilidae	80	100	8.0		0.56		7
7	Western Mediterranean	France	GNS	*Mullus barbatus*	44	44	2.0	0.22		127	16
7	Western Mediterranean	France	GNS	*Mullus* spp.	42	45	1.6	0.25	0.52	120	15
7	Western Mediterranean	France	GNS	*Mullus surmuletus*	45	40	1.8	0.22	0.45	235	17
7	Western Mediterranean	France	GNS	*Pagellus acarne*	80	100	8.0	0.24	0.52	135	62
7	Western Mediterranean	France	GNS	*Solea solea*	80	50	4.0	0.24	0.53	80	20
7	Western Mediterranean	France	GNS	*Sparus aurata*	95	120	10.5	0.31	0.50		13
7	Western Mediterranean	France	GNS	*Zeus faber*	129	73	10.0	0.35	0.50	231	207
8	Western Mediterranean	France	GNS	*Dentex dentex*	214	34	7.3	0.50	0.48		60
8	Western Mediterranean	France	GNS	*Dicentrarchus labrax*	95	37	3.5		0.47	120	15
8	Western Mediterranean	France	GNS	*Merluccius merluccius*	78	80	6.5	0.37	0.52	260	200
8	Western Mediterranean	France	GNS	*Mullus* spp.	42	45	1.6	0.25	0.52	120	15
8	Western Mediterranean	France	GNS	*Pagellus acarne*	80	100	8.0		0.52	135	62
8	Western Mediterranean	France	GNS	*Raja* spp.	214	34	7.3	0.50	0.48		60
8	Western Mediterranean	France	GNS	*Solea solea*	80	50	4.0		0.53	80	20
8	Western Mediterranean	France	GNS	*Zeus faber*	175	50	8.6	0.50	0.49	290	125
9	Western Mediterranean	Italy	GNS	*Boops boops*	50	50	2.5	0.24			

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Twine diameter (mm)	Horizontal hanging ratio	Weight of the leadline (g/m)	Mean depth (m)
9	Western Mediterranean	Italy	GNS	*Chelidonichthys lucerna*	62	74	4.4	0.28	0.51	165	190
9	Western Mediterranean	Italy	GNS	*Conger conger*	77	40	3.1			40	
9	Western Mediterranean	Italy	GNS	*Diplodus* spp.	79	64	5.4	0.24	0.38	100	12
9	Western Mediterranean	Italy	GNS	*Lepidopus caudatus*	73	60	4.3	0.30	0.50	82	300
9	Western Mediterranean	Italy	GNS	*Lithognathus mormyrus*	59	49	2.9	0.35	0.37	250	10
9	Western Mediterranean	Italy	GNS	*Merluccius merluccius*	68	69	4.5	0.30	0.54	132	200
9	Western Mediterranean	Italy	GNS	*Mullus barbatus*	53	71	3.7	0.25	0.48	260	128
9	Western Mediterranean	Italy	GNS	*Sarda sarda*	89	100	8.9		0.48		10
9	Western Mediterranean	Italy	GNS	*Scomber* spp.	72	140	10.4	0.30	0.64	95	88
9	Western Mediterranean	Italy	GNS	*Scophthalmidae*	70	29	2.0	0.25			
9	Western Mediterranean	Italy	GNS	*Seriola dumerili*	82	175	15.0	0.38	0.75	90	13
9	Western Mediterranean	Italy	GNS	Sharks	110	37	3.9	0.49		60	
9	Western Mediterranean	Italy	GNS	*Solea solea*	74	37	2.2	0.23	0.36	145	24
9	Western Mediterranean	Italy	GNS	*Spicara* spp.	33	87	2.9	0.30		80	
9	Western Mediterranean	Italy	GNS	*Trachurus* spp.	67	62	4.0	0.30	0.50	215	175
10	Western Mediterranean	Italy	GNS	*Aristaeomorpha foliacea*	32		4.0				450
10	Western Mediterranean	Italy	GNS	*Boops boops*	56	97	5.5	0.24		207	25
10	Western Mediterranean	Italy	GNS	*Lithognathus mormyrus*	64	50	3.2	0.35		250	
10	Western Mediterranean	Italy	GNS	*Merluccius merluccius*	63	81	5.0	0.31	0.59	127	218
10	Western Mediterranean	Italy	GNS	*Mullus surmuletus*	32	75	2.3	0.17	0.45	80	30

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Twine diameter (mm)	Horizontal hanging ratio	Weight of the leadline (g/m)	Mean depth (m)
10	Western Mediterranean	Italy	GNS	*Oblada melanura*	59	120	7.0				25
10	Western Mediterranean	Italy	GNS	*Sarda sarda*	200		25.0				20
10	Western Mediterranean	Italy	GNS	*Seriola dumerili*	69	115	8.5	0.28	0.86	115	24
10	Western Mediterranean	Italy	GNS	Sharks	110	37	3.9	0.49		60	
10	Western Mediterranean	Italy	GNS	*Solea solea*	62	30	1.7	0.24		55	
10	Western Mediterranean	Italy	GNS	*Spicara* spp.	43	100	4.6	0.30		80	25
12	Central Mediterranean	Tunisia	GNS	*Carcharhinus plumbeus*	150	32	4.8				
12	Central Mediterranean	Tunisia	GNS	*Dicentrarchus labrax*	70	100	2.5	0.28	0.58	225	3
12	Central Mediterranean	Tunisia	GNS	Mugilidae	56	200	4.5	0.30	0.45		8
12	Central Mediterranean	Tunisia	GNS	*Pomatomus saltatrix*	63	163	3.7	0.28	0.50	194	12
12	Central Mediterranean	Tunisia	GNS	*Rhinobatos* spp.	150	32	4.8			104	
12	Central Mediterranean	Tunisia	GNS	*Sardina pilchardus*	42	200	8.6	0.24	0.42		10
12	Central Mediterranean	Tunisia	GNS	*Sardinella aurita*	43	208	7.1	0.24	0.48	200	11
12	Central Mediterranean	Tunisia	GNS	Sharks	150	32	4.8			224	
12	Central Mediterranean	Tunisia	GNS	Sparidae	51	84	3.0	0.26	0.53	190	15
12	Central Mediterranean	Tunisia	GNS	*Spondyliosoma cantharus*	30					100	
12	Central Mediterranean	Tunisia	GNS	*Trachurus* spp.	52	300	4.5	0.26	0.57	225	22
12	Central Mediterranean	Tunisia	GNS	*Mustelus* spp.	130	60	3.2	0.33	0.47	255	30
13	Central Mediterranean	Tunisia	GNS	*Carcharhinus plumbeus*	150	32	4.8				
13	Central Mediterranean	Tunisia	GNS	*Dicentrarchus labrax*	70	100	2.5	0.28	0.58	225	3

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Twine diameter (mm)	Horizontal hanging ratio	Weight of the leadline (g/m)	Mean depth (m)
13	Central Mediterranean	Tunisia	GNS	Mugilidae	56	200	4.5	0.30	0.45		8
13	Central Mediterranean	Tunisia	GNS	*Pomatomus saltatrix*	58	158	3.8	0.28	0.47	163	7
13	Central Mediterranean	Tunisia	GNS	*Rhinobatos* spp.	150	32	4.8			104	
13	Central Mediterranean	Tunisia	GNS	*Sardina pilchardus*	42	200	8.6	0.24	0.42		10
13	Central Mediterranean	Tunisia	GNS	*Sardinella aurita*	42	200	8.6	0.24	0.42		10
13	Central Mediterranean	Tunisia	GNS	Sharks	150	32	4.8			224	
13	Central Mediterranean	Tunisia	GNS	Sparidae	51	84	3.0	0.26	0.53	190	15
13	Central Mediterranean	Tunisia	GNS	*Spondyliosoma cantharus*	30					100	
13	Central Mediterranean	Tunisia	GNS	*Trachurus* spp.	52	300	4.5	0.26	0.57	225	22
13	Central Mediterranean	Tunisia	GNS	*Mustelus* spp.	135	51	2.9	0.42	0.48	260	28
14	Central Mediterranean	Tunisia	GNS	*Carcharhinus plumbeus*	150	32	4.8				
14	Central Mediterranean	Tunisia	GNS	*Dicentrarchus labrax*	70	100	2.5	0.28	0.58	225	3
14	Central Mediterranean	Tunisia	GNS	Mugilidae	56	200	4.5	0.30	0.45		8
14	Central Mediterranean	Tunisia	GNS	*Pomatomus saltatrix*	59	138	3.7	0.27	0.48	197	11
14	Central Mediterranean	Tunisia	GNS	*Rhinobatos* spp.	150	32	4.8			104	
14	Central Mediterranean	Tunisia	GNS	*Sardina pilchardus*	42	200	8.6	0.24	0.42		10
14	Central Mediterranean	Tunisia	GNS	*Sardinella aurita*	45	213	6.3	0.25	0.49	200	11
14	Central Mediterranean	Tunisia	GNS	*Scomber* spp.	52	200	4.0	0.23	0.59	210	22
14	Central Mediterranean	Tunisia	GNS	Sharks	150	32	4.8			224	
14	Central Mediterranean	Tunisia	GNS	Sparidae	51	84	3.0	0.26	0.53	190	15

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Twine diameter (mm)	Horizontal hanging ratio	Weight of the leadline (g/m)	Mean depth (m)
14	Central Mediterranean	Tunisia	GNS	*Spondyliosoma cantharus*	30					100	
14	Central Mediterranean	Tunisia	GNS	*Trachurus* spp.	52	300	4.5	0.26	0.57	225	22
14	Central Mediterranean	Tunisia	GNS	*Elasmobranchs*	265	9	2.2	2.95	0.50	270	35
14	Central Mediterranean	Tunisia	GNS	*Mustelus* spp.	125	50	2.7	0.42	0.48	260	28
16	Central Mediterranean	Italy	GNS	*Mustelus* spp.	150	25	3.8	0.80		200	150
17	Adriatic Sea	Croatia	GNS	*Atherina boyeri*	16						
17	Adriatic Sea	Croatia	GNS	*Boops boops*	51						
17	Adriatic Sea	Croatia	GNS	*Merluccius merluccius*	70		3.0	0.20			50
17	Adriatic Sea	Croatia	GNS	*Palinurus elephas*	190						30
17	Adriatic Sea	Croatia	GNS	*Raja* spp.	260						
17	Adriatic Sea	Croatia	GNS	*Sarda sarda*	80						
17	Adriatic Sea	Croatia	GNS	*Scomber* spp.	36						
17	Adriatic Sea	Croatia	GNS	Scorpaenidae	70						30
17	Adriatic Sea	Croatia	GNS	Sharks	160						
17	Adriatic Sea	Croatia	GNS	*Spicara spp.*	35						
17	Adriatic Sea	Italy	GNS	*Boops boops*	50	50	2.5	0.24			
17	Adriatic Sea	Italy	GNS	*Chelidonichthys lucerna*	70	41	3.0	0.23	0.37		10
17	Adriatic Sea	Italy	GNS	*Dicentrarchus labrax*	109	39	4.0	0.22	0.36	80	12
17	Adriatic Sea	Italy	GNS	*Diplodus* spp.	84	45	3.7	0.23	0.39	70	10

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Twine diameter (mm)	Horizontal hanging ratio	Weight of the leadline (g/m)	Mean depth (m)
17	Adriatic Sea	Italy	GNS	*Homarus gammarus*	120	66	7.9	0.31	0.44		
17	Adriatic Sea	Italy	GNS	*Lichia amia*	90	33	3.0				6
17	Adriatic Sea	Italy	GNS	*Lithognathus mormyrus*	64	56	3.7	0.26	0.39	250	11
17	Adriatic Sea	Italy	GNS	*Merluccius merluccius*	66	78	5.0	0.32		145	
17	Adriatic Sea	Italy	GNS	Mugilidae	100	50	5.0	0.22	0.25	360	12
17	Adriatic Sea	Italy	GNS	*Mullus barbatus*	45	44	2.0		0.37		9
17	Adriatic Sea	Italy	GNS	*Raja* spp.	140	23	3.2	0.30	0.66	60	46
17	Adriatic Sea	Italy	GNS	Sciaenidae	102	38	3.6	0.21	0.39	138	11
17	Adriatic Sea	Italy	GNS	*Scomber* spp.	64	47	3.0			92	6
17	Adriatic Sea	Italy	GNS	*Scophthalmidae*	140	23	3.2	0.30	0.66	60	46
17	Adriatic Sea	Italy	GNS	Sharks	93	35	3.2	0.40	0.37	93	
17	Adriatic Sea	Italy	GNS	*Solea solea*	68	33	2.3	0.21	0.38	61	11
17	Adriatic Sea	Italy	GNS	*Spicara* spp.	33	87	2.9	0.30		80	
17	Adriatic Sea	Italy	GNS	*Squilla mantis*	70	44	3.1	0.22	0.37		11
17	Adriatic Sea	Italy	GNS	*Trachurus* spp.	67	45	3.0		0.38		6
17	Adriatic Sea	Slovenia	GNS	*Merluccius merluccius*	70		3.0	0.20			
17	Adriatic Sea	Slovenia	GNS	*Scomber scombrus*							
17	Adriatic Sea	Slovenia	GNS	*Solea solea*							
17	Adriatic Sea	Slovenia	GNS	*Sparus aurata*							
18	Adriatic Sea	Albania	GNS	*Merluccius merluccius*							

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18	Adriatic Sea	Albania	GNS	*Mullus* spp.	44	60	2.6	0.18	0.66		13
18	Adriatic Sea	Albania	GNS	*Sparus aurata*							
18	Adriatic Sea	Croatia	GNS	*Merluccius merluccius*	80		3.0	0.24			80
18	Adriatic Sea	Italy	GNS	*Belone belone*	30			0.30	0.64		
18	Adriatic Sea	Italy	GNS	*Boops boops*	50	50	2.5	0.25	0.80	260	
18	Adriatic Sea	Italy	GNS	*Diplodus* spp.	69	86	6.0	0.23	0.57	103	18
18	Adriatic Sea	Italy	GNS	*Lithognathus mormyrus*	68	144	9.8	0.20	0.47		15
18	Adriatic Sea	Italy	GNS	*Merluccius merluccius*	62	54	3.1	0.25	0.62	80	
18	Adriatic Sea	Italy	GNS	Mugilidae	76	75	5.7	0.25	0.45	55	20
18	Adriatic Sea	Italy	GNS	*Mullus barbatus*	44	60	2.6	0.18	0.66		12
18	Adriatic Sea	Italy	GNS	*Seriola dumerili*	80	75	6.0	0.20	0.56		
18	Adriatic Sea	Italy	GNS	*Trachurus* spp.	68	144	9.8	0.20	0.47		15
18	Adriatic Sea	Montenegro	GNS	*Atherina boyeri*	20						
18	Adriatic Sea	Montenegro	GNS	*Diplodus* spp.	37						22
18	Adriatic Sea	Montenegro	GNS	*Lophius budegassa*							
18	Adriatic Sea	Montenegro	GNS	*Merluccius merluccius*							
18	Adriatic Sea	Montenegro	GNS	*Mullus barbatus*	41						22
18	Adriatic Sea	Montenegro	GNS	*Palinurus elephas*	120						45
18	Adriatic Sea	Montenegro	GNS	*Raja* spp.	160						
18	Adriatic Sea	Montenegro	GNS	*Sarda sarda*	160						

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18	Adriatic Sea	Montenegro	GNS	*Scomber* spp.	36						
18	Adriatic Sea	Montenegro	GNS	*Scophthalmidae*							
18	Adriatic Sea	Montenegro	GNS	*Sepia officinalis*	64						40
18	Adriatic Sea	Montenegro	GNS	Sharks	120						
18	Adriatic Sea	Montenegro	GNS	*Solea solea*	55						60
18	Adriatic Sea	Montenegro	GNS	*Spicara* spp.	35						
18	Adriatic Sea	Montenegro	GNS	*Trachurus* spp.	43						25
19	Central Mediterranean	Italy	GNS	*Merluccius merluccius*	75	138	11.3	0.34		90	
19	Central Mediterranean	Italy	GNS	*Mullus barbatus*	40	78	2.1	0.25		90	
19	Central Mediterranean	Italy	GNS	*Spicara* spp.	33	88	2.9	0.17	0.61	85	
20	Central Mediterranean	Greece	GNS	*Boops boops*	44	132	5.3	0.24			60
20	Central Mediterranean	Greece	GNS	*Diplodus* spp.	34	100	3.4	0.14		60	12
20	Central Mediterranean	Greece	GNS	*Engraulis encrasicolus*	19	200	3.8	0.24		60	20
20	Central Mediterranean	Greece	GNS	*Merluccius merluccius*	61	86	5.2	0.31	0.43	85	230
20	Central Mediterranean	Greece	GNS	Mugilidae	57	140	7.5	0.19		150	21
20	Central Mediterranean	Greece	GNS	*Mullus barbatus*	38	114	4.4	0.21	0.50	78	17
20	Central Mediterranean	Greece	GNS	*Mullus* spp.	42	50	2.1				35
20	Central Mediterranean	Greece	GNS	*Mullus surmuletus*	40	57	2.3	0.28	0.50		27
20	Central Mediterranean	Greece	GNS	*Oblada melanura*	60	150	9.0	0.24			
20	Central Mediterranean	Greece	GNS	*Pagellus bogaraveo*	81					20	380

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20	Central Mediterranean	Greece	GNS	*Pagrus pagrus*	115	12	1.4	0.61	0.50		
20	Central Mediterranean	Greece	GNS	*Raja* spp.	190	19	3.6	0.24	0.32	345	
20	Central Mediterranean	Greece	GNS	*Sarda sarda*	89	197	25.0	0.30			200
20	Central Mediterranean	Greece	GNS	*Scomber* spp.	51	70	3.5	0.30	0.40	100	
20	Central Mediterranean	Greece	GNS	Sharks	190	19	3.6	0.24	0.32	150	
20	Central Mediterranean	Greece	GNS	*Spicara* spp.	17	133	2.3	0.24	0.39		
20	Central Mediterranean	Greece	GNS	*Trachurus* spp.	60	100	6.0	0.15		86	16
21	Central Mediterranean	Libya	GNS	*Belone belone*	32	250	8.0				20
21	Central Mediterranean	Libya	GNS	*Carcharhinus plumbeus*	300	16	12.0	4.00		1 100	19
21	Central Mediterranean	Libya	GNS	*Diplodus* spp.	80	175	13.1				10
21	Central Mediterranean	Libya	GNS	*Euthynnus alletteratus*	100	175	17.5			225	10
21	Central Mediterranean	Libya	GNS	Mugilidae	80	175	13.1				10
21	Central Mediterranean	Libya	GNS	*Oblada melanura*	49	181	6.5			380	9
21	Central Mediterranean	Libya	GNS	*Sardinella aurita*	48	250	12.0			200	22
21	Central Mediterranean	Libya	GNS	*Seriola dumerili*	80	175	13.6			360	10
21	Central Mediterranean	Libya	GNS	Sharks	300	16	4.8	4.00			19
21	Central Mediterranean	Libya	GNS	*Sphyrena sphyrena*	36	250	9.0				20
21	Central Mediterranean	Libya	GNS	*Sphyraena* spp.	36	250	9.0			360	32
22	Eastern Mediterranean	Greece	GNS	*Atherina boyeri*	16	300	3.2		0.50		
22	Eastern Mediterranean	Greece	GNS	*Belone belone*	36	300	10.8		0.50	137	

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22	Eastern Mediterranean	Greece	GNS	*Boops boops*	45	130	5.7	0.27	0.45	50	17
22	Eastern Mediterranean	Greece	GNS	*Diplodus* spp.	36	91	3.8			60	32
22	Eastern Mediterranean	Greece	GNS	*Engraulis encrasicolus*	18	339	6.1	0.24	0.75	100	
22	Eastern Mediterranean	Greece	GNS	*Homarus gammarus*	190	9	1.6		0.53		
22	Eastern Mediterranean	Greece	GNS	*Loligo vulgaris*	50	60	3.0	0.30	0.50	50	45
22	Eastern Mediterranean	Greece	GNS	*Merluccius merluccius*	61	115	7.8	0.31	0.47	155	90
22	Eastern Mediterranean	Greece	GNS	*Mullus barbatus*	41	78	2.9	0.26	0.54	90	
22	Eastern Mediterranean	Greece	GNS	*Mullus surmuletus*	37	61	2.3	0.28	0.50		33
22	Eastern Mediterranean	Greece	GNS	*Nephrops norvegicus*	54	88	4.8		0.50	156	
22	Eastern Mediterranean	Greece	GNS	*Oblada melanura*	65	270	17.6	0.33	0.38	160	
22	Eastern Mediterranean	Greece	GNS	*Pagrus pagrus*	160	14	2.4	0.61	0.50	25	
22	Eastern Mediterranean	Greece	GNS	*Raja* spp.	190	19	3.6	0.24	0.32	345	
22	Eastern Mediterranean	Greece	GNS	*Sarda sarda*	67	380	19.5	0.39	0.61	90	47
22	Eastern Mediterranean	Greece	GNS	*Sardina pilchardus*	31	392	11.2		0.63	145	17
22	Eastern Mediterranean	Greece	GNS	*Scomber* spp.	53	71	3.8	0.30	0.50	100	
22	Eastern Mediterranean	Greece	GNS	*Sepia officinalis*	50	60	3.0	0.30	0.50	62	47
22	Eastern Mediterranean	Greece	GNS	Sharks	156	17	2.6	0.24	0.47	184	
22	Eastern Mediterranean	Greece	GNS	*Solea solea*	50					100	
22	Eastern Mediterranean	Greece	GNS	Sparidae	25	60		0.30	0.50		7
22	Eastern Mediterranean	Greece	GNS	*Spicara* spp.	22	129	2.8	0.24	0.48	215	

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Twine diameter (mm)	Horizontal hanging ratio	Weight of the leadline (g/m)	Mean depth (m)
22	Eastern Mediterranean	Greece	GNS	*Trachurus* spp.	50	60	3.0	0.30	0.50	76	47
22	Eastern Mediterranean	Türkiye	GNS	*Belone belone*	30	300	9.0	0.30			
22	Eastern Mediterranean	Türkiye	GNS	*Boops boops*	36	92	3.8	0.30	0.50	94	21
22	Eastern Mediterranean	Türkiye	GNS	*Mullus barbatus*	38	37	1.4	0.25	0.48	90	12
22	Eastern Mediterranean	Türkiye	GNS	*Mullus surmuletus*	38	70	2.7	0.24		138	27
22	Eastern Mediterranean	Türkiye	GNS	*Pagellus acarne*	38	70	2.7	0.24		135	27
22	Eastern Mediterranean	Türkiye	GNS	*Sardina pilchardus*	26	500	11.3	0.25	0.50	217	
22	Eastern Mediterranean	Türkiye	GNS	*Scomber* spp.	56	170	9.6	0.29	0.55	135	
22	Eastern Mediterranean	Türkiye	GNS	*Spicara* spp.	40	35	1.4	0.24			16
22	Eastern Mediterranean	Türkiye	GNS	*Trachurus* spp.	60	160	9.7	0.31	0.58	130	
24	Eastern Mediterranean	Türkiye	GNS	*Mullus barbatus*	44	100	4.4	0.50	0.23	111	12
24	Eastern Mediterranean	Türkiye	GNS	Siganidae	24						37
25	Eastern Mediterranean	Cyprus	GNS	Sparidae	64						30
26	Eastern Mediterranean	Egypt	GNS	*Scomberomorus commerson*	42		6.0				13
26	Eastern Mediterranean	Egypt	GNS	Demersal and pelagic species	48		7.5				11
27	Eastern Mediterranean	Lebanon	GNS	*Boops boops*	37	82	3.0	0.33		50	30
27	Eastern Mediterranean	Lebanon	GNS	*Dentex dentex*	167	126	13.0	1.50		250	
27	Eastern Mediterranean	Lebanon	GNS	*Diplodus* spp.	59	73	3.0	0.25	0.50	116	67
27	Eastern Mediterranean	Lebanon	GNS	*Epinephelus* spp.	160	225	13.0	1.50			

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27	Eastern Mediterranean	Lebanon	GNS	*Etrumeus teres*	32	94	3.0	0.33		120	30
27	Eastern Mediterranean	Lebanon	GNS	*Euthynnus alletteratus*	158	115	12.0	1.50		360	
27	Eastern Mediterranean	Lebanon	GNS	*Merluccius merluccius*	80	80	6.4		0.5	500	
27	Eastern Mediterranean	Lebanon	GNS	*Mullus barbatus*	32	94	3.0	0.33		50	30
27	Eastern Mediterranean	Lebanon	GNS	*Scomberomorus commerson*	167	126	13.0	1.50		187	
27	Eastern Mediterranean	Lebanon	GNS	Siganidae	56	88	3.0			64	
27	Eastern Mediterranean	Lebanon	GNS	*Sphyrena sphyrena*	59	88	3.0			100	
27	Eastern Mediterranean	Lebanon	GNS	*Spicara* spp.	31	110	3.0	0.33		40	30
27	Eastern Mediterranean	Lebanon	GNS	*Demersal and pelagic species*	86		6.7	0.61	0.52	140	30
27	Eastern Mediterranean	Palestine	GNS	*Auxis rochei*	66	276	16.0	0.30	0.53	98	14
27	Eastern Mediterranean	Palestine	GNS	*Alpes dgedaba*	84	214	18.0	0.36	0.50	93	14
27	Eastern Mediterranean	Palestine	GNS	*Boops boops*	30	400	12.0	0.20	0.60	110	15
27	Eastern Mediterranean	Palestine	GNS	*Cheilopogon exsiliens*	30	400	12.0	0.20	0.60	110	15
27	Eastern Mediterranean	Palestine	GNS	*Mugil cephalus*	75			0.37			
27	Eastern Mediterranean	Palestine	GNS	Mugilidae	66	276	16.0	0.30	0.53	98	14
27	Eastern Mediterranean	Palestine	GNS	*Sardinella aurita*	30	400	12.0	0.20	0.60	110	15
27	Eastern Mediterranean	Palestine	GNS	*Scomberomorus commerson*	84	214	18.0	0.36	0.50	93	14
27	Eastern Mediterranean	Palestine	GNS	Sparidae	78			0.40			
27	Eastern Mediterranean	Syrian Arab Republic	GNS	*Leiognathus berbis*	15						35

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Twine diameter (mm)	Horizontal hanging ratio	Weight of the leadline (g/m)	Mean depth (m)
27	Eastern Mediterranean	Israel	GNS	Sparidae	95		5.0				17
28	Black Sea	Türkiye	GNS	*Atherina* spp.	22	100	2.2	0.24	0.50	65	4
28	Black Sea	Türkiye	GNS	*Boops boops*	50	105	5.3	0.30	0.50	214	
28	Black Sea	Türkiye	GNS	*Homarus gammarus*	170	9	1.5	0.52	0.50	75	
28	Black Sea	Türkiye	GNS	*Merlangius merlangus*	57	70	3.9	1.20	0.54	72	130
28	Black Sea	Türkiye	GNS	*Mullus barbatus*	44	45	2.0	0.20	0.53	109	
28	Black Sea	Türkiye	GNS	*Pomatomus saltatrix*	64	117	7.5	0.30	0.50	90	
28	Black Sea	Türkiye	GNS	*Sarda sarda*	94	400	35.0	0.39	0.50	457	20
28	Black Sea	Türkiye	GNS	*Scomber japonicus*	44	224	9.9	0.33	0.50	162	
28	Black Sea	Türkiye	GNS	*Spicara* spp.	44	55	2.4	0.40	0.50	381	50
28	Black Sea	Türkiye	GNS	*Trachurus trachurus*	36	240	8.6	0.24	0.50	139	
29	Black Sea	Bulgaria	GNS	*Alosa pontica*	34	75	5.3	0.22	0.50	52	13
29	Black Sea	Bulgaria	GNS	*Belone belone*	24	275	6.5	0.14	0.50	40	8
29	Black Sea	Bulgaria	GNS	*Dasyatis pastinaca*	200	8	3.2	0.38	0.25	33	58
29	Black Sea	Bulgaria	GNS	Gobiidae	20						
29	Black Sea	Bulgaria	GNS	*Mugil cephalus*	24	125	6.0	0.21	0.58	55	6
29	Black Sea	Bulgaria	GNS	*Mullus barbatus*	33	75	3.0	0.21	0.50	40	8
29	Black Sea	Bulgaria	GNS	*Pomatomus saltatrix*	29	125	6.3	0.25	0.59	55	11
29	Black Sea	Bulgaria	GNS	*Raja clavata*	200	8	3.2	0.38	0.25	33	58
29	Black Sea	Bulgaria	GNS	*Sarda sarda*	42	125	9.5	0.27	0.68	65	13

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Twine diameter (mm)	Horizontal hanging ratio	Weight of the leadline (g/m)	Mean depth (m)
29	Black Sea	Bulgaria	GNS	*Scophthalmus maximus*	400	7	2.8	0.42	0.39	36	64
29	Black Sea	Bulgaria	GNS	*Trachurus mediterraneus*	19	75	2.7	0.19	0.55	50	11
29	Black Sea	Romania	GNS	*Alosa maeotica*	31			0.25		35	15
29	Black Sea	Romania	GNS	Gobiidae	20						
29	Black Sea	Romania	GNS	*Scophthalmus maximus*	400	7	2.8	0.54	0.39	39	64
29	Black Sea	Romania	GNS	Sharks	110						
29	Black Sea	Romania	GNS	*Sprattus sprattus*	30						
29	Black Sea	Russian Federation	GNS	*Scophthalmus maximus*	380						
29	Black Sea	Ukraine	GNS	*Alosa* spp.	40						9
29	Black Sea	Ukraine	GNS	*Atherina* spp.	15						
29	Black Sea	Ukraine	GNS	Gobiidae	31						
29	Black Sea	Ukraine	GNS	*Liza haematocheilus*	72						9
29	Black Sea	Ukraine	GNS	*Mullus barbatus*	50						
29	Black Sea	Ukraine	GNS	*Platichthys flesus*	100						9
29	Black Sea	Ukraine	GNS	*Scophthalmus maximus*	390						9
29	Black Sea	Ukraine	GNS	Sharks	110						
29	Black Sea	Ukraine	GNS	*Sprattus sprattus*	20						
29	Black Sea	Türkiye	GNS	*Belone belone*	20	200	4.0	0.24	0.24	129	12
29	Black Sea	Türkiye	GNS	*Engraulis encrasicolus*	20	400	8.0	0.30	0.60	98	

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Twine diameter (mm)	Horizontal hanging ratio	Weight of the leadline (g/m)	Mean depth (m)
29	Black Sea	Türkiye	GNS	*Merlangius merlangus*	34	63	2.1	0.22	0.56	63	
29	Black Sea	Türkiye	GNS	*Mullus barbatus*	37	49	1.8	0.27	0.52	65	15
29	Black Sea	Türkiye	GNS	*Pomatomus saltatrix*	36	150	5.4	0.33	0.50	179	
29	Black Sea	Türkiye	GNS	*Scophthalmus maximus*	400	7	2.5	0.43	0.36	45	39
30	Black Sea	Ukraine	GNS	*Scophthalmus maximus*	240	12		0.30			4
30	Black Sea	Ukraine	GNS	*Alosa maeotica*	50			0.25			4
30	Black Sea	Ukraine	GNS	*Mullus barbatus*	50			0.25			4

Notes: AMB: *Seriola dumerili*; BLU: *Pomatomus saltatrix*; BOG: *Boops boops*; BON: *Sarda sarda*; BSS: *Dicentrarchus labrax*; CBR: *Serranus cabrilla*; COB: *Umbrina cirrosa*; COE: *Conger conger*; CRW: *Palinurus elephas*; CTC: *Sepia officinalis*; GPD: *Epinephelus marginatus*; GPX: *Epinephelus* spp.; GUU: *Chelidonichthys lucerna*; HKE: *Merluccius merluccius*; HOM: *Trachurus trachurus*; JAX: *Trachurus* spp.; JOD: *Zeus faber*; LEE: *Lichia amia*; MAC: *Scomber scombrus*; MAZ: *Scomber* spp.; MTS: *Squilla mantis*; MUF: *Mugil cephalus*; MUT: *Mullus barbatus*; MUX: *Mullus* spp.; OCC: *Octopus vulgaris*; PAX: *Pagellus* spp.; RSE: *Scorpaena scrofa*; SBG: *Sparus aurata*; SBS: *Oblada melanura*; SCS: *Scorpaena* spp.; SFS: *Lepidopus caudatus*; SOL: *Solea solea*; SPC: *Spicara smaris*; SQR: *Loligo vulgaris*: SSB: *Lithognathus mormyrus*; TGS: *Penaeus kerathurus*; TRG: *Balistes carolinensis*; TUR: *Scophthalmus maximus*; XYN: *Xyrichtys novacula*.

Western Mediterranean

Gillnets targeting sparids – bogue, common dentex, *Diplodus* spp., sand steenbras, axillary seabream (*Pagellus acarne*), gilthead seabream and picarels (*Spicara* spp.) – are the most commonly observed in all GSAs of the western Mediterranean.

In Morocco (GSA 3), gillnetters are active at around 90–100 landing sites, especially in Nador Province (Idrissi *et al.*, 2002). The most common gillnets (locally called *boughera*) are used to target bogue, red mullet and other sparids with a mesh length of 40–60 mm and a stretched net height of 2–5 m (Malouli *et al.*, 2008). A specific gillnet is deployed to catch meagre (*Argyrosomus regius*) at a mean depth of 23 m, with a mesh size of 200 mm, a height of 3.6 m and a twine diameter of 1.34 mm. A larger mesh length (260 mm) is used in gillnets targeting leerfish (*Lichia amia*). The *boulahera* is another type of gillnet used in Fnideq, off northeastern Morocco, to catch flyingfish (*Exocoetus* spp.; Idrissi *et al.*, 2002).

In Taza, Algeria (GSA 4), different gillnets are used in different métiers: sparid monofilament gillnet, *Pagellus* set gillnet and European hake set gillnet (Boubekri *et al.*, 2018). Each net has a length of 150 m to 2 000 m and a mesh size of 60–90 mm, according to the targeted species. The sparid monofilament gillnet métier is used in the summer season (May–August) at depths less than 25 m above rocky habitats near *Posidonia* seagrass meadows. The *Pagellus* set gillnet métier is used in the summer season (May–September) at depths greater than 40 m over sandy substrates. The same depths and substrates are exploited by the European hake set gillnet métier, which is carried out in both spring and winter.

In Spain (GSAs 1, 5 and 6), the generic name given to a gillnet is *solta*. There are many modifications to the basic gear as a function of the target species, which can vary greatly in terms of size or behaviour (Urbistondo, 2001). The main species for traditional *soltas* are those belonging to the family Sparidae, as well as red mullet and striped red mullet. Moreover, several gillnets (called *plastiquera* in Santa Pola, GSA 6) are quite widespread along the coast for catching European hake, with a mean mesh size of 72 mm, a hanging ratio of 0.43 and a stretched height of 5 m. A larger mesh (91 mm) is used in gillnets targeting groupers (*Epinephelus* spp.), forkbeards (*Phycis phycis*), scorpenids, and *Diplodus* spp. Furthermore, a particular gillnet employed to catch sand smelt (*Atherina boyeri*), with a small mesh length (24 mm) and a significant stretched net height (15 m), is used in the Ebro Delta coastal lagoons (Rodríguez-Climent *et al.*, 2012). Finally, the *bonitolera* is a widespread gillnet used to target small tuna fish, especially Atlantic bonito (*Sarda sarda*), with a mesh size ranging from 40 mm to 80 mm.

In France (GSAs 7 and 8), a commonly observed type of gillnet targets the European hake and displays a net panel in PA monofilament with a diameter of 0.25–0.37 mm and a mesh size of 70–80 mm (SGMED, 2004). The net reaches a stretched net height of 5.5–6.5 m and a length ranging between 3 000 m and 5 000 m and is deployed at greater than 100 m depth. In addition, gillnets designed to catch red mullets are widespread along the French Mediterranean coast. The fishing areas for striped red mullet occur on bottoms enclosed by rocks and seagrass meadows, between 8 m and 25 m depth, while red mullet are caught mostly on seagrass meadows and muddy and sandy bottoms from 5 m to 30 m depth. The fishers set gillnets that are generally between 200 m and 2 000 m in length with a PA monofilament of 0.18 mm to 0.25 mm; the mesh size ranges between 34 mm and 56 mm (mean of 42–45 mm), and the stretched net height is around 1.6–1.8 m. Sparids (mainly sand steenbras and gilthead seabream) are targeted between 5 m and 40 m depth, especially during the warm season (May–October). The gillnets are made of monofilament nylon of 28 to 35/100 denier, with a large height (from 4 m to 25 m stretched height). The stretched mesh, according to the targeted species, ranges from 62 mm to 125 mm. The lengths are often less than 2 km. In GSA 7, there is a particular gillnet employed to target the common dentex that has a mesh length of

214 mm and a stretched height of 7.3 m and is deployed at about 60 m depth. European seabass are targeted in winter (November–January) at depths ranging from 5 m to 30 m, using gillnets with a mesh size ranging from 80 mm to 100 mm, a PA monofilament of 58–90 Rtex (around 0.25-0.30 mm) and a stretched height less than 4 m. The same net type can be used to target mugilids (also in lagoons) and common sole, with a hanging ratio of 0.53. Finally, a gillnet type with a PA monofilament, a stretched height ranging from 8 m to 12 m and a mesh size from 100 m to 140 mm is deployed at 180–250 m depth to catch monkfish (*Lophius* spp.), John dory and scorpenids.

In Italy (GSAs 9 and 10), there is a high level of differentiation within the gillnets used by different fisheries (Sassu, Cannas and Ferreti, 2001; Ferretti, Tarulli and Palladino, 2002). Significant differences are observed when comparing the characteristics of the fleets, the main features of the gear, the target species and the composition of the landings. The gillnet targeting European hake is widely used along the Italian coast (locally called *barracuda*), especially from October to June (SGMED, 2004), and is principally made of nylon monofilament with a diameter of 0.25–0.30 mm. The stretched mesh size ranges from 50 mm to 64 mm, though 53 mm is most common, which is smaller than in other areas. The height of the net is 4–5 m and the hanging ratio is generally about 0.5. The lead of this gear is about 120 g/m and the net length ranges from 4 000 m to 7 000 m, with a mean length of 5 000 m. Furthermore, the same net type permits catching tub gurnard, sparids, horse mackerel and mackerel (*Scomber* spp). Gillnets used to catch common sole are also widely used and have a 62–80 mm mesh length and a 1.7–3 m stretched height. The gillnets targeting sparids and other white fish are mostly employed in coastal areas, and the mesh length varies according to the different target species (e.g. 33–43 mm for picarels and 59–64 mm for sand steenbras). The highest hanging ratios reported for Italy involve gillnets targeting pelagic fish such as mackerel (hanging ratio of 0.64) and greater amberjack (*Seriola dumerili*; hanging ratio of 0.75–0.86). Finally, there is a gillnet in GSA 9 specifically designed to target the silver scabbardfish with a 74 mm mesh length, a 4.3 m net height and a 0.50 hanging ratio. It is deployed at around 300 m depth.

Central Mediterranean

In Tunisia (GSAs 12, 13 and 14), several gillnets with mesh lengths ranging from 130 mm to 280 mm are used to catch elasmobranchs, such as smooth-hound sharks, the sandbar shark (*Carcharhinus plumbeus*) and guitarfishes from the genus *Rhinobatos* (Echwikhi *et al.*, 2010). Gillnets targeting sparids are widespread and display a mean mesh length of 51 mm, a height of 3 m, a twine diameter of 0.23–0.28 mm and a hanging ratio of 0.50–0.55. Other gillnets are employed to target bluefish (*Pomatomus saltatrix*) and European seabass. Finally, gillnets targeting sardine and round sardinella (*Sardinella aurita*) with 38–40 mm mesh length and 8.6–12 m net height are recorded in Tunisia (Romdhane *et al.*, 2014).

In Italy (GSA 19), gillnets are commonly used to target European hake with a mesh length of around 75 mm and a net height of 4.5 m up to more than 10 m. In this area, gillnets targeting red mullet display a height of 2.1 m and a mesh length of around 40 mm. Only one gillnet type was found in GSA 16: it is used to target smooth-hound sharks using a large mesh size (150 mm).

In Greece (GSA 20), the length of gillnets ranges mainly from 40 m to 220 m; the net height ranges from 50 meshes to 100 meshes when targeting demersal species, while for pelagic and semi-pelagic species it ranges from 200 meshes to 400 meshes (Adamidou, 2007). The hanging ratio can vary from 0.25 (for lobster) to 0.75 (for bogue, picarels, mackerel), while 0.5 is the most common hanging ratio for demersal species (mullet, European hake, seabream). The mesh size varies widely depending on the size and species being targeted. Floats of expanded PVC with a ring, cylinder or egg shape are attached to the headline to maintain the buoyancy. Weights, usually made of steel, with a ring or cylinder shape are attached to the leadline in order to ensure bottom contact, though lead-core leadlines have become more popular to avoid catching on obstructions. The size and frequency of the floats depend on the mesh size (they need to be slightly larger than the mesh openings) and on the depth at which the net is used. The surface gillnets require more floats and fewer weights, while the opposite is necessary for bottom gillnets. Suitable mooring (usually stones) is used to fix the net to the bottom, while plastic buoys provide lift and mark the position of the net. The gillnets targeting red mullet and striped red mullet can have different mesh sizes depending on the area (34 mm, 38 mm, 42 mm, 44 mm, 52 mm; Adamidou, 2007). Striped red mullet is caught on the bottom in areas enclosed by rocks and seagrass meadows at 5–30 m depth, while red mullet is caught mostly in seagrass meadows and on muddy and sandy bottoms at 10–60 m depth. The nets are set once or twice per day, before sunrise and/or after sunset, and stay in the water for 2–3 hours. The fishing period is from June to November. Gillnets targeting European hake have a lower stretched net height than in Italy (5.2 m) and also display a smaller mesh length (mean of 61 mm); they are usually 100–250 m long and 60–100 meshes high. These nets are set in deeper waters (muddy seabed at 60–400 m depth) before sunset and hauled out before sunrise and stay in the water for 10–12 hours. The fishing period is from April to September. High variability, concerning both mesh size and net height, was observed in gillnets targeting different species of the Sparidae family; for instance, gillnets targeting the saddled seabream (*Oblada melanura*) have a mesh length of 60 mm and a height of 9 m, in other words more than double the gillnets employed to catch bogue (4 m), which also have a smaller mesh length (40 mm). Nets are set on sandy seabed and in seagrass meadows at 20–100 m depth. Likewise, they are set once or twice a day, before sunrise and/or after sunset, and stay in the water for 2–3 hours. The fishing period is mainly from May to October. The smallest mesh lengths reported for Greece refer to gillnets used for anchovies (19 mm) and picarels (17 mm). Finally, a special gillnet fishery for blackspot seabream (*Pagellus bogaraveo)* was reported (SGMED, 2004). In this case, the fishing grounds are rough, rocky banks at depths from 300 m to 600 m, which are detected by the depth recorder. Three to four pieces of net are deployed; in order to attract the fish, small bags made from netting of small mesh size with bait inside (sardine) are tied every 10 m to the footline. As the distance from the surface to the bottom is quite long, the fishers have to estimate the currents so that the nets arrive at the intended place on the bottom. According to this practice, for each piece of net, two long pieces of rope (300 m to 700 m) are needed in order to tie the ends of the net to the buoy. Hauling of the nets takes place 4–5 hours later.

In Libya (GSA 21), the same gillnets targeting small pelagic fish (e.g. sardines) as used in Tunisia are observed. Other gillnets with a small mesh length (32 mm) are also used to catch garfish (*Belone belone*). A specific gillnet designed to catch the sandbar shark with a mesh length of 300 mm and height of 12 m was likewise reported. Finally, a gillnet with a large height of 17.5 m and a 100 mm mesh length is employed to catch the little tunny (*Euthynnus alletteratus*).

Adriatic Sea

In the Italian Adriatic Sea (GSAs 17 and 18), a mesh length between 60 mm and 80 mm is used to target most species. The stretched net height in most nets ranges between 2 m and 3 m. The twine diameter usually ranges between 0.18 mm and 0.22 mm, while the horizontal hanging ratio is normally between 0.30 and 0.39. The material used for the netting panels is PA transparent monofilament (with a few exceptions). The headline is mostly made of braided PP and rarely braided PA. The leadline is made of both braided PA and PP. The length of nets ranges from 1 000 m to 5 000 m, mainly depending on the size of the vessel and the availability of manpower on land to clean the different gear. In the northern and central Adriatic Sea, gillnets are mainly employed from April to January to target common sole using a low height (1.6–2.5 m) and a very low buoyancy of floats, which allows the gear to partially lay down on the seabed, thus favouring the capture of benthic fish and sparids – common two-banded seabream (*Diplodus vulgaris*), white seabream (*Diplodus sargus*) and annular seabream (*Diplodus annularis*) (Fabi and Grati, 2008; Fabi *et al.*, 2002). Locally, gillnets are used to catch high value species such as European seabass, brown meagre, shi drum (*Umbrina cirrose*) and turbot. In addition, old and damaged nets are commonly used to target the spottail mantis shrimp (*Squilla mantis*) from July to December. A few vessels from the northern Adriatic Sea use gillnets with large meshes to target sharks, such as the smooth-hound (*Mustelus mustelus*). Spottail mantis shrimp is also targeted by Italian vessels in the southern Adriatic Sea (GSA 18) over January–February and June–October; in the same area, striped red mullet is targeted with gillnets all year round (Grati *et al.*, 2018).

In Croatia (GSAs 17 and 18), gillnets targeting European hake are used all year round on sea bottoms deeper than 50 m (mostly in the southern Adriatic Sea). Some of these nets are made of PA monofilament with a twine diameter of around 0.20–0.24 mm and a stretched net height of 3 m. Some gillnets, locally called *menulara*, *bukvara* and *girara*, are also employed to catch small sparids (e.g. bogue and picarels) with small mesh lengths (35–51 mm). Very small meshes are also used in specific gillnets called *oližnica* (12–16 mm mesh opening) and *gavunara* (20–24 mm mesh opening) targeting sand smelts (*Atherina* spp.). Small pelagic fish are caught using the *voiga* net (32–36 mm mesh opening). Meanwhile, larger pelagic fish such as Atlantic bonito are caught using the *polandara* net with a mesh opening of 80–120 mm. The largest meshes (greater than 190 mm) reported from Croatia are used in gillnets targeting sharks (called *psara*), as well as rays and crabs (called *sklatara*), which include the European spider crab (*Maja squinado*), and lobsters, which include the common spiny lobster (*Palinurus elephas*) and European lobster (*Homarus gammarus*) (Matić-Skoko *et al.*, 2017). Nowadays, some of the gillnets described above are used less than in the past.

In Slovenia (GSA 17), the gillnets employed in the springtime to catch European hake have similar technical properties to those used in Croatia. Gillnets are also used to catch common sole from September to December, Atlantic mackerel (*Scomber scombrus*) from April to November and gilthead seabream from August to January (Grati *et al.*, 2018).

In Albania (GSA 18), gillnets are used all year round to catch red mullets, using a 44 mm mesh size, and European hake; they are also used in winter to catch the gilthead seabream (Grati *et al.*, 2018).

In Montenegro (GSA 18), gillnets with a mesh size of around 22–46 mm, net height of around 1.5–3 m and monofilament PA netting are mainly used for mackerel and several species of the Sparidae family – bogue, *Diplodus* spp., gilthead seabream, *Dentex* spp., red porgy (*Pagrus pagrus*) and common pandora (*Pagellus erythrinus*). Gillnets with a larger mesh size (70–110 mm mesh length) and net height up to 8 m are used to target Atlantic bonito, bullet tuna (*Auxis rochei*), greater amberjack, sharks, rays and crabs (Matić-Skoko *et al.*, 2017). A specific gillnet type is designed to catch the common spiny lobster with a large mesh length (120 mm). Gillnets are also used to catch blackbellied anglerfish (*Lophius budegassa*), European hake and turbot.

Eastern Mediterranean

In Greece (GSA 22), gillnets have similar characteristics to those employed in the Greek Ionian Sea (Adamidou, 2007). Gillnets targeting red mullets are widespread. Those employed to catch sparids are highly diversified and based on the different target species, as in other countries and subregions. For example, the gillnet employed to catch red porgy has a mesh length of 160 mm and a stretched net height of 2.4 m and is deployed at depths of 160 m. Some gillnets are specifically designed for lobsters, such as European lobster, with a 190 mm mesh length and 1.6 m net height, and Norway lobster

(*Nephrops norvegicus*), with a 54 mm mesh size and 4.8 m net height. Gillnets with small mesh lengths target sand smelt (16 mm mesh length) and anchovies (*Engraulis encrasicolus*; 18 mm mesh length).

In Türkiye (GSAs 22 and 24), the stretched gillnet mesh size ranges from 12 mm to 120 mm (Özekinci, 2005; Aydın, Gökçe and Metin, 2008). The gillnets reported to catch red mullet and striped red mullet, despite displaying the same 38 mm mesh length, have a marked difference in stretched net height (1.4 m for red mullet and 2.7 m for striped red mullet), due to a different vertical number of meshes (37 vs 70). In Izmir Bay, fishers generally use a gillnet mesh size of 36 mm to catch red mullet and set the nets near the shore where the depths range between 3 m and 20 m; these areas are called *apoşi* and are characterized by sandy and muddy seabed joined to rocky and seagrass zones (Aydın, Gökçe and Metin, 2008). Some gillnets are employed to catch species in the Siganidae family (20 mm and 28 mm mesh length; Bilecenoglu and Kaya, 2002).

In Cyprus (GSA 25), gillnets are employed to target fish in the Sparidae family at a mean depth of 30 m. The mean mesh size used is 64 mm.

In Egypt (GSA 26), the gillnets operated in the coastal area off Alexandria have different mesh sizes, ranging from 13 mm to 83 mm, and a high stretched net height (5–10 m) to catch both demersal and pelagic species (Ragheb and Rizkalla, 2020). For instance, the gillnet targeting the Lessepsian migrant the narrow-barred Spanish mackerel (*Scomberomorus commerson*) has a 42 mm mesh length and a stretched net height of 6 m (El-Far, 2008).

In Lebanon (GSA 27), gillnets are widely used (Plate 49). They are made of a PA monofilament net with 0.33 mm diameter, and a 31–37 mm stretched mesh size is commonly used to target picarels, red mullet and bogue. Gillnets with larger meshes (48 mm to 120 mm stretched mesh size) are used to target medium-sized fish such as sparids, including common two-banded seabream and annular seabream, as well as siganids including marbled spinefoot (*Siganus rivulatus*) and dusky spinefoot (*Siganus luridus*) on shallow sandy and mixed sandy–rocky bottoms (Lelli, 2007; Sacchi and Dimech, 2011). Gillnets with a stretched net height of 3 m are used to catch the red-eye round herring (*Etrumeus teres*; 32 mm mesh length) and picarels. Monofilament or multifilament gillnets with a twine diameter of about 1.5 mm, stretched mesh size of 140–180 mm and a high net height (12–13 m) are used to target the narrow-barred Spanish mackerel and little tunny, but they can also catch highly prized fish such as the common dentex and groupers. The length of nets usually ranges from a few hundred metres to more than 1 000 m.

PLATE 49
Small gillnetter used in Lebanon

In Palestine (GSA 27), gillnets are usually employed to catch both sparids and flathead grey mullet (*Mugil cephalus*), using a 75–78 mm mesh size. Two types of gillnets are used. The first one, called *quta*, is set in shallow waters without a vessel to catch coastal fish species and has a length of about 20 m to 30 m; the second one, known as *bushlela*, is similar to the *quta*, but longer (50–100 m) and used in deeper waters to catch demersal fish such as gilthead seabream. Both gillnets are fixed at both ends by means of anchors or stones (Ali, 2002).

In the Syrian Arab Republic (GSA 27), only one gillnet type was reported. It has a very small mesh size (15 mm) and is used to target the Lessepsian migrant the Berber ponyfish (*Leiognathus berbis*; Alshawy, Lahlah and Hussein, 2016).

In Israel (GSA 27), gillnets are widely used in shallow waters between 3 m and 30 m, especially above the rocky substrate close to the interface with the sandy bottom. The mesh sizes used are different (from 50 mm to 140 mm) to target different species (mainly sparids) throughout the year (Frid and Belmaker, 2019).

Black Sea

In the Turkish Black Sea (GSAs 28 and 29), gillnets are employed in both GSAs to catch the same target species – whiting (*Merlangius merlangus*), red mullet and bluefish. However, in GSA 28, the mesh lengths (57 mm, 44 mm, 64 mm, respectively) and net heights (2 m, 3.9 m, 7.5 m, respectively) are higher than those reported for GSA 29 (34 mm, 37 mm, 36 mm mesh lengths and 1.8 m, 2.1 m, 5.4 m net heights, respectively). Moreover, in Turkish GSA 28 (and in particular the Dardanelles Strait; Doyuk, 2006), some gillnets are used to catch pelagic species such as Atlantic bonito (94 mm mesh length), Atlantic horse mackerel (*Trachurus trachurus*; 36 mm mesh length) and chub mackerel (*Scomber japonicus*, 44 mm mesh length), while other gillnets are used to catch the European lobster. In GSA 29, a specific gillnet is used in turbot fisheries, with a mean mesh length of around 312 mm (up to 40 mm; Tonay and Öztürk, 2003). According to Bilgin, Kose and Yesilcicek (2018), the total length of these set nets targeting turbot ranges between 0.36 km and 1.8 km; for each fishing operation, they are left at sea for a long time, since their soak time ranges from 4 days to 18 days, depending on the sea conditions.

In Bulgaria (GSA 29), the set gillnet fishery operates in both coastal and offshore waters and mainly targets turbot with meshes of about 320–400 mm and net height around 2 m. These gillnets are deployed in the shelf area during the spring and autumn seasons. The turbot fishery has been regulated using total allowable catch since 2004 (STECF-SGMED, 2008). Piked dogfish, thornback ray (*Raja clavata*), common stingray (*Dasyatis pastinaca*) and sturgeons (Acipenseridae) are often caught as bycatch in this fishery. Smaller meshes (around 15–25 mm) are used to catch mixed demersal species, such as gobids. Gillnets are also used to catch red mullet, whiting and pelagic species, such as Pontic shad (*Alosa pontica*), Atlantic bonito and horse mackerel, with meshes of around 25–60 mm (mesh length). Another gillnet is employed to target small gobids, with a 20–25 mm mesh size.

In Romania (GSA 29), most of the active fleet use set gillnets as their main gear type; the nets used are similar to the ones employed in Bulgaria. Gillnets are mainly used to target turbot with a mesh length of around 310–400 mm (Radu and Anton, 2014). These gillnets are deployed on the shelf area throughout the whole year; the turbot fishery has been regulated using total allowable catch since 2005 (STECF-SGMED, 2008). Gillnets with 15–25 mm mesh length are used for gobids, gillnets with 30 mm mesh length are used for sprat (*Sprattus sprattus*) and Black Sea shad (*Alosa maeotica*), and gillnets with more than 100 mm mesh length are used for piked dogfish.

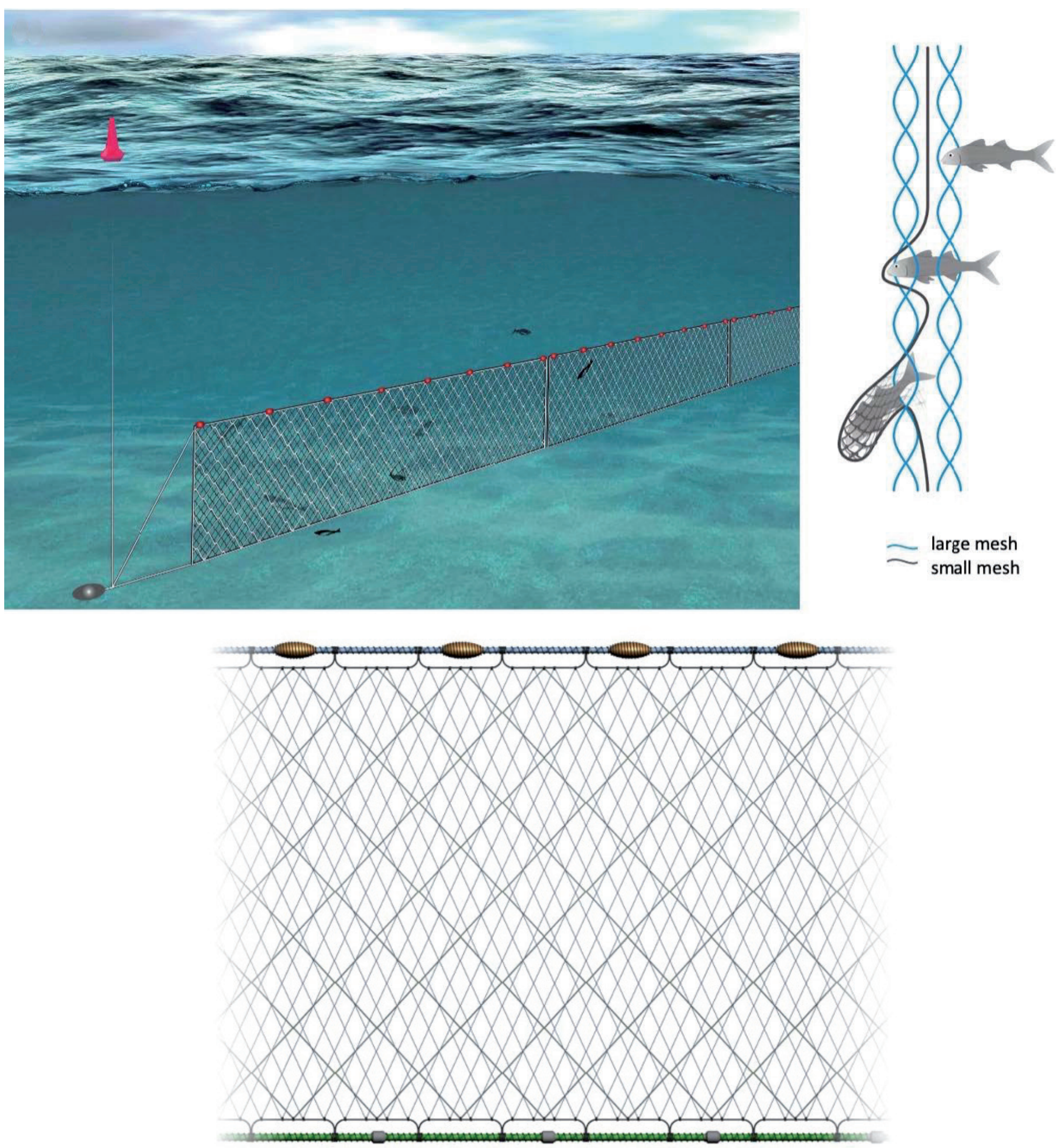
In the Russian Federation (GSA 29), one gillnet type is reported. It is used to catch turbot with a 380 mm mesh size.

In Ukraine (GSAs 29 and 30), gillnets are mainly used to catch shad (*Alosa* spp.), turbot and piked dogfish. Gillnets targeting turbot have a mesh length of around 360–400 mm; turbot exploitation in Ukraine has been regulated using total allowable catch since 1996 (STECF-SGMED, 2008). Moreover, three groups of nets are used to target demersal species of different sizes: 15–20 mm mesh length for gobids; 50–70 mm mesh length for red mullet and whiting; and 100–120 mm mesh length for piked dogfish.

Trammel nets

Trammel nets are fixed nets consisting of three layers of nets (or two layers in rare cases, such as in Greece): a slack, small mesh, inner panel of netting and two outer layers of netting that are tight and have a larger mesh size (Figure 68). The three panels are hung

FIGURE 68
Trammel net (top left, bottom) and catching method (top right)

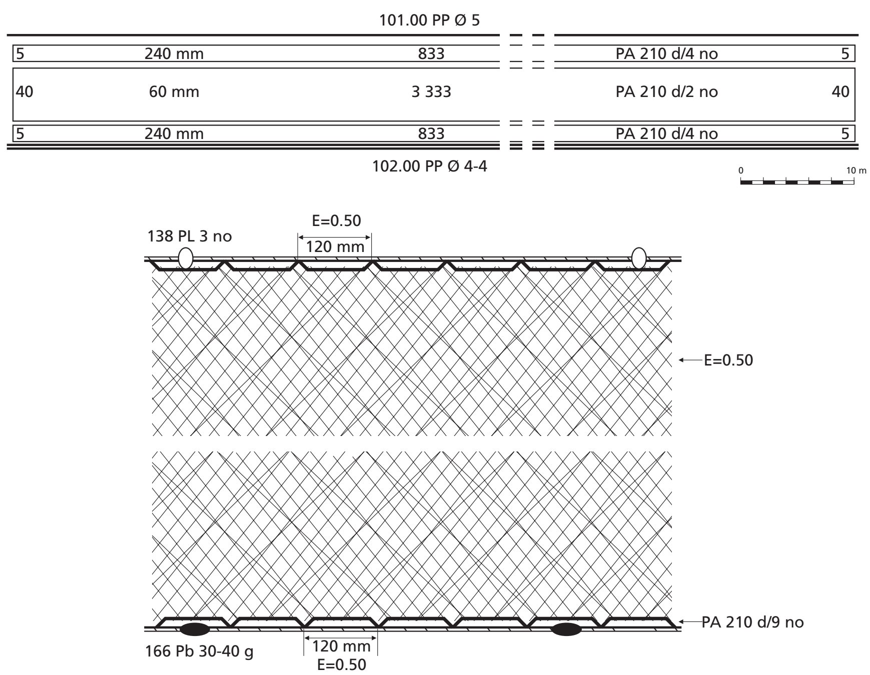


Source: **Seafish.** 2023. Fishing gear database. In: *Seafish*. Cited 23 May 2023. Edinburgh. www.seafish.org/responsible-sourcing/fishing-gear-database/?t=docGear/

jointly in parallel on a single headline and leadline. Although they resemble gillnets, these bottom-set nets operate on a different principle. The catching process requires that fish, in attempting to pass through the larger mesh, entangle themselves in a pocket of small mesh webbing between the two layers of large meshed walls (Figure 69). This type of capture is exclusive to the trammel net. Fish can also be caught gilled, entangled or enmeshed in the netting. Therefore, trammel nets are considered to be less selective than gillnets.

Like gillnets, they are made up of several or many gangs (a variable number of netting panels of set nets connected in a row) and 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 with far more slack. When set over rocky or incoherent substrates, a heavy-mesh skirt may be attached to the leadline to prevent the gear from snagging on rocks or to pick up the debris, while saving the main netting from becoming filled up with this debris. These types of nets usually target demersal and semi-demersal fish or shrimps.

FIGURE 69
Technical specifications of a trammel net



Source: redrawn from **Tokaç, A., Ünal, V., Tosunoğlu, Z., Akyol, O., Özbilgin, H. & Gökçe, G.** 2010. *Ege Denizi Balıkçılığı* [Aegean Sea fisheries]. İzmir, Türkiye, IMEAK Chamber of Shipping İzmir branch.

Trammel nets, like gillnets, are used to target a wide range of species, such as red mullet, scorpionfish (Scorpaenidae), common sole, common cuttlefish (*Sepia officinalis*), common octopus (*Octopus vulgaris*) and common spiny lobster. In some areas, they also target pelagic species. This great variety of target species, as likewise observed for gillnets, requires the use of different variants of trammel nets in different fishing grounds. Furthermore, some differences have been detected in the technical properties of trammel nets targeting the same species in several areas (Table 14).

The main characteristics of the fishing vessels using trammel nets are: GT ranging from 0.81 to 9; LOA from 4.3 m to 13 m; and kW from 10 to 500. In general, trammel nets are used in coastal waters, from 5 m to 50 m depth and sometimes at greater depths (up to 250 m). The total length of trammel nets usually ranges from 100 m to about 6 000 m, even though the majority are 4 000 m to 5 000 m long. Nets made of multifilament PA are mostly used in the Gulf of Lion; in other areas, monofilament PA is also important. The mesh length is strongly related to the target species: for example, a 23–25 mm nominal mesh size is used in trammel nets targeting red mullets; a 30 mm nominal mesh size is used in the Aegean Sea to catch small bogue and red mullet; and the largest mesh sizes are used in northern Spain and the northern Adriatic Sea to catch common spiny lobster and turbot.

Considering the target species, it can be possible to identify six main net types:

- trammel nets targeting common cuttlefish with a mesh opening of the inner panel of about 70 mm and height of the external panel of about 1–2 m;
- trammel nets targeting turbot with a mesh opening of the inner panel of about 110 mm and height of the external panel of about 2 m (internal panel 3–5 m);
- trammel nets targeting sand steenbras with a mesh opening of the inner panel of about 36–90 mm and height of the external panel of about 2–5 m (internal panel
- 4–5 m);
- trammel nets targeting shrimps with a mesh opening of the inner panel of about 40–50 mm and height of the external panel of about 2–3 m (internal panel 5 m);
- trammel nets targeting grey mullet with a mesh opening of the inner panel of about 70 mm and height of the external panel of about 2–4 m (internal panel 1.5 m); and
- trammel nets targeting red mullets with a mesh opening of the inner panel of about 45 mm and height of the external panel of about 1.5 m (internal panel 2.8 m).

Subregional variations

Table 14

Technical parameters (in mean values) of trammel nets used in the Mediterranean and the Black Sea

GSA	Subregion	Country	Gear code	Main target species	Internal mesh length (mm)	Vertical number of meshes	Internal twine diameter (mm)	Internal height (m)	External mesh length (mm)	External vertical number of meshes	External twine diameter (mm)	External height (m)	Vertical slack	Leadline weight (g/m)
1	Western Mediterranean	Spain	GTR	*Mullus barbatus*	47			2.0	350			1.5	1.33	
1	Western Mediterranean	Spain	GTR	*Palinurus mauritanicus*	100			3.5	600			2.5	1.40	
1	Western Mediterranean	Spain	GTR	*Sepia officinalis*	75			2.0	450			1.5	1.33	
1	Western Mediterranean	Spain	GTR	Sparidae	63			2.0				1.5	1.33	
3	Western Mediterranean	Morocco	GTR	*Mullus barbatus*	47	67	0.33	3.2	333	5.7	0.65	1.8	1.66	
3	Western Mediterranean	Morocco	GTR	*Sepia officinalis*	50	50	0.33	2.5	300	8.0	0.60	2.4	1.04	
3	Western Mediterranean	Morocco	GTR	*Solea solea*	50	51	0.33	2.6	400	4.0	0.64	1.6	1.59	
3	Western Mediterranean	Morocco	GTR	Sparidae	45									
3	Western Mediterranean	Morocco	GTR	*Sparus aurata*	100	50	0.54	5.0	300	15.0	0.63	4.5	1.11	
4	Western Mediterranean	Algeria	GTR	*Mullus* spp.	44									
4	Western Mediterranean	Algeria	GTR	*Pagellus* spp.	82	40	0.4	3.3	440	3.5	0.65	1.5	2.1	
4	Western Mediterranean	Algeria	GTR	*Palinurus elephas*	166	20	0.60	3.3	600	3.5	0.85	2.1	1.58	300
5	Western Mediterranean	Spain	GTR	*Dasyatys* spp.	80							1.8		60
5	Western Mediterranean	Spain	GTR	*Elasmobranchs*	80							1.8		80
5	Western Mediterranean	Spain	GTR	*Mullus barbatus*	47			2.0				1.5	1.33	
5	Western Mediterranean	Spain	GTR	*Mullus surmuletus*	51	21		1.1				2.0		
5	Western Mediterranean	Spain	GTR	*Mustelus mustelus*	80							1.8		80
5	Western Mediterranean	Spain	GTR	*Palinurus elephas*	118	13		1.6		4.5	0.81	1.8	1.36	170

GSA	Subregion	Country	Gear code	Main target species	Internal mesh length (mm)	Vertical number of meshes	Internal twine diameter (mm)	Internal height (m)	External mesh length (mm)	External vertical number of meshes	External twine diameter (mm)	External height (m)	Vertical slack	Leadline weight (g/m)
5	Western Mediterranean	Spain	GTR	*Palinurus mauritanicus*	100			3.5				2.5	1.40	
5	Western Mediterranean	Spain	GTR	*Raja* spp.	80							1.8		
5	Western Mediterranean	Spain	GTR	*Sepia officinalis*	80	13		1.4				1.5	1.33	
5	Western Mediterranean	Spain	GTR	Sparidae	78	25		2.2		4.5	0.81	1.6	1.34	210
6	Western Mediterranean	Spain	GTR	*Penaeus kerathurus*	39	57		2.0		8.0	0.44	2.6	0.78	200
6	Western Mediterranean	Spain	GTR	*Mullus barbatus*	45	65		2.5			0.60			360
6	Western Mediterranean	Spain	GTR	*Mullus surmuletus*	49	56	0.24	2.6	404	3.5	0.30	1.4	1.82	
6	Western Mediterranean	Spain	GTR	*Pagellus erythrinus*	50									
6	Western Mediterranean	Spain	GTR	*Palinurus elephas*	89	42	0.30	3.0	505	3.3	0.45	1.8	2.45	327
6	Western Mediterranean	Spain	GTR	*Sepia officinalis*	70	40	0.23	2.3	436	4.2	0.48	1.8	1.44	248
6	Western Mediterranean	Spain	GTR	*Solea solea*	90	33		1.8			0.31			360
7	Western Mediterranean	France	GTR	*Lithognathus mormyrus*	80				550	7.1		3.8		
7	Western Mediterranean	France	GTR	*Mullus barbatus*	50	47		2.3	380	4.0	0.60	1.6	1.45	117
7	Western Mediterranean	France	GTR	*Palinurus elephas*	130	43		5.2			0.77			360
7	Western Mediterranean	France	GTR	*Palinurus* spp.	143	42		5.2	650	3.5		1.7		165
7	Western Mediterranean	France	GTR	Scophthalmidae	160	20		3.2		2.5	0.60	1.7	2.02	200
7	Western Mediterranean	France	GTR	*Scophthalmus maxima*	160	20	0.30	3.2	650	2.5		1.6		125
7	Western Mediterranean	France	GTR	*Scorpaena scrofa*	48	60		2.9	415	5.5		2.3	1.26	90
7	Western Mediterranean	France	GTR	*Scorpaena* spp.	67	51		2.6	477	3.5	0.60	1.6	1.32	100

GSA	Subregion	Country	Gear code	Main target species	Internal mesh length (mm)	Vertical number of meshes	Internal twine diameter (mm)	Internal height (m)	External mesh length (mm)	External vertical number of meshes	External twine diameter (mm)	External height (m)	Vertical slack	Leadline weight (g/m)
7	Western Mediterranean	France	GTR	*Scyllarus arctus*	48	60		2.9	415	5.5		2.3	1.26	
7	Western Mediterranean	France	GTR	*Sepia officinalis*	89	41	0.27	2.7	488	4.0	0.60	1.9	1.53	108
7	Western Mediterranean	France	GTR	*Solea solea*	87	35	0.25	2.2	420	3.7	0.62	1.6	1.48	98
7	Western Mediterranean	France	GTR	*Sparus aurata*	80				550	7.1		3.8		
8	Western Mediterranean	France	GTR	Labridae	65							2.0		
8	Western Mediterranean	France	GTR	*Mullus barbatus*	58	57		2.7	360	4.0		1.8		220
8	Western Mediterranean	France	GTR	*Pagellus erythrinus*	100							1.2		
8	Western Mediterranean	France	GTR	*Pagrus pagrus*	100							1.2		120
8	Western Mediterranean	France	GTR	*Palinurus elephas*	166	18	0.50	3.0	610	3.5	0.80	1.6	1.39	170
8	Western Mediterranean	France	GTR	*Palinurus* spp.	143	42		5.2	650	3.5		1.7		165
8	Western Mediterranean	France	GTR	*Phycis phycis*	133	18	0.50	3.0	610	3.5	0.80	1.7	1.39	
8	Western Mediterranean	France	GTR	*Raja* spp.	165	18	0.50	3.0	610	3.5	0.80	2.1	1.39	
8	Western Mediterranean	France	GTR	*Scophthalmus maxima*	160	20	0.30	3.2	650	2.5		1.6		125
8	Western Mediterranean	France	GTR	*Scorpaena scrofa*	165	18	0.50	3.0	610	3.5	0.80	2.1	1.39	140
8	Western Mediterranean	France	GTR	*Scorpaena* spp.	81	55		3.9	450	3.5		1.6		140
8	Western Mediterranean	France	GTR	*Sepia officinalis*	80	40	0.30	3.2	480	2.5		1.2		110
8	Western Mediterranean	France	GTR	Sparidae	65							2.0		
9	Western Mediterranean	Italy	GTR	*Chelidonichthys lucerna*	88	41	0.23	3.7	451	4.2	0.33	1.9	1.94	100
9	Western Mediterranean	Italy	GTR	*Dicentrarchus labrax*	92	43	0.20	4.0	368	6.0		2.2	1.79	

GSA	Subregion	Country	Gear code	Main target species	Internal mesh length (mm)	Vertical number of meshes	Internal twine diameter (mm)	Internal height (m)	External mesh length (mm)	External vertical number of meshes	External twine diameter (mm)	External height (m)	Vertical slack	Leadline weight (g/m)
9	Western Mediterranean	Italy	GTR	*Lithognathus mormyrus*	65	50	0.44	3.3			0.63	1.8	1.82	80
9	Western Mediterranean	Italy	GTR	*Penaeus kerathurus*	39	60	0.22	2.5	335	6.7	0.39	1.4	1.81	90
9	Western Mediterranean	Italy	GTR	*Merluccius merluccius*	120	33	0.71	3.9		5.0	0.70	2.0	2.00	80
9	Western Mediterranean	Italy	GTR	Mugilidae	92	43	0.20	4.0	368	6.0		2.2	1.79	
9	Western Mediterranean	Italy	GTR	*Mullus barbatus*	42	61	0.39	2.4	306	5.0	0.53	1.4	1.69	151
9	Western Mediterranean	Italy	GTR	*Mullus surmuletus*	43	63	0.27	2.7	306	5.0	0.42	1.5	1.76	
9	Western Mediterranean	Italy	GTR	*Octopus vulgaris*	74	54	0.30	4.0	365	5.0	0.52	1.8	2.19	115
9	Western Mediterranean	Italy	GTR	*Palinurus elephas*	76	45	0.35	3.3	520	7.9	0.61	1.9	1.72	163
9	Western Mediterranean	Italy	GTR	*Raja* spp.	90	40	0.37	3.7	412	4.0	0.58	1.6	2.19	100
9	Western Mediterranean	Italy	GTR	Scophthalmidae	95	47	0.39	4.4	407	5.0	0.85	2.0	2.19	165
9	Western Mediterranean	Italy	GTR	*Scorpaena* spp.	71	55	0.42	3.4	363	6.2	0.72	2.0	1.71	166
9	Western Mediterranean	Italy	GTR	*Sepia officinalis*	61	58	0.30	2.9	354	6.2	0.67	1.7	1.65	164
9	Western Mediterranean	Italy	GTR	*Solea solea*	74	45	0.40	3.4	383	4.3	0.58	1.7	1.98	100
9	Western Mediterranean	Italy	GTR	Sparidae	62	49	0.30	3.3	476	4.5	0.47	1.7	1.90	87
9	Western Mediterranean	Italy	GTR	*Sparus aurata*	92	50	0.25	4.6	529	4.5	0.35	2.4	1.93	
9	Western Mediterranean	Italy	GTR	*Squilla mantis*	64	50	0.18	2.8	376	3.5	0.30	1.3	2.18	50
9	Western Mediterranean	Italy	GTR	*Trachinus draco*	46	70	0.17	3.2	335	4.0	0.30	1.3	2.41	50
9	Western Mediterranean	Italy	GTR	*Umbrina cirrosa*	92	43	0.20	4.0	368	6.0		2.2	1.79	
9	Western Mediterranean	Italy	GTR	*Zeus faber*	70	35		1.7		5.0	0.51	1.7	1.00	

GSA	Subregion	Country	Gear code	Main target species	Internal mesh length (mm)	Vertical number of meshes	Internal twine diameter (mm)	Internal height (m)	External mesh length (mm)	External vertical number of meshes	External twine diameter (mm)	External height (m)	Vertical slack	Leadline weight (g/m)
10	Western Mediterranean	Italy	GTR	*Chelidonichthys lucerna*	36						0.63	1.3		120
10	Western Mediterranean	Italy	GTR	*Conger conger*	80						0.41	1.9		40
10	Western Mediterranean	Italy	GTR	*Dentex dentex*	84					5.0		1.8		80
10	Western Mediterranean	Italy	GTR	*Lepidopus caudatus*	80						0.41	1.9		80
10	Western Mediterranean	Italy	GTR	*Lithognathus mormyrus*	80	50	0.71	4.0		5.0	0.70	1.4	2.86	75
10	Western Mediterranean	Italy	GTR	*Penaeus kerathurus*	36						0.63	1.3		200
10	Western Mediterranean	Italy	GTR	*Merluccius merluccius*	76	64		4.0		16.7	0.41	2.7	0.67	220
10	Western Mediterranean	Italy	GTR	*Mullus barbatus*	44	75	0.49	3.4		7.4	0.56	2.0	1.99	99
10	Western Mediterranean	Italy	GTR	*Mullus* spp.	46	65	0.30	3.0		5.0	0.54	1.2		150
10	Western Mediterranean	Italy	GTR	*Mullus surmuletus*	55					12.5		4.0		
10	Western Mediterranean	Italy	GTR	*Palinurus elephas*	78	35	0.54	2.5		8.1	0.51	1.8	1.44	100
10	Western Mediterranean	Italy	GTR	*Scorpaena* spp.	68	44	0.42	3.3	285	7.8	0.67	2.4	2.16	100
10	Western Mediterranean	Italy	GTR	*Sepia officinalis*	61	60	0.52	3.7	290	6.5	0.61	1.9	2.31	131
10	Western Mediterranean	Italy	GTR	*Solea solea*	83	50	0.30	4.2		5.0	0.71	2.5	1.66	80
11	Western Mediterranean	Italy	GTR	*Epinephelus* spp.	206	18	0.83	3.0		3.5	0.96	2.0	1.53	300
11	Western Mediterranean	Italy	GTR	*Mullus barbatus*	51	50	0.63	2.6		5.3		1.7	1.55	110
11	Western Mediterranean	Italy	GTR	*Palinurus elephas*	151.3	15.7	0.59	2.3	400	4.6		1.77	1.26	80–105
11	Western Mediterranean	Italy	GTR	*Palinurus mauritanicus*	70	17	0.24	1.2						
11	Western Mediterranean	Italy	GTR	*Raja* spp.	110	22	0.79	2.5		4.5	0.92	1.8	1.37	300

GSA	Subregion	Country	Gear code	Main target species	Internal mesh length (mm)	Vertical number of meshes	Internal twine diameter (mm)	Internal height (m)	External mesh length (mm)	External vertical number of meshes	External twine diameter (mm)	External height (m)	Vertical slack	Leadline weight (g/m)
11	Western Mediterranean	Italy	GTR	*Scorpaena scrofa, Phycis phycis*	76.7	26.5	0.35–0.43	2.0	400	4		1.5	1.3	80–100
11	Western Mediterranean	Italy	GTR	*Sepia officinalis, Mullus surmuletus*	55.4	36	0.24	2.0	400	4		1.5	1.3	80
11	Western Mediterranean	Italy	GTR	*Mullus surmuletus, Pagellus* spp.	50		0.20–0.25	2.0				1.5		78–115
12	Central Mediterranean	Tunisia	GTR	*Lithognathus mormyrus*	56	65		3.5		5.6	0.60	1.4	2.68	116
12	Central Mediterranean	Tunisia	GTR	*Penaeus kerathurus*	42	71	0.22	2.5	290	5.6	0.58	1.0	2.58	131
12	Central Mediterranean	Tunisia	GTR	*Mullus barbatus*	34	72	0.24	1.8	290	7.0	0.55	1.1	1.64	240
12	Central Mediterranean	Tunisia	GTR	*Palinurus elephas*	75									
12	Central Mediterranean	Tunisia	GTR	*Palinurus* spp.	140	30	0.60	2.3	300	8.5	0.73	1.3	1.77	230
12	Central Mediterranean	Tunisia	GTR	*Sepia officinalis*	65	59	0.30	3.3	270	6.1	0.60	1.5	2.18	160
12	Central Mediterranean	Tunisia	GTR	*Solea solea*	68	54	0.30	3.5	220	5.7	0.75	1.5	2.40	104
12	Central Mediterranean	Tunisia	GTR	Sparidae	52	72	0.23	1.7	300	7.5	0.55	1.2	1.42	230
12	Central Mediterranean	Tunisia	GTR	Various demersal fish	50	74	0.27	2.2	235	5.8	0.42	1.5	1.51	235
13	Central Mediterranean	Tunisia	GTR	*Penaeus kerathurus*	42	69	0.22	1.5	290	6.5	0.55	0.9	1.61	228
13	Central Mediterranean	Tunisia	GTR	*Mullus barbatus*	34	72	0.24	1.8	290	7.0	0.55	1.1	1.64	240
13	Central Mediterranean	Tunisia	GTR	*Palinurus* spp.	140	30	0.60	2.3	300	8.5	0.73	1.3	1.77	230
13	Central Mediterranean	Tunisia	GTR	*Sepia officinalis*	56	63	0.30	1.9	270	6.3	0.60	1.0	1.95	228
13	Central Mediterranean	Tunisia	GTR	*Solea solea*	61	42	0.30	1.4	220	4.5	0.75	0.5	2.80	140
13	Central Mediterranean	Tunisia	GTR	Sparidae	52	72	0.23	1.7	300	7.5	0.55	1.2	1.42	230

GSA	Subregion	Country	Gear code	Main target species	Internal mesh length (mm)	Vertical number of meshes	Internal twine diameter (mm)	Internal height (m)	External mesh length (mm)	External vertical number of meshes	External twine diameter (mm)	External height (m)	Vertical slack	Leadline weight (g/m)
13	Central Mediterranean	Tunisia	GTR	*Spondyliosoma cantharus*	30									
13	Central Mediterranean	Tunisia	GTR	Various demersal fish	50	74	0.27	2.2	235	5.8	0.42	1.5	1.51	235
14	Central Mediterranean	Tunisia	GTR	Elasmobranchs	40			1.0						
14	Central Mediterranean	Tunisia	GTR	*Penaeus kerathurus*	43	69	0.22	1.5	290	6.5	0.55	0.9	1.61	228
14	Central Mediterranean	Tunisia	GTR	*Mullus barbatus*	34	72	0.24	1.8	290	7.0	0.55	1.1	1.64	240
14	Central Mediterranean	Tunisia	GTR	*Sepia officinalis*	50	63	0.30	1.9	270	6.3	0.60	1.0	1.95	228
14	Central Mediterranean	Tunisia	GTR	*Solea solea*	61	42	0.30	1.4	220	4.5	0.75	0.5	2.80	140
14	Central Mediterranean	Tunisia	GTR	Sparidae	45	69	0.27	1.8	290	7.3	0.55	1.2	1.53	240
14	Central Mediterranean	Tunisia	GTR	Various demersal fish	50	74	0.27	2.2	235	5.8	0.42	1.5	1.51	235
15	Central Mediterranean	Malta	GTR	*Mullus barbatus*	50									
15	Central Mediterranean	Malta	GTR	*Mullus surmuletus*	50									120
15	Central Mediterranean	Malta	GTR	*Pagrus pagrus*	50									120
15	Central Mediterranean	Malta	GTR	*Scorpaena* spp.	50									120
16	Central Mediterranean	Italy	GTR	*Merluccius merluccius*	30	67		2.0	170					
16	Central Mediterranean	Italy	GTR	*Mullus barbatus*	55		0.30	1.8			0.54	1.7		
16	Central Mediterranean	Italy	GTR	*Mullus surmuletus*	84	35	1.65	2.0	111	4.0	0.54	1.1		140
16	Central Mediterranean	Italy	GTR	*Palinurus elephas*	100	20	3.20	1.2	200	5.0	0.54	1.3		180
16	Central Mediterranean	Italy	GTR	*Sepia officinalis*	80	40	1.54	1.2	200	4.5	0.54	1.3		160
17	Adriatic Sea	Croatia	GTR	Elasmobranchs	240				700					

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17	Adriatic Sea	Croatia	GTR	*Mullus surmuletus*	34					10.0		1.5		
17	Adriatic Sea	Croatia	GTR	*Sarpa salpa*	80				300					
17	Adriatic Sea	Croatia	GTR	Scophthalmidae	240				700					
17	Adriatic Sea	Croatia	GTR	*Scorpaena* spp.	42					10.0		1.5		150
17	Adriatic Sea	Croatia	GTR	*Sepia officinalis*	64				300					
17	Adriatic Sea	Croatia	GTR	*Solea solea*	80				300					
17	Adriatic Sea	Italy	GTR	*Diplodus annularis*	68			3.5				2.0	1.75	122
17	Adriatic Sea	Italy	GTR	*Lithognathus mormyrus*	70	71	0.25	3.8	420	11.1	0.49	2.3	1.69	182
17	Adriatic Sea	Italy	GTR	*Merluccius merluccius*	74	70		5.2	405	7.5		3.0	1.71	150
17	Adriatic Sea	Italy	GTR	*Mullus barbatus*	61	80		2.9		5.0	0.63	1.8	1.56	152
17	Adriatic Sea	Italy	GTR	*Palinurus elephas*	72	47		3.3		8.4	0.61	1.8	1.78	190
17	Adriatic Sea	Italy	GTR	Scophthalmidae	103	37	0.30	4.2	668	3.5	0.47	2.0	2.58	91
17	Adriatic Sea	Italy	GTR	*Scorpaena* spp.	60	55		2.1		7.5	0.60	2.1	1.00	
17	Adriatic Sea	Italy	GTR	*Sepia officinalis*	69	59	0.31	2.5	392	6.6	0.61	1.7	1.40	141
17	Adriatic Sea	Italy	GTR	*Solea solea*	74	29	0.32	2.1			0.44	0.8	2.58	165
17	Adriatic Sea	Italy	GTR	Sparidae	70		0.19			9.8	0.30	3.0		
17	Adriatic Sea	Italy	GTR	*Squilla mantis*	70						0.43	2.0		
17	Adriatic Sea	Italy	GTR	*Zeus faber*	70	35		1.7		5.0	0.51	1.7	1.00	
17	Adriatic Sea	Slovenia	GTR	*Solea solea*	72									

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18	Adriatic Sea	Albania	GTR	*Lithognathus mormyrus*	49	63	0.17	3.4	320	5.5	0.44	1.8	1.92	
18	Adriatic Sea	Albania	GTR	*Penaeus kerathurus*	40									
18	Adriatic Sea	Albania	GTR	*Mullus surmuletus*	56									
18	Adriatic Sea	Albania	GTR	Sparidae	49	63	0.17	3.4	320	5.5	0.44	1.8	1.92	180
18	Adriatic Sea	Italy	GTR	Labridae	56	55	0.30	3.0	365	4.0	0.54	1.5	2.09	65
18	Adriatic Sea	Italy	GTR	*Lithognathus mormyrus*	54	57	0.30	3.1	380	4.0	0.54	1.5	2.03	
18	Adriatic Sea	Italy	GTR	*Mullus barbatus*	50	53	0.58	2.8		8.3	0.53	1.7	1.59	99
18	Adriatic Sea	Italy	GTR	*Mullus surmuletus*	60						0.60	2.1		
18	Adriatic Sea	Italy	GTR	*Palinurus elephas*	77	43	0.60	3.3		9.0	0.57	1.8	1.91	115
18	Adriatic Sea	Italy	GTR	*Scorpaena* spp.	59	59	0.55	3.4	380	6.3	0.58	2.0	1.78	150
18	Adriatic Sea	Italy	GTR	*Sepia officinalis*	48	56	0.41	2.8	365	6.5	0.52	1.5	1.90	91
18	Adriatic Sea	Montenegro	GTR	Carangidae	42			13.0						70
18	Adriatic Sea	Montenegro	GTR	*Mullus barbatus*	40			2.8						73
18	Adriatic Sea	Montenegro	GTR	*Palinurus elephas*	60			3.6						73
18	Adriatic Sea	Montenegro	GTR	*Sarpa salpa*	80									
18	Adriatic Sea	Montenegro	GTR	*Sepia officinalis*	49			2.5						73
18	Adriatic Sea	Montenegro	GTR	*Solea solea*	72									
18	Adriatic Sea	Montenegro	GTR	Soleidae	55			2.2						70
18	Adriatic Sea	Montenegro	GTR	Sparidae	36			1.8						73

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19	Central Mediterranean	Italy	GTR	*Merluccius merluccius*	73	60	0.37	4.3		4.0	0.71	1.6	2.67	115
19	Central Mediterranean	Italy	GTR	*Mullus barbatus*	41						0.68	1.1		115
19	Central Mediterranean	Italy	GTR	*Mullus surmuletus*	56									
19	Central Mediterranean	Italy	GTR	*Octopus vulgaris*	50		0.30			10.0	0.63	1.5		
19	Central Mediterranean	Italy	GTR	*Palinurus elephas*	59	60	0.63	3.4		9.5	0.60	1.9	1.81	135
19	Central Mediterranean	Italy	GTR	*Scorpaena* spp.	54	60	0.63	3.8		6.8	0.64	1.6	1.96	98
19	Central Mediterranean	Italy	GTR	*Sepia officinalis*	66	40	0.63	3.2		5.3	0.84	1.1	3.00	112
19	Central Mediterranean	Italy	GTR	*Xyrichtys novacula*	30	133	0.24	4.0			0.58			
20	Central Mediterranean	Greece	GTR	*Boops boops*	48			2.9				1.7	1.78	128
20	Central Mediterranean	Greece	GTR	*Dentex dentex*	56	51	0.42	2.8	202	6.7	0.62	1.6	1.83	46
20	Central Mediterranean	Greece	GTR	*Dicentrarchus labrax*	69	44	0.39	3.0	290	6.5	0.56	1.9	1.53	90
20	Central Mediterranean	Greece	GTR	*Diplodus annularis*	56									
20	Central Mediterranean	Greece	GTR	*Diplodus sargus*	60									
20	Central Mediterranean	Greece	GTR	*Epinephelus* spp.	100	50	0.44	5.0	220	7.5	0.63	3.3	1.52	
20	Central Mediterranean	Greece	GTR	*Homarus gammarus*	62			3.4		6.8		1.9	2.06	20
20	Central Mediterranean	Greece	GTR	Labridae	56									
20	Central Mediterranean	Greece	GTR	*Lithognathus mormyrus*	54	77	0.21	4.0	270	8.6	0.42	2.2	1.96	108
20	Central Mediterranean	Greece	GTR	*Penaeus kerathurus*	45	59	0.19	2.9	137	5.7	0.23	1.1	3.01	78
20	Central Mediterranean	Greece	GTR	Mugilidae	63	48	0.42	3.7	300	11.5	0.60	2.6	1.64	120

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20	Central Mediterranean	Greece	GTR	*Mullus barbatus*	42	61	0.24	2.6	141	7.1	0.37	1.4	2.30	243
20	Central Mediterranean	Greece	GTR	*Mullus surmuletus*	48	50		7.5		7.4	0.34	1.8	4.22	
20	Central Mediterranean	Greece	GTR	*Pagrus pagrus*	72			4.1		7.0		2.6	1.57	140
20	Central Mediterranean	Greece	GTR	*Palinurus elephas*	55	56	0.47	2.8	228	7.2	0.56	1.7	1.74	122
20	Central Mediterranean	Greece	GTR	*Scorpaena* spp.	75			1.2						
20	Central Mediterranean	Greece	GTR	*Sepia officinalis*	62	57	0.27	2.9	210	15.8	0.33	2.6	2.01	265
20	Central Mediterranean	Greece	GTR	*Shrimps*	45	106	0.17	4.7	212	12.1	0.44	2.6	1.83	160
20	Central Mediterranean	Greece	GTR	*Siganus rivulatus*	40			2.0						
20	Central Mediterranean	Greece	GTR	*Solea solea*	57	68	0.25	3.8	267	7.6	0.45	2.0	1.87	107
20	Central Mediterranean	Greece	GTR	Sparidae	61	66	0.28	3.6	273	8.1	0.49	2.3	1.61	121
20	Central Mediterranean	Greece	GTR	*Various demersal fish*	48	60			257	7.8			1.60	
21	Central Mediterranean	Libya	GTR	*Penaeus kerathurus*	50				120	10.4		1.3		207
21	Central Mediterranean	Libya	GTR	Mugilidae	52					30.0		7.2		450
21	Central Mediterranean	Libya	GTR	*Mullus surmuletus*	52				240	9.5		2.0		360
21	Central Mediterranean	Libya	GTR	*Pagellus erythrinus*	52					10.5		2.5		80
21	Central Mediterranean	Libya	GTR	*Sarpa salpa*	52					30.0		7.2		450
21	Central Mediterranean	Libya	GTR	*Sepia officinalis*	52					10.5		2.5		
21	Central Mediterranean	Libya	GTR	*Seriola dumerili*	52					30.0		7.2		450
21	Central Mediterranean	Libya	GTR	*Sphyraena* spp.	52				240	30.0		7.2		450

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22	Eastern Mediterranean	Greece	GTR	*Boops boops*	46	60	0.24	2.9	180	8.0	0.44	1.5	1.91	218
22	Eastern Mediterranean	Greece	GTR	*Dentex dentex*	64	53	0.42	3.1	202	6.8	0.62	1.7	1.82	46
22	Eastern Mediterranean	Greece	GTR	*Diplodus annularis*	56									
22	Eastern Mediterranean	Greece	GTR	*Diplodus sargus*	60									
22	Eastern Mediterranean	Greece	GTR	*Epinephelus* spp.	100	50	0.44	5.0	220	7.5	0.63	3.3	1.52	
22	Eastern Mediterranean	Greece	GTR	*Homarus gammarus*	68	50	0.24	3.6	400	7.2	0.44	2.3	1.78	70
22	Eastern Mediterranean	Greece	GTR	*Lithognathus mormyrus*	60	50	0.24	3.0	140	4.5	0.24	0.6	4.76	
22	Eastern Mediterranean	Greece	GTR	*Penaeus kerathurus*	45	59	0.19	2.9	116	5.8	0.23	1.1	3.19	76
22	Eastern Mediterranean	Greece	GTR	*Merluccius merluccius*	80									
22	Eastern Mediterranean	Greece	GTR	Mugilidae	55			4.0		16.3		3.1	1.64	159
22	Eastern Mediterranean	Greece	GTR	*Mullus barbatus*	43	61	0.25	2.6	135	7.4	0.39	1.4	2.21	242
22	Eastern Mediterranean	Greece	GTR	*Mullus* spp.	44	60			220	7.5				
22	Eastern Mediterranean	Greece	GTR	*Mullus surmuletus*	47	58		4.0		7.7	0.34	2.0	2.09	90
22	Eastern Mediterranean	Greece	GTR	*Pagellus erythrinus*	51	54	0.24	3.0	295	7.0	0.44	2.0	1.50	240
22	Eastern Mediterranean	Greece	GTR	*Pagrus pagrus*	64			4.1		7.0		2.6	1.57	140
22	Eastern Mediterranean	Greece	GTR	*Palinurus elephas*	56	57	0.47	3.0	228	7.3	0.56	1.8	1.74	122
22	Eastern Mediterranean	Greece	GTR	*Scomber* spp.	56									
22	Eastern Mediterranean	Greece	GTR	*Scorpaena* spp.	55	58	0.24	3.3	298	7.3	0.44	2.1	1.55	195
22	Eastern Mediterranean	Greece	GTR	*Sepia officinalis*	62	58	0.25	3.3	313	7.4	0.41	2.1	1.66	223

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22	Eastern Mediterranean	Greece	GTR	*Serranus cabrilla*	56									
22	Eastern Mediterranean	Greece	GTR	Shrimps	44	60		2.6		5.5		1.2	2.26	20
22	Eastern Mediterranean	Greece	GTR	*Siganus rivulatus*	40			2.0						
22	Eastern Mediterranean	Greece	GTR	*Solea solea*	58	51	0.29	3.8	188	5.9	0.39	1.6	2.14	97
22	Eastern Mediterranean	Greece	GTR	Sparidae	68	55	0.39	3.7	244	7.6	0.56	2.5	1.47	179
22	Eastern Mediterranean	Greece	GTR	*Sparus aurata*	80									
22	Eastern Mediterranean	Greece	GTR	*Spicara* spp.	54	60	0.24	3.6	170	8.0	0.44	1.4	2.66	150
22	Eastern Mediterranean	Greece	GTR	*Trachurus* spp.	36	60	0.24	2.2	190	8.0	0.44	1.5	1.42	
22	Eastern Mediterranean	Türkiye	GTR	*Boops boops*	38	70	0.24	2.7		6.3	0.35	1.6	1.70	133
22	Eastern Mediterranean	Türkiye	GTR	*Dentex dentex*	84	50	0.45	4.2		7.3	0.62	2.4	1.72	
22	Eastern Mediterranean	Türkiye	GTR	*Dicentrarchus labrax*	64	80	0.44	5.1		6.5	0.54	1.8	2.81	109
22	Eastern Mediterranean	Türkiye	GTR	*Diplodus annularis*	38	70	0.24	2.7		6.3	0.35	1.6	1.70	104
22	Eastern Mediterranean	Türkiye	GTR	*Loligo vulgaris*	40	52	0.24	2.1		5.5	0.30	1.2	1.72	150
22	Eastern Mediterranean	Türkiye	GTR	*Penaeus kerathurus*	43	53	0.24	2.2		6.3	0.28	1.5	1.51	155
22	Eastern Mediterranean	Türkiye	GTR	*Mullus barbatus*	43	51	0.26	2.2		6.5	0.35	1.4	1.61	182
22	Eastern Mediterranean	Türkiye	GTR	*Mullus surmuletus*	45	69	0.26	3.1		7.6	0.37	2.1	1.58	103
22	Eastern Mediterranean	Türkiye	GTR	*Pagellus acarne*	38	70	0.24	2.7		6.3	0.35	1.6	1.70	135
22	Eastern Mediterranean	Türkiye	GTR	*Palinurus elephas*	84	50	0.52	4.2	360	7.0		2.5	1.67	146
22	Eastern Mediterranean	Türkiye	GTR	*Platichthys flesus*	84	50	0.54	4.2		7.0	0.79	2.5	1.67	

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22	Eastern Mediterranean	Türkiye	GTR	*Sarpa salpa*	68		0.20	13.0						
22	Eastern Mediterranean	Türkiye	GTR	*Scomber* spp.	56	200	0.35	11.2		13.5	0.54	3.8	2.96	
22	Eastern Mediterranean	Türkiye	GTR	*Sepia officinalis*	69	43	0.35	3.0		5.5	0.44	1.5	2.02	90
22	Eastern Mediterranean	Türkiye	GTR	Shrimps	40		0.17	10.0						
22	Eastern Mediterranean	Türkiye	GTR	*Solea solea*	80	33	0.33	2.6	280	4.5	0.40	1.3	2.1	83
22	Eastern Mediterranean	Türkiye	GTR	Sparidae	65	71	0.31	4.5		9.5	0.44	2.7	1.70	145
22	Eastern Mediterranean	Türkiye	GTR	*Sparus aurata*	72	65	0.30	4.7		13.0	0.44	4.2	1.11	90
23	Eastern Mediterranean	Greece	GTR	*Boops boops*	48			2.9				1.7	1.78	128
23	Eastern Mediterranean	Greece	GTR	*Dentex dentex*	74			3.5				2.1	1.67	39
23	Eastern Mediterranean	Greece	GTR	*Homarus gammarus*	62			3.4		6.8		1.9	2.06	20
23	Eastern Mediterranean	Greece	GTR	*Penaeus kerathurus*	48			3.3		6.8		1.6	2.09	80
23	Eastern Mediterranean	Greece	GTR	Mugilidae	52			4.0		16.3		3.1	1.64	159
23	Eastern Mediterranean	Greece	GTR	*Mullus barbatus*	44			2.7		6.3		2.1	1.45	620
23	Eastern Mediterranean	Greece	GTR	*Pagrus pagrus*	72			4.1		7.0		2.6	1.57	140
23	Eastern Mediterranean	Greece	GTR	*Sepia officinalis*	74			3.3				2.4	1.43	290
23	Eastern Mediterranean	Greece	GTR	*Solea solea*	73			6.0		6.2		2.1	2.58	86
24	Eastern Mediterranean	Türkiye	GTR	*Dentex dentex*	88	50	0.33	4.4	360	5.0	0.40	1.8	2.44	95
24	Eastern Mediterranean	Türkiye	GTR	*Penaeus kerathurus*	48	50		2.4	250	5.0	0.30	1.3	1.92	83
24	Eastern Mediterranean	Türkiye	GTR	Mugilidae	56	50	0.35	2.8		5.0	0.44	1.3	2.24	110
24	Eastern Mediterranean	Türkiye	GTR	*Mullus barbatus*	31	57	0.24	2.2	140	5.0	0.34	1	2.00	30

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24	Eastern Mediterranean	Türkiye	GTR	*Mullus surmuletus*	44	50	0.24	2.2		5.0	0.35	1.1	2.00	
24	Eastern Mediterranean	Türkiye	GTR	*Pagellus* spp.	42	50	0.24		200	5.0	0.33	0.0	0.50	
24	Eastern Mediterranean	Türkiye	GTR	*Pomatomus saltatrix*	64	60	0.34	3.8	280	6.0	0.42	1.7	2.29	142
24	Eastern Mediterranean	Türkiye	GTR	*Solea solea*	70	50	0.30	3.5	280	5.0	0.34	1.4	2.50	56
24	Eastern Mediterranean	Türkiye	GTR	Sparidae	64	55	0.30	3.5		6.0	0.44	1.5	2.35	150
24	Eastern Mediterranean	Türkiye	GTR	Various demersal fish	60	150	0.24	9.4	250	5.8	0.40	1.4	6.35	92
25	Eastern Mediterranean	Cyprus	GTR	Siganidae	64							2.5		
26	Eastern Mediterranean	Egypt	GTR	*Diplodus* spp.	34			2.5	60			1.5		
26	Eastern Mediterranean	Egypt	GTR	*Sepia officinalis*	28			0.8	100					
26	Eastern Mediterranean	Egypt	GTR	*Siganus rivulatus*	23			1.2	83					
26	Eastern Mediterranean	Egypt	GTR	Sparidae	52				150					
27	Eastern Mediterranean	Lebanon	GTR	*Boops boops*	28			1.2						
27	Eastern Mediterranean	Lebanon	GTR	*Mullus barbatus*	34	35		1.6	480	3.5		1.6		120
27	Eastern Mediterranean	Lebanon	GTR	*Pagellus acarne*	34							1.6		82
27	Eastern Mediterranean	Lebanon	GTR	*Pagellus erythrinus*	34							1.6		100
27	Eastern Mediterranean	Lebanon	GTR	Shrimps	28		0.17	2.0						
27	Eastern Mediterranean	Lebanon	GTR	*Siganus rivulatus*	34			1.6						
27	Eastern Mediterranean	Palestine	GTR	*Alepes djedaba*	44	159	0.16	7.0	255	20.5	0.35	5.0	0.71	71
27	Eastern Mediterranean	Palestine	GTR	*Argyrosomus* spp.	84	54	0.35	4.5	240	6.0	0.36	3.0	0.67	71
27	Eastern Mediterranean	Palestine	GTR	Mugilidae	43	127	0.16	5.3	252	15.0	0.35	3.8	0.70	80

GSA	Subregion	Country	Gear code	Main target species	Internal mesh length (mm)	Vertical number of meshes	Internal twine diameter (mm)	Internal height (m)	External mesh length (mm)	External vertical number of meshes	External twine diameter (mm)	External height (m)	Vertical slack	Leadline weight (g/m)
27	Eastern Mediterranean	Palestine	GTR	*Penaeus* spp.	40	50		2.0	240	4.0		1.0	0.50	71
27	Eastern Mediterranean	Palestine	GTR	*Portunus pelagicus*	60	47	0.35	2.8	230	4.7	0.36	1.7	0.56	71
27	Eastern Mediterranean	Palestine	GTR	*Sepia officinalis*	56	36		2.0	210	4.0		1.0	0.50	71
27	Eastern Mediterranean	Palestine	GTR	*Siganus* spp.	56	36		2.0	210	4.0		1.0	0.50	71
27	Eastern Mediterranean	Palestine	GTR	*Solea solea*	48	43		2.0	225	4.0		1.0	0.50	71
27	Eastern Mediterranean	Palestine	GTR	Sparidae	50	115	0.19	5.2	250	13.3	0.35	3.7	0.70	82
28	Black Sea	Türkiye	GTR	*Mullus surmuletus*	72	75	0.24	5.4	360	5.5	0.24	2.0	2.73	49
28	Black Sea	Türkiye	GTR	*Mullus barbatus*	36	20	0.20	0.7	200	7.5	0.33	1.5	0.48	74
28	Black Sea	Türkiye	GTR	*Pleuronectes platessa*	140	35	0.29	4.6	420	4.8	0.32	1.9	2.34	90
28	Black Sea	Türkiye	GTR	*Pomatomus saltatrix*	70	75	0.29	5.1	320	9.8	0.43	3.0	1.73	377
28	Black Sea	Türkiye	GTR	*Solea solea*	76	26	0.33	1.9	220	5.0	0.37	1.1	1.63	226
28	Black Sea	Türkiye	GTR	Sparidae	84	35	0.33	2.9	360	4.5	0.52	1.6	1.81	81
28	Black Sea	Türkiye	GTR	*Spicara* spp.	44	55	0.30	2.4	80	18.0	0.30	1.4	1.68	381
29	Black Sea	Bulgaria	GTR	*Mullus barbatus*	21	50	0.20	2.0	110	5.0	0.40	2.1	1.20	60
29	Black Sea	Bulgaria	GTR	Gobiidae	21	50	0.20	2.0	110	5.0	0.40	2.1	1.20	60
29	Black Sea	Romania	GTR	*Alosa immaculata*	30		0.30		250		0.80			
29	Black Sea	Türkiye	GTR	*Mullus barbatus*	37	70	0.24	2.7	164	9.4	0.45	1.7	1.85	64
29	Black Sea	Türkiye	GTR	Mugilidae	50	75	0.35	3.8	250	8.0	0.50	2.0	1.88	322
29	Black Sea	Türkiye	GTR	*Pomatomus saltatrix*	58	100	0.35	5.8	260	11.0	0.50	2.9	2.03	256
29	Black Sea	Türkiye	GTR	*Sarda sarda*	60	100	0.20	6.0	265	20.0	0.30	5.3	1.13	71
29	Black Sea	Türkiye	GTR	*Scorpaena* spp.	50	30	0.24	1.5	240	5.0	0.52	1.2	1.25	95

Notes: AMB: *Seriola dumerili*; BLU: *Pomatomus saltatrix*; BOG: *Boops boops*; BON: *Sarda sarda*; BSS: *Dicentrarchus labrax*; CBR: *Serranus cabrilla*; COB: *Umbrina cirrosa*; COE: *Conger conger*; CRW: *Palinurus elephas*; CTC: *Sepia officinalis*; GPD: *Epinephelus marginatus*; GPX: *Epinephelus* spp.; GUU: *Chelidonichthys lucerna*; HKE: *Merluccius merluccius*; HOM: *Trachurus trachurus*; JAX: *Trachurus* spp.; JOD: *Zeus faber*; LEE: *Lichia amia*; MAC: *Scomber scombrus*; MAZ: *Scomber* spp.; MTS: *Squilla mantis*; MUF: *Mugil cephalus*; MUT: *Mullus barbatus*; MUX: *Mullus* spp.; OCC: *Octopus vulgaris*; PAX: *Pagellus* spp.; RSE: *Scorpaena scrofa*; SBG: *Sparus aurata*; SBS: *Oblada melanura*; SCS: *Scorpaena* spp.; SFS: *Lepidopus caudatus*; SOL: *Solea solea*; SPC: *Spicara smaris*; SQR: *Loligo vulgaris*: SSB: *Lithognathus mormyrus*; TGS: *Penaeus kerathurus*; TRG: *Balistes carolinensis*; TUR: *Scophthalmus maximus*; XYN: *Xyrichtys novacula*.

Western Mediterranean

In Spain (GSAs 1 and 5), the fishing grounds are always located in areas of 5 m depth to greater than 100 m depth, depending on the type of trammel net used (Urbistondo, 2001; Brotons, Grau and Rendell, 2008). The trammel nets named *claros* are generally fixed on rocky areas from 5 m to 10 m depth and target common cuttlefish; the *ciegos* are employed over muddy and sandy bottoms between 15 m and 40 m, mainly to catch red mullet; while the *langosta* trammel net is used up to 200 m depth to target lobsters (*Palinurus mauritanicus*; SGMED, 2004; Lucchetti, 2012). Furthermore, other species represent important catch in these trammel nets, such as some sparids. Both the inner and the outer nets vary in mesh size depending on the target species. The *ciego* has an inner mesh size from 4 cm to 5 cm and an outer mesh size between 30 and 40 cm, while the *claro* usually has an inner mesh size of 7–8 cm and an outer mesh size of 40–50 cm. In the *langosta* trammel net, the inner mesh size is 10 cm and the outer mesh size is 60 cm. The height of the gear also differs depending on target species, ranging between 1.3 and 3.5 m. The hanging ratio varies from 0.5 to 0.65 and the maximum length is 2 500 m, though usually lower than 1 200 m. In Spanish GSA 6, other trammel nets are used, such as the *salmonetero* and *sepiera*, which are the most frequent types of gear (SGMED, 2004). The *salmonetero* mainly targets striped red mullet and is generally fixed on *Posidonia* meadows from 15 m to 30 m depth; the *sepiera* targets cuttlefish and is deployed in sandy ground up to 20 m deep. There are also other nets, such as the *langostero*, which targets the common spiny lobster on rocky bottoms deeper than 50 m, and the *lenguadera*, which is used on sandy bottoms up to 30 m deep mainly to target common sole. Both the inner and the outer nets vary in mesh size depending on the target species. Finally, other species are fished; among them, some sparids and scorpenids are important.

In Morocco (GSA 3), the trammel net is known as the *torssan* and is the most commonly used gear in certain areas, such as Nador (Idrissi *et al.*, 2002). The mesh size of the outer panels is standard for all fishers, at around 300–400 mm, while the mesh size of the inner panel varies according to the target species and is between 40 mm and 120 mm, with a predominance of 50 mm, 60 mm and 70 mm meshes. The main target species are sparids, red mullet, cuttlefish and common sole (Darasi, 2014).

In Algeria (GSA 4), trammel nets are widespread and used all year round (Sahi and Bouaicha, 2003). Those trammel nets targeting red mullet and striped red mullet have an internal mesh length of 22 mm. There are also trammel nets targeting common spiny lobster with a mesh length of 166 mm (internal) and 600 mm (external; Laid, Lamri and Kadri, 2001).

In France (GSAs 7 and 8), the trammel net for common sole and sand sole (*Pegusa lascaris*) is generally made of multifilament with a 70 mm to 110 mm inner mesh size, 300 mm to 500 mm outer mesh size and low buoyancy (SGMED, 2004; Lucchetti, 2012). The height of the net, during fishing operation, reaches approximately 1.5 m and the length does not exceed 5 000 m. Cuttlefish are widely targeted by similar trammel nets. In addition, some trammel nets are used to catch sparids, with an internal mesh length of 60–100 mm, an internal height of 2–4 m and a resulting vertical slack of 1.3–1.9. These nets are usually deployed at depths ranging from 10 m to 30 m, except for those catching common pandora and red porgy, which are deployed at a mean depth of 65 m. Red mullet are targeted with trammel nets in shallower waters (less than 10 m deep) that have an inner mesh size ranging from 45 mm to 55 mm and an outer mesh size ranging from 340 mm to 420 mm; they are made using monofilament or multifilament of 75 m/kg to 120 m/kg. Their stretched mesh varies between 1.5 m and 1.8 m and their length ranges between 100 m and 2 000 m. They are set at sea for 10–12 hours (SGMED, 2004). Other trammel nets are employed in sandy grounds at depths lower than 6 m to catch turbot and in smooth grounds from 16 m to 25 m depth to catch monkfish, rays and brill. These types of trammel nets are 3 000 m to 6 000 m long and are made of monofilament or multifilament, with the inner mesh size from 120 mm to 200 mm. The nets do not exceed 1.8 m in stretched height. Trammel nets are also used on the hard bottom slope of the Catalan and Liguro-Provençal coast, between 50 m and 200 m depth, mainly to catch lobsters (*Palinurus* spp.) and other fish that inhabit rocks. A net of around 500–5 200 m in monofilament or multifilament is used, with the inner mesh size ranging from 80 mm to 120 mm. The stretched net height is generally less than 2 m. Finally, multifilament trammel nets with a length of less than 1 500 m and a mesh size ranging between 38 mm and 82 mm are employed on coralligenous and seaweed bottoms, between 10 m and 40 m. These métiers target species for fish soup, such as *bouillabaisse*, including scorpionfish, *Diplodus* spp. and other small-sized species (red mullets, *Symphodus* spp. and picarels).

In Italy (GSAs 9, 10 and 11), there are different types of trammel nets that differ in height, diameter of the outer walls and internal fine mesh, according to the different target species (SGMED, 2004). In GSA 9, the trammel nets targeting cuttlefish and white fish, such as sand steenbras, gilthead seabream and common sole, have an inner panel with 66 mm mesh size, 3.3 m height and 0.45 hanging ratio, and an outer panel with 340 mm mesh size and 1.8 m height. Gilthead seabream are also caught by trammel nets with a higher internal height (4.6 m) and internal mesh length ranging from 50 mm to 70 mm. Smaller mesh sizes (45 mm inner, 280 mm outer) are used in trammel nets targeting red mullets. In GSAs 9, 10 and 11, another commercially important species is the common spiny lobster, caught using the *tramaglione* with a nylon net of 0.25–0.5 mm diameter and an inner mesh length of 70–80 mm. Generally, it is made of 12–20 different pieces, each about 100 m long (average total length of 1 500 m; SGMED, 2004). As such, it is deployed in deeper waters (50–350 m) than the other trammel nets. Furthermore, trammel nets targeting flatfish (Scophthalmidae) are widespread (e.g. in GSA 10; internal mesh length of 95 mm, mean depth of 38 m), as well as those targeting rays (*Raja* spp.) (e.g. in GSA 9; internal mesh length of 90 mm, mean depth of 59 m). Other locally important species are common octopus and the caramote prawn (*Penaeus kerathurus*).

Central Mediterranean

In Tunisia (GSAs 12, 13 and 14), trammel nets are widespread and target almost the same species as in Greece. The internal mesh length of trammel nets targeting cuttlefish is 40–70 mm, while an internal mesh length of 75–140 mm is used in the common spiny lobster fishery, for which the nets are deployed at a mean depth of 95 m. Caramote prawn and common sole are targeted using trammel nets that have similar technical properties to those employed in Greece. However, the inner mesh size of nets targeting red mullet is smaller (34 mm) than those used in other countries.

In Malta (GSA 15), the same internal mesh length of 50 mm is used to catch red mullet, striped red mullet, red porgy and *Scorpaena* spp. (De Leiva *et al.*, 1998).

In Italy (GSAs 16 and 19), red mullet are caught using trammel nets with a mean internal mesh length of 41–55 mm and striped red mullet are caught using a mean internal mesh length of 56–90 mm (Ferretti, Tarulli and Palladino, 2002; Guidetti *et al.*, 2010; Sieli *et al.*, 2011). Common spiny lobster and common octopus are also important species for this fishery. In the western Ionian Sea (GSA 19), there is also a type of trammel net targeting European hake with a 73 mm inner mesh size, 0.37 mm twine diameter and a vertical slack of 2.67, as well as a type of trammel net used for pearly razorfish (*Xyrichtys novacula*) with a very small internal mesh length (30 mm).

In Greece (GSA 20), trammel nets are the most important gear of the inshore fishery (Adamidou, 2007) and are used throughout the year in nearly all ports. Their netting is made of multifilament twine; the mounted length typically ranges from 40 m to 220 m; the depth of the outer panels ranges from 0.60 m to 1.6 m, with the inner sheet being 1.6 times deeper (Adamidou, 2007). The mesh size of the inner panel varies widely, depending on the size and species being targeted, and is around 4–5 times less than that of the mesh size of the outer panels. For instance, the trammel nets targeting common cuttlefish have a mesh length ranging from 60 mm to 72 mm (internal) and from 300 mm to 360 mm (external), and they are usually set on muddy seabed and seagrass meadows at depths from 5–30 m. They are set before sunset and hauled out before sunrise, thus staying in the water for 12–14 hours. The fishing period is from February to May. In contrast, the trammel nets used to catch red mullet and striped red mullet are usually 100–220 m long, and the inner mesh size varies: 42 mm for red mullet and 48 mm for striped red mullet. The most common mesh size for the outer sheet is 200–240 mm and the hanging ratio is usually 0.5. The nets are set on nearly all types of seabeds at depths from 20–200 m, once or twice a day, before sunrise and/or after sunset, and stay in the water for 2–3 hours. The fishing period is from April to September. For large species of the Sparidae family, trammel nets are usually 100–350 m long and the most common mesh sizes are 60–80 mm and 300–400 mm for the inner and outer sheets, respectively. The hanging ratio is usually 0.5–0.6. These nets are set on any type of seabed at depths ranging from 30 to 300 m. They may be set once, before sunset and hauled out before sunrise, thus staying in the water for 12–14 hours, or twice a day, before sunrise and/or after sunset and stay in the water for 3–4 hours. The fishing period is almost all the year except for winter. To target common spiny lobster and common dentex, the trammel nets are usually 100–220 m long and the most common mesh sizes are 60–90 mm and 300–400 mm for the inner and outer panels, respectively. The hanging ratio is usually 0.4–0.5. These nets are set on rocky and mäerl[3] seabed at depths from 30–150 m, with a soaking time of 10–24 hours. The fishing period is from May to September. For caramote prawn, there are specifically designed trammel nets with an internal mesh length of 45 mm, an internal height of 2.9 m and an external height of 1.1 m, with a resulting vertical slack of 3; they are deployed at a mean depth of 21 m. They are usually 50–100 m long, with the depth of the inner sheet most frequently being 60 meshes and of the outer ones 4.5–6.5 meshes. The hanging ratio is usually 0.5. These nets are set on a muddy seabed at depths from 5 to 30 m; they are set once or twice a day and stay in the water for 3–8 hours. The fishing period is from April to June and from September to November. Finally, common sole is caught using trammel nets with an internal mesh length of 57 mm and a vertical slack of 1.9. They are usually 50–100 m long, with an inner sheet depth of 40–60 meshes and an outer depth of 4.5–5.5 meshes. These nets are set on a sandy and muddy seabed at depths from 10–70 m before sunset and hauled out before sunrise, thus staying in the water for 12–14 hours. The fishing period is from October to April.

In Libya (GSA 21), trammel nets with an internal mesh size of 52 mm are used to catch a wide variety of species, such as red mullet, mugilids, sparids, cuttlefish and some pelagic species such as greater amberjack and barracudas (*Sphyraena* spp.) (Lamboeuf, 2000).

Adriatic Sea

In Italy (GSAs 17 and 18), most trammel nets used in the Adriatic Sea have a mesh size ranging from 50 mm to 70 mm and are made of PA twisted netting (Lucchetti, 2012). The most widely used trammel net in the Adriatic Sea is designed to catch common cuttlefish during spring, which is the spawning season for this species (Petetta *et al.*, 2020). This net has on average the following properties: internal and outer panel mesh sizes of around 70 mm and 380 mm, made of a PA twisted material of 210/3 titre (around 0.3 mm diameter) and 210/6 titre (around 0.4 mm diameter), respectively. These

[3] Maërl is a collective term for various species of non-jointed coralline red algae (Corallinaceae) that live unattached. These species can form extensive beds, mostly in coarse clean sediments of gravels and clean sands or muddy mixed sediments, which occur either on the open coast, in tide-swept channels or in sheltered areas of marine inlets with weak current (OSPAR, 2023).

nets have a stretched net height of around 2 m (height of the external panels), with half of the internal net height for vertical slack, which is around 2. Trammel nets are also used to target species in the Sparidae family (e.g. sand steenbras, *Diplodus* spp.). This trammel net has properties similar to that of the trammel net used for cuttlefish and is sometimes even the same net. When employed for a long time and, as a result, damaged, these nets are used to target the spottail mantis shrimp. Similar nets with a lower net height are also used to target common sole. Furthermore, trammel nets are used locally to target turbot, especially in the winter period. These nets have large meshes (internal mesh larger than 100 mm and external mesh of around 700–800 mm) and a thick PA monofilament netting (around 0.30 mm and 0.50 mm for internal and external netting panels, respectively). In the southern Adriatic Sea (GSA 18), Italian vessels use trammel nets all year round to specifically catch striped red mullet and red mullet; these nets have a small mesh size (around 40–50 mm mesh length), thick netting twine (210/9 titre on average, which is 0.30–0.50 mm diameter) and a stretched net height less than 2 m.

In Croatia (GSAs 17 and 18), the permitted trammel nets have a mesh size of at least 40 mm for the inner panel and of at least 150 mm for the outer panel. They are used to target cuttlefish, mainly during spring, as in Italy (Grati *et al.*, 2018). Trammel nets, locally called the *listarica*, can be used all year round, but are usually employed to target common sole from November to February; they are small in height, have mesh openings of 120 mm (inner panel) and 300 mm (outer panel) and are mainly used on the western coast of the Istrian peninsula (northern Adriatic Sea). In the central and southern Adriatic Sea, other trammel nets are instead common, with the same mesh openings but a greater height compared to the *listarica,* and are used to target mixed demersal and pelagic fish from September to May (Matić-Skoko *et al.*, 2011). Finally, a trammel net called the *rumbara* is specifically deployed to catch turbot and elasmobranchs, with an inner mesh opening of 240 mm and an outer mesh opening of 700 mm.

In Slovenia (GSA 17), trammel nets are used to catch common sole all year round and cuttlefish in spring and winter (Grati *et al.*, 2018).

In Albania (GSA 18), trammel nets are used in spring to catch striped red mullet and the caramote prawn. Moreover, they are also used to catch sparids, such as sand steenbras, with the internal panel having a 49 mm mesh length, 0.17 mm twine diameter and 3.4 m height, and the external panel having a 330 mm mesh length, 0.44 mm twine diameter and 1.8 m height (Lucchetti, 2012).

In Montenegro (GSA 18), trammel nets with internal mesh size of 45–60 mm (up to 90 mm) and net height of around 1.5–5 m are used mainly to target the common spiny lobster, cuttlefish, different species in the Sparidae family – gilthead seabream, *Diplodus* spp., salema (*Sarpa salpa*) – tub gurnard and red mullet (UNEP-MAP-RAC/SPA, 2014; Matić-Skoko *et al.*, 2017).

Eastern Mediterranean

In the Greek eastern Mediterranean (GSAs 22 and 23), the trammel nets employed do not substantially differ from those used in the same country in GSA 20 (Adamidou, 2007). Nevertheless, trammel nets targeting red mullets have a smaller internal mesh length of 43–44 mm, while cuttlefish nets have an internal mesh length of 62–74 mm (SGMED, 2004). The common dentex is specifically targeted using a trammel net with an internal mesh length of 64–74 mm, internal height of 3.1–3.5 m and external height of 1.7–2.1 m. There is also a specific trammel net for the European lobster, with slight differences between GSA 22 (68 mm internal mesh length, 3.6 m internal height, 2.3 m external height) and GSA 23 (62 mm internal mesh size, 3.4 m internal height, 1.9 m external height; SGMED, 2004). Some trammel nets are also employed to catch the Lessepsian migrant the marbled spinefoot, using an internal mesh size of 40 mm.

In Türkiye (GSA 22, 24), trammel nets targeting red mullet have the same properties as those used in other countries; the same is true for trammel nets targeting cuttlefish, which have an internal mesh length of 69 mm. However, many different trammel nets are employed to catch species in the Sparidae family (Karakulak and Erk, 2008). In Türkiye, the common dentex is targeted using nets with an internal mesh length of 84 mm, internal height of 4.2 m and external height of 2.4 m (Tokaç *et al.*, 2010). In Turkish GSA 22, there is a trammel net specifically designed to catch mackerel with a 56 mm internal mesh size, 11.2 m internal net height and 3.8 m external net height (consequent vertical slack of 2.96). There is also a trammel net used in Izmir Bay designed to catch caramote prawn that is traditionally set on sandy and muddy grounds (10–40 m depth). It has a small internal mesh size (40 mm) and a low internal (2.1 m) and external height (1.2 m); its typical length is around 1 500–2 000 m (Metin *et al.*, 2009). The damaged prawn trammel nets are then used at the end of the prawn season to catch European squid (*Loligo vulgaris*) from October to December (Gökçe *et al.*, 2005).

In Cyprus (GSA 25), a kind of trammel net specifically targeting Lessepsian migrants (mostly Siganidae) was observed (64 mm internal mesh size).

In Egypt (GSA 26), trammel nets are an important fishing gear for catching sparids (mainly annular seabream and saddled seabream; Bakhoum, 2018). This net has an internal mesh size ranging from 29 mm to 46 mm and an external mesh size of usually 70 mm, made of PA twisted material of 210/2 titre (around 0.2 mm diameter) and 210/3 titre (around 0.3 mm diameter), respectively. The trammel nets targeting striped red mullet and asymmetrical goatfish (*Upeneus asymmetricus*) have a smaller internal mesh length of 29–32 mm with an internal height of 1.5 m, and an outer mesh length of 65 mm with an external height of 0.95 m. There is also a specific trammel net targeting cuttlefish with a small internal mesh length (28 mm). In addition, there is a trammel net specifically deployed to catch the Lessepsian migrant the marbled spinefoot by using an internal mesh size of 23 mm.

In Palestine (GSA 27), the trammel nets used to catch various demersal and benthic fish are usually built with an inner net of mesh size between 36 mm to 44 mm and two outer nets generally of 240 mm mesh size (Ali, 2002; Abudaya *et al.*, 2013). One type of trammel net is used to catch shrimps.

In Lebanon (GSA 27), trammel nets with an inner panel mesh size of 28–40 mm, a length of 150–1 000 m and a height of 1.2–2 m are used at depths between 5 m to 50 m to catch demersal species, such as red mullet and striped red mullet, bogue and different species in the genera *Siganus*, *Diplodus*, *Spicara* and *Pagellus*. Trammel nets for shrimps with a small inner mesh size are also used in shallow waters (less than 30 m). The Lessepsian species kuruma prawn (*Penaeus japonicus*), *Trachysalambria curvirostris* and *Trachysalambria palaestinensis* comprise 70 percent of the catch. The nets are generally made of PA multifilament or monofilament with 210/1 titre to 210/2 titre (Lelli, 2007; Sacchi and Dimech, 2011).

Black Sea

In Bulgaria (GSA 29), the trammel nets reported target red mullet and gobids by using very small mesh sizes (21 mm internal, 110 mm external). The vertical slack is 1.2.

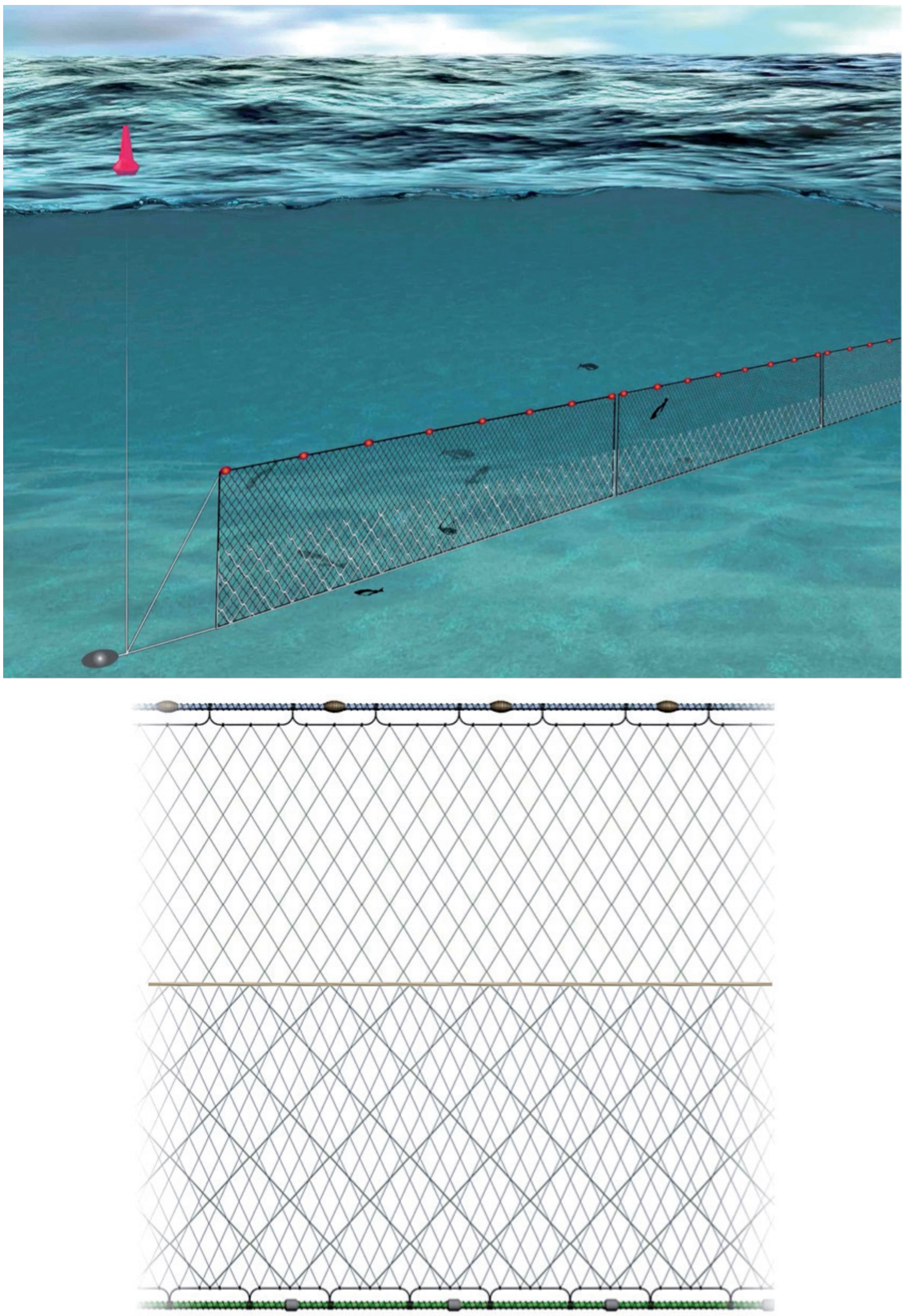
In the Turkish Black Sea (GSAs 28 and 29), the trammel nets employed mainly target red mullets (internal mesh length of 36–72 mm), flatfish – Scophthalmidae, European plaice (*Pleuronectes platessa*) and common sole – sparids, scorpaenids and the caramote prawn (Kalaycı and Yeşilçiçek, 2012). Moreover, there are trammel nets specifically designed for Atlantic bonito, with an internal mesh length of 60 mm, an internal height of 6 m and an external height of 5.3 m that are used at 18 m depth (Samsun and Emirbuyuran, 2017); other trammel nets employed to catch bluefish have almost the same internal mesh length and internal height, but with a lower external height (2.9 m), thus resulting in a higher vertical slack (Doyuk, 2006).

In Romania (GSA 29), a trammel net is reportedly used to catch the Pontic shad (*Alosa immaculata*) with an internal mesh length of 30 mm (Radu and Anton, 2014).

Combined gillnets–trammel nets

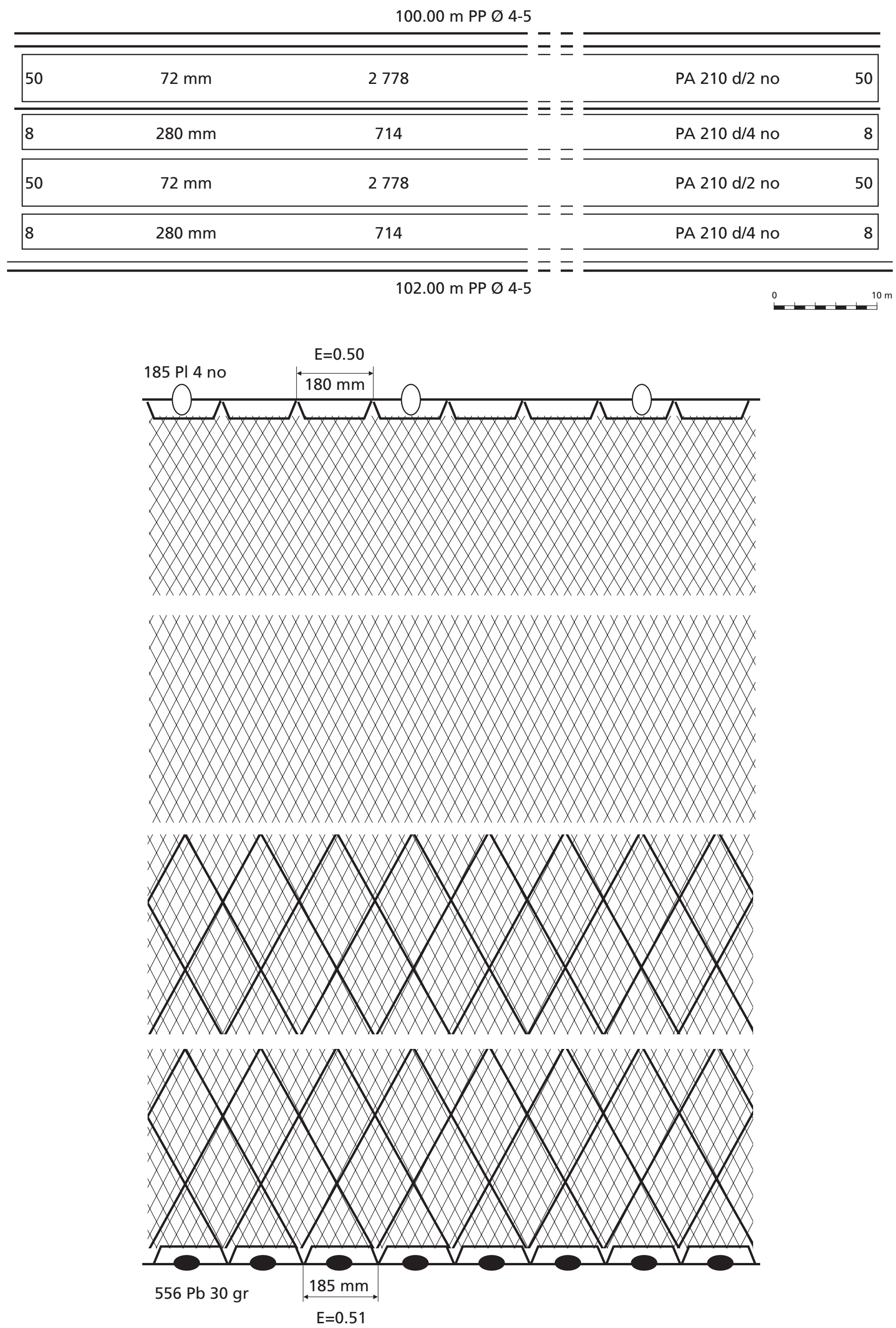
Combined nets are nets fixed on the bottom that are composed of two parts: a trammel net in the lower part and a gillnet in the upper part (Figure 70 and Figure 71). These types of nets combine the catching methods of trammel nets with those of gillnets. In addition to these main fixed net types, some others are locally used.

FIGURE 70
Combined net



Source: **Seafish.** 2023. Fishing gear database. In: *Seafish*. Cited 23 May 2023. Edinburgh. www.seafish.org/responsible-sourcing/fishing-gear-database/?t=docGear/

FIGURE 71
Technical specifications of a combined net



Source: redrawn from **Tokaç, A., Ünal, V., Tosunoğlu, Z., Akyol, O., Özbilgin, H. & Gökçe, G.** 2010. *Ege Denizi Balıkçılığı* [Aegean Sea fisheries]. İzmir, Türkiye, IMEAK Chamber of Shipping İzmir branch

Combined nets are structured to catch both properly benthic species, such as cuttlefish, common sole and spottail mantis shrimp, and species living in the upper levels of the water column, such as gilthead seabream, saddled seabream, bogue, pandoras (*Pagellus* spp.) and greater amberjack.

The fishing vessels using combined nets usually have a GT ranging from 0.9 to 9, an LOA from 5.2 m to 12 m and an engine power from 12 Kw to 130 kW. The use of combined nets is mostly observed at depths ranging between 5 m and 40 m, but in some areas (e.g. in the Aegean and the southern Ionian Sea), they can be deployed down to 200 m depth.

In general, the length of combined nets is shorter than that of gillnets and trammel nets, ranging from a few tens of metres to about 3 000 m, though the majority of nets range from 500 m to 1 600 m long (Table 15). These nets are known as *battudes entremaillées* or *reclares* in France, *cabriboucs* or *boleros* in Spain, and *reti combinate* or *incastellate* in Italy.

Subregional variations

Table 15

Technical parameters (in mean values) of combined nets used in the Mediterranean and the Black Sea

GSA	Country	Subregion	Gear code	Main target species	Gillnet			Trammel net							Mean depth (m)
					Mesh length (mm)	Stretched net height (m)	Twine diameter (mm)	Internal mesh length (mm)	Internal twine diameter (mm)	External mesh length (mm)	External stretched net height (mm)	External twine diameter (mm)	Vertical slack		
3	Morocco	Western Mediterranean	GTN	SBG, SOL, CTC	60.0	1.2	0.44	60.0	0.44	400	3.2	0.60	1.50		5–50
3	Morocco	Western Mediterranean	GTN	SRG, PAX, MUT	40.0	0.8	0.68	40.0	0.68	300	1.8	0.88	1.78		5–70
3	Morocco	Western Mediterranean	GTN	SBG, MUT, CTC, PAX, SRG, Mugilidae	60.0	6.0	0.54	60.0	0.54	300	0.9	0.63	2.67		0.5–7
4	Algeria	Western Mediterranean	GTN	SRG, SBP, BOG, AMB, DOL, JAX	50.0	2.5	0.33	45.5	0.24	400	1.6	0.60	1.44		
6	Spain	Western Mediterranean	GTN	Sparidae, SCS	97.0	7.4	0.30	97.0	0.30	620.0	2.5	0.30	2.43		35–55
6	Spain	Western Mediterranean	GTN	BON	80.0–100.0	13.5	0.41	90.0	0.41	420.0	2.3	0.68	1.40		
6	Spain	Western Mediterranean	GTN	AMB	80.0–400.0	13.5	0.41	90.0	0.41	420.0	2.3	0.68	1.40		
7	France	Western Mediterranean	GTN	Demersal and pelagic fish	62.0		0.33	50.0		420.0	1.5	0.60	1.70		
7	France	Western Mediterranean	GTN	Tunnidae	125.0		0.52	160.0	0.74	440.0		0.60			
7	France	Western Mediterranean	GTN	Sparidae	62.0		0.37		0.37	500.0	1.8	0.52			
7	France	Western Mediterranean	GTN	BON	83.0		0.37		0.37	500.0	1.8	0.52			
7	France	Western Mediterranean	GTN	Scombridae, BOG	58.0		0.33	83.0	0.29	425.0	1.7	0.44	3.91		
7	France	Western Mediterranean	GTN	Scorpaenidae	50.0		0.33	50.0	0.29	400.0	1.6	0.44	2.50		

GSA	Country	Subregion	Gear code	Main target species	Gillnet			Trammel net							Mean depth (m)
					Mesh length (mm)	Stretched net height (m)	Twine diameter (mm)	Internal mesh length (mm)	Internal twine diameter (mm)	External mesh length (mm)	External stretched net height (mm)	External twine diameter (mm)	Vertical slack	
7	France	Western Mediterranean	GTN	BOG	42.0		0.33	50.0	0.29	400.0	1.6	0.44	2.50	
7	France	Western Mediterranean	GTN	Sparidae	56.0–100.0		0.33	91.0	0.29	475.0	2.1	0.44	3.41	
9	Italy	Western Mediterranean	GTN	Sparidae, SOL, SBG, MTS	103.0	2.6	0.25	82.0	0.20	420.0	1.3	0.30	1.95	5–50
9	Italy	Western Mediterranean	GTN	Sparidae, AMB, BON	90.0	8.3	0.30	80.0	0.30	300.0	1.2	0.40	10	300.0
9	Italy	Western Mediterranean	GTN	Sparidae, SSB, SBG, COB, CTC	70.7	3.5	0.35	61.7	0.35	295.0	1.5	0.63	2.51	0–50
9	Italy	Western Mediterranean	GTN	CTC, OCC, MUX, SSB	48.1	2.4	0.24	53.0	0.30	340.0	1.7	0.30	1.56	5–20
9	Italy	Western Mediterranean	GTN	PAX, JOD, RSE	200.0	2.0	0.44	144.0	0.30	610.0	1.8	0.30	1.57	25–40
9	Italy	Western Mediterranean	GTN	Sparidae, SCS, GPD, CTC	88.2	4.2		72.5		358.0	1.6		1.94	20–30
9	Italy	Western Mediterranean	GTN	Sparidae, CTC	41.5	2.0		65.8	0.35	380.0	1.9	0.54	1.97	10–40
9	Italy	Western Mediterranean	GTN	CTC, OCC, Scorpaenidae, Labridae	72.0–98.0	7.2–7.4	0.30	72.0–84.0	0.30	350.0–500.0	1.5–1.8	0.71	2.06–2.46	10–40
9	Italy	Western Mediterranean	GTN	OCC, Scorpaenidae, Labridae	88.0	4.4		72.0		360.0	1.8	0.54	2.00	10–40
9	Italy	Western Mediterranean	GTN	CRW	100.0	5.0	0.40	100.0	0.41	400.0		0.68		
9	Italy	Western Mediterranean	GTN	CTC	68.0–120.0	6.8–7.5	0.24–0.40	68.0–120.0	0.23–0.58	340.0–390.0	1.8-2.2	0.41-0.70	1.70-2.08	
9	Italy	Western Mediterranean	GTN	CTC, Sparidae	72.0–81.0	4.1–10.8	0.35	68.0–70.0	0.29	300.0		0.68		

GSA	Country	Subregion	Gear code	Main target species	Gillnet			Trammel net							Mean depth (m)
					Mesh length (mm)	Stretched net height (m)	Twine diameter (mm)	Internal mesh length (mm)	Internal twine diameter (mm)	External mesh length (mm)	External stretched net height (mm)	External twine diameter (mm)	Vertical slack		
9	Italy	Western Mediterranean	GTN	SQR	52.0–60.0		0.29	50.0–56.0	0.29	280.0	1.4-1.7	0.51-0.54	1.79-2.00		
9	Italy	Western Mediterranean	GTN	CRW	100.0		0.40	100.0	0.41	400.0	1.6	0.68	1.88		
9	Italy	Western Mediterranean	GTN	SOL	60.0		0.33	50.0	0.29	260.0	1.4	0.51	1.75		
9	Italy	Western Mediterranean	GTN	GUU	100.0		0.24	90.0	0.60	280.0	1.7	0.70	1.88		
9	Italy	Western Mediterranean	GTN	XYN	45.0		0.29	30.0	0.23	310.0	1.2	0.51	1.57		
9	Italy	Western Mediterranean	GTN	TGS	27.0	0.2	0.29	35.0	0.24	180.0	1.4	0.44	1.75		5–15
10	Italy	Western Mediterranean	GTN	GPX, COE, HKE, SFS	80.0	3.2	0.25	80.0		350.0		0.41			
10	Italy	Western Mediterranean	GTN	CTC	66.0			55.0		380.0					
10	Italy	Western Mediterranean	GTN	HKE, SOL, Scophthalmidae	54.8	3.0		76.0		200.0					80–100
10	Italy	Western Mediterranean	GTN	MUT, CBR	82.0	2.0	0.30	36.0	0.30	155.0		0.54			10–34
10	Italy	Western Mediterranean	GTN	CTC, Scorpaenidae, Mugilidae, CRW	48.0–72.0	1.7–3.0	0.30	60.0–72.0	0.30	170.0–200.0		0.54			10–34
10	Italy	Western Mediterranean	GTN	AMB, Mugilidae	100.0	8.5	0.44	82.0	0.30	220.0		0.54			10–34
10	Italy	Western Mediterranean	GTN	CTC, Scorpaenidae, Mugilidae	60.0	2.4		60.0	0.30	128.0	0.6	0.63	3.75		
10	Italy	Western Mediterranean	GTN	GPX, COE, HKE, SFS	80.0	3.2	0.25	80.0		400.0		0.41			

GSA	Country	Subregion	Gear code	Main target species	Gillnet			Trammel net							Mean depth (m)
					Mesh length (mm)	Stretched net height (m)	Twine diameter (mm)	Internal mesh length (mm)	Internal twine diameter (mm)	External mesh length (mm)	External stretched net height (mm)	External twine diameter (mm)	Vertical slack	
10	Italy	Western Mediterranean	GTN	CTC, SQR	52.0	5.2	0.29–0.30	50.0	0.29–0.30	280.0		0.51–0.54		
10	Italy	Western Mediterranean	GTN	CTC, SQR, OCC	60.0	3.0–7.2	0.29–0.33	50.0–56.0	0.29	260.0–280.0		0.51–0.54		
10	Italy	Western Mediterranean	GTN	CTC, Triglidae	100.0	8.0	0.23	90.0	0.60	280.0		0.70		
10	Italy	Western Mediterranean	GTN	XYN	45.0	7.4	0.29	30.0	0.23	310.0		0.51		
10	Italy	Western Mediterranean	GTN	SQR	52.0–60.0		0.29	50.0–56.0	0.29	280.0	1.4-1.7	0.51–0.54	1.79–2.00	
10	Italy	Western Mediterranean	GTN	CRW	100.0		0.40	100.0	0.41	400.0	1.6	0.68	1.88	
10	Italy	Western Mediterranean	GTN	CTC	68.0–120.0		0.19–0.35	68.0–120.0	0.29–0.58	340.0–390.0	1.8–2.2	0.41–0.70	1.70–2.08	
10	Italy	Western Mediterranean	GTN	SOL	60.0		0.33	50.0	0.29	260.0	1.4	0.51	1.75	
10	Italy	Western Mediterranean	GTN	GUU	100.0		0.24	90.0	0.60	280.0	1.7	0.70	1.88	
10	Italy	Western Mediterranean	GTN	XYN	45.0		0.29	30.0	0.23	310.0	1.2	0.51	1.57	
10	Italy	Western Mediterranean	GTN	MUX	44.0			34.0		225.0				
12	Tunisia	Central Mediterranean	GTN	HKE, JAX, CTC, SSB, SBG, TRG, MAZ, Mugilidae	52.0–70.0	2.5–7	0.30–0.33	48.0–60.0	0.30–0.33	280–300	0.8–1.2	0.5–0.6		5–50
13	Tunisia	Central Mediterranean	GTN	HKE, JAX, CTC, SSB, SBG, TRG, MAZ, Mugilidae	52.0–70.0	2.5–7	0.30–0.33	48.0–60.0	0.30–0.33	280–300	0.8–1.2	0.5–0.6		5–50
14	Tunisia	Central Mediterranean	GTN	HKE, JAX, CTC, SSB, SBG, TRG, MAZ, Mugilidae	52.0–70.0	2.5–7	0.30–0.33	48.0–60.0	0.30–0.33	280–300	0.8–1.2	0.5–0.6		5–50

GSA	Country	Subregion	Gear code	Main target species	Gillnet			Trammel net							Mean depth (m)
					Mesh length (mm)	Stretched net height (m)	Twine diameter (mm)	Internal mesh length (mm)	Internal twine diameter (mm)	External mesh length (mm)	External stretched net height (mm)	External twine diameter (mm)	Vertical slack		
16	Italy	Central Mediterranean	GTN	Demersal species	60.0	3.0		50.0	0.20	340	1.7				
17	Croatia	Adriatic Sea	GTN	SLM	80.0			300.0							
17	Croatia	Adriatic Sea	GTN	CTC	64.0			300.0							
17	Italy	Adriatic Sea	GTN	CTC, Mugilidae	70.0–120.0	1.8–6.0	0.19–0.31	75.0–120.0	0.58	340.0–390.0		0.41–0.70			
17	Italy	Adriatic Sea	GTN	SSB	72.0	2.0–3.0	0.20	72.0		340.0					
17	Italy	Adriatic Sea	GTN	SQR	52.0–60.0		0.29	50.0–56.0	0.29	280.0	1.4–1.7	0.51–0.54	1.79–2.00		
17	Italy	Adriatic Sea	GTN	CRW	100.0		0.40	100.0	0.41	400.0	1.6	0.68	1.88		
17	Italy	Adriatic Sea	GTN	CTC	68.0–120.0		0.19–0.35	68.0–120.0	0.23–0.58	340.0–390.0	1.8–2.2	0.41-0.70	1.97-2.08		
17	Italy	Adriatic Sea	GTN	SOL	60.0		0.33	50.0	0.29	260.0	1.4	0.51	1.75		
17	Italy	Adriatic Sea	GTN	GUU	100.0		0.24	90.0	0.60	280.0	1.7	0.70	1.88		
17	Italy	Adriatic Sea	GTN	XYN	45.0		0.29	30.0	0.23	310.0	1.2	0.51	1.57		
19	Italy	Central Mediterranean	GTN	BON	80.0	8.5	0.35	25.0	0.30	150.0		0.63			
19	Italy	Central Mediterranean	GTN	CTC, Mugilidae	120.0	6.0	0.31	120.0	0.58	390.0	0.7	0.34			
19	Italy	Central Mediterranean	GTN	Demersal species	60.0	3.0		50.0	0.20	340.0	1.7				

GSA	Country	Subregion	Gear code	Main target species	Gillnet			Trammel net							Mean depth (m)
					Mesh length (mm)	Stretched net height (m)	Twine diameter (mm)	Internal mesh length (mm)	Internal twine diameter (mm)	External mesh length (mm)	External stretched net height (mm)	External twine diameter (mm)	Vertical slack		
20	Greece	Central Mediterranean	GTN	BOG, BON, SBG, SBS, PIC, MUX	60.0–100.0	6.0		40.0–64.0							10–100
21	Libya	Central Mediterranean	GTN	Mugilidae, demersal species	48.0–56.0	4.8–5.6		48.0–56.0		240.0	1.0–1.7		1.80		
22	Greece	Eastern Mediterranean	GTN	BOG, SBS, Sparidae	26.2–72.0	2.6	0.24	52.5–100.0	0.24	300.0	2.0	0.35–0.44	1.61		5–100
22	Greece	Eastern Mediterranean	GTN	BOG, MAZ, Mugilidae, JAX	36.0–44.0		0.29	40.0		480.0	1.2		1.67		
22	Greece	Eastern Mediterranean	GTN	BOG, MAZ, Mugilidae, JAX	44.0		0.29	40.0		480.0	1.2		1.67		
22	Türkiye	Eastern Mediterranean	GTN	Demersal species	40.0–72.0	3.6–4.8	0.24	40.0–72.0	0.24	280.0	2.2–3.6	0.33–0.35	1.32–1.61		
22	Türkiye	Eastern Mediterranean	GTN	BOG	40.0	4.8	0.24	40.0	0.24	280.0	3.6	0.40	1.33		
28	Türkiye	Black Sea	GTN	BLU	64.0	6.4	0.33	64.0	0.33	280.0	3.8	0.52	1.69		
29	Türkiye	Black Sea	GTN	MUT, HOM, SPC	32.0	1.6	0.33	32.0	0.33	200.0	2.0	0.50			
29	Bulgaria	Black Sea	GTN	BLU, MUF, BON	22.0–32.0	2.0–4.0	0.25	22–32	0.25	200.0	1.5	0.25			8

Notes: AMB: *Seriola dumerili*; BLU: *Pomatomus saltatrix*; BOG: *Boops boops*; BON: *Sarda sarda*; BSS: *Dicentrarchus labrax*; CBR: *Serranus cabrilla*; COB: *Umbrina cirrosa*; COE: *Conger conger*; CRW: *Palinurus elephas*; CTC: *Sepia officinalis*; GPD: *Epinephelus marginatus*; GPX: *Epinephelus* spp.; GUU: *Chelidonichthys lucerna*; HKE: *Merluccius merluccius*; HOM: *Trachurus trachurus*; JAX: *Trachurus* spp.; JOD: *Zeus faber*; LEE: *Lichia amia*; MAC: *Scomber scombrus*; MAZ: *Scomber* spp.; MTS: *Squilla mantis*; MUF: *Mugil cephalus*; MUT: *Mullus barbatus*; MUX: *Mullus* spp.; OCC: *Octopus vulgaris*; PAX: *Pagellus* spp.; RSE: *Scorpaena scrofa*; SBG: *Sparus aurata*; SBS: *Oblada melanura*; SCS: *Scorpaena* spp.; SFS: *Lepidopus caudatus*; SOL: *Solea solea*; SPC: *Spicara smaris*; SQR: *Loligo vulgaris*: SSB: *Lithognathus mormyrus*; TGS: *Penaeus kerathurus*; TRG: *Balistes carolinensis*; TUR: *Scophthalmus maximus*; XYN: *Xyrichtys novacula*.

Western Mediterranean

In Morocco (GSA 3), a combined net type is used to target mainly demersal species (red mullet, cuttlefish, mugilids and sparids; Roullot and Fahfouhi, 1984). The upper gillnet is 6 m high and has a 60 mm mesh size, while the lower trammel net is 2.4 m high (internal) and 0.9 m high (external) and has 60 mm and 300 mm mesh size in the internal and external panels, respectively. Another net type, deployed to catch sparids, cuttlefish and common sole, has a shorter gillnet section (0.8–1.2 m) and a higher trammel net section (3.2–4.8 m internal height).

In Algeria (GSA 4), one combined net type was recorded. It is used to catch a wide variety of species (from sparids to pelagic fish such as amberjacks and common dolphinfish). The gillnet mesh length is 50 mm, and the height is 2.5 m, while the trammel net is made of meshes of 45 mm (internal) and 400 mm (external) size (Laid, Lamri and Kadri, 2001).

In Spain (GSA 6), combined nets mostly target pelagic species such as Atlantic bonito and greater amberjack; while the internal and external mesh lengths of the trammel net remain constant (90 mm internal and 420 mm external mesh lengths), the gillnet mesh length is higher in those targeting greater amberjack (420 mm vs 80–100 mm). Another net type, deployed to catch sparids and scorpenids, has a smaller gillnet height (7.4 m) and twine diameter (0.30 mm vs 0.41 mm of the previous types). Its trammel net has a vertical slack of 2.4 (Lucchetti, 2012).

In France, combined nets are mainly used on the Provençal and French Ligurian coasts (GSA 7), and occasionally in the Gulf of Lion, to catch various benthic or mid-water species. All these nets are characterized by the superposition of a gillnet above a trammel net of generally the same inner mesh size as the gillnet. They can be used to catch transient pelagic and mid-water fish (*battudes*), as well as littoral bottom fish (*battudons*, *cabribouc*; SGMED, 2004). The inner mesh size and the net height of the gillnet part are appropriate to the target species and agreed upon by local fisher organizations (*prud'homies*) according to the season and the areas. For instance, for bogue and mackerel, the gillnet mesh size is 53 mm, the inner trammel net mesh is 83 mm and the stretched net height is 5–6 m; for striped red mullet and *Scorpaena* spp., the gillnet mesh size is 42–50 mm, the inner trammel net mesh is 50 mm and the stretched net height is 5–6 m; for leerfish and Atlantic bonito, the gillnet mesh size is 62–83 mm, the inner trammel net mesh is 83 mm and the stretched net height is 25–30 m; for gilthead seabream, the gillnet mesh size is 56–100 mm, the inner trammel net mesh is 83–100 mm and the stretched net height is 10–20 m; and for greater amberjack, the gillnet mesh size is 125 mm, the inner trammel net mesh is 160 mm and the stretched net height is 20–25 m. All of these combined nets can be set anywhere between 5 m and 40 m depth and built in such a way that the floatline of the upper gillnet reaches the surface water (*veille*). The largest nets called *battudes* or *reclares* are generally set as "post nets" near capes or in channels, or on shallow waters in well-known areas for the passage of migratory fish, such as gilthead seabream, Atlantic bonito, leerfish, greater amberjack and other pelagic fish. The soak time does not last more than 15 hours. Most of these nets are less than 1 500 m long and are set in a straight line from the coast to deeper bottoms. The end of the net must make a loop so that the fish schools driven by the straight part of the net are finally trapped in it. Regardless of the fishery, the nets must be hauled after sunrise: hitting the hull or the water (*battude*) faciltates the enmeshment of the fish. In the western coastal waters of the Gulf of Lion, the *cabribouc* is used to catch sand steenbras and consists of a gillnet (*paradière*) set from the shore perpendicular to a combined net (*escargot*), whose spiral ends facilitate the enmeshment of the fish driven by the *paradière*. The gillnet is 200 m long and 5 m high and has an 80 mm stretched mesh; the trammel part of the *escargot* is 2 m high and has an internal mesh of 80 mm and an external mesh of 400 mm; the gillnet part of the *escargot* is 3 m high and has a mesh of 54–80 mm. These nets are set for 12 to 14 hours; two to four nets can be set according to the weather conditions.

In Italy (GSAs 9 and 10), a combined net used to catch cuttlefish and other non-target species is commonly noted and has a gillnet mesh length and a trammel net internal mesh length usually ranging from 50 mm to 120 mm (Lucchetti, 2012). The gillnet height is highly variable among different nets (usually from 2 m to 11 m), as well as the twine diameters employed in both gillnet and trammel net sections (from 0.2 mm to 0.7 mm). The combined net described for camarote prawn displays a very small lower gillnet section (0.2 m height), which is called the *greca* or guarding net; it is a strip of monofilament net placed just above the leadline that is useful for reducing unwanted catch (mainly non-commercial benthic invertebrates). Another particular combined net, with a gillnet mesh length of 45 mm and a trammel net internal mesh length of 30 mm, is specifically designed to catch the pearly razorfish (Lucchetti, 2012).

Central Mediterranean

In Tunisia (GSAs 12, 13 and 14), combined nets are used to catch a wide variety of species (Plate 50). The upper gillnet (52–70 mm mesh length, 2.5–7 m height, 0.30–0.33 mm twine diameter) targets European hake, horse mackerel, mackerel, sparids and mugilids; the lower trammel net (48–60 mm internal mesh length, 1.3–2 m internal height, 0.30–0.33 mm internal twine diameter) is specifically used for cuttlefish and sparids. The mean depth of deployment varies, ranging from 5 m to 50 m (Romdhane, 1998).

PLATE 50
Combined nets used in Tunisia

In Malta (GSA 15), combined nets are used to catch bogue and horse mackerel at depths ranging from 10 m to 40 m (Lucchetti, 2012).

In Italy (GSAs 16 and 19), a combined net is used to catch Atlantic bonito, and its gillnet properties are similar to those from other subregions for the same target species (80 mm mesh length and 8.4 m net height), while the trammel net displays some differences, such as smaller internal and external mesh lengths (25 mm and 150 mm). Another combined net is employed to catch both mugilids (mainly in the upper gillnet section), cuttlefish and other demersal fish (using the lower trammel net; Cannizzaro *et al.*, 2000).

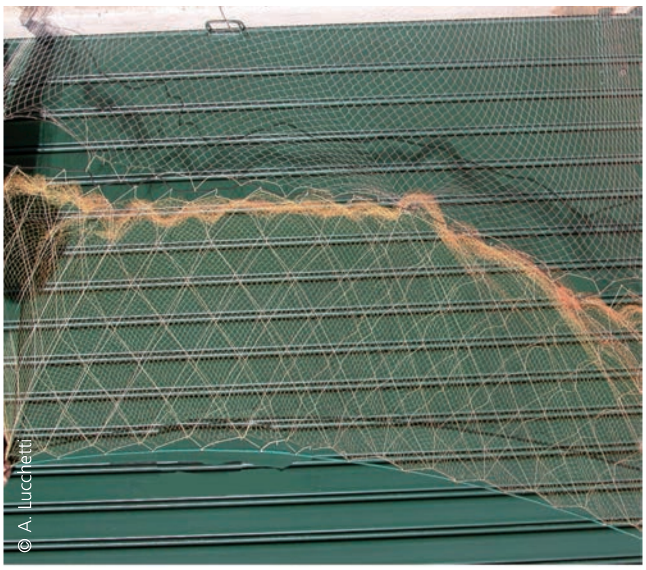
In the Greek Ionian Sea (GSA 20), the combined net is a commonly used gear. According to Adamidou (2007), the majority of combined nets have a length of 100–300 m and a height (depth) of 100–300 meshes (4–6 m). The depth of the nets joined in a fleet is often not constant but increases gradually from the first to the last net.

The trammel net may cover 20–50 percent of the entire depth of the net. The internal mesh length varies mostly from 40 mm to 64 mm (stretched mesh), while the gillnet mesh length varies from 60 mm to 100 mm. Floats and sinkers are the same types as used in all set nets but are placed with greater frequency on their respective ropes. An auxiliary rope is connected to the leadline to support it on rough bottoms. Combined nets are usually set as a single net or in small fleets, on any type of seabed, at depths ranging from 10–100 m. They are often arranged around rocky areas or vertical to the shoreline, forming a half circle targeting species that are travelling along the shore, or across known fish movement paths. Both pelagic species, such as Atlantic bonito, and demersal species, such as bogue, picarels, saddled seabream, red mullets and gilthead seabream, are targeted.

Adriatic Sea

In the Italian northern Adriatic Sea (GSA 17), combined nets (Plate 51) are mainly used to catch common cuttlefish, European squid, tub gurnard, common sole and striped seabream. A particular net is designed to catch the common spiny lobster, with a gillnet mesh length of 60 mm and, concerning the trammel net, an internal mesh length of 50 mm and an external mesh length of 260 mm (Lucchetti, 2012).

PLATE 51
Combined nets used in Italy



In Croatia (GSA 17), combined nets are used to target both salema and common cuttlefish, using an inner mesh opening of 64–80 mm and an outer mesh opening of 300 mm.

Eastern Mediterranean

In Türkiye (GSA 22), combined nets are mainly used to catch demersal species, sparids (e.g. bogue) and mugilids, using a mesh length of 40–72 mm for both the gillnet and the internal trammel net panel (Lucchetti, 2012; Tokaç *et al.*, 2010).

In the Greek central and southern Aegean Sea (GSA 22), combined nets are widely used and follow the same technical characteristics as those used in the Ionian Sea (Adamidou, 2007). They are employed to target sparids, mugilids and pelagic species, such as horse mackerel and mackerel. The gillnet mesh length is variable (from 26 mm to 72 mm), with the trammel net internal mesh length being 40 mm to 100 mm.

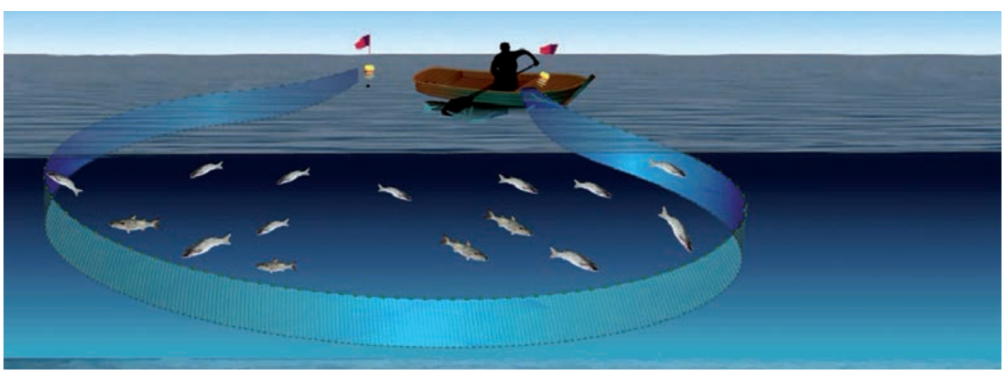
In the Gaza Strip, Palestine (GSA 27), combinations of gillnets and trammel nets are not used (Ali, 2002).

Black Sea

In the Turkish Black Sea (GSA 29), the combined net is used in the fishery for pelagic fish, such as Atlantic bonito, *Mugil* spp. and bluefish, by surrounding the school of fish (Doyuk, 2006). The net is a long and deep net that is fitted together with the splicing of several nets, one above the other and side by side, and rigged by thin lines. The smallest combined net has a total of six compartments, three lengths and two depth layers. All parts of the net can be a trammel net, while the upper and lower sections can be a gillnet, so as to increase the height and reduce the bycatch of crustaceans and some fish species. The inner layer has a mesh size of 56 mm and the outer layer has a mesh size of 220 mm, while the hanging ratio of the inner net is approximately 0.6. The selvage (a thicker net for guarding the main net from possible breakage) is added to both floatlines and leadlines. Another combined net is designed to catch demersal species such as red mullet, picarel (*Spicara smaris*) and Atlantic mackerel. In addition, there are some combined nets, gillnet-to-gillnet, used to catch both bluefish and Atlantic horse mackerel. The nets that target bluefish have two gillnet layers rigged to a thin line in the middle, while the nets targeting Atlantic horse mackerel have two gillnet layers rigged to a five-mesh selvage net in the middle and also to five-mesh selvages on both the leadlines and floatlines.

In Bulgaria (GSA 29), a combined net type was described. It is used to catch pelagic species (bluefish and bonito, through the upper gillnet) and red mullet (through the trammel net). The gillnet is 2–4 m high and has a twine diameter of 0.25 mm and meshes of 44–64 mm in length. The same meshes are used in the inner panel of the trammel net, while the outer panels have 400 mm meshes. The mean depth is 8 m.

FIGURE 72
Encircling gillnet



Source: illustrated by A. Lucchetti.

Encircling gillnets

Encircling gillnets are gillnets set in a circular shape around a fish aggregation; they are commonly used in shallow waters or in lagoons with the headrope on the surface and the footrope on the seabed (Figure 72; Table 16). After the school of fish has been surrounded by the net, noise or visual stimuli (i.e. knocking on the boat, hitting the sea surface with a paddle, sometimes fishers swimming in the water) are used to scare the fish and force them towards the net so that they become gilled or entangled in the netting. It is a technology commonly used by groups of small-scale fishers.

Subregional variations

Table 16

Technical parameters (in mean values) of encircling gillnets used in the Mediterranean and the Black Sea

GSA	Country	Subregion	Gear code	Target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Twine diameter (mm)	Horizonal hanging ratio in the headrope	Leadline weight (g/m)	Mean depth (m)
7	France	Western Mediterranean	GNC	*Sparus aurata*	80–140	80–100			0.50	180.0–250.0	0–40
8	France	Western Mediterranean	GNC	*Sparus aurata*	80–140	80–100			0.50	180.0–250.0	0–40
12	Tunisia	Central Mediterranean	GNC	*Sardinella aurita*	40	300	4.0	0.27	0.78	37.5	12
12	Tunisia	Central Mediterranean	GNC	*Belone belone*	29	275	4.0	0.33	0.77	127.0	4
13	Tunisia	Central Mediterranean	GNC	*Belone belone*	29	275	4.0	0.33	0.77	127.0	4
13	Tunisia	Central Mediterranean	GNC	*Dicentrarchus labrax*	68	300	4.5	0.26	0.65	185.0	12
14	Tunisia	Central Mediterranean	GNC	*Sardinella aurita*	40	300	4.0	0.27	0.78	37.5	12
14	Tunisia	Central Mediterranean	GNC	*Belone belone*	29	275	4.0	0.33	0.77	127.0	4
20	Greece	Central Mediterranean	GNC	*Sarpa salpa*	58						35
21	Libya	Central Mediterranean	GNC	*Sphyraena* spp.	54	300	16.2			450.0	12
21	Libya	Central Mediterranean	GNC	*Sarpa salpa*	50–60	300					0–10
21	Libya	Central Mediterranean	GNC	*Seriola dumerilii*	54	100–200				450.0	6–19
21	Libya	Central Mediterranean	GNC	Mugilidae	80–90	100–200				360.0	9–28
21	Libya	Central Mediterranean	GNC	*Sardina pilchardus*	36–48	200–300				360.0–400.0	18–28

GSA	Country	Subregion	Gear code	Target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Twine diameter (mm)	Horizonal hanging ratio in the headrope	Leadline weight (g/m)	Mean depth (m)
22	Türkiye	Eastern Mediterranean	GNC	*Sardina pilchardus*	24	600	14.4	0.20	0.50	111.0	
22	Türkiye	Eastern Mediterranean	GNC	*Alosa fallax*	44	500	22.0	0.30	0.50	378.0	
25	Cyprus	Eastern Mediterranean	GNC	*Lichia amia*	180	70	12.6	0.16	0.50	168.0	
25	Cyprus	Eastern Mediterranean	GNC	*Merluccius merluccius*	120	10	1.2	0.60	0.50	139.0	
25	Cyprus	Eastern Mediterranean	GNC	*Mullus barbatus*	36	30	1.1	0.18	0.52	115.0	
25	Cyprus	Eastern Mediterranean	GNC	*Boops boops*	40	80	3.2	0.20	0.50	115.0	
25	Cyprus	Eastern Mediterranean	GNC	*Sarda sarda*	80	100	8.0	0.20	0.50	115.0	
28	Türkiye	Black Sea	GNC	*Atherina* spp.	21	350	7.4	0.24	0.66	145.5	
28	Türkiye	Black Sea	GNC	*Belone belone*	26	100	2.6	0.24	0.67	121.3	
28	Türkiye	Black Sea	GNC	*Pomatomus saltatrix*	80	200	16.0	0.30	0.50	125.0	12
28	Türkiye	Black Sea	GNC	*Sardina pilchardus*	26	600	15.3	0.33	0.66	600.0	
28	Türkiye	Black Sea	GNC	*Trachurus trachurus*	27	400	10.8	0.24	0.33	925.6	10
28	Türkiye	Black Sea	GNC	*Merluccius merluccius*	30	65	3.4		0.50		50–70
29	Türkiye	Black Sea	GNC	*Belone belone*	20–22	350–800	7.7–16.0	0.20	0.58–0.60	69.0–98.0	
29	Türkiye	Black Sea	GNC	*Trachurus* spp.	34	100	3.4	0.24	0.55	61.0	

Western Mediterranean

In Morocco (GSA 3), encircling nets of small dimensions are used in very shallow waters to catch coastal species (Plate 52).

In France (GSAs 7 and 8), the *battue* or *battude* is a system of fishing that consists of encircling the fish gathered in schools with the help of a gillnet or a trammel net and forcing their enmeshment by frightening them with the noise of the oars struck on the water or, at night, using strong light projections (Ifremer *et al.*, 1998). The target species are fish that regularly live in schools, such as sardines, sardinella, mullet or seabream (e.g. gilthead seabream), and that aggregate for spawning or to seek shelter (shelter-behaviour). This fishing method is practised in lagoons, channels, river mouths or near the coast at shallow depths, with the nets having to cover the entire water column from the surface to the bottom. However, most of these encircling nets have the same technical characteristics as those used for set or drift fishing. Thus, sardinal type nets with a mesh size of 31 mm, length of about 400 m and stretched drop of 25 m are used to encircle sardines in coastal areas or in lagoons and capture them by entanglement. To catch seabream, grey mullet or seabass, fishers use gillnets from 80 mm to 140 mm mesh size and 10 m to 25 m in stretched height where trammel nets of the same characteristics are used.

PLATE 52
Encircling gillnet used in Morocco

Central Mediterranean

In Tunisia (GSAs 12, 13 and 14), encircling gillnets are employed (Plate 53) to target pelagic fish such as round sardinella (using a 40 mm mesh size) and garfish (using a very small mesh size, 29 mm). In GSA 13, a gillnet is employed to catch European seabass with 68 mm meshes. All the nets are deployed in shallow waters (4–12 m) and have a high horizontal hanging ratio (0.7–0.8; Romdhane, 1998).

PLATE 53
Encircling gillnet used in Tunisia

In Greece (GSA 20), an encircling gillnet is used at a mean depth of 35 m to catch salema with a mesh length of 58 mm (Adamidou, 2007).

In Libya (GSA 21), an encircling gillnet with a large stretched height (over 16 m) and a 54 mm mesh length is used to catch barracudas.

Adriatic Sea

No specific encircling gillnets are used in the Adriatic Sea. Some gillnets may be used as encircling gillnets in specific seasons to target migratory fish (e.g. migratory grey mullet in October–November in the Italian GSA 17).

Eastern Mediterranean

In the northern and central Greek Aegean Sea (GSA 22), small surrounding nets called *kouloura* are widely used (Adamidou, 2007). They are comprised of one to nine oblong nets (*ferses* or *kanatia* in Greek) that are connected vertically. The nets can be all gillnets, or all trammel nets or a combination of these (gillnets for the first and last net, trammel nets for the inner ones). The stretched mesh size ranges from 44 mm to 72 mm. The length of the nets ranges from 250 m to 500 m and can remain equal or increase from the upper to the lower net. The nets are connected using lacing ropes. On each lacing rope, the last part of the previous net and the first part of the next net are rigged. The length of the lacing ropes is equal to or a little longer than the nets that are connected. The first and last oblong net are connected to the headline and leadline, respectively. An auxiliary piece of netting exists at the two sides of the surrounding net in order to facilitate the hauling of the gear. At the headline, a sufficient number of floats are placed with increased frequency providing the adequate buoyancy to keep the upper part of the net at the water's surface during fishing. The leadline is supplied with weights to ensure the vertical position of the net in the water. The small surrounding net is used mainly for pelagic and semi-pelagic species that are shoaling – salema, *Mugil* spp., Atlantic bonito, skipjack tuna (*Katsuwonus pelamis*) and bluefish. However, when it is used at depths lower than the height of the gear, it also targets demersal species. When the target species is detected, an anchored buoy is set in the water with one end of the net attached to it. The vessel, following a circular course, leaves the rest of the net, surrounds the school of fish and returns to its initial place. Then, the net is gathered in simultaneously from the two ends. Thus, the fish are trapped in a space that is continually reduced. The fishing operation lasts about 30 minutes to one hour and the fishing depth ranges from 4 m to 65 m, with 4–30 m being more usual.

In Türkiye (GSA 22), an encircling gillnet is used to catch the twaite shad (*Alosa fallax*): it has a very large stretched height (22 m) and a mesh length of 44 mm (Tokaç *et al.*, 2010).

In Cyprus (GSA 25), encircling gillnets are employed to target European hake with a 120 mm mesh length, bogue with a 40 mm mesh length, and red mullet with a 36 mm mesh length. Moreover, some gillnets target pelagic fish such as Atlantic bonito using an 80 mm mesh length and 8 m of net height and leerfish using a 180 mm mesh length and 13 m of net height (Haktanir *et al.*, 2015).

In Lebanon (GSA 27), fishers sometimes set their traditional gillnets to surround a fish school; these encircling nets are locally known as *M'batan* (Sacchi and Dimech, 2011).

Black Sea

In Türkiye (GSAs 28 and 29), several different encircling gillnets are employed (Doyuk, 2006; Akyol and Ceyhan, 2011; Ay and Duman, 2015). The main target species are pelagic fish (garfish, sand smelts, horse mackerel, bluefish, sardine), and the mesh size varies according to their body size (from 20 mm to target garfish to 80 mm to target bluefish). The stretched net height is highly variable, ranging from 2.6 m to 16 m; the same occurs for the horizontal hanging ratio (0.33–0.67).

Drift gillnets

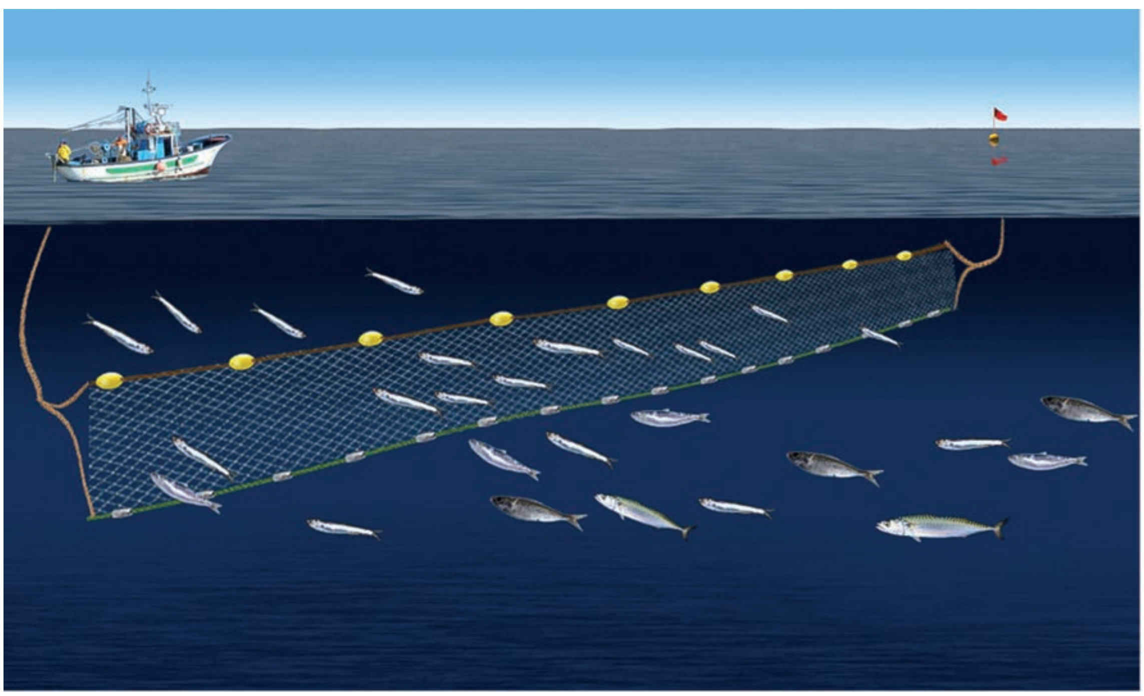
The drift gillnet, or simply driftnet, is a kind of gillnet (one single netting panel) that is not fixed to the seabed and is held at the sea surface or at a certain distance below it using floats and as a consequence drifts with the current (Figure 73). The length of the buoy ropes controls the depth of the net. Driftnets can either be attached to the vessel by means of a rope or cable at one end of the net and with a marker (buoy and highflyer) attached to the other end of the gear, or they can move on their own. Driftnets are usually set in a fleet, which can extend over a great distance in open waters. In the case of large driftnets used in the open sea, the marker may be equipped with radio or satellite transmitters for easy location. The main capture mechanism is by gilling, and in this situation the nets are thus highly size-selective, but it can also be by wedging, snagging or entangling.

When the driftnets are set for fishing, the vessel remains in the fishing ground because: a) the diurnal migration of some pelagic species can lead to very abundant catch in a short time; b) the loss of a net left drifting with the currents is a real risk; and c) the driftnet is exposed to damage by passing ships. Construction of a driftnet is not very different from a stationary gillnet, and the same net is often used for both fishing methods; the differences lie in the rigging arrangements and net operation. The hanging ratio used for fixed nets (gillnets, trammel nets, combined nets) is generally in the range of 0.5 or less, whereas the hanging ratio for driftnets generally ranges from 0.5 to 0.8 or more.

Driftnets are mainly used in the Mediterranean and the Black Sea to catch both small- and medium-sized pelagic species. They have been used for decades by numerous small-scale artisanal fleets along the coasts of the Mediterranean and the Black Sea without raising major environmental concerns. Problems started in the late 1970s–1980s with the introduction of hydraulic winches, the availability of new netting materials, and the possibility of building larger boats, which induced radical changes: the use of driftnets with larger meshes and much greater overall size rapidly expanded outside any preventive control, notably targeting swordfish (*Xiphias gladius*), bluefin tuna (*Thunnus thynnus*), and albacore (*Thunnus alalunga*). As a result, the driftnets targeting large pelagic species (locally known as *spadara* and *thonaille*) extended up to 50 km in length and 20–30 m in height. These types of nets led to large incidences of unwanted catch (e.g. marine mammals, sea turtles, sharks and seabirds) and created great environmental concerns. In 2005, the GFCM endorsed an International Commission for the Conservation of Atlantic Tunas (ICCAT) decision that rendered a total ban on driftnet fishing, irrespective of net size, of large pelagic species (including tuna, sharks, and swordfish) applicable to all Mediterranean states. Therefore, the use of driftnets for the catch of large pelagic species, such as swordfish, bluefin tuna and tuna-like species, is forbidden in all Mediterranean countries (Recommendation GFCM/22/1997/1 on the limitation of the use of driftnets in the Mediterranean [GFCM, 2022], Recommendation GFCM/29/2005/3 prohibiting the use of driftnets for fisheries of large pelagic species [GFCM, 2022], and Recommendation 03-04 by ICCAT relating to Mediterranean swordfish [ICCAT, 2022]).

On the other hand, small-scale driftnets using small mesh sizes and total length less than 2.5 km are legal and still used to primarily target pelagic schooling species such as anchovy, sardine, mackerel, horse mackerel, bluefish, bogue, round sardinella, saddled seabream and greater amberjack (Lucchetti *et al.*, 2017) (Table 17).

FIGURE 73
Driftnet



Source: illustrated by A. Lucchetti.

Subregional variations

Table 17

Technical parameters of driftnets used in the Mediterranean and the Black Sea

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Stretched net height (m)	Titre	Twine diameter (mm)	Vertical number of meshes	Rigging	Horizontal hanging ratio	Leadline weight (g/m)
1	Spain	Western Mediterranean	GND	PIL	30.0–40.0							
1	Spain	Western Mediterranean	GND	AND	60.0							
3	Morocco	Western Mediterranean	GND	AMB	80.0			0.33	100	D	0.65	
3	Morocco	Western Mediterranean	GND	Medium-sized pelagic species	110.0			1.29	80	D	0.47	
3	Morocco	Western Mediterranean	GND	Medium-sized pelagic species	70.0			0.33–0.41	100–120	D	0.53–0.57	
3	Morocco	Western Mediterranean	GND	Medium-sized pelagic species	80.0			0.43	100	D	0.66	
4	Algeria	Western Mediterranean	GND	AMB	400.0			1.14	90		0.80	460
6	Spain	Western Mediterranean	GND	AMB								
7	France	Western Mediterranean	GND	LZZ, MAZ	48.0–52.0	3.6		0.33	70–75	D		
7	France	Western Mediterranean	GND	AMB	80.0–90.0	4.0–9.0		0.25–0.33	50–100	D		
7	France	Western Mediterranean	GND	PIL	24.0–31.0	25.0	210/2	0.22	800–820	T90	0.97	250
9	Italy	Western Mediterranean	GND	AMB, SBS	100.0	40.0		0.35	400	T90	0.96	70
9	Italy	Western Mediterranean	GND	MAS	110.0	33.0–44.0	210/8	0.51	300–400	T90	0.93	40
9	Italy	Western Mediterranean	GND	SBS	66.5–82.0	13.3–32.0	210/4	0.25–0.35	200–390	D, T90	0.66–0.83	35–80
9	Italy	Western Mediterranean	GND	SBS, BOG, LZZ	75.0	11.3–15.0		0.25	150–200	D	0.63	100

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Stretched net height (m)	Titre	Twine diameter (mm)	Vertical number of meshes	Rigging	Horizontal hanging ratio	Leadline weight (g/m)
9	Italy	Western Mediterranean	GND	SBS, LZZ, JAX	84.0	12.6–16.8		0.25	150–200	T90	0.74	100
9	Italy	Western Mediterranean	GND	SBS, MAS, JAX	72.0–78.0	15.6–36.0		0.25	200–500	D, T90	0.62–0.74	80
9	Italy	Western Mediterranean	GND	ANE	26.5	23.9	210/2	0.24	900	T90	0.87	264
10	Italy	Western Mediterranean	GND	MAS, POP	70.0–86.0	35.0–44.0	210/4	0.25–0.35	500	T90	0.92–1.00	70–80
10	Italy	Western Mediterranean	GND	AMB	70.0–110.0	7.4–40.0	210/6, 210/10	0.20–0.58	70–400	D, T90	0.59–1.00	80–180
10	Italy	Western Mediterranean	GND	ANE	26.0–28.0	20.8–26.0	210/2	0.24	800–1 000	T90	0.72–0.85	150–160
10	Italy	Western Mediterranean	GND	SAA, BOG	64.0	32.0	210/4	0.35	500	T90	0.98	120
10	Italy	Western Mediterranean	GND	BLU	88.0	26.4	210/9	0.54	300	T90		100
10	Italy	Western Mediterranean	GND	MAZ, HOM	70.5–85.0	28.2–42.5		0.30	400–500			
15	Malta	Central Mediterranean	GND	SBS								
17	Slovenia	Adriatic Sea	GND	PIL	34.0	20.4	210/2	0.24	600	T90	0.84–0.90	180
18	Montenegro	Adriatic Sea	GND		80	22						
19	Italy	Central Mediterranean	GND	ANE	19.0–22.0	22.8–26.4	210/2	0.24	1 200	T90	0.88–1.00	600–700
19	Italy	Central Mediterranean	GND	ANE, PIL	20.0	24.0	210/2	0.24	1 200	T90	0.74	600
19	Italy	Central Mediterranean	GND	PIL	34.0	40.8	210/2	0.24	1 200	T90	0.81	500
19	Italy	Central Mediterranean	GND	BOG	60.0	18.0		0.20	300			

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Stretched net height (m)	Titre	Twine diameter (mm)	Vertical number of meshes	Rigging	Horizontal hanging ratio	Leadline weight (g/m)
19	Italy	Central Mediterranean	GND	ANN, TGS, MUT, JAX								
21	Libya	Central Mediterranean	GND		100.0	5.0–15.0			150–200			100–360
22	Türkiye	Eastern Mediterranean	GND	MAC	52.0–56.0	32.0		0.30			0.66	
22	Türkiye	Eastern Mediterranean	GND	PIL	25.5	13.0		0.20			0.66	
22	Türkiye	Eastern Mediterranean	GND	SAA	44.0	11.0		0.30			0.50	
22	Türkiye	Eastern Mediterranean	GND	JAX	56.0	34.0		0.30			0.66	
22	Türkiye	Eastern Mediterranean	GND	SLM	68.0	13.0		0.20			0.50	
24	Türkiye	Eastern Mediterranean	GND		80.0	24.0		0.33	300		0.50	
27	Palestine	Eastern Mediterranean	GND	SAA, PIL, PIC, SAE	14.0–15.0	12.0						
27	Palestine	Eastern Mediterranean	GND	AMB, MGR, GPD	42.0	12.0						
27	Palestine	Eastern Mediterranean	GND	PIL	15.0–21.0							
27	Palestine	Eastern Mediterranean	GND	Medium-sized pelagic species	40.0–120.0							
27	Palestine	Eastern Mediterranean	GND	HDR	17.0–30.0			0.12				
26	Egypt	Eastern Mediterranean	GND	Medium-sized pelagic species	50.0			0.75				11
26	Egypt	Eastern Mediterranean	GND	Medium-sized pelagic species	15.0			0.75				11
28	Türkiye	Black Sea	GND	Medium-sized pelagic species	84.0	33.6		0.30	400	D	0.62	

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Stretched net height (m)	Titre	Twine diameter (mm)	Vertical number of meshes	Rigging	Horizontal hanging ratio	Leadline weight (g/m)
29	Bulgaria	Black Sea	GND	Medium-sized pelagic species	36.0–48.0	5.4–19.2			150–400			
29	Bulgaria	Black Sea	GND	JAX	70.0							
29	Bulgaria	Black Sea	GND	SPR	25.0							
29	Bulgaria	Black Sea	GND	Medium-sized pelagic species	60.0–100.0							
29	Bulgaria	Black Sea	GND	BLU	60.0–100.0							
29	Bulgaria	Black Sea	GND	Medium-sized pelagic species	38.0–45.0	10–28	210/3–210/4	0.23–0.3	200–400	D	0.6–0.7	40
29	Romania	Black Sea	GND	JAX	70.0							
29	Romania	Black Sea	GND	SPR	25.0							
29	Romania	Black Sea	GND	Medium-sized pelagic species	60.0–110.0							
29	Romania	Black Sea	GND	BLU	60.0–100.0							
29	Türkiye	Black Sea	GND	Medium-sized pelagic species	56.0–80.0	11.2–48.0	210/3–210.4	0.30–0.33	200–600	D	0.59–0.70	8–33
29	Türkiye	Black Sea	GND	JAX	17.0	1.7	210/2	0.24	100	D	0.55	68
29	Türkiye	Black Sea	GND	SHE	30.0	3.0	210/2	0.24	100	D	0.55	70
29	Ukraine	Black Sea	GND	JAX	70.0							
29	Ukraine	Black Sea	GND	SPR	25.0							
29	Ukraine	Black Sea	GND	Medium-sized pelagic species	60.0–100.0							
29	Ukraine	Black Sea	GND	BLU	60.0–100.0							

Notes: AMB: *Seriola dumerili*; AND: *Tylosurus acus*; ANE: *Engraulis encrasicolus*; ANN: *Diplodus annularis*; BLU: *Pomatomus saltatrix*; BOG: *Boops boops*; GPD: *Epinephelus marginatus*; HDR: *Hirundichthys rondeletii*; HOM: *Trachurus trachurus*; JAX: *Trachurus* spp.; LZZ: *Liza* spp.; MAS: *Scomber japonicus*; MAC: *Scomber scombrus*; MAZ: *Scomber* spp.; MGR: *Argyrosomus regius*; MUT: *Mullus barbatus*; PIC: *Spicara* spp.; POP: *Trachinotus ovatus*; SAA: *Sardinella aurita*; SAE: *Sardinella maderensis*; SBS: *Oblada melanura*; SHE: *Alosa maeotica*; SLM: *Sarpa salpa*; SPR: *Sprattus sprattus*; TGS: *Penaeus kerathurus*.

Western Mediterranean

Along the Spanish Mediterranean coast (GSAs 1, 5 and 6), Urbistondo (2001), García-Rodriguez, Fernandez and Esteban (2006) and De La Serna *et al.* (2000) recorded driftnets together with other types of gear (e.g. hand lines) as seasonally used to catch greater amberjack, common dolphinfish (*Coryphaena hippurus*), European squid and different Scombridae species. Furthermore, the catalogue of fishing gear by Cortés and Manrubia (2003) noted the presence of small driftnets called *sardinal* targeting sardines in Andalucía, without providing additional information on their use. Sala (2015) reported that the vessels in the area of Malaga (Spain) used the *sardinal* from May to September when the price for sardines is higher. This net is similar to the *xeito* driftnet originating from northern Spain. It has a mesh size of 30–40 mm, a total length of around 750 m and a net height of 20 m. Another driftnet called the *voladera*, with a mesh length of around 60 mm, was also used to target flying fish, including *Tylosurus acus imperialis* and the tropical two-wing flyingfish (*Exocoetus volitans*). More recent investigations did not reveal the presence of vessels using small-scale driftnets (Sartor, 2014; Lucchetti *et al.*, 2017).

In Morocco (GSA 3), in the late 1990s, small-scale driftnets were mostly used in Tétouane, Chefchaouen and Nador (Damiano, 1999).

In Algeria (GSA 4), driftnets were mainly used in the ports of El Tarf, Alger and Tipaza to catch different medium-sized species, such as juveniles of greater amberjack (Sahi and Bouaicha, 2003).

In France (GSAs 7 and 8), Sacchi and Lespagnol (2010) reported that until 2008, driftnets were used to target bluefin tuna (*thonaille*) and bonito (*bonitière*), while only a few vessels declared catching other species. According to European Union Fleet Register data, in the French Mediterranean there are only a few vessels (moored in several ports of GSA 7) licensed to use small driftnets, which were no longer active in 2013 (Sartor, 2014; Lucchetti *et al.*, 2017). Nevertheless, today small driftnets of less than 500 m in length can be used from time to time, mainly to catch sardine (*sardinal*), mackerel and greater amberjack. The *sardinal* has a mesh size of 24–31 mm and a net height of 25 m. For mackerel and mugilids, the mesh size is around 50 mm with a net height of less than 4 m. For larger pelagic fish such as greater amberjack, the common mesh size used is between 80 mm and 90 mm and the net height is between 4 m and 9 m. These two last types of nets can also be used anchored or as encircling gillnets (Sacchi, 2009).

In Italy (GSAs 9, 10 and 11), several different small driftnets are used, and identified by the generic name of *ferrettara*. Each of them has a specific target species, and the technical properties vary accordingly (Box 6).

Box 6

Different types of small driftnets in Italy (GSAs 9, 10 and 11)

The *menaide,* or *menaica*, is the most ancient small-scale driftnet used in Italy. Two main types of *menaide* are identified: one targeting anchovy (*Engraulis encrasicolus*) and another, used more rarely, targeting sardine (*Sardina pilchardus*). The nets targeting anchovy catch a very small amount of bycatch, mainly sardines.

Menaide nets are found primarily in eastern Sicily and the southern Tyrrhenian Sea. They are commonly operated by small vessels (gross tonnage: 1.3–4.9; length overall: 5.2–11.5 m; engine power: 18–79 kW; crew: one or two, up to four). The two types of *menaide* nets share similar rigging and technical features, except that the mesh opening used to target sardine (average 34.3 mm) is greater than the type used to target anchovy (25.3 mm).

In the *menaide*, where a thin twine is used, fishers are used to applying some technical changes to the nets:

- two lateral wings of netting made of large meshes and thick twine are joined to the two ends of the net so as to reinforce the driftnet during the hauling process;
- two strips of netting made of large meshes and thick twine are joined to the headline and leadline so as to strengthen the net during hauling; and
- a double headrope is often used to reduce the risk of breaking the net within the net winch during hauling procedures.

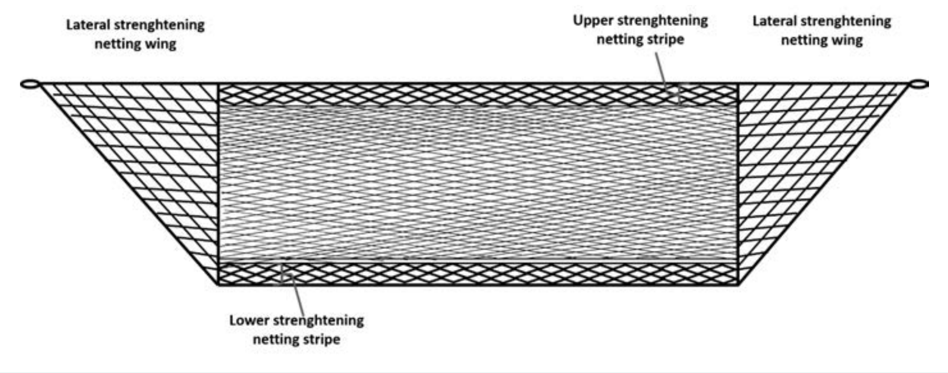
The stretched net height is around 20–25 m (in rare cases, up to 40 m). Normally, fishers use around 100–500 m of net.

All the nets have a high hanging ratio, ranging from 0.72 to 1.00; net rigging is consistently T90. The estimated real net height during fishing operations is around 14 m.

All nets share the same twine material: polyamide (PA) netting, both white and red, with a thickness of 210 denier × 2 (a diameter of around 0.24 mm).

Details of headline and leadline of a *menaide* used in the southern Tyrrhenian Sea.

Schematic of a driftnet used to target small pelagic species



(*Source:* redrawn from A. Lucchetti).

Details of a *menaide* during hauling.

The *occhiatara* is employed by some vessels in Liguria (northern Tyrrhenian Sea) mainly to target the saddled seabream (*Oblada melanura*) and, to a lesser extent, other medium-sized pelagic species – bogue (*Boops boops*), *Liza* spp., horse mackerel (*Trachurus* spp.) and mackerel (*Scomber* spp.).

The mesh opening ranges from 70 mm to 90 mm. The stretched net height is usually between 11 m and 17 m (in rare cases, up to 25–36 m). The real net height while fishing is around 7–12 m. The hanging ratio on the headline and leadline is commonly between 0.62 and 0.83 (on average, 0.70). The net length ranges from 375 m to 500 m, and the configuration includes both T90 and diamond mesh rigging. The twine diameter is usually 0.25 mm (PA monofilament).

The *ricciolara* has recently been introduced in the southern Tyrrhenian Sea to catch greater amberjack (*Seriola dumerilii*). The *ricciolara* is similar to a common gillnet. Over the year, fishers use a net with different mesh sizes to target greater amberjack as it grows, from 74 mm in late summer to 100 mm or more in autumn. The nets are made of PA monofilament with a diameter of 0.20–0.25 mm. The stretched height commonly ranges from 6 m to 8 m; the rigging includes both the diamond and the T90 configuration. The estimated net height during fishing operations ranges from 3 m to 6 m. The hanging ratio is around 0.59–0.87 (on average, 0.68), with the diamond and the T90 configuration, respectively. A twisted twine netting of 210 denier × 10 (twine diameter of around 0.58 mm) can also be used.

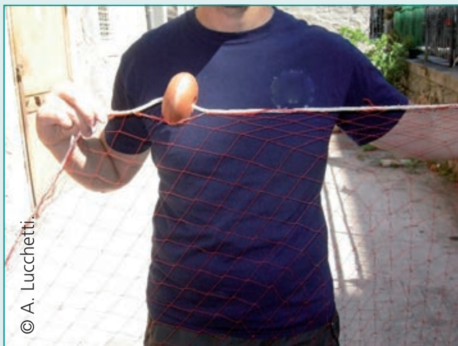
Another type of *ricciolara* is used in the north of Sicily from late summer to autumn. The mesh opening used to target greater amberjack is around 74 mm and the twine diameter is commonly 0.20–0.25 mm (PA monofilament); the stretched net height is around 21 m. In all of the nets, the mesh rigging configuration is T90. About 800–1 000 m of net are commonly used.

Sgomberara nets are mainly used in the north of Sicily to target horse mackerel and mackerel. The main gear characteristics can be summarized as follows: mesh length is usually between 70.5 mm and 85 mm (average, 80.2 mm); the fully extended net height ranges from 28 m to 43 m (on average, 34.9 m); each vessel in the area sets from 500 m to 1 500 m of net; the meshes are rigged to the headline and leadline according to a T90 configuration. The twine is usually a transparent PA monofilament, 0.30 mm in diameter.

Another small-scale driftnet is used in the southern Tyrrhenian Sea (Campania) to target bluefish (*Pomatomus saltatrix*). This net has the following technical properties: the mesh opening is around 88 mm and the stretched net height is around 26.5 m; the mean net length is around 2 400 m; the meshes are rigged according to a T90 configuration; a PA twisted twine measuring 210 denier × 9 (approximately 0.5 mm) is used.

The *alacciara* net is used in the north of Sicily to target round sardinella (*Sardinella aurita*), although fishers reported also catching other pelagic species. Its characteristics are similar to those of the *sgomberara*. The mesh opening is about 67 mm and the stretched net height is around 32 m. The net length is about 600 m. Meshes are joined to the headline and leadline in a T90 configuration. A PA twisted twine measuring 210 denier × 4 (approximately 0.35 mm) is commonly used.

The *palamitara* net is used in the Ligurian Sea and eastern Sicily. The *palamitara* targets medium-sized pelagic species such as greater amberjack and pompano (*Trachinotus ovatus*). The main differences between the *palamitara* and the other driftnets are the mesh opening and twine diameter, which are usually greater. The mesh opening used ranges from 88 mm to 112 mm (on average, 102 mm). Such a mesh size also enables catching smaller pelagic species such as Atlantic chub mackerel (*Scomber colias*). The stretched net height usually ranges from 30 m to 44 m (average, 35.9 m), though the estimated real net height during fishing is around 9–22 m. As in the other driftnets, the hanging ratio is high (0.72–0.97, with an average of 0.91). The length of the nets varies from 300 to 1 600 m. All nets have adopted the T90 mesh rigging configuration. A PA twisted twine netting between 210 denier × 6 and 210 denier × 12 (0.2–0.6 mm in diameter, estimated) is commonly observed.



Details of headline and leadline of a *palamitara* used in the southern Tyrrhenian Sea.

The *bisantonara*, mainly employed in the southern Tyrrhenian sea, is used to target mackerel and other small-sized pelagic species. Its technical features are quite similar to those of the *palamitara*: mesh opening ranges from 70 mm to 100 mm (on average, 84.9 mm) and the stretched net height is between 35 m and 44 m (average, 40 m). A high horizontal hanging ratio (on average, 0.95) is used. The net length ranges from 400 m to 1 200 m; the T90 mesh configuration is always used. Both PA twisted and monofilament twine with a diameter of 0.30–0.44 mm are used.

The *bogara* driftnet targeting the bogue is quite rare and observed exclusively in eastern Sicily. Its mesh opening is around 60 mm and the stretched net height is around 18 m. The net length varies from 600 m to 700 m, and the meshes are rigged according to the T90 configuration. A PA monofilament twine 0.20 mm in diameter is used.

Central Mediterranean

In some Tunisian fisheries, according to Jabeur, Gobert and Missaoui (2000) and De la Serna *et al.* (2000), drifting gillnets called *marnine* are commonly used to seasonally catch bluefish, great amberjack and common dolphinfish. The nets are set in the direction of the wind and can reach 2.5–3.0 km in length. They are generally set up at night and retrieved early in the morning.

In Malta (GSA 15), De Leiva *et al.* (1998) noted the use of small driftnets, from November to February, targeting saddled seabream and Scombridae. However, the investigations carried out during the DRIFTMED project (Sartor, 2014) recorded that small-scale driftnets were no longer used in Malta.

In Italy (GSA 19), the driftnets targeting anchovies and sardines have similar technical properties to those described from the Italian Tyrrhenian Sea: mesh length of 19–34 mm and a stretched net height of 23–40 m. Moreover, a net specifically designed to catch bogue (*bogara*) with a 60 mm mesh length, 18 m net height and 0.20 mm twine diameter was reported in the same area.

In Greek waters (GSA 20), no driftnets were reported (Adamidou, 2007).

In Libya (GSA 21), a drift gillnet locally called *sayeb ayam*, used from October to March to catch medium-sized pelagic species, has been described (Lamboeuf, 2001).

Adriatic Sea

In the Gulf of Trieste (northern Adriatic Sea, GSA 17), a few Italian and Slovenian vessels rarely use *menaide* on a seasonal basis (spring–summer), with technical properties similar to the types described from the Tyrrhenian Sea, to catch both anchovy and sardine (Lucchetti *et al.*, 2017).

In Montenegro (GSA 18), the driftnets used are called *polandara*; they are all classified as gillnets for pelagic species. According to the *Rulebook on construction–technical basis, mesh size, method of use and purpose of certain net types and other means for commercial fishing* (Official Gazette of Montenegro, 8/2011), the minimum stretched mesh size of this gear is 80 mm, the maximum height is 22 m and length 400 m.

In Croatia (GSAs 17 and 18), driftnets have never been used, as fishers employ the *sardelara* purse seine for small pelagics (sardine and anchovy; Lucchetti *et al.*, 2017).

Eastern Mediterranean

In Turkish GSA 22, the driftnets used target a wide variety of species, with consequent differences in their technical properties. The technical characteristics and regulations (national and international) of the driftnets used in Turkish waters have been reviewed by Akyol *et al.* (2008), who described 12 types of driftnets in the Gulf of Izmir. Four types were used by large vessels to catch medium-sized and large pelagics, while the others were employed by small vessels. Driftnets ranged from 400 m to 6 900 m in length. The driftnet targeting sardine has the smallest mesh length (25.5 mm) and a net height of 13 m. Sardine driftnets were reported in the Izmir region from May to September. The driftnet targeting round sardinella has a larger mesh length (44 mm), but a shorter net height (11 m), as well as a smaller horizontal hanging ratio (0.50 vs 0.66). Driftnets targeting Atlantic mackerel and horse mackerel have almost the same properties: mesh length of 52–56 mm, stretched net height of 32–34 m and twine diameter of 0.30 mm. The driftnet targeting salema has the largest mesh length (68 mm), with a stretched net height of 13 m and a twine diameter of 0.20 mm.

In Greek GSA 22, no driftnets were reported (Adamidou, 2007).

In Cyprus (GSA 25), the information collected during the DRIFTMED project (Sartor, 2014) did not reveal the presence of vessels using driftnets.

In Palestine (GSA 27), a specific driftnet for small pelagics (*maltash*) is used in spring (March–June) and autumn (September–November); target species include Madeiran sardinella (*Sardinella maderensis*), sardine, yellowstripe barracuda (*Sphyraena chrysotaenia*), picarel and blotched picarel (*Spicara maena*). The mesh size is 20–30 mm (Ali, 2002). The nets are set by a fleet of ten floating pieces, 100 m long and each 12 m deep. A driftnet with a larger mesh size (60–84 mm, locally called *zeada* or *zida*) is used to catch a variety of medium-sized pelagic species throughout the year (Abudaya *et al.*, 2013); target species include greater amberjack, meagre, dusky grouper (*Epinephelus marginatus*) and flathead grey mullet.

In Lebanon (GSA 27), according to the information collected from the Department of Fisheries and Wildlife (Ministry of Agriculture) and local experts involved in international projects on small-scale fisheries, such as the National Council for Scientific Research (CNRS) project on Establishing Monitoring and Sustainable Development of the Lebanese Sea (CANA-CNRS Project), driftnets do not seem to be currently used by the artisanal fleet.

Black Sea

In the Black Sea (Ukraine, Bulgaria and Romania), driftnet fisheries mainly target bluefish with mesh sizes between 60 mm and 100 mm.

In the Turkish Marmara Sea (GSA 28) and Black Sea (GSA 29), the driftnets used in the past to target Atlantic bonito had a mesh length of 56–84 mm (rigged in diamond direction) and a stretched net height of 11–48 m (Doyuk, 2006; Akyol *et al.*, 2008).

Other Turkish driftnets targeted Atlantic horse mackerel using a very small mesh length (17 mm) and net height (1.7 m) and the Black Sea shad using a 30 mm mesh length and a net height of 3 m (Ay and Duman, 2015). Nowadays, driftnets are illegal in Türkiye.

In Bulgaria (GSA 29), the majority of the vessels engaged in the driftnet fishery target medium-sized pelagic species with a net locally called the *fustanella* (Raykov and Triantaphyllidis, 2015). This net has a small mesh length (36 mm) at the beginning of the fishing season (e.g. September) to catch smaller individuals and an increased mesh length (48 mm) to catch larger individuals at the end of the fishing season (e.g. November) with a shorter net height (5–19 m). On the headrope of this net, a 30 mm width small mesh (*sardon*) net is attached in order to prevent buoys from becoming entangled with the *fustanella*. The *fustanella* is 500 m long and the width ranges from 150 meshes to 400 meshes. On the leadrope, lead rings with a diameter of 10–12 cm are placed every 3–4 m likewise so as not to entangle with the *fustanella* net. The soaking time varies (3–4 hours) and fishing takes place during night-time when the moon is not present.

In Romania and Ukraine (GSA 29), the same driftnets described for Bulgaria are employed to catch bluefish, sprat and horse mackerel.

4.2.2 Traps

Traps are types of gear that marine organisms enter voluntarily, either for sheltering or attracted by a bait, and from which they are then hampered or prevented from leaving. They are designed in such a way that the entrance(s) become(s) a non-return device allowing the animals (i.e. fish, molluscs, crustaceans) to enter the trap but making it impossible for them to leave the catching chamber. According to increasing dimensions, traps include:

- Pots or creels are small types of fishing gear that are occasionally hauled by fishers (usually every 24–48 hours or more), with dimensions up to 1–2 m; pieces of fish or squid are often used as bait.
- Fyke nets are larger types of gear also requiring the use of nets, often fixed to the seabed, that convey the organisms inside of the trap, with dimensions of tens of metres, including the guiding panel and the trap; these traps are commonly used in shallow or inshore sites and are positioned to take into account the behaviour of the target species.
- Fixed traps are very large traps (often a system of traps or rooms) hundreds of metres in size.

The classification according to the ISSCFG is given in Table 18.

Table 18

Classification of traps according to the International Standard Statistical Classification of Fishing Gear

Gear categories (first tier)	Subcategories (second tier)	Standard abbreviations	ISSCFG code
Traps			8
	Stationary uncovered pound nets	FPN	8.1
	Pots	FPO	8.2
	Fyke nets	FYK	8.3
	Stow nets	FSN	8.4
	Barriers, fences, weirs, etc.	FWR	8.5
	Aerial traps	FAR	8.6
	Traps (nei)	FIX	8.9

Source: **FAO.** 2016. *International Standard Statistical Classification of Fishing Gear. Handbook on Fisheries Statistics.* Rome. fao.org/3/bt988e/bt988e.pdf.

All the pots reported below are used both at sea and in lagoons, while the other types of gear falling under the traps definition are used exclusively in lagoons and will be described in Chapter 7.

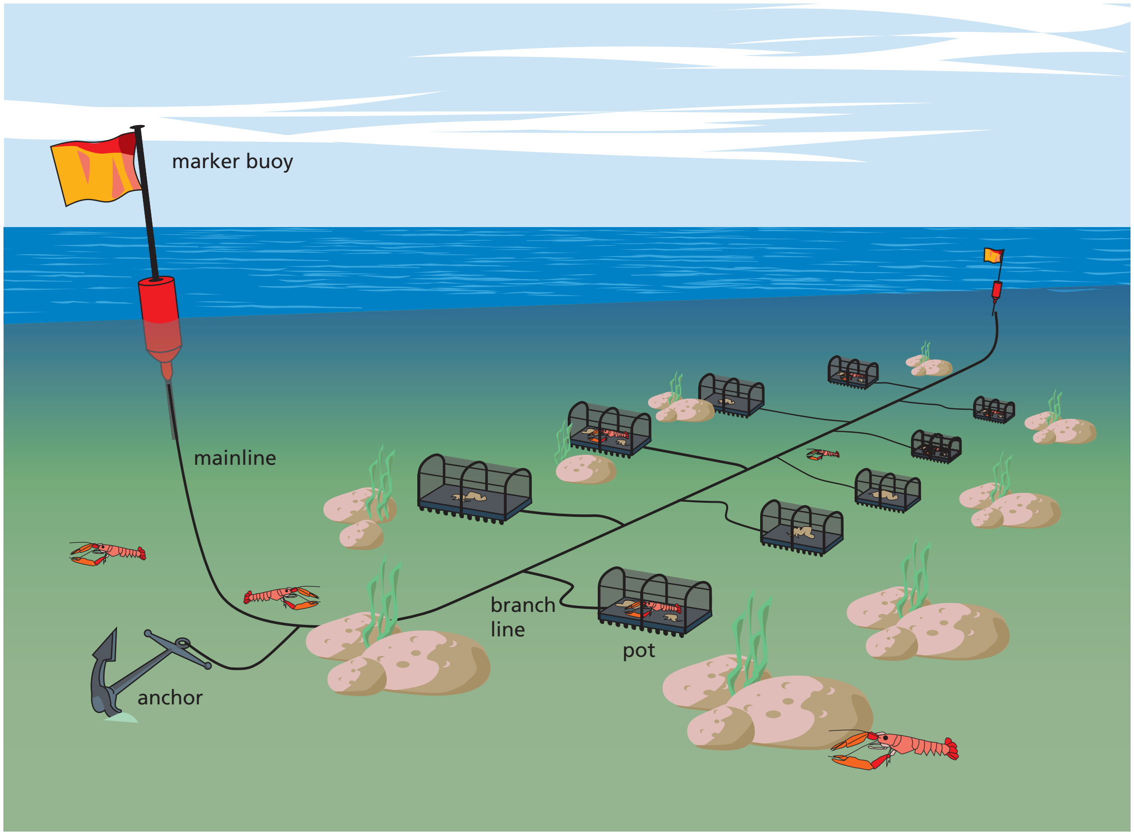
Pots

Pots (or creels) are small traps that can differ in shape, dimensions and material according to the target species (considering its form and behaviour) or the sea bottom characteristics, but they all have an entrance (or more than one) that makes it easy for organisms to enter but more difficult or even impossible to escape. Pots usually consist of a rigid or semi-rigid frame made of various materials (metal rods, plastic, wood, wicker) covered with a PA netting or a grid made of metal or plastic. They can also be made entirely of wood, plastic or other materials and usually take the form of a rectangular box or cage, a basket, a horizontal half-cylinder or more complicated shapes with dimensions ranging from around 30 cm to 2 m. A bait (a piece of fish or squid or an artificial bait) is secured in the pot to lure organisms inside; the type is based on tradition and target species behaviour. For example, plastic material or laurel branches are used to attract cuttlefish seeking shelter in the pot during the reproduction season, while fish and crustaceans are attracted by bait, etc. One or more access devices can be mounted in a pot and are designed in such a way that the fish or other prey can enter the pot but cannot escape from it. A funnel-shaped entrance is the most widely used: organisms enter the pot through the larger opening, but they are unable to escape by returning through the narrow, inner part of the entrance funnel. Another option is to use a mobile door that can only open inwards so that the prey can enter but can no longer exit. Certain pots simply have a circular opening and rely on the behaviour of species that by nature seek a refuge in which to hide.

Pots are usually set in in rows in which 20–30 or even more pots are joined to a main line (Figure 74). The two ends of a set of pots are anchored to the bottom and their position is marked on the sea surface with a float attached to the main line. Fishers visit traps regularly (around every 24 hours, 48 hours or more) to collect their catch (usually the pot has a small door that can be opened to retrieve the catch) and replace the bait if necessary. The interval between two hauling operations, as well as the time of day at which the pots are retrieved, depends on the behaviour of the target species: certain species caught in a trap may attack each other; some others may die relatively quickly and start to decay if left too long in the pot; and some may be territorial and prevent others from entering the trap, thus reducing catch efficiency. Pots can easily be moved from one fishing area to another. As such, pots are hauled in either by hand, if they are positioned in shallow waters and there are only a few pots to be retrieved, or with a hauler (e.g. for deep-water fishing or hauling in a series of pots).

Pots are normally used to catch a wide range of species, including fish, lobster, crabs, shrimps, octopus and cuttlefish. Regarding the target species, pots are generally used in a very wide range of depths either in marine, estuarine or inland waters, and they are usually set on the bottom, even if a few models targeting fish and prawns are designed to be set in mid-water. Each type of pot is designed specifically to catch a single species or a group of species (Petetta *et al.*, 2021a). Therefore, the pots used in the different areas have been classified according to the target species.

FIGURE 74
Pots set in a row



Source: redrawn by Koen Ivens from **Seafish.** 2023. Fishing gear database. In: *Seafish*. Cited 23 May 2023. Edinburgh. www.seafish.org/responsible-sourcing/fishing-gear-database/?t=docGear/

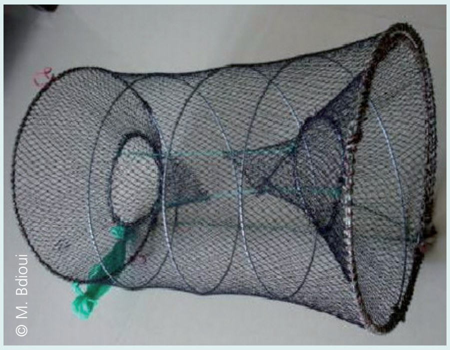
Subregional variations

Western Mediterranean

In Spain, Italy and North Africa, the common octopus is targeted through a wide variety of pot designs (Box 7; Sartor *et al.*, 2008). The Spanish Atlantic floating pots targeting plesionika shrimps (*Plesionika* spp.) are also used along the Spanish Mediterranean coast and, to a lesser extent, in the Italian Tyrrhenian Sea. The traditional pots, made of natural materials (reeds) to catch common spiny lobsters in Spain have been increasingly replaced with plastic pots and trammel nets (Goñi, Quetglas and Reñones, 2003; Amengual-Ramis *et al.*, 2016). In some small-scale fisheries, pots used to catch fish and crustaceans are employed occasionally and in a small number, especially to integrate the catch with other types of gear such as passive nets (Petetta *et al.*, 2021a).

Box 7

Pot designs in the western Mediterranean



Target species: common octopus (*Octopus vulgaris*)

Area: Morocco

Type of bottom: sand, mud

Bottom depth: 10–50 m

Dimensions: maximum 25 cm high; 50 cm long

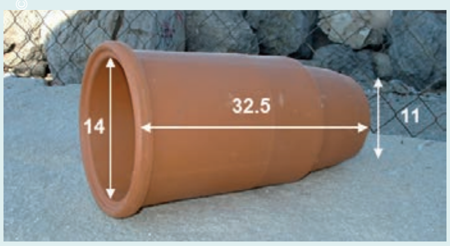
Shape: cylindrical

Material: frame made of galvanized iron covered by polyamide netting

Number and shape of entrances: one circular funnel-shaped opening

Bait: sardines or none, as octopuses are attracted into the pot to find shelter

Setting: tied on a single rope or main line at about 8–15 m from each other



Target species: common octopus (*Octopus vulgaris*)

Area: Spain

Type of bottom: sand, mud

Bottom depth: 3–30 m

Dimensions: 11–14 cm high; 32.5 cm long

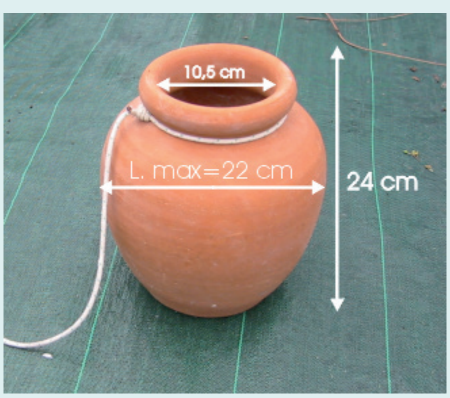
Shape: truncated cone

Material: ceramic

Number and shape of entrances: one circular opening around 14 cm in diameter

Bait: none, octopuses are attracted into the pot to find shelter and do not try to get out even after the pot has been pulled out of the water

Setting: tied on a single rope or main line at about 8–15 m from each other



Target species: common octopus (*Octopus vulgaris*)

Area: eastern Spain; northern Tyrrhenian Sea, Italy

Type of bottom: sand, mud, rocks

Bottom depth: 3–30 m

Dimensions: 24 cm high; 22 cm long

Shape: jar

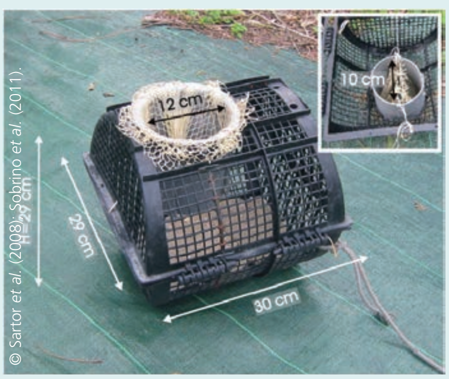
Material: ceramic

Number and shape of entrances: one circular opening around 10–11 cm in diameter

Bait: none, octopuses are attracted into the pot to find shelter and do not try to get out even after the pot has been pulled out of the water

Setting: tied on a single rope or main line at about 8–15 m from each other

Target species: common octopus (*Octopus vulgaris*)
Area: Spain
Type of bottom: sand, mud, rocks
Bottom depth: 3–30 m
Dimensions: 30 cm high; 50–60 cm long
Shape: cylindrical with base wider than height
Material: funnel consists of a removable plastic container
Number and shape of entrances: a circular opening approximately 20 cm in diameter on the upper side
Bait: poor-quality fish
Setting: tied on a single rope or main line at about 10–15 m from each other



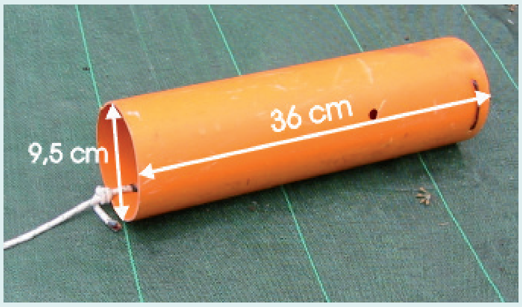
Target species: common octopus (*Octopus vulgaris*)
Area: Atlantic, Spain; northern Tyrrhenian Sea, Italy
Type of bottom: sand, mud, rocks
Bottom depth: 3–30 m
Dimensions: 29 cm high; 29 cm wide; 30 cm long
Shape: cylindrical
Material: plastic
Number and shape of entrances: one circular opening around 10 cm in diameter on the upper side
Bait: live crabs
Setting: tied on a single rope or main line at about 8–15 m from each other

Target species: common octopus (*Octopus vulgaris*)
Area: Alboran Sea, Spain (Estepona, Fuengirola, Caleta de Vélez); northern Tyrrhenian Sea, Italy; Gulf of Lion, Corsica, France
Type of bottom: sand, mud, rocks
Bottom depth: 3–30 m
Dimensions: 15–16 cm high; 32–33 cm long
Shape: cylindrical
Material: polyvinyl chloride
Number and shape of entrances: one circular opening around 10–15 cm in diameter

Source: **Pretti, C.** 2019. *Caratterizzazione e impatto della pesca del polpo comune,* Octopus vulgaris*, con attrezzi assimilabili a "barattoli", nella fascia costiera del mar tirreno settentrionale e centrale.* Rome, Mipaaft.

Bait: none, octopuses are attracted into the pot to find shelter and do not try to get out even after the pot has been pulled out of the water

Setting: tied on a single rope or main line at about 8–15 m from each other



Target species: common octopus (*Octopus vulgaris*)

Area: western Mediterranean, Spain, Italy

Type of bottom: sand, mud, rocks

Bottom depth: 3–30 m

Dimensions: 9-10 cm high; 36 cm long

Shape: cylindrical and obtained from pipes for the building industry; similar pots can be obtained from other material used for other purposes (building industry, gardening, etc.)

Material: polyvinyl chloride

Number and shape of entrances: one circular opening around 10–15 cm in diameter

Bait: none, octopuses are attracted into the pot to find shelter and do not try to get out even after the pot has been pulled out of the water

Setting: tied on a single rope or main line at about 8–15 m from each other

Source: **Pretti, C.** 2019. *Caratterizzazione e impatto della pesca del polpo comune,* Octopus vulgaris, *con attrezzi assimilabili a "barattoli", nella fascia costiera del mar tirreno settentrionale e centrale.* Rome, Mipaaft.

Target species: common octopus (*Octopus vulgaris*), with black seabream (*Spondyliosoma cantharus*), Mediterranean moray (*Muraena helena*), forkbeard (*Phycis phycis*) and European conger (*Conger conger*) as bycatch

Area: northwestern Sardinia, Italy

Type of bottom: rocks, *Posidonia oceanica* meadows

Bottom depth: 10–50 m

Dimensions: 60–70 cm high; from 20 cm to 40 cm in diameter (lower ring)

Shape: cylindrical

Material: plastic braided netting; frame made of galvanized iron with rubber protection

Mesh size: 20–25 mm (mesh opening)

Number and shape of entrances: one circular entrance

Bait: poor-quality fish (sardines, crabs, discards)

Setting: tied on a single rope at about 15 m from each other (generally 20 pots per buoy signal)

Target species: black seabream (*Spondyliosoma cantharus*), with common octopus (*Octopus vulgaris*), Mediterranean moray (*Muraena Helena*), forkbeard (*Phycis phycis*) and European conger (*Conger conger*) as bycatch

Area: northwestern Sardinia (Alghero), Italy

Type of bottom: rocks and sandy bottom

Bottom depth: 40–90 m

Dimensions: 90 cm high; from 25 cm to 45–50 cm in diameter

Shape: cylindrical

Material: plastic braided netting; frame made of galvanized iron with rubber protection

Mesh size: 20–30 mm (mesh opening)

Number and shape of entrances: one circular entrance

Bait: poor-quality fish (sardines, discards)

Setting: the pots are tied on a single rope at about 15 m from each other (generally 20 pots per buoy signal)

Target species: common octopus (*Octopus vulgaris*)

Area: southern Tyrrhenian Sea, Italy

Type of bottom: rocks, *Posidonia oceanica* meadows

Bottom depth: 10–50 m

Dimensions: 50 cm long; 30 cm in diamater

Shape: cylindrical

Material: plastic braided netting or polyamide netting; frame made of galvanized iron with rubber protection

Mesh size: 20–25 mm (mesh side)

Number and shape of entrances: one funnel entrance

Bait: crabs

Setting: tied on a single rope at about 15 m from each other (generally 20 pots per buoy signal)

Target species: changeable nassa (*Tritia mutabilis*)

Area: Gulf of Lion, France

Type of bottom: sand, mud

Bottom depth: 3–20 m

Dimensions: 10–15 cm high; from 20 cm (upper ring) to 40 cm in diamater (lower ring)

Shape: truncated cone

Material: polyamide braided netting; frame made of galvanized iron, steel, or stainless steel with rubber protection

Mesh size: 19–20 mm (mesh opening)

Number and shape of entrances: one circular entrance

Bait: poor-quality fish (sardines, anchovies, mackerel)

Setting: The pots are tied on a single rope at about 15 m from each other

Target species: ccommon spiny lobster (*Palinurus elephas*), European conger (*Conger conger*), Mediterranean moray (*Muraena helena*)

Area: eastern Spain; Sardinia, Italy; Corsica, France

Type of bottom: rocks

Bottom depth: 30–50 m

Dimensions: 90–100 cm high; 65 cm long

Shape: bell

Material: natural material (intertwined reeds)

Mesh size: triangular mesh

Number and shape of entrances: one circular funnel-shaped opening with 20 cm in diameter

Bait: poor-quality fish (sardines, mackerel)

Setting: tied on a single rope or main line at about 10–15 m from each other

Source: **Viale, I., Palomba, A. & Gerardi, M.** 2013. *Indagine conoscitiva sull'uso delle nasse in Sardegna*. Cagliari, Italy, Laore.

Target species: pandalid shrimps (*Plesionika* spp.)

Area: Spain; southern Tyrrhenian Sea, Italy; Provençal coast, Corsica, France

Type of bottom: sand, mud

Bottom depth: 100–500 m

Dimensions: 45 cm high; 50 cm wide

Shape: cylindrical

Material: frame made of galvanized iron covered by plastics or galvanized netting

Mesh size: square mesh with 10 mm bar

Number and shape of entrances: one circular funnel-shaped opening around 55 cm in diameter

Bait: sardine and discarded fish in a bag in front of the entrance

Setting: connected at 20–30 m intervals to a mainline of 12 mm in diameter weighted with an anchor of 20 kg at each end; two polypropylene droplines extend from the bottom weights to buoys at the surface; usually left in the sea overnight and hauled, emptied, and rebaited

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Target species: common spiny lobster (*Palinurus elephas*)

Area: Algeria

Type of bottom: sand, mud

Bottom depth: 100–500 m

Dimensions: 35 cm high; 40 cm wide; 110–120 cm long

Shape: cylindrical but flattened on one side

Material: frame made of solid round iron with a diameter of 6–8 mm covered by iron netting with 20 mm mesh length

Mesh size: square mesh with 10 mm bar

Number and shape of entrances: two to three openings; two funnel-shaped openings provided with pointed rods in fine and flexible steel so as to allow the lobster to penetrate and slow down its exit from the trap; the third opening has a small door to enable recovery of the catch

Bait: sardine and discarded fish in a bag in front of the entrance

Target species: Norway lobster (*Nephrops norvegicus*)

Area: France

Type of bottom: mud

Bottom depth: 250–400 m

Dimensions: 40 cm high; 30 cm wide; 57 cm long

Shape: semi-cylindrical and flattened on one side

Material: frame made of round iron with a diameter of 5–8 mm covered by polyamide or polyethenyle 590 tex

Mesh size: 20–32 mm mesh bar

Number and shape of entrances: two funnel-shaped openings (polyamide at 32 mm) opposite each other with a 60 mm diameter ring entrance

Bait: sardines and discarded fish in a bag in front of the entrance

Setting: anchored by long lines of 30 traps spaced 10 fathoms (about 18 m) apart along the centre line (12 mm diameter) by 3 m branchlines (10 mm) fixed to the top of the traps. The mainline is moored at each end to a first rope of 15 fathoms (about 27 m) and to a second rope of 27 fathoms (about 50 m); the whole long line is kept within buoy lines (length 400 m each)

Source: **Morello, E.B., Antolini, B., Gramitto, M.E., Atkinson, R.J.A. & Froglia, C.** 2009. The fishery for Nephrops norvegicus (Linnaeus, 1758) in the central Adriatic Sea (Italy): preliminary observations comparing bottom trawl and baited creels. *Fisheries Research*, 95(2–3): 325–331.

Central Mediterranean

In Tunisia and Libya, clay pots have been employed since ancient times to catch common octopus and remain widespread (Lamboeuf, 2001; Chedia, Widien and Amina, 2010) (Box 8).

In Tunisia, clay pots are set at the start of the regulated and monitored fishing season (October–November) in shallow waters (5–10 m). As the fishing season progresses, they are moved from one place to another to reach, by the end of the season, waters located at 40 m depth. This fishing method requires the use of a large number of pots that can reach up to 4 000 units per vessel. During the season, pots are visited whenever weather conditions permit the catch to be collected. Stone pots are also employed in Tunisia to target the common octopus. Given the high number of pots used, they are not visited in a single day, but are inspected in turn. The catch is removed in two ways: either by using a metal rod with a hook, which enables the octopus to hang on and be brought on board; or by using a mirror that facilitates the observation of the octopus when it takes refuge in the stone. In this case, the stone pot is taken on board the boat to recover the catch and then put back in the water. Currently, this métier with traditional pots risks being abandoned, particularly in the Gulf of Gabès. The traditional bell-shaped pots called *drina* are also increasingly less used and have been mostly replaced by pots made of metal or plastic structures.

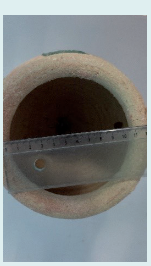
In Libya, clay pots are used in Benghazi (eastern Libyan coast) and from Farwa to Sabrata (western Libyan coast). The most important octopus fishing activity using clay pots occurs in the Zwara region, notably in Bou Kammash. Here, the octopus fishery using pots starts in November and ends in March of the next year. As such, pots are left out all season at the bottom in the same area and checked whenever the conditions are considered suitable by the fisher. The number of pots used on board a *mator* (a local type of fishing vessel with 7 m to 18 m or more LOA) varies from 2 000 to 3 000 and from 1 000 pots to 1 500 pots on board a *fluka* (a local type of fishing vessel with 3 m to 7 m LOA) or a *batah* (a local type of fishing vessel with 7 m to 8 m LOA) (Zgozi *et al.*, 2020).

In Malta, pots are used to catch a wide range of demersal species and are constructed in different shapes and sizes according to the species being targeted. The materials used to construct these traps also vary according to species. For species such as Mediterranean moray (*Muraena helena*), common octopus and common spiny lobster, the material used is chicken wire netting, while for bogue, picarel and similar species, the material used is cane cut into fine strips or special reeds that are imported from North Africa (De Leiva *et al.*, 1998).

In the Italian Ionian Sea (GSA 19), baited creels targeting Norway lobster are employed, though their use is rare and limited to small vessels (Morello *et al.*, 2009).

Box 8
Pot designs in the central Mediterranean

Target species: fish, cephalopods, lobsters
Area: Tunisia, Libya
Type of bottom: sand, mud, rocks
Bottom depth: 3–20 m
Dimensions: 50 cm wide; 100–150 cm long
Shape: bell (locally called *drina*)
Material: intertwined reeds; iron for both netting and frame
Mesh type: triangular mesh
Number and shape of entrances: one circular funnel-shaped opening around 40–50 cm in diameter
Bait: poor-quality fish (sardines, anchovies)
Setting: tied on a single rope or main line (8 mm diameter) at about 10 m from each other



Target species: common octopus (*Octopus vulgaris*)
Area: Gulf of Gabès, Tunisia; Libya
Type of bottom: sand, mud
Bottom depth: 3–40 m
Dimensions: 20–40 cm high; 22 cm wide
Shape and material: ceramic jar
Number and shape of entrances: one circular opening around 10–20 cm in diameter
Bait: none, octopuses are attracted into the pot to find shelter and do not try to get out even after the pot has been pulled out of the water
Setting: tied on a single rope or main line at about 2–10 m from each other

Target species: common octopus (*Octopus vulgaris*)

Area: Gulf of Gabès, Tunisia

Type of bottom: sand, mud

Bottom depth: 3–5 m

Dimensions: 20 cm high; 21 cm wide; 25 cm long

Shape: parallelepiped or cylindrical shape

Material: cement, sand and gravel

Mesh size: 20–32 mm mesh bar

Number and shape of entrances: one circular opening around 10–20 cm in diameter

Bait: none, octopuses are attracted into the pot to find shelter and do not try to get out even after the pot has been pulled out of the water

Setting: placed individually on clear bottoms located between the *Posidonia* barrier reefs; their number is very high and can exceed 10 000 pieces, with an average of 5 000 stone pots per vessel

Target species: crabs (*Carcinus* spp.)

Area: coastal areas and lagoons, Tunisia

Type of bottom: sand, mud

Bottom depth: 3–5 m

Dimensions: 50–60 cm high; 30 cm wide

Shape: conical or cylindrical

Material: iron frame and plastic netting with a small cement weight of approximately 1 kg placed inside the pot

Mesh size: square mesh, 20 mm bar

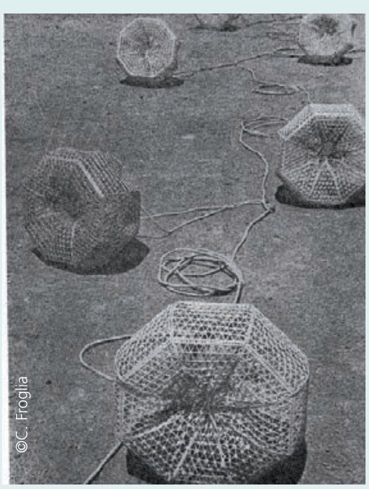
Number and shape of entrances: one circular opening around 10–20 cm in diameter

Bait: none, octopuses are attracted into the pot to find shelter and do not try to get out even after the pot has been pulled out of the water

Setting: placed individually on clear bottoms located between the *Posidonia* barrier reefs; their number is very high and can exceed 10 000 pieces, with an average of 5 000 stone pots per vessel.

Target species: Norway lobster (*Nephrops norvegicus*)
Area: western Ionian Sea, Italy
Type of bottom: rocky
Bottom depth: 50–70 m
Dimensions: 50 cm high; 50 cm wide; 80 cm long
Shape: rectangular
Material: Metal netting and steel frame
Mesh size: square mesh, 12 mm bar
Number and shape of entrances: two opposite oval funnel-shaped openings
Bait: poor-quality fish (salted sardines, crabs, mackerel) in a bag between the two entrances
Setting: deployed in a longline system with each comprising 30 creels; longlines are set in the early morning hours and retrieved after one or two days

Target species: rocky fish
Area: Ionian Sea, Italy
Type of bottom: rocky/sand bottoms
Bottom depth: less than 50 m
Dimensions: 50 cm high; 50 cm wide; 70 cm long
Shape: cylindrical
Material: plastic netting and iron frame
Mesh size: hexagonal mesh (around 20–30 mm mesh bar)
Number and shape of entrances: one or two circular entrances
Bait: poor-quality fish
Setting: deployed in a longline system



Target species: salema (*Sarpa salpa*)
Area: Malta
Type of bottom: rocky/sand bottoms
Bottom depth: less than 50 m
Dimensions: 40 cm high; 70 cm wide; 70 cm long
Shape: spherical
Material: natural or plastic frame and netting
Mesh size: triangular mesh (25–30 mm mesh bar)
Number and shape of entrances: one circular entrance at the top
Bait: algae
Setting: deployed in a longline system

Target species: striped soldier shrimp (*Plesionika edwardsii*)

Area: Ionian Sea, Italy

Type of bottom: sand, mud

Bottom depth: 300–450 m

Dimensions: 45 cm high; 50 cm wide

Shape: cylindrical

Material: frame made of galvanized iron covered by plastic or galvanized netting

Mesh size: square mesh, 10 mm bar

Number and shape of entrances: one circular funnel-shaped opening around 55 cm in diameter

Bait: sardines and discarded fish in a bag in front of the entrance

Setting: connected at 20–30 m intervals to a groundline of 12 mm in diameter weighted with an anchor of 20 kg at each end; two polypropylene droplines are extended from the bottom weights to buoys at the surface. The traps are usually left in the sea overnight and hauled in, emptied, and rebaited

Adriatic Sea

In Italian GSA 17, traditional pot fisheries targeting changeable nassa (*Nassarius mutabilis*) are by far the most important small-scale fishing activity, in terms of both fishing effort and landings each year (Grati *et al.*, 2010). These pots are set on sandy–mud bottoms at shallow depths (10–20 m), especially in the autumn–winter period (Box 9). In contrast, pots targeting common cuttlefish are intensively used in the spring–summer period (Fabi *et al.*, 2001; Melli *et al.*, 2014). Moreover, pots targeting spottail mantis shrimp and gobies (mainly *Gobius niger*) are being increasingly used instead of the traditional gillnet (Bon *et al.*, 2006; Petetta *et al.*, 2021a).

In Slovenia (GSA 17), pots for catching spottail mantis shrimp are the most important, followed by pots for common cuttlefish (Grati *et al.*, 2018).

In Croatia, on the eastern side of the Adriatic Sea (GSAs 17 and 18), pots are used to target common octopus, European conger (*Conger conger*), Norway lobster (*Nephrops norvegicus*) and white fish (Sparidae, Sciaenidae, etc.; Matić-Skoko *et al.*, 2017). The catch of Norway lobster in Croatian fisheries has great commercial value, especially in the area of the Velebit, Brač and Hvar Channels (northern Adriatic Sea; Dulčić *et al.*, 2001). Fishing is carried out within 1.5 nautical miles of the coast at a depth ranging between 70 m and 90 m, with a soaking time usually of one day. The pot has a frame (length 70 cm, width 45 cm and height 27 cm) made of iron wire with a diameter of 5 mm, covered by PA netting of 40 mm or 36 mm mesh size. The pots are set in a longline system with the distance between each pot of around 25 m. The pots are commonly baited with horse mackerel and the sandy swimming crab (*Liocarcinus depurator*).

Box 9
Pot designs in the Adriatic Sea



Target species: spottail mantis shrimp (*Squilla mantis*), gobies
Area: central and northern Adriatic Sea, Italy
Type of bottom: sand, mud
Bottom depth: 3–20 m
Dimensions: 10 cm high; 28 cm wide; 24 cm long
Shape: semi-ellipsoidal
Material: plastics or galvanized wire netting, and galvanized iron frame
Mesh size: square mesh 12 mm (mesh bar) or rectangular mesh 11 mm × 22 mm
Number and shape of entrances: one funnel-shaped opening
Bait: poor-quality fish (sardines, anchovies)
Setting: tied on a single rope or main line at about 10 m from each other


Target species: spottail mantis shrimp (*Squilla mantis*), gobies (*Gobius* spp.)
Area: central and northern Adriatic Sea, Italy
Type of bottom: sand, mud
Bottom depth: 3–20 m
Dimensions: 17 cm high; 38 cm wide; 38 cm long
Shape: cylindrical with base wider than height
Material: plastic netting and galvanized iron frame
Mesh size: square mesh 12 mm (mesh bar)
Number and shape of entrances: one funnel-shaped opening on short side
Bait: poor-quality fish (sardines, anchovies, mussels)
Setting: The pots are tied on a single rope or main line at about 10 m from each other

Target species: common cuttlefish (*Sepia officinalis*)

Area: northern and central Adriatic Sea, Italy

Type of bottom: sand, mud, sandy–rocky

Bottom depth: 3–20 m

Dimensions: 28 cm high; 45 cm wide; 80 cm long

Shape: rectangle parallelepiped

Material: polyamide (PA) braided around 210/36 denier netting, and frame made of galvanized iron, steel or stainless steel. The pot can also be made entirely of polyvinyl chloride (both frame and netting)

Mesh size: 50–60 mm (mesh opening)

Number and shape of entrances: one (rarely two) funnel-shaped entrance on the short side, or two small mobile doors on the long sides allowing the prey to enter but not to exit

Bait: either laurel branches or black plastic fragments as substratum for the spawning of female cuttlefishes

Setting: tied on a single rope at about 15 m from each other

Target species: changeable nassa (*Nassarius mutabilis*)

Area: northern, central and southern Adriatic Sea, Italy

Type of bottom: sand, mud

Bottom depth: 3–20 m

Dimensions: 10–15 cm high; from 20 cm (upper ring) to 40 cm in diameter (lower ring)

Shape: truncated cone

Material: PA braided netting; frame made of galvanized iron, steel or stainless steel with rubber protection

Mesh size: 19–20 mm (mesh opening)

Number and shape of entrances: one circular entrance

Bait: poor-quality fish (sardines, anchovies, mackerel)

Setting: The pots are tied on a single rope at about 15 m from each other

Target species: common cuttlefish (*Sepia officinalis*)

Area: northern, central and southern Adriatic Sea, Italy

Type of bottom: sand, mud

Bottom depth: 3–20 m

Dimensions: 40 cm high; 74 cm wide; 160 cm long

Shape: truncated cone (this is a foldable pot)

Material: PA braided netting; frame made of polyvinyl chloride, galvanized iron, steel or stainless steel

Mesh size: 80 mm (mesh opening) at the entrance decreasing to 50 mm (mesh opening) in the main body of the pot. The inner entrances (two or three that define two or three internal chambers) have smaller meshes (around 40 mm mesh opening)

Number and shape of entrances: one semi-circular entrance, with two or more internal funnel-shaped devices used to prevent cuttlefish returning to the entrance

Bait: none, cuttlefish enter the pots to lay eggs

Setting: basket pots are placed on the seabed with the opening oriented against the sea current and tied to each other by a rope about 13 m long

Target species: Sparidae

Area: northern and central Adriatic Sea, Croatia

Type of bottom: sand, mud, rocky

Bottom depth: 3–50 m

Dimensions: 40–60 high; 100–140 cm long

Shape: pentagonal (this is a foldable pot)

Material: PA, PE braided netting; steel, stainless steel frame

Mesh size: 32 mm square-mesh bar

Number and shape of entrances: one oval entrance made of flexible steel bars and optionally two or three other funnel-shaped openings made of plastic

Bait: poor-quality fish (sardines, anchovies, mackerel) and mussels

Setting: tied on a single rope at about 15 m from each other

Target species: European lobster (*Homarus gammarus*), common spiny lobster (*Palinurus elephas*)

Area: northern and central Adriatic Sea, Croatia

Type of bottom: rocky

Bottom depth: 3–50 m

Dimensions: 40 cm high; 100 cm wide

Shape: cylindrical

Material: metal netting; iron frame

Mesh size: 55 mm square-mesh bar

Number and shape of entrances: one funnel-shaped entrance

Bait: poor-quality fish (sardines, anchovies, mackerel) and molluscs

Target species: Norway lobster (*Nephrops norvegicus*)

Area: Croatia

Type of bottom: rocky

Bottom depth: 50–70 m

Dimensions: 70 cm high; 26.5 wide; 45 cm long

Shape: rectangular

Material: PA netting, steel frame

Mesh size: 41 mm square-mesh bar

Number and shape of entrances: two opposite oval entrances with funnels

Bait: poor-quality fish (salted sardines, mackerel) and crabs in a bag between the two entrances

Setting: deployed in a longline system, each comprising 30 creels, 25 m apart; pots are set in the early morning and retrieved after one or two days

Target species: demersal species (Sparidae)

Area: Croatia

Type of bottom: rocky

Bottom depth: 50–70 m

Dimensions: 30–40 cm high; 50–60 cm wide; 50–60 cm long

Shape: cylindrical

Material: PA or wire netting; steel or iron frame

Mesh size: hexagonal mesh, 20 mm mesh side

Number and shape of entrances: one funnel-shaped entrance

Bait: plant leaves with bread or smashed sea shells or crabs or poor-quality fish

Setting: deployed in a longline system or as a single unit

Eastern Mediterranean

In the Greek Aegean Sea (GSA 22), the small-scale trap fishery for the narwal shrimp (*Plesionika narval*) is one of the most profitable small-scale fisheries (Kalogirou *et al.*, 2019). The fishery is carried out by 5–15 m long vessels from dusk to dawn with baited shrimp traps at depths ranging from 5 m to 200 m, deployed close to the bottom (Box 10). Both square and round traps with a mesh bar of 8–12 mm are used (Vasilakopoulos *et al.*, 2019). Depending on vessel size and trap capacity, the number of traps can vary from 15 to 250 traps. Narwal shrimp represents approximately 85 percent of the total catch; the remaining percentage mainly consists of bycatch of striped soldier shrimp (*Plesionika edwardsii*), common octopus and discards.

In Turkish lagoons, the blue crab (*Callinectes sapidus*), a non-indigenous species, has gradually become abundant, so that the blue crab fishery is now very important (Atar *et al.*, 2002; Öndes and Gökçe, 2021). The blue crab is mainly caught on sandy–muddy bottoms ranging from 0.5 m to 2 m depth.

Box 10

Pot designs in the eastern Mediterranean

Target species: fish (*Ephinephelus* spp., *Sparids*)
Area: Greece, Lebanon, Türkiye
Type of bottom: sand, mud
Bottom depth: less than 50 m
Dimensions: 25 cm high; 60 cm wide
Shape: spherical
Material: galvanized wire mesh netting and galvanized iron frame
Mesh size: 12 mm square or triangular mesh
Number and shape of entrances: one circular entrance at the top, with funnel
Bait: sardines, molluscs, crabs, seagrass
Setting: usually left for 24 hours before retrieval

Target species: fish
Area: Lebanon
Type of bottom: sand, rocky
Bottom depth: 10–30 m
Dimensions: 40–50 cm high; 60 cm wide; 100 cm long
Material: wire netting and frame
Mesh size: 20–25 mm hexagonal mesh
Number and shape of entrances: one circular entrance, with funnel
Bait: poor-quality fish

Target species: fish
Area: Lebanon
Type of bottom: sand, rocky
Bottom depth: 10–30 m
Dimensions: 50–60 cm high; 60–70 cm wide
Shape: cylindrical
Material: wire netting and frame
Mesh size: 20–25 mm square mesh
Number and shape of entrances: three circular entrances
Bait: poor-quality fish

Target species: common octopus (*Octopus vulgaris*), European eel (*Anguilla anguilla*), Gobiidae, Sparidae
Area: Ionian Sea, Greece
Type of bottom: mud, seagrass meadows
Bottom depth: 5–30 m
Dimensions: 38–60 cm wide; 120–160 cm long
Shape: conical (foldable)
Material: polyamide or braided netting; galvanized steel wire frame with an external plastic coating
Mesh size: 40–44 mm diamond mesh
Number and shape of entrances: one circular entrance, with two or more internal funnel-shaped devices used to prevent fish returning to the entrance
Bait: none, cuttlefish enter the pots to lay eggs
Setting: usually set out in fleets of 20–50 pairs (100 to 500 pairs in total), either by hand or using a winch. They are left out to fish from one to seven days depending on the fishing conditions, then they are retrieved, emptied and reset

Target species: common spiny lobster (*Palinurus elephas*)

Area: Dodecanese archipelago, Greece

Type of bottom: rocky

Bottom depth: 50–100 m

Dimensions: N/A

Shape: cylindrical, conical

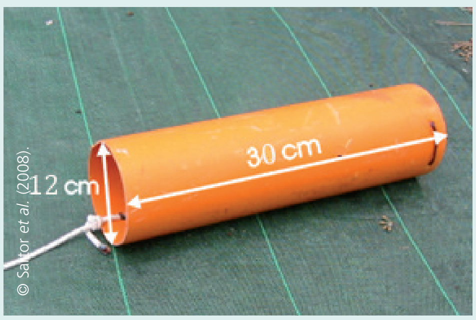
Material: plastic netting and metal, wood or plastic frame

Mesh size: 40–80 mm

Number and shape of entrances: one oval entrance at the top, with a funnel

Bait: poor-quality fish

Setting: usually left for days before retrieving



Target species: common octopus (*Octopus vulgaris*), European eel (*Anguilla anguilla*), Gobiidae, Sparidae

Area: northern and eastern Aegean Sea, Greece, Türkiye

Type of bottom: sand, mud, rocks

Bottom depth: 10–70 m

Dimensions: 12 cm high; 30 cm long

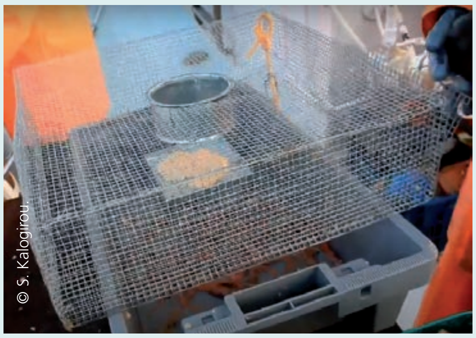
Shape: cylindrical and originating from pipes used in the building industry. Similar pots can be obtained from other material used for other purposes (building industry, gardening, etc.)

Material: polyvinyl chloride

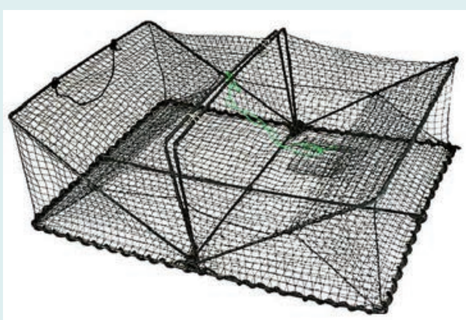
Number and shape of entrances: one circular opening around 10–15 cm in diameter

Bait: none, octopuses are attracted into the pot to find shelter and do not try to get out even after the pot has been pulled out of the water

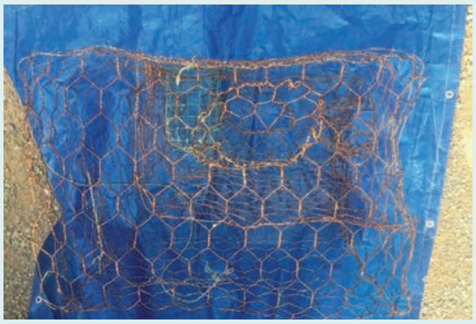
Setting: The pots are set in fleets of 50–100, tied on a single rope or mainline at about 8–15 m apart. The soaking time is 5–10 days

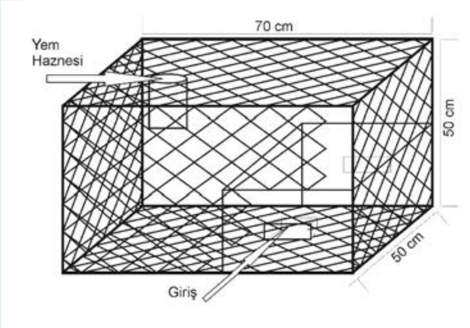


Target species: narwal shrimp (*Plesionika narval*)
Area: Dodecanese archipelago, Greece
Type of bottom: rocky
Bottom depth: 50–100 m
Dimensions: 20 cm high; 60 cm wide; 60 cm long
Shape: cylindrical, parallelepiped
Material: plastic or metal netting; metal frame
Mesh size: 16–24 mm
Number and shape of entrances: one circular entrance at the top, without a funnel
Bait: dough mixed from fermented oily fish, such as sardine (*Sardina pilchardus*) and Atlantic mackerel (*Scomber scombrus*), and stabilized with flour and water
Setting: deployed on a mainline; each pot is connected to the mainline through a 2 m bridle (35 m between pots); the soak time is around 9–10 hours



Target species: blue crab (*Callinectes sapidus*)
Area: Turkish lagoons, Tunisia
Type of bottom: sand, mud
Bottom depth: 1.5–2 m
Dimensions: 24 cm high; 46 cm wide; 62 cm long
Shape: parallelepiped (collapsible)
Material: polyamide netting and plastic frame reinforced with metal
Mesh size: 13 mm square mesh
Number and shape of entrances: two rectangular opposite entrance
Bait: fish
Setting: usually left for 24 hours before retrieval





Target species: blue crab (*Callinectes sapidus*)
Area: Turkish lagoons
Type of bottom: sand, mud
Bottom depth: 1.5–2 m
Dimensions: 50 cm high; 50 cm wide; 70 cm long
Shape: parallelepiped
Material: wire netting and frame
Mesh size: 20–25 mm hexagonal mesh
Number and shape of entrances: two opposite entrances on the long side
Bait: sardine, carp, mullet, smelt, chicken
Setting: usually left for 24 hours before retrieval

Source: **Özdemir, S., Gökçe, G. & Cekic, M.** 2015. Determination of size selectivity of traps for blue crab (*Callinectes sapidus* Rathbun, 1896) in the Mediterranean Sea. *Journal of Agricultural Sciences*, 21(2): 256–261.

Black Sea

In Romania and Bulgaria (GSA 29), pots are used at a mean depth of 10 m to catch gobids, such as knout goby (*Mesogobius batrachocephalus*) (Box 11).

In Ukraine (GSAs 29 and 30), pots are widely used to catch mullet and other non-target demersal species.

Box 11
Pot designs used in the Black Sea

Target species: knout goby (*Mesogobius batrachocephalus*)
Area: Romania, Bulgaria
Type of bottom: sand, mud
Bottom depth: 10 m
Dimensions: 30 cm wide; 50 cm long
Shape: cylindrical
Material: plastic netting and metal frame
Mesh size: 25–40 mm diamond mesh
Number and shape of entrances: : two opposite entrances on the long side
Bait: mussels, whiting
Setting: deployed in a longline system; the distance between branch lines varies from 3 m to 15 m

4.2.3 Seine nets

Seine nets can be cone-shaped nets with long wings and a codend, or a long piece of net without a codend; they catch fish by encircling and herding and are used by small-scale fisheries. Seines are long nets usually towed from the shore or by small boats, and therefore it is possible to identify two types of seines: beach seines and boat seines (Table 17). The catching principle is to surround an area with the net and then to tow the net until the last part of it is recovered.

The net usually has a cone-shaped design, with two long wings and a body ending with a small mesh bag or bunt, which is similar to the codend of a trawl. The seine mouth is framed by a groundrope with lead weights on its bottom and a headrope with floats in its top section, which define the vertical opening of the net. In this type of net, the weight of the groundrope prevails over the thrust of the headrope, so that the net operates by crawling on the bottom. Two long ropes fixed to the net wings are used both for hauling the net and for herding the fish. As such, net hauling can be done either by hand or with a winch. It is also possible, especially for beach seines, to identify a different design: in this case, the net has a very simple design that is similar to a gillnet in its basic construction (a string of netting panels), but the central part of the net has the smallest meshes and has slack, as this is the netting section where the catch is driven into and retained. Moreover, in the smallest nets, two short wooden rods, joining the headrope and the groundrope, are usually mounted at the two ends of the net to facilitate the towing procedure by the operators from the beach.

Seine nets are mainly used in shallow waters (less than 50 m depth) on a smooth seabed with fewer obstructions to reduce net damage. In the last 30 years, boat and beach seining have been commonly operated in the Mediterranean and the Black Sea with nets having small meshes (3–5 mm mesh openings or even less), mainly in estuaries and shallow waters where the spawning, breeding and growth of most fish occur. Bycatch and capture of juveniles is a reason of major concern for fishing practices carried out in coastal areas with small meshes. Therefore, boat and beach seines have come under intense criticism in recent times by resource managers, policymakers and environmentalists due to their destructive effects on coastal and marine fisheries resources and habitat degradation. Without reasonable management limiting these types of gear, the areas and the seasonal activity, such fishing practices may reduce the recruitment potential of many fish species, especially the small pelagic stocks shared by countries. In the last few years, there have been requests for restrictions on boat and beach seining, while in some countries these types of gear have been banned. This action may be beneficial to improve the natural assets of the coastal environment and resources, but it would on the other hand increase the vulnerability of fishers' communities to poverty, as the beach seine fishery provides livelihoods and food security in many coastal rural areas.

Table 19

Classification of seine nets according to the International Standard Statistical Classification of Fishing Gear

Gear categories (first tier)	Subcategories (second tier)	Standard abbreviations	ISSCFG code
Seine nets			2
	Beach seines	SB	2.1
	Boat seines	SV	2.2
	Seine nets (nei)	SX	2.9

Source: **FAO.** 2016. *International Standard Statistical Classification of Fishing Gear. Handbook on Fisheries Statistics.* Rome. fao.org/3/bt988e/bt988e.pdf

Beach seines

A beach seine is a long-winged net with or without a codend that encircles fish in shallow waters, typically on a beach (Figure 75).

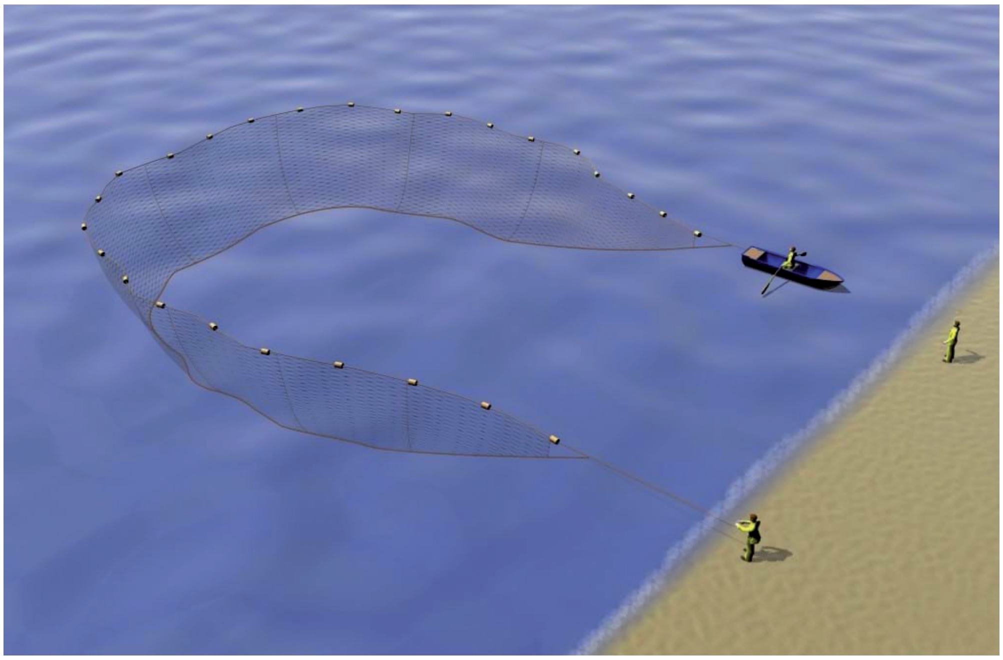
The beach seine can be set either by hand or by a small boat (usually a rowing boat) in shallow waters near the shore (Plate 54). No specific equipment or winch are usually required for fishing operations, as the net is simply hauled in from land by two or more fishers (Plate 55 and Plate 56). Sometimes, the net can be hauled by winches or other machinery installed on the beach.

The net can have a conical shape or, more simply, be made of a string of netting, without a codend. In this case, a short bunt with small meshes is used to collect the catch. Two long ropes can be joined to the net wings in order to herd the school of fish during the encircling phase and to haul the net. Alternatively, the beach seine can be towed directly by the two wings. As such, a wooden danleno can be fixed onto each wing to facilitate hauling the net to shore. In these seine nets, it is not necessary for the bag to be exactly in the centre and in this case the wings are not of equal length.

Gear setting begins by pulling the first rope (if any), then the first wing, the bag, second wing and second rope (if any) to form a circle. The end of the second tow rope is always kept on the shore. Once the net and the ropes have been set, the hauling phase begins by towing the two ropes (or directly the two wings) from the shore. The net is lowered into shallow waters, so that the headline is always on the surface and the groundrope is in contact with the bottom. Therefore, the net usually extends from the surface to the bottom, both of which act as natural barriers preventing the fish from escaping the area encircled by the net.

Beach seines are also used to catch juveniles of commercial species that are used in aquaculture (Ferretti, Tarulli and Palladino, 2002).

FIGURE 75
Beach seine



Source: **Seafish.** 2023. Fishing gear database. In: *Seafish.* Cited 23 May 2023. Edinburgh. www.seafish.org/responsible-sourcing/fishing-gear-database/?t=docGear/

PLATE 54
Recovery of a beach seine set by a small boat

PLATE 55
Recovery of a beach seine by a group on shore

PLATE 56
Catch of a beach seine operated from the shore

Boat or vessel seines

In the Mediterranean and the Black Sea, boat seines are operated from small boats without specific deck equipment (Figure 76). In modern vessels, hydraulic winches (Plate 57) are used to recover the two sweep ropes, and rope drums can be used to store them. Compared with a trawl net, a seine net usually has longer wings and utilizes long heavy ropes (seine ropes) that extend from the wings of the net through a pair of bridles to increase the area over which fish are herded. A seine net also differs from a trawl net in how the gear is operated. In contrast to trawl nets, which maintain their shape throughout the fishing operation once the net is stabilized, a seine net changes its shape during the fishing operation and relies heavily on ropes to herd fish towards the path of the net. As a consequence, the path swept by the seine ropes and seine net changes constantly during fishing, whereas the swept width of the trawl net remains more or less constant. A boat seine is usually towed slower and for a shorter time than a trawl net.

The shooting and hauling phases involve the following processes:

- In modern vessels, the school of fish might be located using an echo sounder and its position in the water marked by a small buoy to help the net positioning. To evaluate the actual nature and size of the shoal, the boat circles around it several times; this procedure also allows the strength of the sea currents and their dominant direction to be quantified. In older vessels, fishers may use a "mirror" (a sort of bucket equipped with a glass bottom) to locate the school of fish.
- The sweep rope is lowered into the sea on the outer side of a fish school; one end of the sweep rope is attached to a float (marker buoy) to signal the starting point, and the other end is attached to the net wing. The net wing is lowered into the waters with the prow of the boat against the current. The length of the seine rope to a large extent determines the shape and size of the fished area.
- The boat is positioned alongside and upwind of the buoy when the whole wing is underwater. Then the mouth of the net and the body are dropped into the current, a few metres from the shoal of fish. An incorrect evaluation of this distance can lead to non-optimal positioning of the net with respect to the school, causing failure of the capture operation.
- When the body of the net is deployed into the water, the other wing is dropped, followed by the second rope, thus encircling an area, until it reaches the starting point (the float attached to the first sweep rope). The two sweep ropes are then retrieved on board.
- The net falls down and it almost reaches the sea floor; the boat is then anchored to the bottom and the mechanical winch starts slowly hauling on board the sweep ropes; this is the towing phase. Along the sweep ropes there are markers that guarantee a balanced hauling of the net. Then, the two wings are also hauled on board. In this phase, the buoy at sea launched at the beginning acts as a reference point for locating the position of the school and must stay at the centre of the net mouth.
- Although the recovery of the sweep ropes and wings can be mechanical, that of the net body and bunt is manual. For this final operation, the boat is positioned laterally and the codend is lifted on board with the contents emptied into a container.

The speed of the boat in the circling and net dropping phase is always slow (1–2 knots) and completely reduced during the net hauling and catching of the fish school. The conditions of the sea and weather strongly limit this fishing activity.

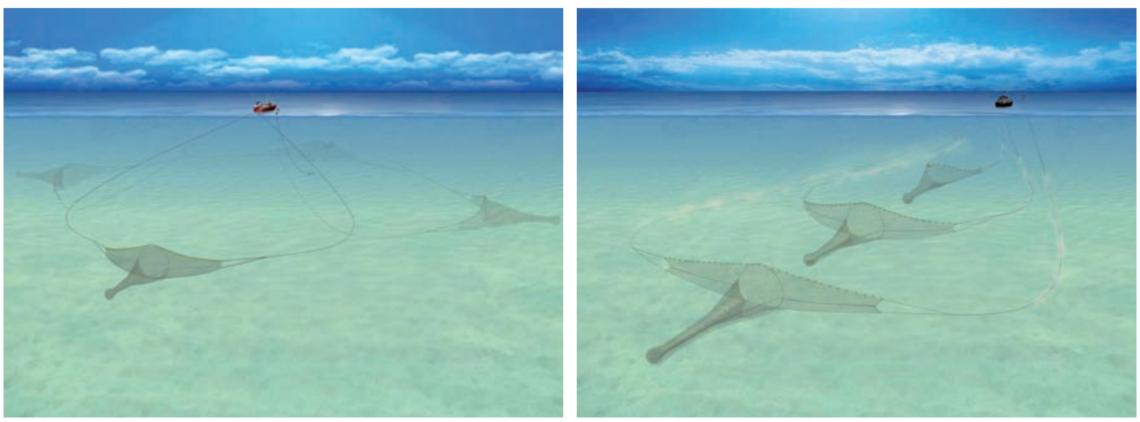
One of the main technical properties of seine nets is the prevalence of the weight of the groundrope on the buoyancy of the headrope. This means that the net touches the bottom during towing but the impact exerted by this type of net on the seabed is less destructive compared with a bottom trawl, considering both net dimensions and the towing speed.

In some areas, plastic bags or ragged pieces of material are used at intervals along the two ropes to scare the fish by herding them towards the net.

The technical characteristics of this fishery and the way in which the net is deployed make the process quite selective: large specimens escape capture and only small marine organisms are gathered in the net. The conditions of the sea and weather greatly limit fishing activities, which are only carried out during daytime, because at night the shoals of transparent goby (*Aphia minuta*) scatter, as is often the case in gregarious species.

Seine nets are commonly used to catch demersal species of small size, such as the fry of sardines, transparent gobiids, sandeels and picarel, or to catch juveniles of commercial species that are to be used in aquaculture (Table 20). Therefore, small meshes are commonly used in the codend (Plate 58).

FIGURE 76
Boat seine

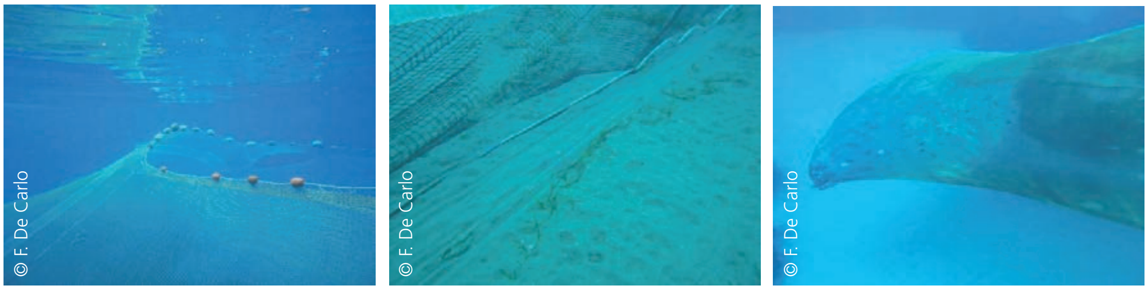


Source: **Seafish.** 2023. Fishing gear database. In: *Seafish.* Cited 23 May 2023. Edinburgh. www.seafish.org/responsible-sourcing/fishing-gear-database/?t=docGear/

PLATE 57
Boat seine hauling

PLATE 58

Boat seine headrope (left), groundrope (centre) and codend (right)



Subregional variations

Table 20

Technical parameters of seine nets used in the Mediterranean Sea and the Black Sea

GSA	Subregion	Country	Gear code	Main target species	Mesh length (mm)	Vertical number of meshes	Stretched net height (m)	Twine diamater (mm)	Headline length (m)	Mean depth (m)
3	Western Mediterranean	Morocco	SB	Sparidae	12.0–16.0				180–200	20–30
4	Western Mediterranean	Algeria	SV	SLM, Mugilidae	18.0	1 500–8 000		0.65		
7	Western Mediterranean	France	SB	SLM, AMB, AVX, PIL	14.0–30.0	375–666	20.0–22.5		450	0–10
8	Western Mediterranean	France	SB	SLM, AMB, AVX, PIL	14.0–30.0	375–666	20.0–22.5		450	0–10
9	Western Mediterranean	Italy	SV	ZGX, FIM	3.0–4.0		10.0		100–300	5–30
9	Western Mediterranean	Italy	SV	Sparidae	5.0				60–80	
18	Adriatic Sea	Italy	SV	FIM	2.0–5.0					3–40
20	Central Mediterranean	Greece	SV	SPC, BOG, PIL, SQR, MUT, PAC, MAS	16.0–20.0					10–50
20	Central Mediterranean	Greece	SV	PIL, BOG, MUT, SQR, PAC, SPC	20.0–28.0				600	0–50
22	Eastern Mediterranean	Greece	SV	SPC, BOG, PIL, SQR, MUT, PAC, MAS	16.0–20.0					10–50
29	Black Sea	Romania	SB	Mugilidae, MUT, GAR, HMM	20.0			0.30	100	2.5

Notes: AMB: *Seriola dumerili*; AVX: *Atherina* spp.; BOG: *Boops boops*; FIM: *Aphia minuta*; GAR: *Belone belone*; HMM: *Trachurus mediterraneus*; MAS: *Scomber japonicus*; MUT: *Mullus barbatus*; PAC: *Pagellus erythrinus*; PIL: *Sardina pilchardus*; SLM: *Sarpa salpa*; SQR: *Loligo vulgaris*; SPC: *Spicara smaris*; ZGX: *Gymnammodytes* spp.

SB: beach seines; SV: boat seines.

Western Mediterranean

In Morocco (GSA 3), beach seines are used to target several species, especially in the Sparidae family (INRH, 1999). The depth of the fishing area is around 20–30 m. This technique is not widely used, and only a few boats practice it, mainly in the sites of Kaa Asras and Martil. The fishing technique requires a high number of fishers to haul the seine from the sea to the coast, and sometimes donkeys or tractors are used. The net is then hauled on the beach, by its two wings, by two teams of seven to eight people. The net has a headrope length of around 180–200 m, with towing ropes of around 10–150 m and a short bunt (codend) with 12–16 mm mesh size. In some cases, a beach seine without a bunt is used (e.g. in Martil; Darasi, 2014).

In Algeria (GSA 4), boat seines were reported to target salema and mullet with a mesh size at the bunt of 18 mm (Laid, Lamri and Kadri, 2001).

In Spain (Catalunia, GSA 6), the boat seine called *sonsera* (ICM, 2013) is used in the framework of management plans to catch mainly the Mediterranean sand eel (*Gymnammodytes cicerelus*) and some very small amounts of smooth sandeel (*Gymnammodytes semisquamatus*) (known both as *sonso* in Catalan) as well as some small gobids, namely transparent goby, crystal goby (*Crystallogobius linearis*), and occasionally very low quantities of Ferrer's goby (*Pseudoaphya ferreri*). It is normally fished between 6 m and 16 m, not being permitted below 30 m. The *sonsera* design is based on two long lateral wings and a bag between the wings including the codend. The following dimensions are usually adopted for the different sections: maximum wing length of 125 m; maximum wing height of 35 m; and maximum body-codend length of 30 m. A rope no longer than 100 m is attached at the end of each wing. The mesh size decreases from the end of the wing (100 mm) to the net mouth (16 mm). The mesh size of the body-codend decreases from the mouth (33 mm) to the lower white portion of the mesh of the codend (no less than 2 mm). The wings have a leadline with a large number of weights along the net bottom (a maximum of six weights per metre; maximum 250 g per weight), and a floatline along the top of the net to provide flotation in order to achieve a positive buoyancy during the dropping operation (ICM, 2013).

In the Balearic Islands (GSA 5), there is a special *jonquillo* fishery, a seasonal fishery carried out from December to April by small vessels (mean length of 7 m), using small boat seines (SGMED, 2004). The target species, named *jonquillo*, are the transparent goby and Ferrer's goby, but other goby species and juveniles of the pandoras are also caught (Morales-Nin *et al.*, 2017). This fishery is very selective, as only detected schools are fished and it is regulated by autonomous legislation.

In France (GSA 7), the beach seines (*senne de plage, bourgin, issaugue, traîne, caluche*) are still used from time to time both at sea and in some lagoons in Languedoc-Roussillon, in the Provence-Alpes-Côte d'Azur and eastern Corsica region. The management plan set up in 2006 for professional beach seine fishing in the Mediterranean Sea by French vessels sets its maximum length at 450 m, its maximum height at 10 m and the minimum mesh size at 14 mm in accordance with the derogation granted by Council Regulation (EC) No 1967/2006. Council Regulation (EC) No 1967/2006 (Council of the European Union, 2006). Small boats often with an outboard motor are involved in beach seining targeting Mugilidae, flatfishes, salema, sand smelts (*Atherina* spp.) and greater amberjack. In Languedoc-Roussillon, the *traînes* or *caluches* are beach seines with wings 100 m to 200 m long, 0.8 m high at the end, and 2 m to 4 m at the entrance to the bag. For example, the beach seine shown in Plate 59 is 10 m long and has 40 mm stretched meshes. The wings are mounted on ropes with a 12–16 mm thick diameter. In addition, floats of 80–90 g each are placed every three spacings on the headline, while it is weighted down at its lower part by lead plates. In the Berre Lagoon, near Marseille, beach seines (*bourgin, tirasse*) are used at night and in summer to fish eels, mullet, salema and bogue. They have wings 100 m to 300 m long and 3.5 m high, and a bag

10 m to 18.5 m long; the wings and the bag are made of PP with a 32 mm mesh size for the first and the front part of the pocket and 16 mm for its terminal part (*queue*). The upper part of the net is mounted on a PP rope equipped with floats reaching the surface, while the lower part is mounted on a double-weighted braid line; the seine operates on the entire water column. All these beach seines are equipped with pulling ropes from 100 m to 600 m in length for hand hauling. In this same lagoon, the fishing of atherines (*cabassons, joëls*), anchovies and sardines is practised using a small seine 50 m to 100 m long, with a small mesh (20 mm to 40 mm), pulled from a small boat by a fisher while a diver prevents the net from getting caught on the rocks.

PLATE 59
Beach seine used in the Gulf of Lion

Along the French Ligurian coast and Berre Lagoon, the beach seine (*issaugue, petit bourgin*) is regularly used from February to May to catch anchovy and sardine fry (*poutine, mélet*) and transparent gobies called *nonnat,* following strict regulations. The length of the seine is limited to 200 m; the stretched mesh size of the bag (*chaudron* or *marga*) is 2 mm. Only authorized vessels can practice this fishing technique between 1 February and 31 May (but it is prohibited on Sundays and Mondays). It is carried out with one or more boats, on foot, or by swimming in some cases. Only pelagic fish may be caught up to a maximum daily allowable catch of 50 kg per vessel per day; an early closure of the fishing period may occur when the fish become pigmented (*rafaneta*). In beach seine fishing, the method consists of surrounding the fish school while keeping the end of one of the wings moored to the beach. Once the fish school is surrounded, it is pulled back towards the beach by the fishers that haul the seine. This is achieved by slowly and steadily retrieving the net, until the pocket is brought back to the shore.

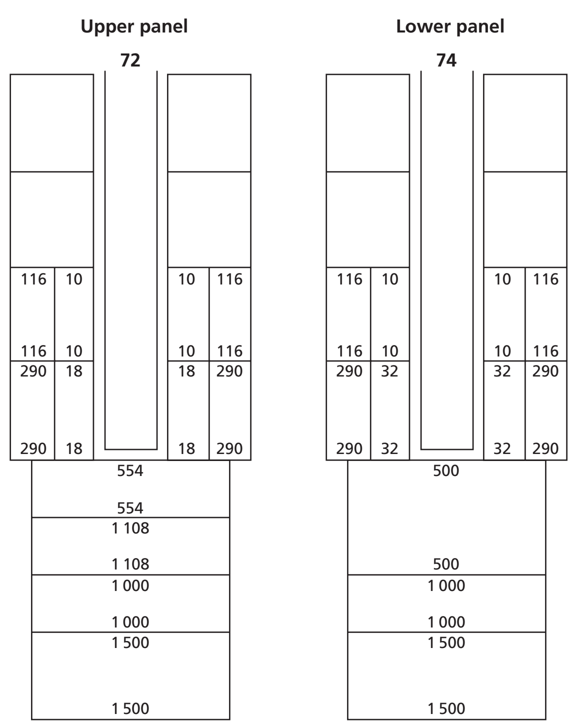
In Italy, boat seine fishery is typical along the coast of the northern Tyrrhenian Sea (GSA 9; Notti *et al.*, 2016). The design of a typical boat seine involves a top and a bottom side netting panels (two-face net; Figure 77). It is a symmetric net consisting of two lateral portions, or wings, and a central body. Floats on the headrope and lead weights on the leadrope guarantee the vertical net opening. The headrope length ranges from 100 m to 300 m, and the floats, similar to those used in coastal gillnet fishery, are joined to the rope every 5–6 m. The footrope is slightly longer than the headrope and carries cylindrical sinkers weighing 50–100 g, placed 30 cm apart (total weight, 200–500 g/m).

The wings of the net range from 60 m to 200 m in length (80–90 m on average) and up to 150 m for larger vessels. The wings are made of 3–4 netting panels, with mesh size decreasing from the wings (40–50 cm stretched mesh opening) to the central body (around 5 cm mesh opening). The rest of the net (belly and codend) is around 6–10 m in length and has very small meshes (from 10 mm to 3–5 mm mesh opening in the codend). The netting panels of the wings vary from ochre to garnet, while the codend is usually black or red. The codend is around 1.5 m high and 4.5 m wide with 3–5 mm mesh. A twisted PA netting is always used with a twine thickness decreasing from the wings to the codend. The sweeps used during hauling–towing operations range from 150 m to 300 m, depending on depth. The boat seine fleet consists of fishing vessels having a GT up to 10, an average LOA of 6.5 m, and 25 kW of engine power. The catch mostly consists of small-sized fish such as transparent goby, which is a small goby with a maximum size of 6 cm, and Mediterranean sand eel. It is a seasonal fishery, typically carried out from November to March depending on fish availability and on its profitability compared with other fisheries. However, this is a multispecies fishery, with annual landings that in some areas have reached 200 tonnes per year (Repetto *et al.*, 1998). The schools are identified by means of an echo sounder or by sight. This fishing practice can involve one, two or three vessels.

In this area, another type of boat seine is used to target picarel, blotched picarel and other species in the Sparidae family (*Diplodus* spp., bogue, pandoras, saddled seabream), red mullet and striped red mullet, and occasionally European squid. This boat seine has a mean headrope length of about 60–80 m, two lateral wings of about 50–60 m, a main body of about 10–12 m and a small codend of around 1.5–2 m in length. Meshes decrease from around 500–550 mm to 10 mm mesh openings from the wing to the body. The mesh opening of the codend is around 5 mm.

FIGURE 77
Technical specifications of a boat seine used in the northern Tyrrhenian Sea

Mesh opening (mm)	Number meshes	Length of panel (m)	Twine
550	25	13.00	210/36
56	446	26.00	210/5
52 / 10 / 35	307 / 1600 / 457	16.00	210/9
20	36	0.72	210/6
10	760	7.60	210/6
10	400	4.00	210/9
5	320	1.60	210/6

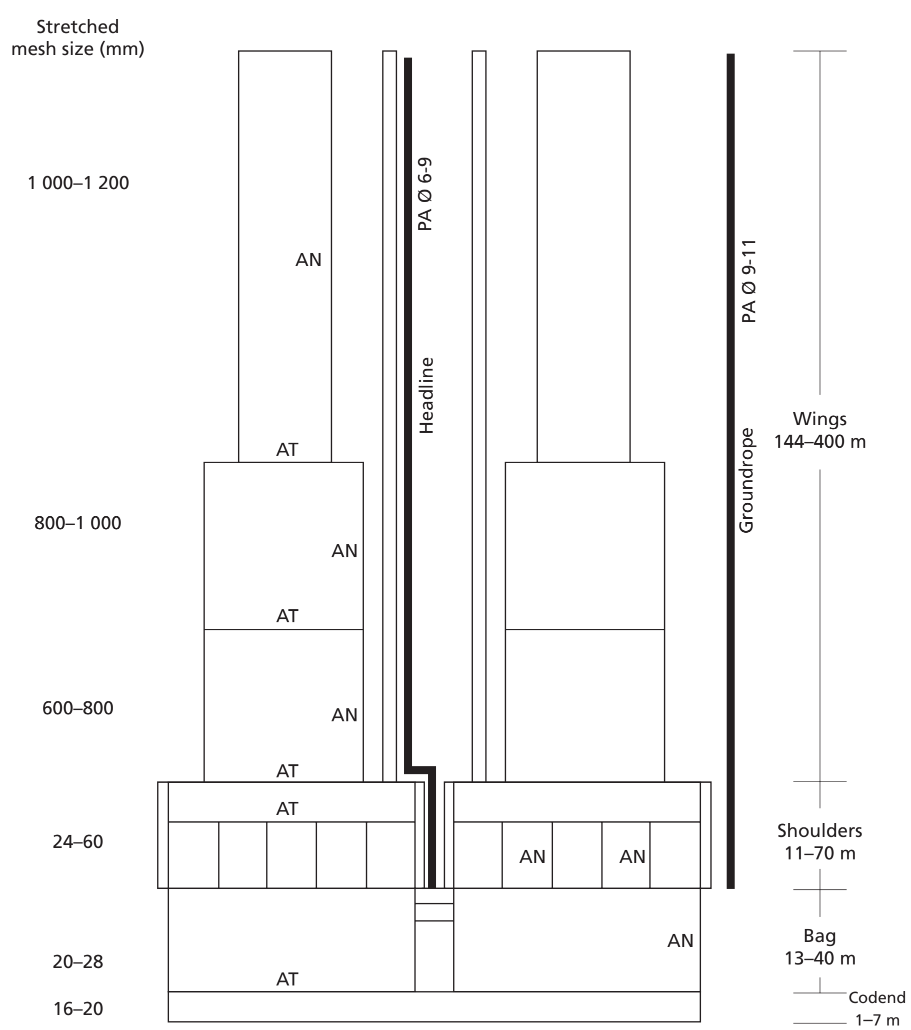


Source: redrawn from F. De Carlo.

Central Mediterranean

In Greek waters, according to Adamidou (2007), there is a commercial boat seine operating that consists of four main sections: the codend, the bag, the main body or shoulders and the relatively long wings (Figure 78). The total length of the net ranges from 200 m to 440 m and the stretched circumference of the mouth opening is 36–129 m. The bag is the central part of the net. It is 13–40 m long and the stretched netting mesh size is 20–28 mm. It consists of 8–16 rectangular pieces of netting of the same mesh size and twine thickness. The rearmost part of the bag is the codend, which is 1–7 m long, and the stretched netting mesh size is 16–20 mm. Shoulders are made of two half sections. The length of the shoulders varies from 11 m to 70 m and the stretched mesh size is from 24 mm to 60 mm. They consist of 2–10 rectangular pieces of netting with different mesh sizes and twine thickness. The wings are the longest part of the net representing 75 percent of the total length of the gear; they are also made of two half sections, with a length of 144 m to 400 m and a stretched mesh size of at least 600 mm.

FIGURE 78
Technical specifications of a boat seine used in Greece



Source: redrawn from **Adamidou, A.** 2007. Commercial fishing gears and methods used in Hellas. In: Papaconstantinou C., Zenetos A., Vassilopoulou C. & Tserpes G., eds. *State of Hellenic Fisheries*, pp. 118–181. Athens, Hellenic Centre for Marine Research and Institute of Marine Biological Resources.

At the wings and shoulders, there is a strengthening piece of enforced netting that is used to join the main netting with the headline and the groundrope, and to prevent damage to the main netting. A spreader is used at the end of each wing to attach the netting to the hauling ropes. The headline and groundrope are made of braided PA or PP rope and have a thickness of 6–12 mm and a length of about 600 m, with the groundrope being slightly longer. The rigging of the gear is strongly related to the species targeted and the geomorphology of the fishing area. Oval and cylindrical floats are usually employed on the headline for buoyancy and lead weights are used on the groundrope to weigh it down. Floats and weights increase progressively from the wings to the bag. Important components in the capture efficiency of boat seines are the long hauling ropes, with a maximum length of 700 m, which extend from the wings and are used to encircle a large area. The boat seine operates close to the coastline fishing grounds (less than 0.5 nautical miles) at depths of less than 50 m; they can be used also on rougher grounds, but with shorter ropes as the net can be damaged very easily. Target species for the boat seine fishery in Greece are picarel, the primary target species, as well as sardine, bogue, red mullet, European squid and common pandora, the secondary target species.

Adriatic Sea

In Italy, boat seines have replaced bottom trawls (used in the past with small codend meshes of 3–5 mm) for catching transparent goby in the southern Adriatic Sea (Gulf of Manfredonia, GSA 18). These boat seine nets have small meshes in the codend (around 2–5 mm) and are used in coastal waters, including the area within three nautical miles from the coast, on sandy–muddy bottoms at depths between 3 m and 40 m. The fishing season generally starts in the late autumn (November–December) until March–May; sometimes it runs from January to March. This fishery is carried out at depths of less than 12 m during the winter and at greater depths (20–40 m) during the spring. The bycatch is made up for the most part of juveniles and adults of sardines and anchovies. A small part of the catch is also made of small Gobiidae (adult specimens) of the genus *Pomatoschistus* and Sparidae, such as salema, annular seabream and common pandora, among others. The catch also includes cephalopods, such as common squid (*Alloteuthis* spp.) and bobtail squid (*Sepiola* spp.), as well as crustaceans (decapods, gastropods, amphipods and Mysidacea). Therefore, this is not a selective fishing practice. Owing to the small meshes used for the catch and to the coastal activity, this fishery is allowed only within the framework of management plans.

The characteristics of these boat seines and of the fishing practices are similar to those described for the Ligurian Sea (western Mediterranean).

The net is structured as follows: two wings made up of four panels that decrease in size from the spreader:

- the first is 8 m long with a stretched mesh size of 40 cm;
- the second is 8 m long with a stretched mesh size of 20 cm;
- the third is 8 m long with a stretched mesh size of 10 cm; and
- the fourth is 6 m long with a stretched mesh size of 5 cm.

After this part is the main body of the net, which is 6 m long including the codend. The lower part (belly) is approximately 1 200 meshes wide, the stretched mesh size is 7 mm and there is a small stripe with larger meshes. The upper part is 1 000 meshes wide and the stretched mesh size is 10 mm; there is also a stripe here with larger meshes. The codend, known locally as *tulle*, is 1.5 m high and 4.5 m wide with 3 mm mesh. The headrope has floats positioned every 6 m, similar to those used in gillnets, while the footrope carries sinkers weighing only 50–100 g, positioned 30 cm apart. This fishery is carried out by vessels characterized by an average engine power of 99.6 kW, 14.6 GT and an average LOA of 13.2 m, but only within the framework of management plans.

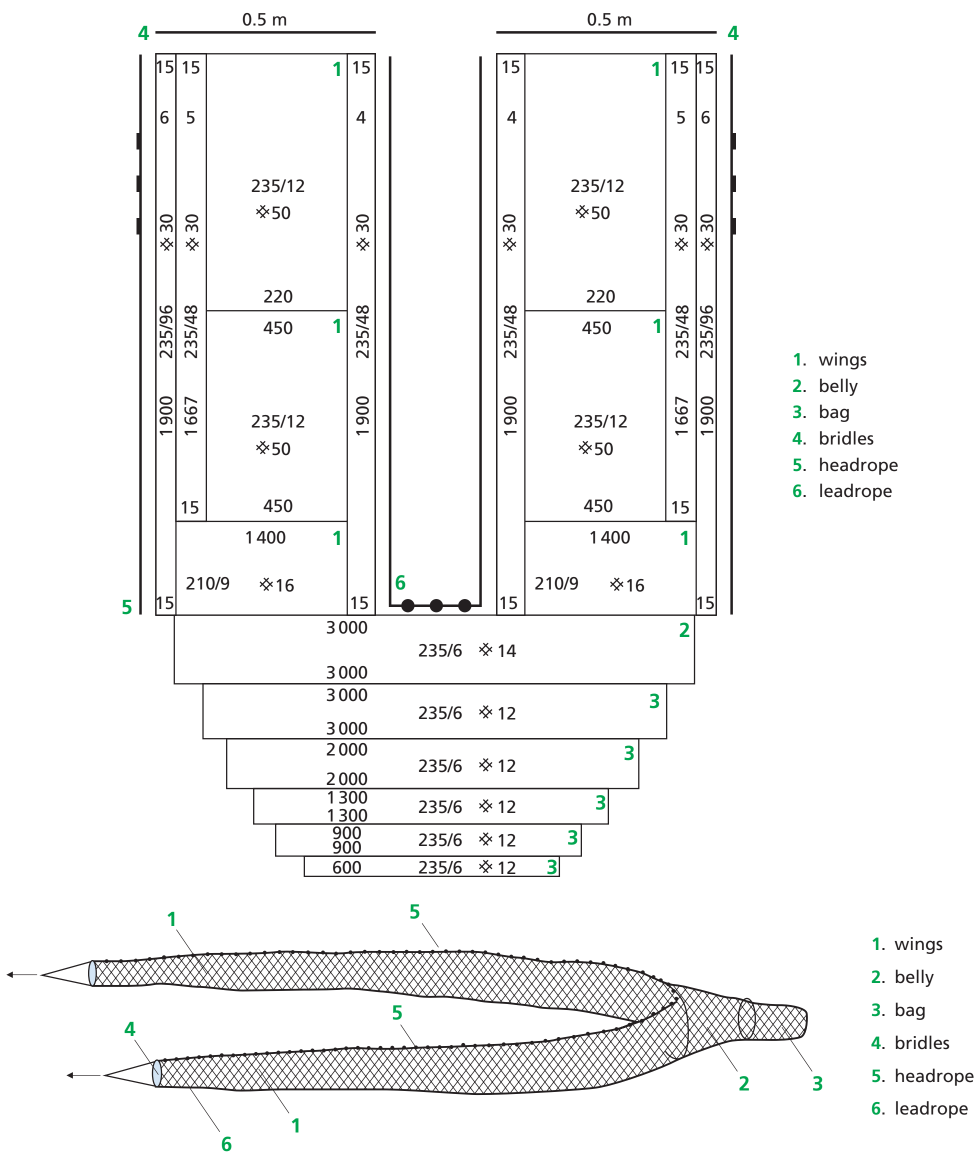
In Croatia (GSA 17), the types of gear described below are not beach seines *sensu stricto*, as today some of them are pulled from the boat. In Croatian legislation, they are classified as "shore seines".

Three types of shore seines are allowed within Croatian territorial waters:

- the large mesh size shore seine *šabakun*;
- the small mesh size shore seine *oližnica*; and
- the shore seines *girarica* and *migavica*.

The *šabakun* mainly targets greater amberjack. The minimum allowed mesh size is 56 mm and the fishing season lasts from 1 April to 1 October. The *oližnica* targets sand smelt with a mesh size ranging from 10 mm to 15 mm. The fishing season lasts from 1 November to 31 March. The *girarica* and *migavica* target picarel with a minimum mesh size of 40 mm (Figure 79; Cetinić *et al.*, 1999; Soldo and Cetinić, 2009). The fishing season lasts from 1 November to 31 March.

FIGURE 79
Technical specifications of the *migavica* beach seine



Source: redrawn from **Soldo, A. & Cetinić, P.** 2009. Impact of fishing gear on Posidonia seagrass meadows. In: *Fishing gear-seabed interaction*, 09: 11–19.

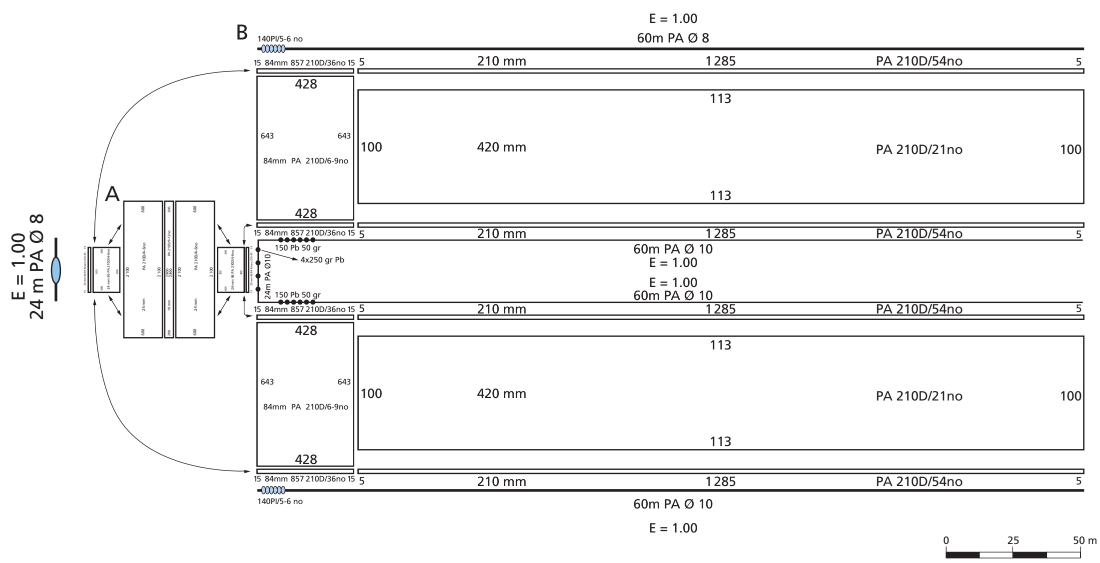
In Montenegro (GSA 18), juveniles of sardine and anchovy are the main commercial species targeted in beach seine fisheries in the Bay of Kotor, using artificial light (Joksimović *et al.*, 2019). A small boat carries a lamp that attracts fish for 3–4 hours at about 300 m off the shore. When enough fish congregate, the boat with the lamp is encircled by another boat, which surrounds the fish with the net. One side of the net is kept on the shore and once the fish school is surrounded, the two sides of the net are brought together. The mesh size of the codend is around 4.5–8 mm. Fishers also use the beach seine called *šabakun*, especially in the summer period. The *šabakun* is designed to catch Atlantic bonito, mullet, sparids and greater amberjack (UNEP-MAP-RAC/SPA, 2014).

Eastern Mediterranean

In Greece (GSA 22), the boat seines used have the same characteristics as described for the central Mediterranean (Adamidou, 2007).

In Türkiye, boat seines are used in GSA 22 to target red mullet, mackerel, cuttlefish, octopus, sardine and squid (Tokaç *et al.*, 2010; Figure 80). Each fishing operation normally lasts 1.5–2 hours. Beach seines are forbidden in Türkiye.

FIGURE 80
Technical specifications of a boat seine used in Türkiye



Source: redrawn from **Tokaç, A., Ünal, V., Tosunoğlu, Z., Akyol, O., Özbilgin, H. & Gökçe, G.** 2010. Ege Denizi Balıkçılığı [Aegean Sea fisheries]. İzmir, Türkiye, IMEAK Chamber of Shipping İzmir branch.

In Lebanon (GSA 27), beach seines, locally called *jaroufi*, have been reported as catching barracudas, juvenile Sparidae, bogue and picarel. They are made of three panels of 10 mm stretched mesh and are 200 m to 300 m in length (Brême, 2004; Sacchi and Dimech, 2011).

In Palestine (GSA 27), small seines are used by small vessels (*hasakas*; 5–7.5 m long) made of wood, but more recently with fibreglass. They are powered by outboard engines of 10–20 hp. The beach seine, locally called a *jarafah*, is set from the beach by a small boat, usually a *hasaka* with oars (Ali, 2002; Ezeldin, 2004). It consists of a trawl-shaped net 150–300 m long and about 7 m high, pulled with two 300–500 m ropes. Once set in a semi-circle from the beach, it is hauled by a group of 10 to 14 people. The catch usually consists of a mix of small fish such as mullet. Smaller beach seines (50 m long) are also used to catch sardines near the mouth of Wadi Gaza.

Black Sea

In the Turkish Istanbul Strait (GSA 28), Uzer, Yıldız and Karakulak (2017) reported a boat seine net specialized for catching bony fish that live or travel close to beaches. It has a total length of approximately 143 m, with mesh size and twine diameter decreasing from the wings to the bag net. In total, 180 m and 18 mm hauling ropes are attached to both ends of the wings of the seine. The wings following the towing ropes are 130 m in length and 8.2 m in height and consist of three parts. The meshes of the bag net are diamond-shaped. The codend, with 768 meshes in its circumference, is constructed from black, single, twisted PA twine (Rtex 390).

In Bulgaria (GSA 29), beach seines are used in inshore areas from April to July, mainly in two areas, Mai–Vama Veche and Constanţa–Cap Midia.

In Romania (GSA 29), beach seines are also used, mainly to catch flathead grey mullet, golden grey mullet (*Chelon auratus*), red mullet, garfish, Mediterranean horse mackerel (*Trachurus mediterraneus*) and Gobiidae. They are deployed at 2.5 m depth. The headline length is 100 m, the twine diameter is 0.30 mm and the mesh length is 20 mm.

In Ukraine, the same species are also targeted, with beach seines active both in the Azov Sea (GSA 30) and in the Black Sea (GSA 29).

5. Longliners

5.1 General characteristics

The longline is a fishing gear that comprises a mainline carrying numerous hooks on branch lines (snoods) of variable lengths and spacing depending on the target species. It may be set either at or near the bottom (bottom-set longline), in mid-water or near the surface (surface longline).

Longlines are used in many areas of the Mediterranean and the Black Sea to catch a variety of species. The hook is the core of the longline system. The main technical features of a hook can be summarized as: eye, shank, length, width, point, gap and throat (Figure 81).

The main factors affecting the catch of a longline are:

- the number of hooks;
- the hook shape and material;
- the bait type (squid bait, fish bait, artificial bait, lightsticks, etc.);
- the longline rigging (mainline diameter, branch line length, space between snoods, etc.);
- the bait colour;
- the fishing depth (depth at which the branch line is positioned);
- the location of fishing grounds in relation to topographic and oceanographic features, sea temperature, etc.;
- the location of fishing grounds in relation to the target species' migration routes; and
- the total catch (higher catch makes the longline more visible).

Species and size selectivity of a longline can be modified by the type of bait and hook properties (size, shape, etc.) (Figure 82). The hook size also strongly influences the size that can be captured (Alós *et al.*, 2008). Only large fish can bite a big hook, meaning that setting a minimum hook size is one way to manage longline fisheries. The hook size is usually reported by a number that decreases as the size of the hook increases. Each hook company has its own conversion table from hook number to hook size (length, width). Usually, the hook size increases from hook size number 20 to hook size number 0, but sometimes larger hooks are numbered differently, from 0 to 10/0. Furthermore, hook shape (J or circle) influences the location of the hook in the prey; circle hooks seem to be more easily stuck in the mouth of the prey, while the J hook is more easily swallowed, thus leading to high direct mortality rates.

The classification of the ISSCFG for hooks and lines is given in Table 21.

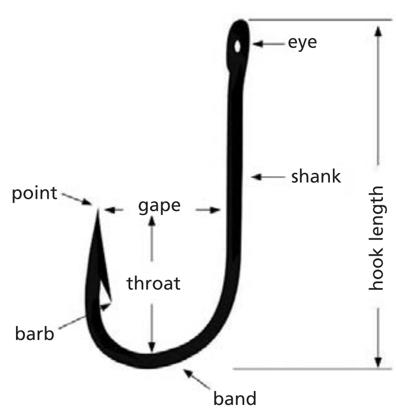
Table 21

Classification of longlines according to the International Standard Statistical Classification of Fishing Gear

Gear categories (first tier)	Subcategories (second tier)	Standard abbreviations	ISSCFG code
Hooks and lines			9
	Handlines and hand-operated pole-and-lines	LHP	9.1
	Mechanized lines and pole-and-lines	LHM	9.2
	Set longlines	LLS	9.31
	Drifting longlines	LLD	9.32
	Longlines (nei)	LL	9.39
	Vertical lines	LVT	9.4
	Trolling lines	LTL	9.5
	Hooks and lines (nei)	LX	9.9

Source: **FAO.** 2016. International Standard Statistical Classification of Fishing Gear. Handbook on Fisheries Statistics. Rome. www.fao.org/3/bt988e/bt988e.pdf

FIGURE 81
Technical elements of a fish hook affecting the catching process



Source: adapted from **He, P., Chopin, F., Suuronen, P., Ferro, R.S.T. & Lansley, J.** 2021. *Classification and illustrated definition of fishing gears.* FAO Fisheries and Aquaculture Technical Paper No. 672. Rome, FAO. https://doi.org/10.4060/cb4966en

FIGURE 82
Examples of fish hooks

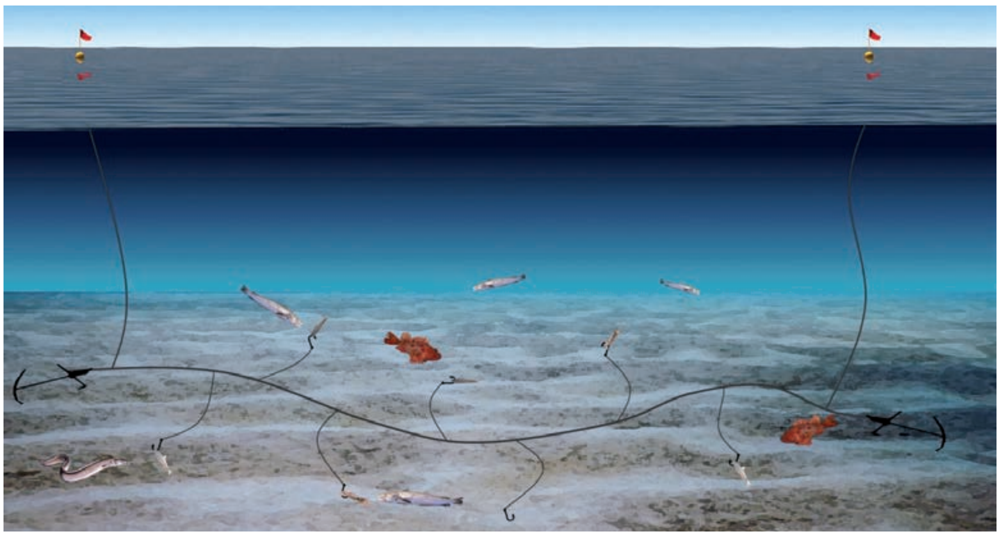
Source: adapted from **He, P., Chopin, F., Suuronen, P., Ferro, R.S.T. & Lansley, J.** 2021. *Classification and illustrated definition of fishing gears.* FAO Fisheries and Aquaculture Technical Paper No. 672. Rome, FAO. https://doi.org/10.4060/cb4966en

5.2 Main longline gear

5.2.1 Set longlines

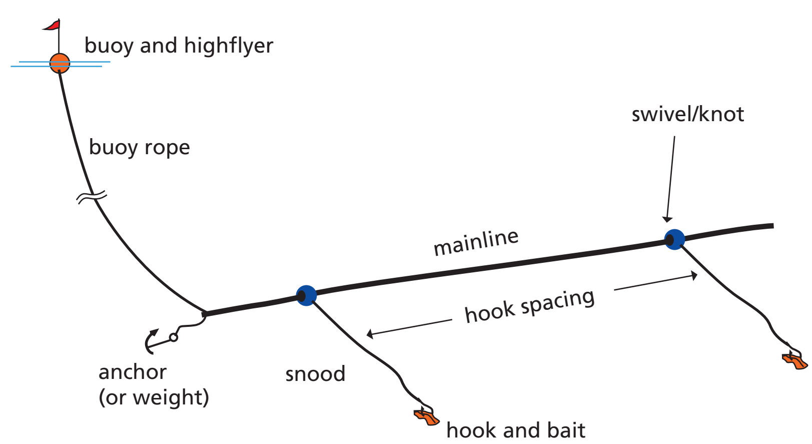
A set longline, also called bottom or demersal longline, is a longline in which the two ends of the mainline are anchored to the seabed (Figure 83 and Figure 84). The weights at the two ends are also connected with ropes to floating signal buoys acting as markers on the sea surface, sometimes with reflectors to be visible at night. Sometimes, more buoys are connected to the longline when there is a larger risk for breakage of the mainline, for example, on rocky bottoms. In the Mediterranean and the Black Sea, bottom longlines usually fish on or near the bottom for demersal species like hake, groupers, seabass, sparids and flatfish, among others. The mainline of a bottom longline can be laid on the bottom or floating a few metres above it, in order to catch demersal species swimming near the bottom. In very shallow waters, the mainline can be near the surface. Snoods with baited hooks are attached to the mainline at regular intervals (usually 1–2 m) by means of a knot or with a swivel. The gap between the snoods, the length of snoods, the thickness of the mainline and the size of the hooks are much smaller than that of a surface longline. Frozen sardines (*Sardina pilchardus*) or other fish with low value are commonly used as bait.

FIGURE 83
Set longline



Source: illustrated by A. Lucchetti.

FIGURE 84
Technical elements of a set longline



Source: redrawn from **He, P., Chopin, F., Suuronen, P., Ferro, R.S.T. & Lansley, J.** 2021. *Classification and illustrated definition of fishing gears.* FAO Fisheries and Aquaculture Technical Paper No. 672. Rome, FAO. https://doi.org/10.4060/cb4966en

Subregional variations

In Table 22, the characteristics of the bottom-set longlines used in the different areas of the Mediterranean and the Black Sea are summarized, according to the main target species.

Table 22

Technical parameters of bottom-set longlines used in the Mediterranean and Black Sea

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (m)	Diameter (mm)	Type	Distance between branch lines (m)		
1	Western Mediterranean	Spain	SBR, BRF	J	3.3–3.9	70	0.1	1.2	Mono	1.0	0.6	Mono	1	Sardine	850
1	Western Mediterranean	Spain	SWO, SFS	J	7.5	600–900	11.0–28.0	2.0	Mono	4.0–5.0	1.5	Mono	12	Mackerel, round sardinella	80–400
3	Western Mediterranean	Morocco	SBR, RPG, PAX, FOR	J		1 500		1.6	Mono	2.0	0.7	Mono	3	Sardine, octopus, cuttlefish	300
3	Western Mediterranean	Morocco	Elasmobranchs, MGR	J	7.2	200–300	1.4–2.1		Br	1.7	1.6	Mono	7	Cuttlefish, round sardinella	40
3	Western Mediterranean	Morocco	DEC, SBG, PAX, GUU	J	5.4	500–1 500		1.7	Mono	1.5	1.3	Mono	3.5	Sardine, octopus, anchovy	40–150
3	Western Mediterranean	Morocco	GPX, DEC	J	4.7	350–700		1.3	Mono	1.1	0.6	Mono	2.7	Cuttlefish, bogue, octopus	35–55
3	Western Mediterranean	Morocco	RSE, COE, MMH, GPX	J	5.4	300		2.0	Mono	1.8	1.0	Mono	5.4	Octopus, cuttlefish, sardine, bogue, anchovy	30–40
3	Western Mediterranean	Morocco	GPX, COE, PAX, BSS, SRG	J	2.3–3.1	200–500		1.1	Mono	1.0	0.5	Mono	4	Sardine, anchovy, octopus, squid	20–80
3	Western Mediterranean	Morocco	ELE, BXD, COE, WHB			1 000–1 500	8.0–10.0						2–3		
3	Western Mediterranean	Morocco	Sparidae, COE			1 500–2 000	7.0–8.0								
4	Western Mediterranean	Spain	SWO, SFS	J	7.5	600–900	11.0–28.0	2.0	Mono	4.0–5.0	1.5	Mono	12	Mackerel, round sardinella	80–400
4	Western Mediterranean	Algeria	GPX, COE, SKA, FOR, PAX			360			Multi	1.8	0.8	Mono	7		10–50
4	Western Mediterranean	Algeria	GPX, COE, FOR, PAX			200–300			Multi	2.7	0.9 + 2.0	Mono + S	5.5		200–400

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (m)	Diameter (mm)	Type	Distance between branch lines (m)		
5	Western Mediterranean	Spain	HKE, BRF, SBR, DEC, SBG	J	3.0	500–1 500								Sardine, round sardinella	10–150
5	Western Mediterranean	Spain	HKE, RPG, SBR, DEC, GPD	J	2.9–5.1	500				2.0–5.0			5–12	Sardine, round sardinella	
6	Western Mediterranean	Spain	RPG, HKE, SBR, DEC	J	3.4	114–2 000								Sardine, round sardinella	
6	Western Mediterranean	Spain	SWO, SFS	J	7.5	600–900	11.0–28.0	2.0	Mono	4.0–5.0	1.5	Mono	12	Mackerel, round sardinella	80–400
6	Western Mediterranean	Spain	HKE, BRF, SBR, DEC, SBG	J	3.0	500–1 500								Sardine, round sardinella	10–150
6	Western Mediterranean	Spain	HKE, RPG, SBR, DEC, GPD	J	2.9–5.1	500				2.0–5.0			5–12	Sardine, round sardinella	
6	Western Mediterranean	Spain	HKE, SHO, BRF, SYC	J	3.2					2.0			3–4		
7	Western Mediterranean	France	SWO	J	4.9–6.0	300–500	17.0–20.0	1.6	Mono	10.0–15.0	1.2	Mono	18–25	Sardine	100–200
7	Western Mediterranean	France	COE	J	7.0	200–500	2.5–3.5	3.0–4.0	Br	0.6–0.8	1.4–1.8	Mono	4–5	Round sardinella, mackerel, bogue	10–100
7	Western Mediterranean	France	SBG, PAC	J	2.6–2.8	120–2 500	3.5–5	0.6–1.2	Mono	1.0–2.0	0.4–0.5	Mono	4–5	Razor clam, crab, Sipunculidae	10–50
7	Western Mediterranean	France	BSS	J	2.6	60–500	0.2–1.5	2.0	Mono	1.0–2.0	1.3	Mono	3–4	Razor clam, crab, Sipunculidae	11–50
7	Western Mediterranean	France	HKE, SBR	J	2.8	500–1 000	1.5–3.5	1.2–1.5	Mono	1.0–1.5	0.6–0.8	Mono	3–4	Sardine	50–200
7	Western Mediterranean	Spain	HKE, SHO, BRF, SYC	J	3.2					2.0			3–4		
7	Western Mediterranean	France	HKE	J		1 500–2 000									160–600
7	Western Mediterranean	France	SBR			450									300–600

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (m)	Diameter (mm)	Type	Distance between branch lines (m)		
8	Western Mediterranean	France	COE	J	7.0	200–500	2.5–3.5	3.0–4.0	Br	0.6–0.8	1.4–1.8	Mono	4–5	Round sardinella, mackerel, bogue	10–100
8	Western Mediterranean	France	SBG, PAC	J	2.6–2.8	120–2 500	3.5–5.0	0.6–1.2	Mono	1.0–2.0	0.4–0.5	Mono	4–5	Razor clam, crab, Sipunculidae	10–50
8	Western Mediterranean	France	BSS	J	2.6	60–500	0.2–1.5	2.0	Mono	1.0–2.0	1.3	Mono	3–4	Razor clam, crab, Sipunculidae	11–50
8	Western Mediterranean	France	HKE, SBR	J	2.8	500–1 000	1.5–3.5	1.2–1.5	Mono	1.0–1.5	0.6–0.8	Mono	3–4	Sardine	50–200
10	Western Mediterranean	Italy	HKE	J		600–1 000	7.0		Br	2.0		Br	7	Sardine	200–500
10	Western Mediterranean	Italy	SFS	J		1 400–2 000	2.5–4.0	1.2	Mono	1.0	0.3–0.4	Mono	5–6	Sardine	150–300
10	Western Mediterranean	Italy	Sparidae	J		100–200	0.5–1.0	0.7–0.8	Mono	1.0–2.0	0.4–1.2	Mono	1–2	Shrimp, octopus, squid, sea cucumber, limpet	20–50
10	Western Mediterranean	Italy	GPD	J		400–700	2.0–4.0	1.2–1.6	Mono	2.0–3.0	0.9–1.2	Mono	6–8	Sardine	10–80
10	Western Mediterranean	Italy	HKE	J		500–750		6.0	Mono			Mono		Clupeoid fish, mackerel	
10	Western Mediterranean	Italy	SBR	J		1 000		1.0	Mono		0.6	Mono		Clupeoid fish, bullet tuna	150–300
10	Western Mediterranean	Italy	POA	J		1 500	12.0	1.8	Br	3.0	1.2	Mono	8	Sardine, round sardinella, squid	280–560
10	Western Mediterranean	Italy	GPX, DEC	J		300	2.3	1.4	Br	2.0	0.9	Mono	8	Sardine, round sardinella, squid	30–40
10	Western Mediterranean	Italy	Sparidae	J		400–500	0.8	0.7–0.8	Br	2.0	0.4	Mono	7–8	Sardine, anchovy, squid	5–40
10	Western Mediterranean	Italy	HKE, GUU	J		60	0.3	1.5	Br	2.0	0.7	Mono	5	Sardine, anchovy, squid	150–300

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (m)	Diameter (mm)	Type	Distance between branch lines (m)		
12	Central Mediterranean	Tunisia	CCB, CCP, SMA, SMD, GPW, EPK, GPD	J	9.2	5 100		1.6	Mono	6.0–7.0	1.4	Mono			50–100
12	Central Mediterranean	Tunisia	CCB, CCP, SMA, SMD, GPW, EPK, GPD	C	7.1	5 100		1.6	Mono	6.0–7.0	1.4	Mono			50–100
12	Central Mediterranean	Tunisia	GPX	J		1 200–1 800	7.5–20.0	3.0	Br	1.0–1.5	1.2–1.4	Mono	8	Round sardinella, sardine, cuttlefish, bogue, grey mullet, musky octopus, seabream	20–80
12	Central Mediterranean	Tunisia	WRF, SBL	C		700–1 500	1.5–5.0	5.0–6.0	Multi	1.5–2.0	1.4–1.6	Mono	10	Round sardinella, sardine, cuttlefish, bogue, grey mullet, musky octopus, seabream	400–900
12	Central Mediterranean	Tunisia	PAX, SBP, SWA	J		3 000–5 000	6.0–10.0	2.0	Br	0.4–0.5	0.5–0.8	Mono	2–2.5	Round sardinella, sardine, cuttlefish	20–50
12	Central Mediterranean	Tunisia	DEX, SBP	J		1 000–3 000	6.0–10.0	2.0–2.5	Br	0.5–0.7	0.6–0.8	Mono	2–2.5	Round sardinella, sardine, cuttlefish	20–100
12	Central Mediterranean	Tunisia	Sparidae	J		1 800–3 000	7.5–15.0	2.0	Br	0.2	0.4–0.6	Mono	1–1.5	Round sardinella, sardine, cuttlefish, musky octopus	20–80
13	Central Mediterranean	Tunisia	SBG, GPD, DEC, SBP, PAX, BSS, Rajidae	J	2.0–5.0	900		1.5–3.0		5.0–15.0	1.0–1.6	Mono	10–22	Sardine, mackerel, cuttlefish	3–60
13	Central Mediterranean	Tunisia	GPX	J		1 200–1 800	7.5–20.0	3.0	Br	1.0–1.5	1.2–1.4	Mono	8	Round sardinella, sardine, cuttlefish, bogue, grey mullet, musky octopus, seabream	20–80
13	Central Mediterranean	Tunisia	PAX, SBP, SWA	J		3 000–5 000	6.0–10.0	2.0	Br	0.4–0.5	0.5–0.8	Mono	2–2.5	Round sardinella, sardine, cuttlefish	20–50

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (m)	Diameter (mm)	Type	Distance between branch lines (m)		
13	Central Mediterranean	Tunisia	Sparidae	J		1 800–3 000	7.5–15.0	2.0	Br	0.2	0.4–0.6	Mono	1–1.5	Round sardinella, sardine, cuttlefish, musky octopus	20–80
14	Central Mediterranean	Tunisia	GPX, elasmobranchs	J	7.8	2 000–3 500	10.0–12.0		Mono	1.0	2.0	Mono	7	Round sardinella, cuttlefish	
14	Central Mediterranean	Tunisia	GPX, elasmobranchs	J		500	1.3		Mono	1.0	2.0	Mono	4	Round sardinella	
14	Central Mediterranean	Tunisia	GPX, elasmobranchs	C		500	1.3		Mono	1.0	2.0	Mono	4	Round sardinella	
14	Central Mediterranean	Tunisia	SBG, GPD, DEC, SBP, PAX, BSS, Rajidae	J	2.0–5.0	900		1.5–3.0		5.0–15.0	1.0–1.6	Mono	10–22	Sardine, mackerel, cuttlefish	3–60
14	Central Mediterranean	Tunisia	GPX	J		1 200–1 800	7.5–20.0	3.0	Br	1.0–1.5	1.2–1.4	Mono	8	Round sardinella, sardine, cuttlefish, bogue, grey mullet, musky octopus, seabreams	20–80
14	Central Mediterranean	Tunisia	PAX, SBP, SWA	J		3 000–5 000	6.0–10.0	2.0	Br	0.4–0.5	0.5–0.8	Mono	2–2.5	Round sardinella, sardine, cuttlefish	20–50
14	Central Mediterranean	Tunisia	DEX, SBP	J		1 000–3 000	6.0–10.0	2.0–2.5	Br	0.5–0.7	0.6–0.8	Mono	2–2.5	Round sardinella, sardine, cuttlefish	20–100
14	Central Mediterranean	Tunisia	Sparidae	J		1 800–3 000	7.5–15.0	2.0	Br	0.2	0.4–0.6	Mono	1–1.5	Round sardinella, sardine, cuttlefish, musky octopus	20–80
14	Central Mediterranean	Tunisia	GPX, elasmobranchs	J		1 500–3 500								Round sardinella, sardine, rays, cuttlefish	20–100
15	Central Mediterranean	Malta	Sparidae, GPX, WRF												
16	Central Mediterranean	Italy	BOG, SBA	J		200	0.5			1.0			3	Squid	20

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (m)	Diameter (mm)	Type	Distance between branch lines (m)		
16	Central Mediterranean	Italy	HKE, demersal fish	J	2.0	2 000	2.5	1.2	Mono	0.6	0.8	Mono		Sardine	80–130
16	Central Mediterranean	Italy	HKE, demersal fish	J	1.9	800	1.8	1.2	Mono	0.8	0.8	Mono		Sardine	80–120
16	Central Mediterranean	Italy	HKE	J	1.9	1 600	3.0	1.2	Mono	1.5	0.8	Mono		Sardine	35–60
16	Central Mediterranean	Italy	Sparidae	J	2.3	1 000	4.6	0.8	Mono	1.0	0.4	Mono		Shrimps, squid	10
16	Central Mediterranean	Italy	Sparidae	J	2.3	1 000	4.0	0.8	Mono	2.0	0.4	Mono		Shrimps	30
16	Central Mediterranean	Italy	Sparidae	J	2.3	550	3.7	0.8	Mono	1.0	0.4	Mono		Shrimps	15
16	Central Mediterranean	Italy	Sparidae	J	2.3	1 000	4.0	0.8	Mono	2.0	0.4	Mono		Shrimps	30
17	Adriatic Sea	Italy	HKE, GUU, BLL, Scorpaenidae DEC	J	5.0	3 000	26.0–30.0	2.5	Mono	4.0	1.1	Mono	10	Sardine	
17	Adriatic Sea	Croatia	HKE, TUR, GUU, LTA, DGS, COE			3 000	18.0–22.0						8		90–160
18	Adriatic Sea	Croatia	HKE, TUR, GUU, LTA, DGS, COE			3 000	18.0–22.0						8		90–160
18	Adriatic Sea	Italy	HKE, GUU, SBR	J	4.0–6.0	500–700	3.5	5.0	Multi	2.0	1.2	Mono	6	Sardine, squid	150–400
18	Adriatic Sea	Montenegro	HKE, MNZ, SMD, DGS, GUU, DEC, COE	J			0.6–1.5	1.0	Mono	1.0–3.0	0.3–0.4	Mono	3		
18	Adriatic Sea	Montenegro	DEP, RPG, GPD, HKE, JRS, GUU, MNZ, COE	J			0.5–1.5	1.0	Mono	1.0–3.0	0.3–0.4	Mono	3		

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (m)	Diameter (mm)	Type	Distance between branch lines (m)		
18	Adriatic Sea	Montenegro	HKE, DEP, RPG, ANK, JAI, GUU	J		100–500	0.5–1.5			1.0–3.0			3		
19	Central Mediterranean	Italy	Demersal fish	J	2.6	130–600		1.0	Mono	0.6	0.5	Mono	3.6	Palaemonidae, golden shrimp, deep-water rose shrimp, Sepiolidae, Holothuroidea	
20	Central Mediterranean	Greece	HKE, AMB			300–500									50–75
20	Central Mediterranean	Greece	DEC			300–500									20–36
20	Central Mediterranean	Greece	PAC, SWA, RPG, SBG	J	2.0–3.0			0.5–1.0			0.2–0.6		3–5		20–100
20	Central Mediterranean	Greece	PAC, SWA, RPG, SBG, GPX	J	3.0–4.0			0.5–1.2			0.4–0.8		5–8		80–180
20	Central Mediterranean	Greece	HKE, DEC, GPX, WRF, AMB, elasmobranchs	J	4.5–7.0			1.0–2.5			0.1–0.5		8–11		200–700
21	Central Mediterranean	Libya	GPX, DEP	J		900	2.7	2.5	Br	2.0	1.0–1.2	Mono	3	Sardine, bogue	5–200
21	Central Mediterranean	Libya	PAC, CTB, RPG, DEC	J		1 500	2.0	1.5	Br	1.0	0.7	Mono	2	Octopus, squid, cuttlefish	3–35
21	Central Mediterranean	Libya	Carcharhinidae	J		100	10.0	4.0	Br	1.0	2.0	Mono	10	Small seabream, wrasse	1–30
21	Central Mediterranean	Libya	GPD, EPK, EFJ, DEP, GPW			300	1.6	2.5	Br	1.5	1.5	Mono	2	Sardine, bogue	9–372
21	Central Mediterranean	Libya	DEC, GPD, EPK, DEP, RPG			400	1.8	2.0	Br	1.5		Mono	2	Sardine	9–372
21	Central Mediterranean	Libya	PAC, CTB, DEC, RPG			500	1.8	1.5	Br	1.0		Mono	1	Octopus, squid, cuttlefish	6–65

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (m)	Diameter (mm)	Type	Distance between branch lines (m)		
21	Central Mediterranean	Libya	GPX, DEX	J		600–2 100	5.0–11.5	2.5	Br	1.5	1.0–1.2	Mono	5.5	Sardine, bogue	9–370
21	Central Mediterranean	Libya	SBP, DEX, GPX	J		800–3 200	3.5–12.5	2.0	Br	1.5	0.9	Mono	3.6	Sardine	9.3–370
21	Central Mediterranean	Libya	PAC, SBP, DEC, CTB	J		1 000–3 500	3.5–12.5	1.5	Br	1.0	0.7	Mono	3.6	Octopus, squid, cuttlefish	5.5–65
21	Central Mediterranean	Libya	Elasmobranchs	J		100	1.8	4.0	Br	1.5	2.0	Mono + S	18.2	Various fish species as bycatch	1.82–55
22	Eastern Mediterranean	Greece	PAC, SWA, RPG, SBG	J	2.0–3.0			0.5–1.0	Mono		0.2–0.6	Mono	3–5		20–100
22	Eastern Mediterranean	Greece	PAC, SWA, RPG, SBG, GPX	J	3.0–4.0			0.5–1.2	Mono		0.4–0.8	Mono	5–8		80–180
22	Eastern Mediterranean	Greece	HKE, DEC, GPX, WRF, AMB, elasmobranchs	J	4.5–7.0			1.0–2.5	Mono		0.1–0.5	Mono	8–11		200–700
22	Eastern Mediterranean	Greece	Sparidae, CBR, COE	J		1 000		1.1	Mono	1.0	0.5	Mono	2	Squid, cuttlefish, mackerel	4–90
22	Eastern Mediterranean	Greece	DEC, MMH			300–600									17–120
22	Eastern Mediterranean	Greece	CBR, COE, PAC, SRG		1.9–2.8	250		1.1	Mono	1.0	0.5	Mono	2	Squid, cuttlefish	
22	Eastern Mediterranean	Greece	SWO, Tunnidae	J				1.5–3.0	Mono		1.0–2.0	Mono			
22	Eastern Mediterranean	Türkiye	Sparidae, GPX	J				0.5	Mono	1.0	0.3	Mono	5	Sardine, anchovy, cuttlefish, sea cucumber, murex	4–17
22	Eastern Mediterranean	Türkiye	PAC, DEC, NNZ, SBG	J		600		0.6	Mono	1.0	0.4	Mono	3	Mud shrimp	10–70
22	Eastern Mediterranean	Türkiye	DEP	J		110	2.0	0.9	Mono	1.1	0.8	Mono	18	Sardine	

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (m)	Diameter (mm)	Type	Distance between branch lines (m)		
24	Eastern Mediterranean	Türkiye	LEE	J		100	1.5	1.1	Mono	1.7	1.0	Mono	30	Cuttlefish, sardine, squid, octopus, live fish bait	
24	Eastern Mediterranean	Türkiye	SWO	J		200	3.6	1.5	Mono	2.0	1.2	Mono	18	Grey mullet, sardine	
24	Eastern Mediterranean	Türkiye	GPW	J		200	1.5	1.0	Mono	1.8	0.8	Mono	7.2	Sardine	
25	Eastern Mediterranean	Cyprus	DEX, GPD	J		300	0.8	0.7	Mono	1.5	0.5	Mono	2.5	Cuttlefish, chicken breast, shrimp	
25	Eastern Mediterranean	Cyprus	DEX, GPD, GPW, DEC	J		230	1.0	0.9–1.2	Mono	1.5	0.6–0.9	Mono	4.5	Mackerel, horse mackerel, shad, sardine, bogue	
25	Eastern Mediterranean	Cyprus	GPD, GPW	J		600	3.5	1.5	Mono	1.8	1.2	Mono	6	Sardine, bogue	
26	Eastern Mediterranean	Egypt	LFZ	J	2–6	75–150	0.2–0.5	1.2	Mono	1.0	1.2	Mono	2–3	Octopus, cuttlefish	6–150
26	Eastern Mediterranean	Egypt	CWC, BLU, SWA	J	4.0	400				2.0			5	Round sardinella, mullet, octopus, cuttlefish	6–30
26	Eastern Mediterranean	Egypt	ALB, SWO, LTA, SKJ		4.5	500	4.0–4.5	1.2	Mono	5.0	1.0	Mono		Sardine	
27	Eastern Mediterranean	Lebanon	SBP, DEC, SRG, GPX	J	3.0	600		1.2	Mono	1.0	0.6	Mono	5–6	Cuttlefish, sardine, squid	
27	Eastern Mediterranean	Lebanon	SBP, DEC, SRG, GPX	J	1.5	600		1.2	Mono	1.0	0.4	Mono	5–6	Cuttlefish, sardine, squid	
27	Eastern Mediterranean	Lebanon	BSC, RPG, SWA, SBZ, GPD	J	3.0	200–300		1.2	Mono						
27	Eastern Mediterranean	Palestine	AMB, GPX, SBG, PAC, SSB				0.1		Mono	0.7–0.9		Mono		Cuttlefish, sardine, small shrimp	

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (m)	Diameter (mm)	Type	Distance between branch lines (m)		
28	Black Sea	Türkiye	SWA, DEC, SBP	J		150–170	1.8–2.0	1.2	Mono	0.5	0.8	Mono	4	Cuttlefish, sardine, squid	20
29	Black Sea	Romania	DGS, RJC	J	4.0–7.5	100	0.3	5.0	Mono	0.4	0.5	Mono	1.5	Horse mackerel	20
29	Black Sea	Bulgaria	DGS	J	3.5–4.0	300	1.0–1.5	2.0–2.5	Mono	1.0	0.8	Mono	3.5–5	Horse mackerel	50–100
29	Black Sea	Ukraine	DGS, RJC	J	4.0–7.5	100	0.3	5.0	Mono	0.4	0.5	Mono	1.5	Horse mackerel	20

Notes: ALB: *Thunnus alalunga*; AMB: *Seriola dumerili*; ANK: *Lophius budegassa*; ARB: *Ariosoma balearicum*; BFT: *Thunnus thynnus*; BLL: *Scophthalmus rhombus*; BLU: *Pomatomus saltatrix*; BOG: *Boops boops*; BON: *Sarda sarda*; BRF: *Helicolenus dactylopterus*; BSC: *Pagrus caeruleostictus*; BSS: *Dicentrarchus labrax*; BXD: *Beryx decadactylus*; CBR: *Serranus cabrilla*; CCB: *Carcharhinus brevipinna*; CCP: *Carcharhinus plumbeus*; COE: *Conger conger*; CTB: *Diplodus vulgaris*; CWC: *Crenidens crenidens*; DEC: *Dentex dentex*; DEP: *Dentex gibbosus*; DEX: *Dentex* spp.; DGS: *Squalus acanthias*; DOL: *Coryphaena hippurus*; EEA: *Epinephelus fasciatus*; EFJ: *Epinephelus caninus*; ELE: *Anguilla anguilla*; EPK: *Epinephelus costae*; FOR: *Phycis phycis*; GPD: *Epinephelus marginatus*; GPW: *Epinephelus aeneus*; GPX: *Epinephelus* spp.; GUU: *Chelidonichthys lucerna*; HKE: *Merluccius merluccius*; HMY: *Caranx rhonchus*; HOM: *Trachurus trachurus*; JAI: *Raja miraletus*; JRS: *Raja asterias*; LEE: *Lichia amia*; LFZ: *Lagocephalus sceleratus*; LTA: *Euthynnus alletteratus*; MGR: *Argyrosomus regius*; MLR: *Chelon labrosus*; MMH: *Muraena helena*; MNZ: *Lophius* spp.; NNZ: *Nemipterus randalli*; PAC: *Pagellus erythrinus*; PAX: *Pagellus* spp; POA: *Brama brama*; QUB: *Squalus blainville*; RJC: *Raja clavata*; RPG: *Pagrus pagrus*; RSE: *Scorpaena scrofa*; SBA: *Pagellus acarne*; SBG: *Sparus aurata*; SBP: *Pagrus* spp.; SBR: *Pagellus bogaraveo*; SBZ: *Diplodus cervinus*; SDV: *Mustelus* spp.; SFS: *Lepidopus caudatus*; SHO: *Galeus melastomus*; SKA: *Raja* spp.; SKJ: *Katsuwonus pelamis*; SMA: *Isurus oxyrinchus*; SMD: *Mustelus mustelus*; SRG: *Diplodus* spp.; SSB: *Lithognathus mormyrus*; SWA: *Diplodus sargus*; SWO: *Xiphias gladius*; SYC: *Scyliorhinus canicula*; TUR: *Scophthalmus maximus*; WHB: *Micromesistius poutassou*; WRF: *Polyprion americanus*; Mono: monofilament twine; Multi: multifilament twine; Br: braided twine; Mono + S: monofilament and steel wire.

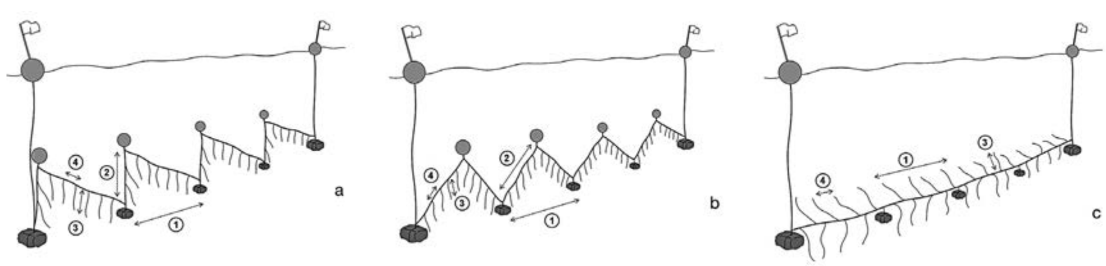
Western Mediterranean

In Morocco (GSA 3), a wide variety of set longlines are employed. One type is used to catch sparids, mainly blackspot seabream (*Pagellus bogaraveo*), at a mean depth of 300 m. Very large hooks (7.2 cm long) in relatively low numbers (200–300) are used in longlines targeting elasmobranchs and the meagre (*Argyrosomus regius*) at around 40 m depth. Smaller hooks (2–5 cm long) are employed in larger numbers (from 200 to 1 500) to target different species, such as groupers (*Epinephelus* spp.), large sparids, including common dentex (*Dentex dentex*), pargo breams (*Pagrus* spp.) and gilthead seabream (*Sparus aurata*), as well as European conger (*Conger conger*) and Mediterranean moray (*Muraena helena*). The depth of deployment ranges from 20 m to 150 m, and the baits used are mainly sardines and cephalopods (Benhardouze, 2009; Darasi, 2014).

In Algeria (GSA 4), this type of gear is widespread but is dominant in the central region of the country (Laid, Lamri and Kadri, 2001; Sahi and Bouaicha, 2003). It mainly targets conger eel (*Conger* spp.), groupers, pandoras (*Pagellus* spp.), forkbeards (*Phycis* spp.) and rays at depths ranging from 10 m to 1 000 m.

The Spanish set longlines operate in GSAs 1, 5 and 6 and mainly target sparids, including blackspot seabream, common dentex, gilthead seabream and red porgy (*Pagrus pagrus*), as well as European hake (*Merluccius merluccius*) and blackbelly rosefish (*Helicolenus dactylopterus*) from 10 m depth up to 850 m. The number of hooks employed is highly variable, from 70 to 2 000; however, the hook is always J-shaped and the length is around 3 cm. In the Balearic Islands (GSA 5) and the northeastern Iberian waters (GSA 6), the demersal longline fleet uses two types of configurations (Figure 86): i) the *piedra bola* (PB) system, which is characterized by using a combination of weights and floats so that hooks are kept at different depths; and ii) the bottom longline, which keeps the hooks level over the sea floor by only attaching weights to the snoods at regular intervals (Cortés, Arcos and González-Solís, 2017). The PB system may also be divided into two different subgroups: the zigzag (Figure 85, left) and the pyramidal structure (Figure 85, centre). The zigzag structure is most commonly used by medium-scale vessels targeting European hake and blackbelly rosefish. Pyramidal structures are less frequently used and target blackspot seabream and occasionally more pelagic species such as Atlantic pomfret (*Brama brama*). Bottom longlines are typically used by small-scale vessels to catch a wide diversity of demersal fish, such as common pandora (*Pagellus erythrinus*), common dentex and gilthead seabream. The Spanish artisanal longline fishery targeting blackspot seabream has been developed in the Strait of Gibraltar area, sharing a small part in the Mediterranean and in International Council for Exploration of the Sea (ICES) subarea 9. The gear used is locally called *voracera*, a particular mechanized hook and line baited with sardine.

FIGURE 85
***Piedra bola* (left and centre) and longline (right) riggings used in the Balearic Islands**



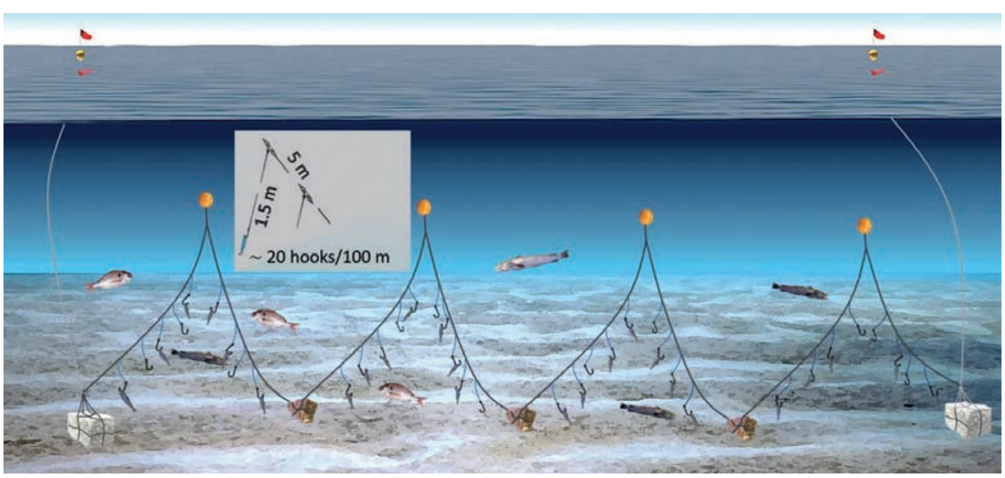
Notes: 1. distance between weights; 2. minimum distance between the weight and the float; 3. length of branch lines; 4. distance between hooks.

Source: **Cortés, V., Arcos, J.M. & González-Solís, J.** 2017. Seabirds and demersal longliners in the northwestern Mediterranean: factors driving their interactions and bycatch rates. *Marine Ecology Progress Series*, 565: 1–16.

In Spain, there is also a specific set longline (García-Barcelona *et al.*, 2010) targeting swordfish (*Xiphias gladius*). This gear is operated by the longline fleet mainly from July to October, although its use is not regulated by the current swordfish fishing legislation (ICCAT, 2022). It is also used by traditional vessels with small gross register tonnage, operating in coastal waters or grounds near their home ports. As such, the specific set longline is a variant of the bottom longline targeting silver scabbardfish (*Lepidopus caudatus*), consisting of a longline similar to the traditional one but with a shorter distance between the hooks and fixed at the bottom by means of a few weights or stones interspersed between floats. It is not a drifting longline and is usually employed close to the continental slope. The number of hooks in each fishing set does not usually exceed 900 and typically only reaches 600. The bait used is usually mackerel (*Scomber* spp.) or round sardinella (*Sardinella aurita*).

In France (GSA 7), several types of longlines are used by the small-scale fishing fleet as an alternative technique in order to target demersal or benthic fish (J. Sacchi, personal communication, 2023). A bottom longline having 200–1 100 hooks with a length of 25.5 mm and width of 12 mm, or with length of 31 mm and width of 16 mm, is used to catch European conger. The mainline is made of braided material (4 mm diameter) and its length is between 2 500 m and 3 500 m. The length of the branch lines is 80–200 cm; they are set every 4–5 m and are made of polyamide (PA) with 1.4–1.8 mm diameter. Baits include round sardinella, mackerel or bogue (*Boops boops*). Another set longline is deployed in shallower waters (11–50 m) to catch the European seabass (*Dicentrarchus labrax*) and sparids (gilthead seabream, pandoras). It employs from 60 to 500 J-hooks on a 5 km maximum PA monofilament mainline of 3 mm diameter with 100 cm monofilament branchlines (1.2–1.5 mm diameter) spaced every 4–5 m and baited with mussels, crabs, grooved razor clam (*Solen marginatus*) or sipunculids. European hake and blackspot seabream are targeted at depths ranging from 160 m to 600 m with a set longline called *en pendis* and adapted from the *piedra bola* longline originating from the Bay of Biscay (Aldebert, Recasens and Lleonart, 1993; Figure 86). The fishing gear consists of a monofilament mainline of 1.2–1.3 mm in diameter formed of sections 3–4 m long, each supporting about twenty monofilament branch lines 0.6–0.8 mm thick and 1.5 m long; between each section, a 1-litre float or 1.5–2 kg of ballast are alternately fixed. The configuration of this longline is designed to catch species in open water, which prevents hooks (J 3/0), baited with mackerel, sardine or bogue, from being within the reach of benthic scavengers. Another set longline with a similar conception is used in this area to catch swordfish.

FIGURE 86
Piedra bola **mid-water longline used in the Gulf of Lion, France**



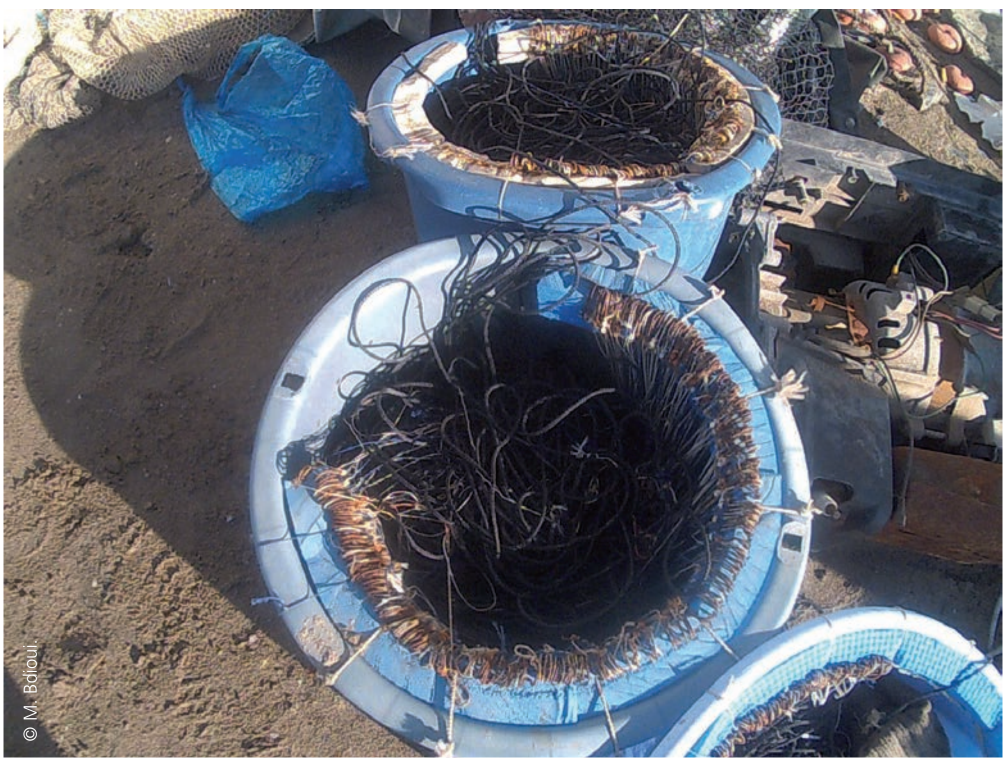
Source: illustrated by A. Lucchetti.

In Italy (GSA 10), a particular longline with very large hooks (7 cm hook length), and with both braided mainlines and branch lines is employed to catch European hake. In the same area, there are also longlines targeting sparids and other species, such as Atlantic pomfret, that are made of a braided mainline and monofilament branch lines, and the J-hooks are mostly baited with sardines. In addition, some longlines are exclusively made of monofilament mainline and branch lines; for instance, a set longline with 1 400–2 000 hooks baited with sardine is deployed at depths of 150–300 m to catch the silver scabbardfish, which is abundant in these areas of the Tyrrhenian Sea (Colloca *et al.*, 2003; Battaglia *et al.*, 2010).

Central Mediterranean

In Tunisia (GSAs 12, 13 and 14), set longlines are widely employed, especially in the Gulf of Gabès (Echwikhi *et al.*, 2012). They catch sparids, groupers of the genera *Epinephelus* and *Polyprion* and elasmobranchs; both C-hooks and J-hooks are used, in numbers ranging from 500 to 5 000, and are mostly baited with round sardinella and sardine, but also with other fish and cephalopods (Romdhane *et al.*, 2014; Echwikhi *et al.*, 2014). The hook length varies from 2 cm (used for sparids) to 9 cm (used for large sharks in the genus *Carcharhinus*). The mainline, which can be up to 20 km long, can be a braided or monofilament line, as can the branch lines (Plate 60). The operational depth ranges from 20 m to 900 m.

PLATE 60
Demersal longline used in Tunisia



In Malta (GSA 15), a set longline has been reported. It is deployed at 150–400 m depth to target elasmobranchs, namely longnose spurdog (*Squalus Blainville*), piked dogfish (*Squalus acanthias*), smooth-hounds (*Mustelus* spp.) and *Raja* spp. (Dimech *et al.*, 2009). In addition, De Leiva *et al.* (1998) have reported a surface set longline targeting piked dogfish called *ormeggio*. It is used in the southern part of Malta and in the southwest of Gozo all year round by being anchored and baited with chunks of meat or pieces of large fish to attract sharks. The main season for this fishery is from November to May. Other set bottom longlines are used mainly to target species of the Sparidae family, such as pandoras, red porgy and common dentex, but also Serranidae such as wreckfish (*Polyprion americanus*) and blacktip grouper (*Epinephelus fasciatus*). These longlines are set in deep rocky areas near the slope, at depths of 200 m or more.

In Italy (GSA 16), a small longline (500 m mainline and 200 J-hooks) is employed in shallow waters (20 m) to catch bogue and axillary seabream (*Pagellus acarne*), using squid as bait (Cillari *et al.*, 2012). Other longlines, employing from 130 to 2 000 J-hooks (1.9–2.6 cm long) are used in both GSA 16 and GSA 19 to catch sparids, European hake and other demersal fish (Cannizzaro *et al.*, 2000). They are mainly baited with sardines, shrimps and sea cucumbers and deployed at depths ranging from 10–30 m (to catch sparids) to 35–130 m (to catch European hake).

In Greece (GSA 20), set longlines are used at depths ranging from 20 m to 100 m. In the Patraikos Gulf, no more than 300–500 hooks are used by the longline boats to catch European hake from May to September, greater amberjack (*Seriola dumerili*) from August to September and common dentex from March to November (Tzanatos *et al.*, 2007). In addition, longlines targeting other sparids (*Diplodus* spp., gilthead seabream, pandoras, red porgy) are reported (Tzanatos *et al.*, 2007). The technical features follow the description given in the section on the eastern Mediterranean (Adamidou, 2007).

In Libya (GSA 21), a great variety of set longlines are used in relation to the target species (mostly groupers, sparids and sharks; Lamboeuf, 2001). These differ in the number of hooks deployed (100–1 500), the types of bait used (fish and cephalopods) and the operational depths (from a few meters up to 400 m). Nevertheless, they are always made of a braided mainline and monofilament branch lines and use J-hooks.

Adriatic Sea

In Italy, the offshore bottom longline fishery is mostly carried out on the continental slope off the southern Adriatic Sea (GSA 18), where both soft and rocky areas are exploited (Tatone, 2008; Colombelli, Pulcinella and Sala, 2018). The fishing activity mainly targets European hake on muddy bottoms from 200 m to 400 m depth; scorpionfishes (*Scorpaena* spp.), tub gurnard (*Chelidonichthys lucerna*) and blackspot seabream are mostly caught at depths of 150–350 m on mixed bottoms. Other species may be caught as bycatch: European conger, blackmouth catshark (*Galeus melastomus*), blackbelly rosefish, bluntnose sixgill shark (*Hexanchus griseus*), silver scabbardfish, smooth-hound (*Mustelus mustelus*), greater forkbeard (*Phycis blennoides*), forkbeard (*Phycis phycis*), wreckfish, *Raja* spp. and piked dogfish. The typical fishing trip duration is from two to four days, depending on the weather conditions. The standard offshore bottom longline is generally 3 500 m long and the number of hooks ranges from 500 to 700. The material used for the mainline has changed in the last twenty years from polypropylene (PP) multifilament to PA monofilament. Currently, the PA monofilament with a diameter of 2.0–2.5 mm is used. Each vessel can use more than one bottom longline set during the fishing trip. The branch lines have a length of about 1.8–3.5 m (1.0–1.2 mm diameter) and the hook type and size are normally 4–6 cm long J-hooks. A distance of around 5–10 m is used between the snoods. The most common baits are frozen sardines and squids. Sardines, hooked by the eyes, provide a good balance between attractive suitability, size of the bait, price and fast baiting operation. The bottom-set longline is lowered during the night, with hauling operations lasting about four to five hours, depending on the length of the longline set. The fishing operations begin several hours later, around midday, and generally last until late in the evening. The bottom longline is lowered by advancing in opposite or divergent directions forming a series of angles (zigzags). All of the branch lines have the same length and are connected to the mainline by a swivel joint. The introduction of swivels has improved and made the hauling operations faster. Tangling and twisting of the snoods around the mainline have decreased compared to the traditional design where the snood was connected directly to the mainline with a knot. Two metal clamps limit the movement of the swivel on the longline (Plate 61). Alternatively, the swivel can be attached to the mainline between two knots and fluorescent beads that constrain its movements (Plate 61).

PLATE 61
Traditional swivel attachment using metal clamps (left) and innovative swivel attachment using nylon knots and plastic balls (right)

In Croatia (GSAs 17 and 18), the catch composition of set longlines is dominated by European hake, followed by gurnards (Triglidae) and European conger (Matić-Skoko *et al.*, 2017). Around 3 000 hooks are used (18–22 km mainline) at 90–160 m depth. Up to 3 500 hooks are allowed by legislation, depending on the region (18–22 km mainline), at 90–160 m depth. The minimum hook gap allowed is 10 mm. Set longlines (up to 100 hooks) are also allowed in sport fisheries.

In Montenegro (GSA 18), set longlines are widely used to catch several demersal species. The European conger is the dominant species, followed by red porgy, European hake and gurnards (Matić-Skoko *et al.*, 2017). The mainline length is usually 0.6–1.5 km.

Eastern Mediterranean

In Greece (GSA 22), the set longlines employed are highly diversified. According to Adamidou (2007), they are divided, based on the size of the hook and operational depths, into small, medium and large longlines. For the small longlines, the hooks are around 2–3 cm long, the mainline is 0.5–1 mm thick, the branch lines are 0.2–0.6 mm thick and the space between them is 2.5–5 m. They are used at depths from 20 m to 100 m for sparids, namely common pandora, white seabream (*Diplodus sargus*), red porgy and gilthead seabream. For example, the artisanal longline employed in the Cyclades (Aegean Sea) uses small hooks (1.9–2.8 cm long) baited with squid and cuttlefish and mainly catches comber (*Serranus cabrilla*), European conger and sparids, namely common pandora, annular seabream (*Diplodus annularis*) and common two-banded seabream (*Diplodus vulgaris*) (Stergiou and Erzini, 2002). For the medium longlines, the hooks are around 3–4 cm long, the mainline is 0.5–1.2 mm thick, the branch lines are 0.4–0.8 mm thick and the space between them is 5–8 m. They are used at depths from 80 m to 180 m for larger species of the Sparidae family (common pandora, white seabream, red porgy, gilthead seabream), dusky grouper (*Epinephelus marginatus*) and white grouper (*Epinephelus aeneus*). For the large longlines, the hooks are 4.5–7 cm long, the mainline is 1–2.5 mm thick, the branch lines are 0.5–0.1 mm thick, sometimes made of wire, and the space between them is 8–11 m. They are used at depths from 200 m to 700 m for European hake, common dentex, dusky grouper, white grouper, wreckfish, greater amberjack, blacktip grouper and elasmobranchs. In addition, a particular set surface longline specifically targets swordfish and tunnids. It has stabilization equipment (weights) at one or both ends, a thick mainline (1.5–3 mm) and branch lines (1–2 mm) spaced 20–45 m apart. The hooks are 4.5–6 cm long. At intervals of 5–15 hooks, plastic buoys of 1.5–3 litres and weights of 0.5 kg are connected to the mainline; meanwhile at each end and in the middle of the mainline, large buoys of 20 litres and weights of 5–10 kg are also connected. Flags and reflectors placed on buoys at the ends of the longline enable it to be located.

Along the Turkish Mediterranean coast (GSAs 22 and 24), the longline fishery is very common (Soykan, Aydın and Kınacıgil, 2016). These longlines target the same species (i.e. sparids and groupers) as the Greek longlines, but use thinner mainlines (0.5–0.6 mm) and branch lines (0.3–0.4 mm), and also a greater variety of bait – squid, cuttlefish, mackerel, sardine, anchovy, sea cucumbers, *Murex* spp. and the Mediterranean mud shrimp (*Upogebia pusilla*) (Gülşahin and Soykan, 2017). Longline fishing is mostly conducted daily by small vessels (6–10 m length) with one or two fishers. Set longlines are also used to catch leerfish (*Lichia amia*) and larger sparids, including pink dentex (*Dentex gibbosus*), as well as groupers and swordfish using a thicker mainline (0.6–1.5 mm) and branch lines (0.4–1.2 mm; Tokaç *et al.*, 2010; Özbilgin *et al.*, 2010).

In Cyprus (GSA 25), the longlines recorded have a small number of hooks (200–600) and consequently a mainline with a maximum length of 3.5 km. Both the mainline and branch lines are made of monofilament line. They mainly target large sparids (e.g. *Dentex* spp., pargo breams) and groupers at depths ranging from 5 m to 500 m (Haktanir *et al*., 2015).

In Egypt (GSA 26), there are set longlines designed to catch large pelagic species, such as: tunnids, including little tunny (*Euthynnus alletteratus*), albacore (*Thunnus alalunga*) and skipjack tuna (*Katsuwonus pelamis*); swordfish (Gabr and El-Haweet, 2012); sparids, namely white seabream and the Lessepsian migrant karanteen seabream (*Crenidens crenidens*) (El-Far, 2008); and the silver-cheeked toadfish (*Lagocephalus sceleratus*; Farrag, 2014). The hooks (400–500 per longline) are 4–4.5 cm long and baited with sardines and cephalopods; both the mainline and branch lines are made of monofilament line.

In Lebanese waters (GSA 27), the bottom longlines used, locally known as *sharrak*, usually consist of a transparent PA monofilament mainline, with PA monofilament snoods of about 1 m long spaced 5–6 m apart (Sacchi and Dimech, 2011). The most common gear has a mainline of 1.2 mm diameter, with a snood of 0.4–0.6 mm and hooks 3 cm long and 1.5 cm wide. The smallest longlines have a snood of 0.35 mm diameter and hooks of 1.5 mm length and 0.5 mm width. Floats can be alternately fixed on the mainline every five snoods to set the bait away from the bottom and to avoid the bait being consumed by scavengers. During the same fishing day, the vessels can deploy more than one longline unit (2–3 per vessel) with 200 to 300 hooks each. Bottom longlines in Lebanon are widely used to catch high-value fish, such as sparids, including bluespotted seabream (*Pagrus caeruleostictus*), red porgy, common dentex, white seabream and zebra seabream (*Diplodus cervinus*), as well as and serranids (dusky grouper and blacktip grouper).

In Palestine (GSA 27), a short bottom longline (100 m) entirely made of monofilament line is used to target sparids, groupers and greater amberjack. Other bottom longlines with 800 hooks and baited with sardines or fish meat are also targeting groupers and other demersal species (Ali, 2002).

Black Sea

In the Turkish Marmara Sea (GSA 28), two types of set longlines are employed. They both target the common dentex and sparids (white seabream, pargo breams), and have 150–170 hooks, a 1.2 mm mainline and 0.8 mm branch lines (both monofilament), but one is deployed at depths of 30–80 m with a mainline length of 1 km, whereas the other is deployed in shallower waters (20 m) with a mainline length of 1.8–2 km (Doyuk, 2006).

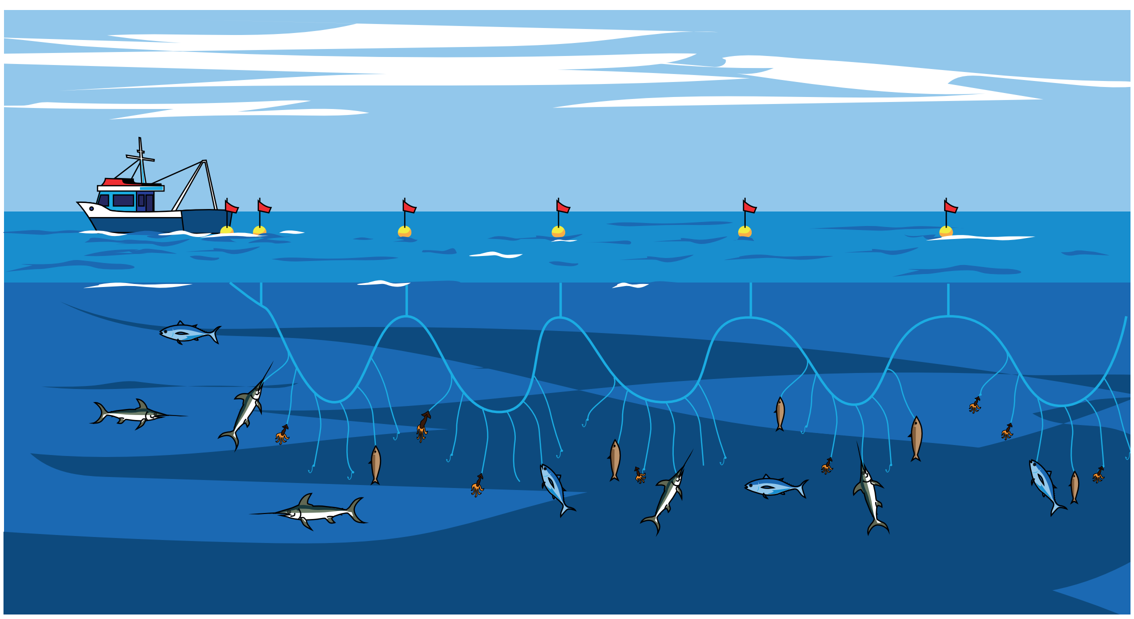
In Bulgaria (GSA 29), a set longline is recorded as catching piked dogfish at depths ranging from 50 m to 100 m. It is made of 300 J-hooks (3.5–4 cm long), baited with horse mackerel. Both mainline and branch lines are made of monofilament line.

Similar set longlines are also used in Romania to catch piked dogfish and in Ukraine (GSAs 29 and 30) to catch rays, including thornback ray (*Raja clavata*) and common stingray (*Dasyatis pastinaca*), as well as sharks (i.e. piked dogfish; Radu and Radu, 2008). The vessels usually deploy an average of 80 lines with lengths of around 25 hooks per line. This provides an estimate of 2 000 hooks per boat on average. The most commonly reported hook size is a No. 1, which varies slightly in size depending on the manufacturer.

5.2.2 Drifting longlines

A drifting longline is a type of longline that is not anchored to the sea floor (as in the case of set longlines) and passively drifts with the current; one end of the longline can also be attached to the boat (Figure 87). The mainline of a drifting longline can either be set on the sea surface or in the water column (meso-pelagic longline).

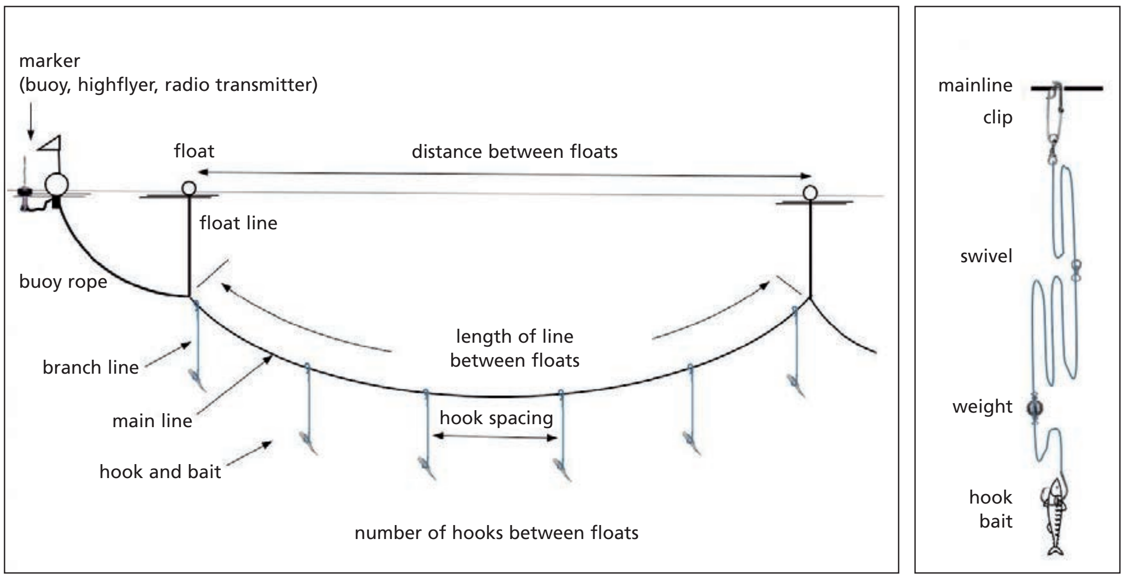
FIGURE 87
Drifting longline



Source: redrawn by Koen Ivens from A. Lucchetti.

In the Mediterranean, drifting longlines are often used in offshore waters and comprise a mainline up to 60–80 km long. They are mainly deployed to target large pelagic species such as Atlantic bluefin tuna (*Thunnus thynnus*), swordfish and albacore. Sometimes, sharks are considered as target species. The success of this type of fishing activity is based on setting the longline for optimized overlap between the distribution of hook depths and the supposed preferential vertical habitats of the target species. Therefore, the depth of the hooks influences both catch rates and species composition and can be controlled in a number of ways, including: the length of line between floats, the length of the floatline, the length of the branch line, and the depth of mainline catenary, which is determined by the length of the mainline relative to the distance between the nearest floats (He *et al.*, 2021). The length of the branch lines in drifting longlines can exceed 10 m and may include a clip, one or more swivels and a weight (Figure 88). Radio or satellite buoys are often used at intervals along the mainline to monitor the position of the gear.

FIGURE 88
Technical elements of a drifting longline



Source: **He, P., Chopin, F., Suuronen, P., Ferro, R.S.T & Lansley, J.** 2021. *Classification and illustrated definition of fishing gears.* FAO Fisheries and Aquaculture Technical Paper No. 672. Rome, FAO. https://doi.org/10.4060/cb4966en

Subregional variations

In Table 23, the characteristics of the drifting longlines used in the different areas of the Mediterranean Sea are summarized.

Table 23

Technical parameters of drifting longlines used in the Mediterranean Sea

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (km)	Diameter (mm)	Type	Distance between branch lines (m)		
1	Western Mediterranean	Spain	ALB	J	4.3	2 000–7 000	35.0–90.0	1.8	Mono	7	0.8	Mono	14	Sardine	20–50
1	Western Mediterranean	Spain	SWO	J	7.5	900–1 300	90.0–100.0			7–10			70–90	Mackerel, round sardinella, squid	50–90
1	Western Mediterranean	Spain	SWO	J	7.5	1 500–4 000	37.0–65.0	1.8–2.0	Mono	6–11	1.3–1.6	Mono	22	Mackerel, sardine, round sardinella, Atlantic saury, silver scabbardfish, squid	40–70
1	Western Mediterranean	Spain	SWO	J	7.5	900–1 500	37.0–65.0						33	Mackerel, squid, round sardinella	200–700
1	Western Mediterranean	Spain	BFT	C	7.5	250–1 200	9.0–90.0	4.0–7.0	Mono	22–43	2.5–3.0	Mono	50–70	Squid, mackerel, bogue	50–90
1	Western Mediterranean	Spain	SWO	J		1 400–1 600								Squid, mackerel	
3	Western Mediterranean	Morocco	SWO, Tunnidae, Carcharhinidae			2 000–5 000	20.0–50.0			2			1	Cuttlefish, sardine, mackerel	
3	Western Mediterranean	Morocco	SWO, Tunnidae, Carcharhinidae	J	10.7	216	7.7	3.0	Mono	14	1.9	Mono	22.5	Sardine, round sardinella	
3	Western Mediterranean	Morocco	SWO, Tunnidae, Carcharhinidae	J	9.1	300		3.0	Mono	9	1.8	Mono	20	Squid, octopus, mackerel, sardine, round sardinella	
4	Western Mediterranean	Spain	ALB	J	4.3	2 000–7 000	35.0–90.0	1.8	Mono	7	0.8	Mono	14	Sardine	20–50
4	Western Mediterranean	Spain	SWO	J	7.5	900–1 300	90.0–100.0			7–10			70–90	Mackerel, round sardinella, squid	50–90
4	Western Mediterranean	Spain	SWO	J	7.5	1 500–4 000	37.0–65.0	1.8–2.0	Mono	6–11	1.3–1.6	Mono	22	Mackerel, sardine, round sardinella, Atlantic saury, silver scabbardfish, squid	40–70

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (km)	Diameter (mm)	Type	Distance between branch lines (m)		
4	Western Mediterranean	Spain	BFT	C	7.5	250–1 200	9.0–90.0	4.0–7.0	Mono	22–43	2.5–3.0	Mono	50–70	Squid, mackerel, bogue	50–90
4	Western Mediterranean	Algeria	BFT, SWO, DGS			320	3.2	4.0	Multi	6	1.6	Mono	18		60–200
5	Western Mediterranean	Spain	ALB	J	4.3	2 000–7 000	35.0–90.0	1.8	Mono	7	0.8	Mono	14	Sardine	20–50
5	Western Mediterranean	Spain	SWO	J	7.5	900–1 300	90.0–100.0			7–10			70–90	Mackerel, round sardinella, squid	50–90
5	Western Mediterranean	Spain	SWO	J	7.5	1 500–4 000	37.0–65.0	1.8–2.0	Mono	6–11	1.3–1.6	Mono	22	Mackerel, sardine, round sardinella, Atlantic saury, silver scabbardfish, squid	40–70
5	Western Mediterranean	Spain	SWO	J	7.5	900–1 500	37.0–65.0						33	Mackerel, squid, round sardinella	200–700
5	Western Mediterranean	Spain	BFT	C	7.5	250–1 200	9.0–90.0	4.0–7.0	Mono	22–43	2.5–3.0	Mono	50–70	Squid, mackerel, bogue	50–90
6	Western Mediterranean	Spain	ALB	J	4.3	2 000–7 000	35.0–90.0	1.8	Mono	7	0.8	Mono	14	Sardine	20–50
6	Western Mediterranean	Spain	SWO	J	7.5	900–1 300	90.0–100.0			7–10			70–90	Mackerel, round sardinella, squid	50–90
6	Western Mediterranean	Spain	SWO	J	7.5	1 500–4 000	37.0–65.0	1.8–2.0	Mono	6–11	1.3–1.6	Mono	22	Mackerel, sardine, round sardinella, Atlantic saury, silver scabbardfish, squid	40–70
6	Western Mediterranean	Spain	SWO	J	7.5	900–1 500	37.0–65.0						33	Mackerel, squid, round sardinella	200–700
6	Western Mediterranean	Spain	BFT	C	7.5	250–1 200	9.0–90.0	4.0–7.0	Mono	22–43	2.5–3.0	Mono	50–70	Squid, mackerel, bogue	50–90
7	Western Mediterranean	France	SWO, ALB, BFT	J		400–900								Sardine	

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (km)	Diameter (mm)	Type	Distance between branch lines (m)		
7	Western Mediterranean	France	BFT	J	8–9		20.0–100.0	3.0–5.0	Mono	20–30	2.0–3.0	Mono	35–50	Sardine, squid	
7	Western Mediterranean	France	SWO	J	8–9	400–1 800	20.0–100.0	2.0	Mono	11	1.3	Mono	25–30	Sardine	
7	Western Mediterranean	France	SWO	J	4.9–6.0	300–500	6.0–10.0	1.4	Mono	5	1.2	Mono	20–30	Sardine, round sardinella, mackerel	50–200
7	Western Mediterranean	France	SWO	J	4.9–6.0	300–500	17.0–20.0	1.6	Mono	10–15	1.2	Mono	20–30	Sardine	
8	Western Mediterranean	France	SWO, ALB, BFT	J		400–900								Sardine	
8	Western Mediterranean	France	SWO, ALB, BFT	C		400–900								Sardine	
8	Western Mediterranean	France	BFT	C	8–9		20.0–100.0	3.0–5.0	Mono	20–30	2.0–3.0	Mono	35–50	Sardine, squid	
8	Western Mediterranean	France	SWO	J	8–9	400–1 800	20.0–100.0	2.0	Mono	11	1.3	Mono	25–30	Sardine	
8	Western Mediterranean	France	SWO	J	4.9–6.0	300–500	6.0–10.0	1.4	Mono	5	1.2	Mono	20–30	Sardine, round sardinella, mackerel	50–200
8	Western Mediterranean	France	SWO	J	4.9–6.0	300–500	17.0–20.0	1.6	Mono	10–15	1.2	Mono	20–30	Sardine	
9	Western Mediterranean	Italy	BFT	J	4.5–4.8	1 250–2 500	50.0–100.0	0.8	Mono	20–50		Mono+S	40–50	Mackerel, squid	
9	Western Mediterranean	Italy	BFT	J, C	9.0–10.0	1 500–2 500	60.0–100.0	0.8	Mono	30–55		Mono+S	40–50	Mackerel, squid	
9	Western Mediterranean	Italy	SWO	J	5.0–9.0	100–3 000	2.0–90.0	1.5–1.8		6–50		Mono	30–50	Mackerel, squid, sardine	
9	Western Mediterranean	Italy	ALB	J	2.0–4.0	200–3 000	2.0–50.0	1.2–1.5	Mono	2–6	0.6–0.7	Mono	11–20	Sardine, round sardinella	

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (km)	Diameter (mm)	Type	Distance between branch lines (m)		
9	Western Mediterranean	Italy	SWO	J	7.0	600–1 500		1.4	Mono		1.3	Mono			10–20
9	Western Mediterranean	Italy	SWO	J		500–1 800		2.0	Mono		Two sections: 1.3 + 1.2	Mono+S		Sardine, plastic bait	100–600
10	Western Mediterranean	Italy	BFT	J	4.5–4.8	1 250–2 500	50.0–100.0	0.8	Mono	20–50		Mono+S	40–50	Mackerel, squid	
10	Western Mediterranean	Italy	BFT	J	9.0–10.0	1 500–2 500	60.0–100.0	0.8	Mono	30–55		Mono+S	40–50	Mackerel, squid	
10	Western Mediterranean	Italy	SWO	J	5.0–9.0	100–3 000	2.0–90.0	1.5–1.8		6–50		Mono	30–50	Mackerel, squid, sardine	
10	Western Mediterranean	Italy	ALB	J	2.0–4.0	200–3 000	2.0–50.0	1.2–1.5	Mono	2–6	0.6–0.7	Mono	11–20	Sardine, round sardinella	
10	Western Mediterranean	Italy	ALB	J		1 200–2 500		1.2–1.8	Mono	5–8		Mono		Clupeoid fish	
10	Western Mediterranean	Italy	SWO	J		800–1 300		1.8	Mono	9		Mono		Mackerel, squid	
10	Western Mediterranean	Italy	BFT	C		800–1 200		2.3	Mono	10–12	1.8–2.0	Mono		Squid	
10	Western Mediterranean	Italy	BFT, SWO	J		700–800	24.0–28.0	1.4	Mono	5–6	1.2	Mono	25–35	Mackerel	
10	Western Mediterranean	Italy	DOL, ALB, SWO	J		300–500	6.0–13.0	1.2	Mono	5–6	0.8–0.9	Mono	20–22	Sardine, mackerel	
12	Central Mediterranean	Tunisia	SWO, Tunnidae	J		1 500		1.5–2.5		0.5–2	0.6–1.0	Mono	2–10		
12	Central Mediterranean	Tunisia	SWO	J		600–2 500	20.0–60.0	1.5–2.5	Br	8–20	1.1–1.3	Mono	40–50	Round sardinella, mackerel, bogue	8–40
12	Central Mediterranean	Tunisia	SWO	J		600–1 800	20.0–40.0	1.3	Mono	8–15	1–1.2	Mono	30–50	Round sardinella, mackerel, bogue	8–40

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (km)	Diameter (mm)	Type	Distance between branch lines (m)		
13	Central Mediterranean	Italy	BFT	J	9.0–10.0	1 500–2 500	60.0–100.0	0.8	Mono	30–55		Mono+S	40–50	Mackerel, squid	
13	Central Mediterranean	Italy	SWO	J	5.0–9.0	100–3 000	2.0–90.0	1.5–1.8		6–50		Mono	30–50	Mackerel, squid, sardine	
13	Central Mediterranean	Italy	ALB	J	2.0–4.0	200–3 000	2.0–50.0	1.2–1.5	Mono	2–6	0.6–0.7	Mono	11–20	Sardine, round sardinella	
13	Central Mediterranean	Tunisia	SWO, Tunnidae	J		1 500		1.5–2.5		0.5–2	0.6–1.0	Mono	2–10		
13	Central Mediterranean	Tunisia	SWO	J		600–2 500	20.0–60.0	1.5–2.5	Br	8–20	1.1–1.3	Mono	40–50	Round sardinella, mackerel, bogue	8–40
13	Central Mediterranean	Tunisia	SWO	J		600–1 800	20.0–40.0	1.3	Mono	8–15	1–1.2	Mono	30–50	Round sardinella, mackerel, bogue	8–40
13	Central Mediterranean	Tunisia	BSS, SBG, SRG	J		1 000–1 500	4.0–7.5	1.5	Br	0.5	0.6–0.8	Mono	2.0–2.5	Gobids, sand smelt, cuttlefish, grey mullet, musky octopus	2–30
13	Central Mediterranean	Tunisia	GAR	J		1 000–1 500	2.0–3.8	1.5	Br	0.5	0.5–0.6	Mono	2.0–2.5	Gobids, sand smelt	2–5
14	Central Mediterranean	Tunisia	SWO, Tunnidae	J		1 500		1.5–2.5		0.5–2	0.6–1.0	Mono	2–10		
14	Central Mediterranean	Tunisia	CWZ, SMA	J		400–1 200	10.0–50.0	1.6	Mono	6–6.5	1.4	Mono	34–40	Mackerel	40–100
14	Central Mediterranean	Tunisia	SWO	J		600–2 500	20.0–60.0	1.5–2.5	Br	8–20	1.1–1.3	Mono	40–50	Round sardinella, mackerel, bogue	8–40
14	Central Mediterranean	Tunisia	SWO	J		600–1 800	20.0–40.0	1.3	Mono	8–15	1–1.2	Mono	30–50	Round sardinella, mackerel, bogue	8–40
14	Central Mediterranean	Tunisia	BSS, SBG, SRG	J		1 000–1 500	4.0–7.5	1.5	Br	0.5	0.6–0.8	Mono	2.0–2.5	Gobids, sand smelt, cuttlefish, grey mullet, musky octopus	2–30

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (km)	Diameter (mm)	Type	Distance between branch lines (m)		
14	Central Mediterranean	Tunisia	SWO	J		600–900	1.4–30.0	1.5–2.0	Br	5–6	1.2–1.6	Mono	35–50	Round sardinella, mackerel, bogue	8–40
14	Central Mediterranean	Tunisia	SWO, Elasmobranchs	J	9.8–11.1	500–2 500	20.0–50.0			8			40	Mackerel, bogue, ray	8–15
15	Central Mediterranean	Italy	BFT	J	4.5–4.8	1 250–2 500	50.0–100.0	0.8	Mono	20–50		Mono+S	40–50	Mackerel, squid	
15	Central Mediterranean	Italy	BFT	J	9.0–10.0	1 500–2 500	60.0–100.0	0.8	Mono	30–55		Mono+S	40–50	Mackerel, squid	
15	Central Mediterranean	Italy	SWO	J	5.0–9.0	100–3 000	2.0–90.0	1.5–1.8		6–50		Mono	30–50	Mackerel, squid, sardine	
15	Central Mediterranean	Italy	ALB	J	2.0–4.0	200–3 000	2.0–50.0	1.2–1.5	Mono	2–6	0.6–0.7	Mono	11–20	Sardine, round sardinella	
15	Central Mediterranean	Malta	BFT			500–1 800								Mackerel, squid	
15	Central Mediterranean	Tunisia	SWO, Elasmobranchs			1 000–1 200			Mono			Mono	35–40	Round sardinella, sardine, ray, mackerel, bogue	6–24
16	Central Mediterranean	Italy	BFT	J	4.5–4.8	1 250–2 500	50.0–100.0	0.8	Mono	20–50		Mono+S	40–50	Mackerel, squid	
16	Central Mediterranean	Italy	BFT	J	9.0–10.0	1 500–2 500	60.0–100.0	0.8	Mono	30–55		Mono+S	40–50	Mackerel, squid	
16	Central Mediterranean	Italy	SWO	J	5.0–9.0	100–3 000	2.0–90.0	1.5–1.8		6–50		Mono	30–50	Mackerel, squid, sardine	
16	Central Mediterranean	Italy	ALB	J	2.0–4.0	200–3 000	2.0–50.0	1.2–1.5	Mono	2–6	0.6–0.7	Mono	11–20	Sardine, round sardinella	
16	Central Mediterranean	Italy	SWO	J		600–1 100	52.0		Mono	18		Mono		Mackerel	18–50
16	Central Mediterranean	Italy	SWO	C	5.0	600–1 100	52.0		Mono	18		Mono		Mackerel	18–50

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (km)	Diameter (mm)	Type	Distance between branch lines (m)		
17	Adriatic Sea	Italy	BFT	C	7.5										
17	Adriatic Sea	Croatia	SWO, ALB, BFT												
18	Adriatic Sea	Croatia	SWO, ALB, BFT												
18	Adriatic Sea	Italy	SWO	J	8.0–10.0	2 000–3 500	40.0–60.0	1.4–1.6	Mono	4–6	1.2	Mono		Mackerel	
18	Adriatic Sea	Italy	ALB	J	4.0–5.0	3 500–5 000	40.0–60.0	1.4–1.6	Mono	4–6	1.2	Mono		Sardine	
18	Adriatic Sea	Montenegro	SWO, YFT, BSH	J		200–1 000	0.5–1.5			1–3			2–5		
19	Central Mediterranean	Italy	BFT	J	4.5–4.8	1 250–2 500	50.0–100.0	0.8	Mono	20–50		Mono+S	40–50	Mackerel, squid	
19	Central Mediterranean	Italy	BFT	J	9.0–10.0	1 500–2 500	60.0–100.0	0.8	Mono	30–55		Mono+S	40–50	Mackerel, squid	
19	Central Mediterranean	Italy	SWO	J	5.0–9.0	100–3 000	2.0–90.0	1.5–1.8		6–50		Mono	30–50	Mackerel, squid, sardine	
19	Central Mediterranean	Italy	ALB	J	2.0–4.0	200–3 000	2.0–50.0	1.2–1.5	Mono	2–6	0.6–0.7	Mono	11–20	Sardine, round sardinella	
19	Central Mediterranean	Italy	SWO	J	5.0–9.0	800–2 400	24.0–67.0	1.8	Mono	6–10	1.6	Mono	28–30	Mackerel, squid, sardine	
19	Central Mediterranean	Italy	ALB	J	2.0–4.0	1 200–2 900	13.0–50.0	1.2–1.5	Mono	5–7	0.8	Mono	11–20	Sardine, round sardinella	
19	Central Mediterranean	Italy	SWO	J	2.0–4.0	350–600	14.0–28.0	1.8–2.0	Mono	8–12	1.3–1.7	Mono	33–45	Mackerel, squid	10–100
19	Central Mediterranean	Italy	SWO	J	4.0	450–500	15.0–18.0	1.8	Mono	12	1.3	Mono	33	Mackerel, squid	70–540

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (km)	Diameter (mm)	Type	Distance between branch lines (m)		
20	Central Mediterranean	Greece	SWO			375–683	13.0–52.0			3–18			30–150		30
20	Central Mediterranean	Greece	SWO	J		800–2 800								Sardine, mackerel, squid	
20	Central Mediterranean	Greece	SWO	J		350–700				15–50				Sardine, mackerel, squid	
20	Central Mediterranean	Greece	ALB	J		800–4 000		1.0–1.6		3–6				Sardine, round sardinella	
20	Central Mediterranean	Greece	BFT	J	4.5–6.5	1 000–1 200		5.0		45				Sardine, mackerel, squid	
21	Central Mediterranean	Libya	SWO, Carcharhinidae, Lamnidae	J		600		2.0–3.0	Mono	1.5	1.3	Mono	25	Mackerel	5–300
21	Central Mediterranean	Libya	SWO			300	13.9	2.5	Mono	1.5					9–370
21	Central Mediterranean	Libya	SWO	J		300–600	13.9	2.5	Mono	1.5	1.3	Mono	45	Mackerel	9–550
22	Eastern Mediterranean	Greece	SWO, Tunnidae	C				1.5–2.5			1.0–2.0		20–45		
22	Eastern Mediterranean	Greece	SWO			375–683	13.0–52.0			3–18			30–150		30
22	Eastern Mediterranean	Greece	SWO	J		800–2 800								Sardine, mackerel, squid	
22	Eastern Mediterranean	Greece	SWO	J	8.0	350–700				15–50				Sardine, mackerel, squid	
22	Eastern Mediterranean	Greece	ALB	J	3.0–5.0	800–4 000		1.0–1.6		3–6				Sardine, round sardinella	
22	Eastern Mediterranean	Greece	BFT	J	9.0–10.0	1 000–1 200		5.0		45				Sardine, mackerel, squid	

GSA	Subregion	Country	Main target species	Hook			Mainline			Branch line				Bait type	Mean depth (m)
				Shape (J, C)	Length (cm)	Number	Length (km)	Diameter (mm)	Type	Length (km)	Diameter (mm)	Type	Distance between branch lines (m)		
25	Eastern Mediterranean	Cyprus	ALB, SWO, BFT	J	2.0–12.0	200–1 000	7.0–55.0	1.2–3.0	mono	5–30	0.9–1.6	Mono	35–70	Sardine, mackerel, squid	30–55
25	Eastern Mediterranean	Cyprus	SWO		7.0	500–1 000								Mackerel, squid	
26	Eastern Mediterranean	Egypt	ALB	J	4.5	4 000–5 000		1.2	Mono	5	1.0	Mono	11–13	Sardine	20–30
27	Eastern Mediterranean	Lebanon	SWO, BFT, Carcharhinidae	J	8.3										
27	Eastern Mediterranean	Lebanon	ALB	J	8.3		0.1								

Notes: ALB: *Thunnus alalunga*; BFT: *Thunnus thynnus*; BSH: *Prionace glauca*; BSS: *Dicentrarchus labrax*; CWZ: *Carcharhinus* spp.: DGS: *Squalus acanthias*; DOL: *Coryphaena hippurus*; GAR: *Belone belone*; SBG: *Sparus aurata*; SMA: *Isurus oxyrinchus*; SRG: *Diplodus* spp.; SWO: *Xiphias gladius*; YFT: *Thunnus albacares*; mono: monofilament twine; multi: multifilament twine; br: braided twine; mono + S: monofilament and steel wire.

Western Mediterranean

The Spanish drifting longlines, also used in the entire Mediterranean, mainly target swordfish, Atlantic bluefin tuna and albacore. García-Barcelona *et al.* (2010) have classified them into five different types, according to the differences in target species, operational depths and technical characteristics.

Traditional longline

The length of traditional drifting longlines targeting swordfish is variable, ranging from 37 km to 65 km and capable of setting 1 500 to 4 000 hooks. The mainline hangs from floats, and the information recorded by means of depth sensors indicates that the average depth of surface hooks is 30 m (maximum depth 50 m). The dimensions of the hooks used are 7.5 cm long and 2.5 cm wide, usually baited with Atlantic mackerel (*Scomber scombrus*) or chub mackerel (*Scomber japonicus*) ranging in size from 25 cm to 30 cm (total length). Depending on both the fishing season and bait price, hooks can also be baited with forage fish such as garfish (*Belone belone*) or silver scabbardfish. In addition, chemical and electrical lights are used to attract prey. Setting this type of gear begins in mid-afternoon and lasts until after sunset. Gear retrieval begins in the early hours of the morning and lasts until mid-morning. This type of gear is used throughout the year.

American longline

The American longline (monofilament) is a type of gear imported from the Italian and American longliners in the early 2000s. Unlike the traditional longline, the monofilament longline reaches 90 km to 100 km in length with a smaller number of hooks (900 to 1 100), indicating a greater distance between each hook. The fishing depth is greater, with the deepest hooks working at 70 m below the sea surface. The monofilament longline allows the distance between hooks to vary between each set. Normally, hooks are separated by 70 m to 90 m, which allows for faster hauling. Furthermore, the soak time is longer than for the traditional longline. Both the mainline and the branch lines are thicker than in traditional longlines, and hooks are equipped with weights ranging from 30 g to 70 g, which increases the bait sinking rate. As regards the hook type and bait, both are the same as in traditional longlines. Like the traditional longline, the American longline is used throughout the year.

Half-water or semi-pelagic longline

Since 2006, an improved surface longline has been used by the fleet in the entire Mediterranean (e.g. in the Ligurian and Ionian Seas; Garibaldi, 2015). The improvement involves increasing the depth of the hooks during the months when the sea surface temperatures are higher (summer). As a result, the hooks work at deeper depths of around 150–200 m, usually for a longer period. The gear is similar to the traditional longline, but with the peculiarity that the number of hooks between the floats is larger and some weights or stones are placed along the mainline. These modifications give the gear greater stability against the currents and also enhance the depth of hooks in the water column. Because the speed of setting is less than for the traditional longline, the number of hooks set does not usually exceed 1 500, which is fewer compared with a traditional surface longline. The half-water or semi-pelagic longline is used seasonally, mainly from July to October. Bycatch at these depths is small, with very low catch of sea turtles and sharks. In fact, swordfish represents the most abundant catch species by number, and it has reduced the catch of strictly epipelagic species, such as common dolphinfish (*Coryphaena hippurus*), albacore, Atlantic bonito (*Sarda sarda*) and Mediterranean spearfish (*Tetrapturus belone*), as well as elasmobranchs such as blue shark (*Prionace glauca*), thresher (*Alopias vulpinus*), porbeagle (*Lamna nasus*), shortfin mako (*Isurus oxyrinchus*) and notably the pelagic stingray (*Pteroplatytrygon violacea*). On the other hand, the bycatch of other species has increased, such as the rudderfish (*Centrolophus niger*) and the scalloped ribbonfish (*Zu cristatus*), among others.

Atlantic bluefin tuna longline

This is a monofilament longline used exclusively during the months of May, June and the first half of July, which is the period when Atlantic bluefin tuna enter the Mediterranean to breed. The differences between this gear and the swordfish monofilament longline are that the fishing depth is greater, the bait is almost always shortfin squids (*Illex* spp.) bigger than 500 g, and the soaking time is 24 hours. The number of hooks per set does not exceed 1 200.

Albacore longline

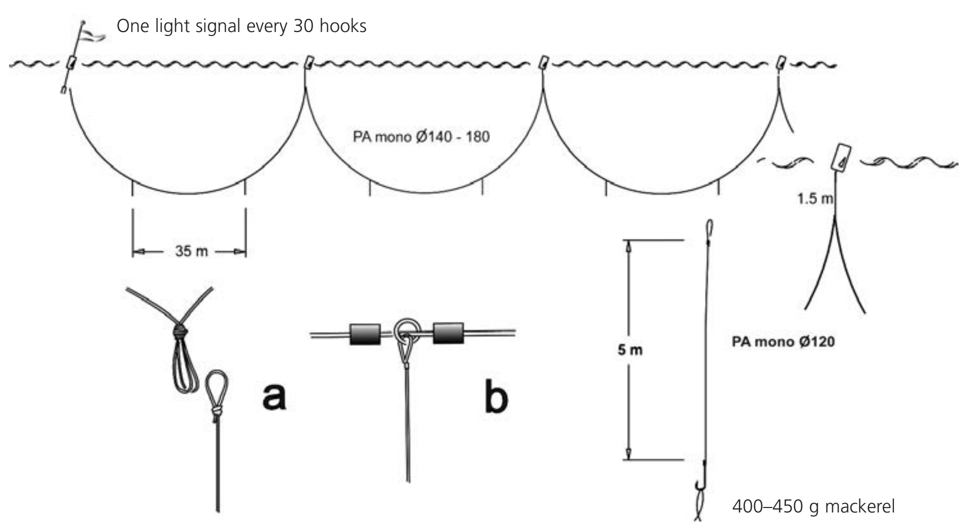
This is the shallowest longline gear. Both the size of the hooks and the thickness and length of the fishing lines are lower than other longlines. Between 2 000 and 7 000 hooks are set and the bait used is sardine. Albacore longlines operate in high-sea fishing grounds at bottom depths up to 1 500 m and are employed mainly from July to October.

In Morocco (GSA 3), drifting longlines are used to mainly target swordfish and tuna; the number of hooks used and consequently the length of the mainline are variable. Both the mainline and branch lines are characterized by large diameters, while the hooks employed are also big (hook length up to 10.7 cm; Roullot and Fahfouhi, 1984).

In Algeria (GSA 4), this gear is commonly used throughout the year to mainly target swordfish, Atlantic bluefin tuna and sharks, at depths ranging from 60 m to 200 m (Sahi and Bouaicha, 2003).

In France (GSAs 7 and 8), due to the driftnet ban, several tuna gillnetters have converted to tuna longlining, inspired by Italian or Spanish techniques, and adapted them to their seasonal activity, complementing other fishing activities (Poisson *et al*., 2019). The surface longline fishery operates mainly in the Gulf of Lion and around Corsica. These longlines have from 300 to 900 hooks and target 10–60 kg Atlantic bluefin tuna and swordfish between April and December. The mainline is monofilament with a diameter of 1.4–1.8 mm and branch lines 5–7.5 m long and 1.2 mm thick, spaced from 13 m to 35 m apart; the hooks are indifferently straight or circular (around 6 cm long) and baited with sardine or mackerel. Furthermore, one buoy of 2–3 litres (approximately 2 kg) is moored at the end of a branch line every six to ten hooks and one light signal weighing 2–3 kg is set every 30–150 hooks. The branch line is mounted directly on the mainline using a swivel held in position by beads fixed on each side (Figure 89). These vessels

FIGURE 89
Technical elements of a longline used for swordfish in France



Source: illustrated by J. Sacchi.

have a line hauler while the longline is coiled into a 500-litre container. The longline is set in the evening after sunset, in other words the prime time, at 5 to 6 knots and is raised two hours after sunrise. The main species comprising the catch are pelagic stingrays (considered as bycatch), Atlantic bluefin tuna, blue shark (also bycatch) and swordfish.

Offshore vessels (Plate 62) are equipped with a line shooter and hydraulic drums to store nearly 100 km of mainline made of PA monofilament with 1.8–2.5 mm diameter (according to the size of fish targeted). The PA monofilament branch lines are 1.2–3 mm in diameter, 20–30 m in length, fitted with a stainless steel snap clip and spaced every 35–45 m. These longliners can set more than 1 000 tuna hooks with a length of 8–9 cm and a gape of 3.5 cm.

PLATE 62
French catamaran longliner

The artisanal longliners targeting swordfish use longlines of 300–500 hooks (5–6 cm long) with 5 m branch lines spaced every 18 to 25 m. The mainline is made of 1.4 mm to 1.6 mm thick PA monofilament, while the branch line is made of one or two monofilaments of 1.2 mm diameter. Branch lines are fixed to the mainline either by a swivel or by a triple loop knot for easy replacement in case of deformation or breakage. Buoyancy is ensured by a series of 5-litre floats tied on the mainline every two or three branch lines with 5–6 m long PP ropes. Small mackerel, horse mackerel and sardines are the main baits used. In Provence and Corsica, when the swordfish approaches the edge of the continental slope (which in these regions is not too far from shore), the artisanal fishers use a system of set longlines similar to those used by the Spanish longliners. This is classified as a mid-water or semi-pelagic longline. Set at dusk and retrieved in the morning, this arrangement on the one hand prevents small fishing vessels from spending long nights at sea, while on the other hand it prevents the capture of unwanted pelagic species, such as the blue shark.

In Italy, in the northern Tyrrhenian Sea and the Ligurian Sea (GSA 9), until 2009, the main gear was the traditional surface drifting swordfish longline; this gear is set strictly at the surface (maximum depth of 15 m) during the afternoon and hauled during the night. It comprises a mainline made of a monofilament nylon (1.4 mm in diameter) and branch lines of monofilament nylon (1.3 mm in diameter), with 7 cm long hooks, maintained at the surface by floating devices (bottles and balls). The number of hooks per haul is usually 600–1 500, with an average of 750. Starting in 2010, a new type of longline was introduced (Garibaldi, 2015); the main differences relate to the setting depth and the timing of fishing operations. The mainline is made of a monofilament nylon (2.0 mm in diameter), with the branch lines composed of two different parts: the first one is a monofilament nylon (1.3 mm in diameter), while the second terminal part, bringing the hook, is made of double-strength monofilament nylon (1.17 mm in diameter). The first hook is displaced at about 100 m depth and is followed by 40 other hooks, the deepest reaching 600 m depth. Considering that 75 percent of the hooks are set in mesopelagic waters, this longline is referred to as the mesopelagic swordfish longline. The gear is set during the day, left for 1.5–2 days at sea and then hauled in; all boats are equipped with radio buoy systems for constant monitoring of the drift and to facilitate the recovery of the gear. Atlantic bluefin tuna is targeted with the Atlantic bluefin tuna longline, while the albacore is targeted with the albacore longline; both longlines display the same features as those employed in Spain (STECF, 2005). Battaglia *et al.* (2010) provide technical descriptions of the different drifting longlines used in the Aeolian Islands (GSA 10):

The traditional longline targeting albacore consists of a nylon monofilament mainline ranging from 1.2 mm to 1.8 mm diameter in cross-section. The mainline is suspended by floats, with branch lines 5–8 m long. The number of hooks ranges between 1 200 and 2 500. Hook length is around 6–7 cm. The gear is set in the evening and the setting operation ends before midnight. The fishing trip starts in the early morning and can last from five to ten hours, depending on the length of the gear, the sea conditions and the quantity of fish caught. Clupeoids are used as bait.

The drifting longline targeting swordfish consists of a nylon monofilament mainline 1.8 mm in diameter. The mainline is suspended by floats, while the branch lines are 9 m long. The number of hooks ranges between 800 and 1 300. Long-shank J-shaped hooks, 5–9 cm long, are used. The gear is set in the evening and the setting operation ends before midnight. The longline retrieval operation starts in the early morning and can last from five to ten hours, depending on the length of the gear, the sea conditions and the quantity of fish caught. Mackerel and squid are used as bait.

The Atlantic bluefin tuna longline consists of a 2.3 mm nylon monofilament mainline. The mainline is suspended by floats, with branch lines 1.8–2.0 mm in diameter and 10–12 m in length. The number of hooks ranges between 800 and 1 200. Circle hooks around 9 cm long are used. The gear is set in the afternoon and the setting operation ends before evening. The trip starts in the early morning and can last from five to eight hours, depending on the length of the gear, the sea conditions and the quantity of fish caught. Squid is used as bait.

Central Mediterranean

In Tunisia (GSAs 12, 13 and 14), longlines target swordfish and albacore. The mean number of hooks employed ranges from 600 to 2 500, the diameter of the mainline is 1.3–2.5 mm and the diameter of the branch lines is 0.6–1.2 mm (Romdhane *et al.*, 2014). In GSA 14, there are pelagic longlines specifically designed to catch sharks (*Carcharhinus* spp., shortfin mako) described by Jribi *et al.* (2008) and Saïdi *et al.* (2020). These types of fishing gear were initially used to target swordfish, but the recent rarity of this species has resulted in a shift to targeting other species such as the sandbar shark (*Carcharhinus plumbeus*). These longlines consist of a nylon monofilament mainline of 1.6 mm diameter with double nylon monofilament branch lines of 1.4 mm diameter and 6.0–6.5 m in length, attached without a swivel at intervals of 34–40 m. Floatlines are made of polyester 4 mm in diameter, with an average length of 10 m that can be varied depending on the water column depth. The J-hooks are stainless steel with a 10° offset. The bait used is Atlantic mackerel, bogue and Atlantic horse mackerel (*Trachurus trachurus*). Each fishing boat uses 400–1 200 hooks, contained in three or four boxes. These longliners operate their lines manually and typically set their lines at sunset, allowing them to soak overnight, hauling them back in the morning after 10–12 hours. The fishing depth is usually between 40 m and 100 m (Saïdi *et al.*, 2020). Another type of longline is employed to catch garfish by using 1 000–1 500 hooks tied to monofilament branch lines (0.5–0.6 mm diameter), which are connected to a braided mainline (1.5 mm diameter). This type of gear is deployed in shallow waters (2–5 m) with gobids and sand smelt (*therina presbyter*) used as bait. Another drifting longline with similar technical features is deployed to catch demersal species such as sparids and European seabass at 5–30 m depth.

Three different Italian longlines operating in GSAs 13, 15, 16 and 19 have been recorded, based on the target species (STECF, 2005). The longline targeting Atlantic bluefin tuna has large J-hooks (from 5 cm to 10 cm hook length) that vary from 1 250 to 2 500 in number, with a mainline length of 50–100 km. The branch lines are placed every 40–50 m and are 20–50 m long. Both mainline and branch lines are made of monofilament, but the final part of the branch lines before the hook (around 1 m) is made of steel wire, to avoid line breaking. The longline targeting swordfish also has large J-hooks (4–9 cm long) equal to 100–3 000 in number, with a resulting mainline length of 2–90 km. The longline designed for albacore is made of smaller hooks (2–4 cm hook length), 200–3 000 in number, and with a mainline length of 2–50 km. The branch lines are shorter (2–6 m long), and sardine, mackerel, squid and round sardinella are used as bait.

In Malta (GSA 15), longlines targeting Atlantic bluefin tuna are also employed (500–1 800 hooks; Burgess *et al.*, 2010). Furthermore, drifting longlines are used in Malta to catch other species like common dolphinfish.

In Greece (GSA 20), the longlines targeting Atlantic bluefin tuna usually have 1 000–1 200 hooks. Other longlines reported in Greece target swordfish (both the traditional longline and the American longline) and albacore (up to 4 000 hooks employed). Sardines and mackerel are the main bait used. According to Adamidou (2007), Greek drifting longlines have a mainline that is 1.5–2.5 mm thick and branch lines that are 1–2 mm thick with 20–45 m between them. The hooks are 4.5–6.5 cm long. At appropriate intervals (every 5–10 hooks), plastic buoys of 5–10 litres are connected to the mainline, while at the two ends and in the middle of the mainline, large 20-litre buoys joined to flags and reflectors enable location.

In Libya (GSA 21), there are longlines designed to catch swordfish and sharks, mainly Carcharhinidae (*Carcharhinus* spp.) and Lamnidae (shortfin mako; Lamboeuf, 2001). They are deployed at depths of 5–400 m and have 400–1 200 J-hooks baited with mackerel and the same monofilament branch lines 1.3–1.4 mm in diameter. The monofilament mainline is very thick (2–3 mm diameter).

Adriatic Sea

In Italy, the drifting longline fishery is mainly carried out in the southern and, to a lesser extent, central Adriatic Sea (GSA 18 and southern GSA 17, respectively; Colombelli, Pulcinella and Sala, 2018). The hooks used in this area usually have a barb and are made of high-carbon steel and stainless steel, with or without offset. The hook size varies according to the target species: hook length is equal to 8–10 cm for swordfish and 4–5 cm for albacore. Mainly J-hooks are used, although sometimes circle hooks are employed to target Atlantic bluefin tuna. On average, 2 000–3 500 hooks are used to catch swordfish and 3 500–5 000 hooks are used for albacore. The mainline is made of monofilament (diameter 1.5–2 mm) with a length of around 40–60 km. Branch lines are made of monofilament (diameter 1.2 mm) and have a length of around 4–6 m. The branch line is usually attached to the mainline by means of a swivel; in tuna fishing, the branch line is usually attached directly to the mainline through snap clips, which keep the branch line firmly attached but at the same time allow sliding along the mainline in case of strong jerks received in relation to the vitality of the target species captured. The types of bait vary according to market prices: usually the best, though the most expensive, is frozen squid; therefore, mackerel is generally used as bait for swordfish and sardine for albacore. Alternatively, a single artificial bait containing a sardine can be used. In addition, lightstick attractors, mounted at the junction point between the two sections of the branch line, can be used to attract swordfish. The simultaneous use of different types of bait is also possible. The following species can be caught as bycatch: Atlantic bluefin tuna, bullet tuna (*Auxis rochei*), little tunny, Atlantic bonito, blue shark, oilfish (*Ruvettus pretiosus*), thresher, Atlantic pomfret, common dolphinfish (*Coryphaena hippurus*), porbeagle and leerfish.

In Croatia (GSAs 17 and 18), the landing composition of the drift longlines is dominated by swordfish, albacore and Atlantic bluefin tuna (Matić-Skoko *et al.*, 2017).

In Montenegro (GSA 18), drifting longlines are only rarely used to catch swordfish and blue shark. Around 200–1 000 hooks are used for a total mainline length of around 500–1 500 m (UNEP-MAP-RAC/SPA, 2014).

Eastern Mediterranean

In Greek GSA 22, four types of longlines are used to catch large pelagic species (Megalofonou, Damalas and Yannopoulos, 2005). The longlines targeting swordfish are the traditional longline with 800–3 200 hooks and the American longline, which was introduced in the Greek fishery in the mid-1980s and consists of fewer hooks (350–700) around 8 cm long, much longer branch lines (15–50 m) and a fish attractant lightstick attached to each branch line, 1 m above the bait. The albacore longline is a more lightly constructed longline that has 800 to 4 000 J-hooks each around 3–5 cm long, a mainline from 1 mm to 1.6 mm in diameter, and shorter branch lines (3–6 m). The Atlantic bluefin tuna longline is the most robust longline, with 1 000 to 1 200 J-hooks around 9–10 cm long, a mainline 5.0 mm in diameter, and branch lines 45 m long. Frozen Atlantic mackerel or chub mackerel and frozen shortfin squids or common squids (*Loligo* spp.) are used as bait, as in the swordfish and Atlantic bluefin tuna fishery, whereas frozen sardines (*Sardina pilchardus* or *Sardinella* sp.) are the main bait used in the albacore fishery.

In Cyprus (GSA 25), drifting longlines are used to catch swordfish, albacore and Atlantic bluefin tuna. The hook length is highly variable (from 2 cm to 12 cm) and up to 1 000 hooks can be employed (55 km in total). Both mainline and branch lines are made of monofilament line. Most commonly, chub mackerel and the European flying squid (*Todarodes sagittatus*) are used as bait (Kleitou *et al.*, 2017).

In Egypt (GSA 26), the albacore longline is reported by Gabr and El-Haweet (2012). This type of gear, used by Egyptian fishers to catch albacore tuna, is a pelagic longline that is set horizontally. The mainline is made of nylon monofilament (1.2 mm in diameter) to which thousands of branch lines are attached through swivels; each branch line is made of nylon monofilament (1.0 mm in diameter) with a single baited straight shank hook around 4.5 cm long. Frozen sardine is usually used as the bait. Each fishing boat often uses from 4 000 to 4 500 hooks, contained in eight or nine boxes. Each box contains a part of the mainline to which about 500 branch lines are attached. Longlines are usually set and hauled by hand once per day. Setting the longline usually starts just before sunset and takes about five hours. Hauling the longline starts early in the morning and continues through the daytime, with setting starting again for the next day (Gabr and El-Haweet, 2012).

In Lebanon (GSA 27), the albacore longline is used by a few fishers; this type of gear is employed in some harbours (e.g. Tripoli) to target large pelagic species during May and June with large hooks (83 mm length, 30 mm width) and small tunnids in autumn (Sacchi and Dimech, 2011).

In Palestine (GSA 27), drifting longlines are no longer used by fishers from the Gaza Strip (Ali, 2002).

Black Sea

No drifting longlines are reported for this subregion.

6. Other fishing methods and practices

6.1 Fish aggregating devices

Fish aggregating devices (FADs) are permanent, semi-permanent or temporary structures or devices used in some surface and mid-water fisheries to concentrate schools of fish (Plate 63 and Figure 90). They exploit the aggregatory behaviour of some species under floating objects; therefore, floating FADs have been used since ancient times to improve pelagic fish catch, especially in the central Mediterranean. Fish aggregating devices are heavily used in certain areas because they provide the opportunity to decrease the time spent searching and thus the operating costs. The main fishing areas are those around Malta, Tunisia, Sicily and the Balearic Islands, and the FADs are named *cima, ghanatsi* or *jrid*, *cannizzo*, and *capcer*, respectively.

In the Mediterranean Sea, FADs are mostly built using cheap materials; palm leaves or bush branches are used to create shadows underwater. They are set on the sea surface by means of floats, usually made of cork, wood, empty plastic bottles or, in some cases, a group of tyres. In Tunisia, palm leaves are attached to a trapezoidal or V-shaped wooden frame, about 1 m × 0.6 m wide, and 20 cm high. In some cases, plastic sheets may replace palm leaves. These floating objects are moored on the bottom by means of weights such as limestone blocks, concrete blocks, or heavy bricks (more than 30 kg each) over depths ranging from less than 100 m to over 1 000 m; these weights are joined to the floats by means of thin ropes. Occasionally, drifting FADs are deployed.

PLATE 63
Fish aggregating device built with palm leaves and floating objects

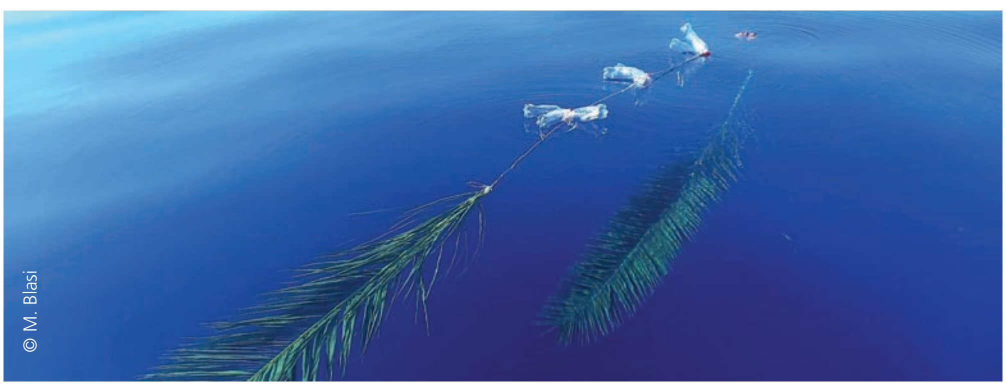
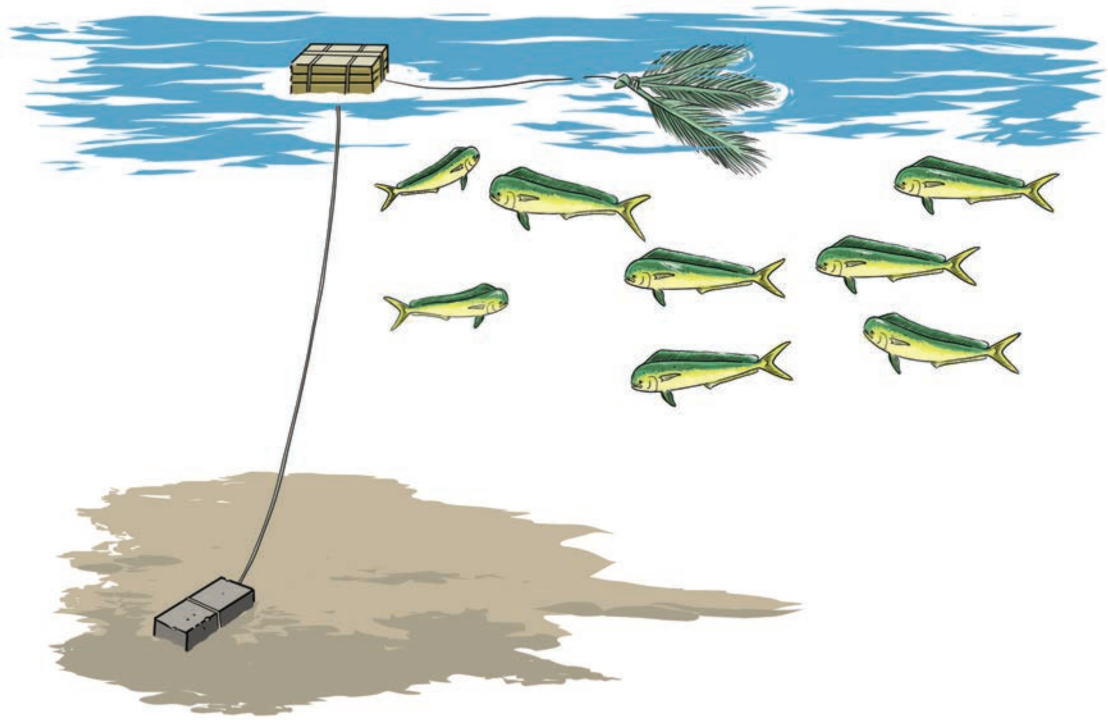


FIGURE 90
Fish aggregating device



Source: illustrated by Alberto Gennari.

The fishing grounds vary from shallow waters to areas located 60 nautical miles off the coast (1 500 m deep). In the Mediterranean Sea, FADs are mostly used to aggregate pelagic species such as the common dolphinfish (*Coryphaena hippurus*), the pilotfish (*Naucrates ductor*) and the greater amberjack (*Seriola dumerili*). Each vessel sets from 20 to 100 FADs.

Specifically designed surrounding nets with or without a purse line (locally known as *llampuguera* in the Balearic Islands, *lampuki* in Malta, *lampugara* or *caponara* in Sicily, and *lamboukara* in Tunisia) are commonly used to catch fish gathered under the FADs.

In Spain, Malta and Italy, these surrounding nets have a length of around 180–200 m. To enable the net to be closed, while taking into account the hindrance of the FAD line, handlines are used in certain areas to lure one of the fish from the school under the palm leaves. Once caught, the fish is pulled away from the FAD and followed by the rest of the school. After the school of fish has been removed from the FAD, surrounding nets are used to catch the entire school.

In Spain, the FADs (*capcers*), measuring approximately 1.2 m × 1.5 m, are generally made up of corks held together by ropes, to which Canary Island date palm (*Phoenix canariensis*) branches are attached to enable them to be located from a distance. They are anchored with the help of ballasts or *pedrals* (Morales-Nin *et al.*, 2000).

In Malta (GSA 15), the net used is called a *lampuki*, which consists of four main sections: two wings (the setting wing and the second wing), the body and a landing bag. The nets can be modified throughout the fishing season, including changes in the total length (e.g. by changing the length of the wings). Large stones used in the construction industry are employed to anchor the FAD to the bottom (Plate 64).

PLATE 64
Stones used in Malta to anchor fish aggregating devices to the bottom

In northern Sicily (Italian GSA 10), fishers use a traditional purse seine or the so-called *raustina*, which is a surrounding net without a purse line that originated from a beach seine through modifications to its height and buoyancy. This net has a central bunt with 15 mm mesh size and two lateral wings with 30 mm mesh size. The net is around 170 m long and 25 m high, with an operational height during fishing operations of around 10 m. The purse seines used in this fishery have two lateral wings of 50 mm mesh size, a central bunt of 30 mm mesh size, headline length of around 180 m and height around 30 m (reduced to an operational height of around 15 m during fishing operations). The FADs usually consist of Canary Island date palm leaves, six 2.5-litre plastic bottles and a 30–40 kg stone to anchor it to the seabed, all tied together with a 5 mm polypropylene line.

In Tunisia, fishers also use larger nets, up to 400 m long. The stretched net height is normally around 25–45 m (at the bunt), although the operating net height is around 10–15 m or less. The mesh size decreases from the wings (around 30–50 mm) to the bunt (around 15–30 mm).

PLATE 65
Fish aggregating devices used in Tunisia

Fishing operations consist of a visit to the FAD at sunrise, and once the fish are detected visually, a quick haul is conducted by setting the net around or close to the FAD. Sometimes, to facilitate fishing operations, the school of fish is attracted away from the FAD. For this purpose, lines are lowered near the palm branches of the FAD (Plate 65). When a prey takes the bait, it is slowly pulled away from the FAD. By this movement, the hooked fish is followed by the school, which, at a certain distance from the FAD, can be encircled by the net.

In 2000, some authors noted that a large fleet was engaged in this fishery in the Mediterranean Sea, especially in summer and autumn from August to December (Morales-Nin, 2011; Morales-Nin *et al.*, 2000). Nevertheless, in recent years, the number of vessels engaged in this fishery has decreased in Italy, Malta, Tunisia and the Balearic Islands (CopeMed II, 2016; Moltó *et al.*, 2020), though the fishing effort remains high, with approximately 60 000–65 000 FADs mainly used in Tunisia (around 27 000), the southern Tyrrhenian Sea (around 22 000), Malta (around 15 000) and the Balearic Islands (around 1 500; Scott and Lopez, 2014; Morales-Nin *et al.*, 2000; Sinopoli *et al.*, 2019). However, the lack of information in some countries hinders the full description of the fishery and the true extent of its scale.

6.2 Barriers, fences, weirs

Stationary nets or barrages are used in certain areas to catch migrating fish, as they guide them towards chambers where they are caught. Basically, these devices can be considered as large traps that are placed in specific grounds for certain periods of time. These types of gear were widely used in the past, mainly to catch Atlantic bluefin tuna (*Thunnus thynnus*) during the reproduction season between May and June, but presently such large and selective traps are being replaced by purse seines. The legislation in several western Mediterranean coastal states, namely Italy, Libya, Morocco and Tunisia, establishes a licensing (Libya and Tunisia) or concession/leasing system (Italy and Morocco) on the basis of historical concession rights for the exploitation of this type of gear, also known as *madrague* in French-speaking countries.

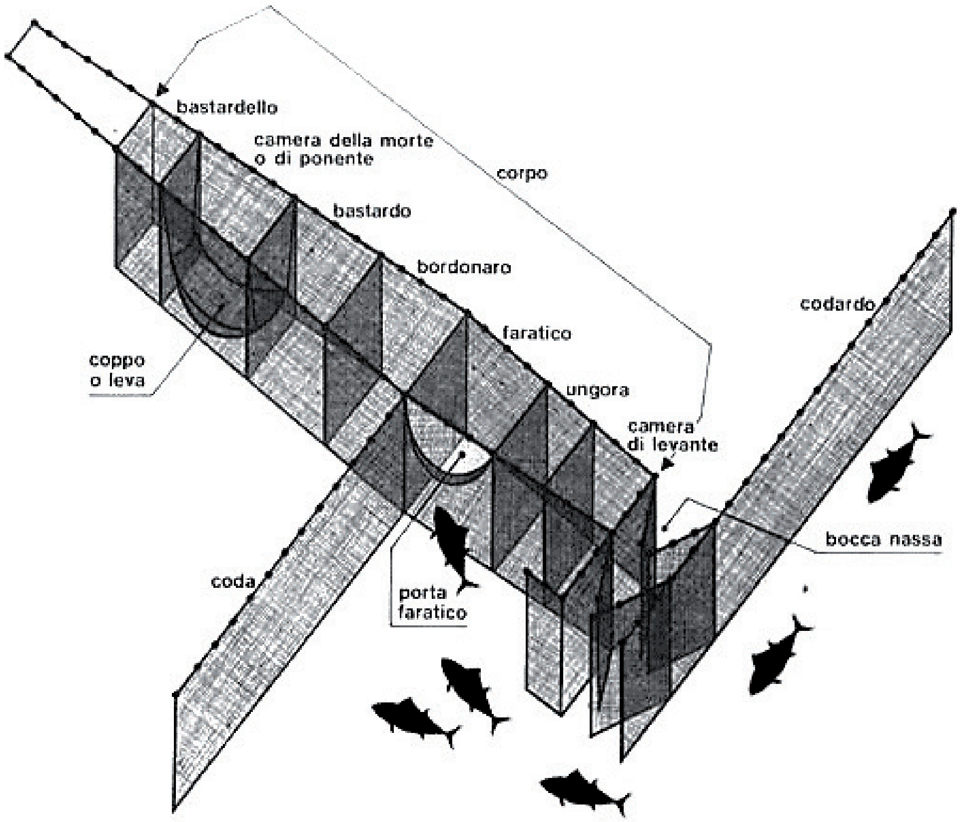
In Tunisia, a kind of fixed trap called *charfia* is used in the shallow waters of the Gulf of Gabès (GSA 14), where the continental shelf is wide and the amplitude of the tides high. From the shore or very shallow water, a wall of palm leaves is lowered seaward, which is used to guide fish and ends in two V-shaped hedges whose tips are directed toward the open sea in general (Plate 66). At the tip of the V, there is an entrance corridor that opens into a capture chamber made of small-mesh netting giving access to 2–4 traps in which the fish are caught at low tide (Plate 67). The pattern described above can be repeated several times to obtain large *charfia* with several capture chambers and thus allowing the use of a greater number of traps. The catch composition from *charfia*, in particular Sparidae, seabream, Mugilidae, sole, cuttlefish and octopus, is reputed to be highly valued by local consumers for freshness. *Charfias* are used mainly on the Kerkennah Peninsula, but also in the shallow waters off Chebba and around Djerba Island.

PLATE 66
***Charfia* barrier used in Tunisia**

PLATE 67
***Charfia* capture chamber**

In Italy, the barriers used to catch Atlantic bluefin tuna are locally called *tonnare*. They are employed in Sardinia (GSA 11) and Sicily (GSAs 10 and 16), albeit in a much more limited way than in the past (only two or three remain active). Presently, these large and selective traps are being replaced worldwide by purse seines. These traps are placed during the pre-spawning or post-spawning migration of tuna on their historical migration routes. Each *tonnara* comprises a long nylon netting panel (leader or tail), with 34–40 cm mesh size, which departs perpendicularly from the coastline to the open sea and is used to drive the migrating tuna towards a complex catching system (the proper trap) composed of 3–5 chambers (the castle) until the last chamber (death room). Only the death chamber (*camera della morte* in Figure 91) has a netting floor with small meshes that is used to draw up the fish during the *mattanza* (i.e. the killing phase of the entrapped tuna) (Figure 91 and Plate 68). Although tuna enter the trap naturally, swimming through the leader, the catching system of the *tonnara* requires a complex organization of fishers who control a manually operated system of moving nets to bring the fish towards the death chamber.

FIGURE 91
***Tonnara* used in Italy**



Source: **Racheli, G.** 1976. *Egadi, mare e vita: natura, storia, arte, turismo dell'Arcipelago eguseo e delle Isole dello Stagnone.* Milan, Italy, Mursia.

PLATE 68
Killing of Atlantic bluefin tuna (*Thunnus thynnus*) entrapped in the death chamber of the *tonnara* barrier used in Italy

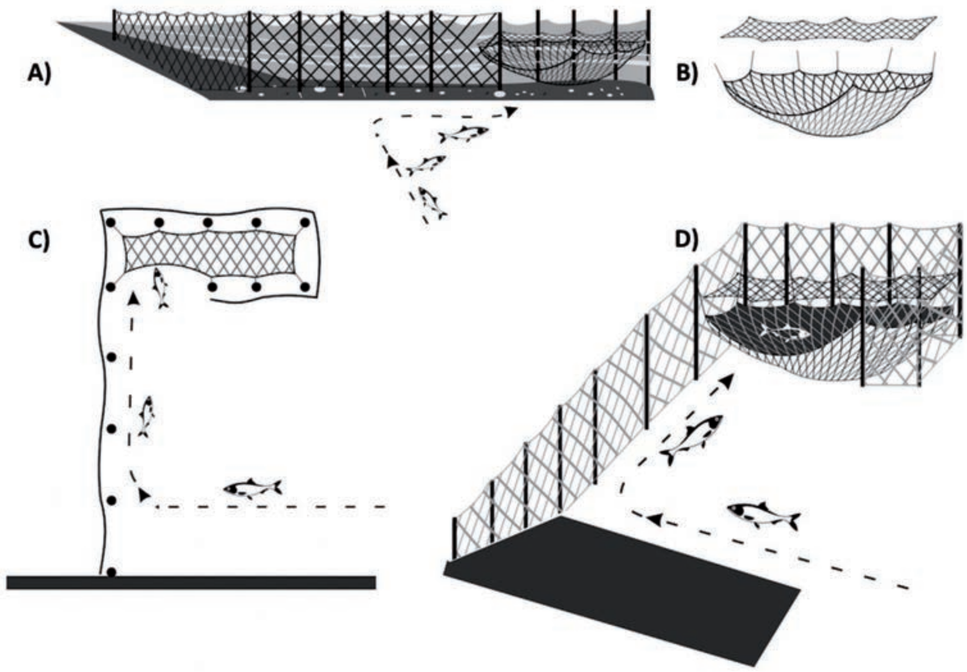
In Italy, similar traps called *tonnarelle* are also employed to catch migrating pelagic species belonging to the Carangidae family, such as greater amberjack and horse mackerels (*Trachurus* spp.), as well as species belonging to the Scombridae family, such as Atlantic bonito (*Sarda sarda*), chub mackerel (*Scomber japonicus*) and little tunny (*Euthynnus alletteratus*). For instance, Buscaino *et al.* (2021) reported the use, on the island of Lampedusa (GSA 16), of a fixed monofilament net called *sgammerara,* which is 150 m long and 2 m high with a mesh size of 9 cm by 4 cm. The nets are usually placed along the coast (2 m depth) and moved away from it for approximately 100 m (10 m depth), defining a straight segment called a *braccio* (arm) and a semicircle part (with the shape of a hook) of 50 m called a *campile*. In this section, the probability of catching target species is reported by fishers to be greater. The nets are set during the afternoon and left to soak until they are hauled in early the following morning. The common target species of these types of gear is the greater amberjack.

In the northern Adriatic Sea, in the stretch of sea outside the Venetian Lagoon, a peculiar type of trap is used to catch fish and cuttlefish. The trap consists of two very long net wings (90–200 m depending on where the trap is used), with a mesh side of 40 mm and a stretched net height of 8–14 m, that guide the fish that stumble into it to a central part (mouth). Mounted on the mouth is the main body of the net (with 80 mm mesh, about 18–27 m long), which is funnel-shaped and leads to the final part where catching takes place – a fyke net (height 1.5–2.5 m, length around 10 m) with mesh side of around 26–28 mm.

In Lebanon, gillnets called *mafaith*, made of stretched mesh size 100 mm to 140 mm, can be set stationary, covering the whole water column from the surface to the bottom, from the shore to the open sea, as in the shape of a question mark or a snail, in two parts: one part is cast in a straight line away from the shore into the open sea and the other part protrudes perpendicular to it, forming one loop on each side (Sacchi and Dimech, 2011). When the length is more than 300 m, the fleet of nets is generally set from the shore to the open sea, in a zigzag shape. The catching mode is by enmeshment like other static nets, and the soaking time does not exceed 12 hours (Brême, 2004). Besides these main gear types, a trap net is used close to a small peninsula near El Heri (northern coast of Lebanon), from the shore towards the open sea, covering the whole water column from the surface to the bottom.

In Greece, Türkiye and Bulgaria, a type of stationary fish trap net called *dalyan* (in Bulgaria) (Zaharieva *et al.*, 2020; Figure 92) or *ağ dalyan* (in Türkiye) (Plate 69) is used for passive commercial fishing and is attached to both the seabed and the beach. The *dalyan* is located very close to the shore or 150 m from the shore, and the size of the construction varies from 25–30 m to 35–50 m. It is deployed between 3 m and 12 m depth, and the netting usually reaches above the waterline with the trap open at the surface. The mesh opening varies according to the target species. To operate the *dalyan*, fishers use a small motorized boat or row boat. The main fish caught with this gear are small and large pelagic species such as European sprat (*Sprattus sprattus*), Mediterranean horse mackerel (*Trachurus mediterraneus*), garfish (*Belone belone*), pontic shad (*Alosa immaculata*) and Atlantic bonito.

FIGURE 92
Technical elements of a *dalyan* net used in Bulgaria



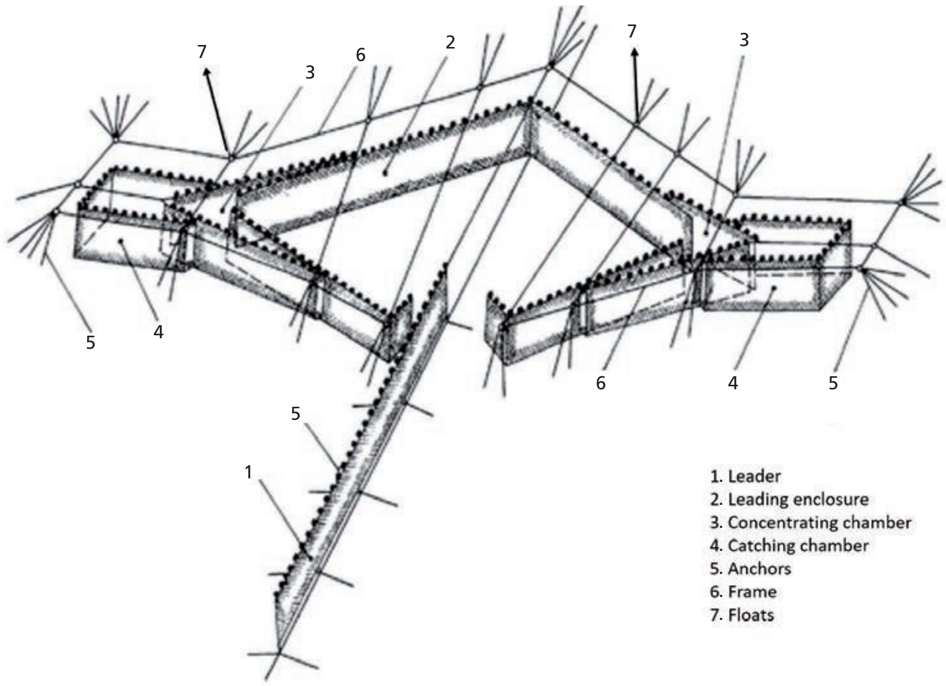
Notes: A) side view of poles, leader and trap – fish swim perpendicular to the shore, reaching the leader, which leads them to the trap; B) side view of the trap – the fish fall into the lower net of the trap, and fishers in their boats gradually remove them; C) top view of the leader and trap; and D) view from the shore of the fish swimming towards the leader, which then leads them to the trap.

Source: **Zaharieva, Z., Racheva, V., Parvanov, D. & Delov, V.** 2020. The conflict between fisheries and cetaceans in Bulgaria's Black Sea territorial waters. *Aquatic Mammals*, 46(1): 99–110.

PLATE 69
***Beykoz ağ dalyan* fish trap net (left) and subsequent harvest (right)**

In Bulgaria, pound nets are used in shallow waters (9–12 m depth) in spring–autumn (from March to November; Radu *et al.*, 2010). These traps are positioned along the entire coastline from Cape Sivriburun (in the northern part) to Rezovo (in the southern part) (Figure 93). The target species vary according to season: European sprat in spring–beginning of summer; and anchovy (*Engraulis encrasicolus*) and Mediterranean horse mackerel in summer and autumn. Whiting (*Merlangius merlangus*), turbot (*Scophthalmus maximus*), red mullet and other demersal species are incidentally caught as bycatch.

FIGURE 93
Pound net



Source: **Radu, G., Anton, E., Yankova, M., Panayotova, M. & Raykov, V.** 2010. Sprat and turbot fisheries in the Bulgarian and Romanian Black Sea area. *International Multidisciplinary Scientific Geoconference & Expo SGEM*, 20: 1–26.

On the Romanian Black Sea coast (GSA 29), stationary uncovered pound nets, similar to those described above, are used at 7–12 m depth to target pelagic species such as sprat, anchovy and horse mackerels. They are used in the period April–September (Radu *et al.*, 2010). The leader is 300 m long with 18–22 mm meshes; the slope is 120 m long with 12 mm meshes and the chamber is 70 m long with a mesh length of 7 mm. The netting material is PA (Radu and Radu, 2008).

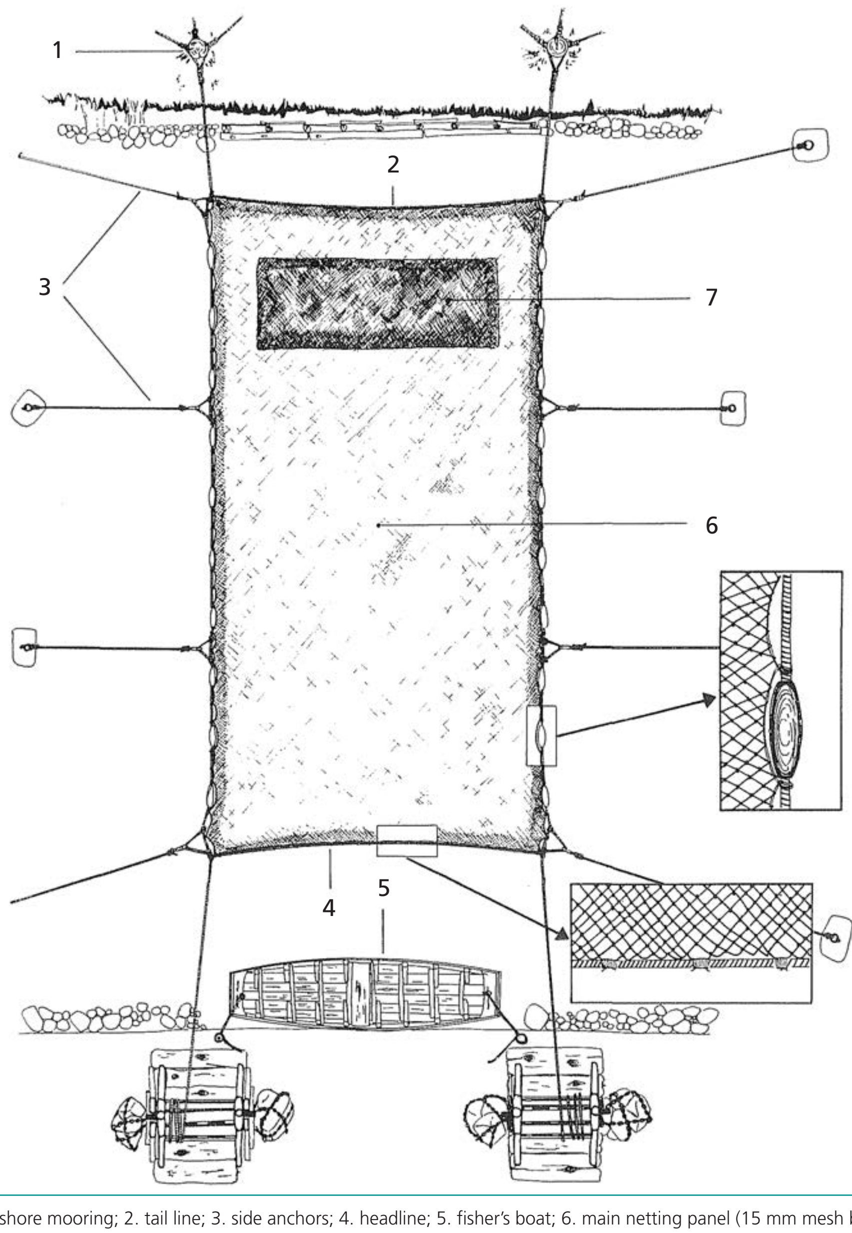
In Ukraine (GSAs 29 and 30), stationary uncovered pound nets are widely used in shallow waters (3–7 m depth) to catch a wide variety of species. A small mesh length (13–20 mm) is used to target red mullet, anchovy, mackerel and sardine, while a mesh length of 40–60 mm is employed to target species of the Mugilidae family.

6.3 Lift nets

This is a traditional small-scale type of fishing gear used in many coastal areas, as well as in channels, estuaries and lagoons, to catch crabs, planktonic shrimps and shallow-water fish; it is made of a horizontal netting panel or bag that is parallelepiped-, pyramid- or cone-shaped with the opening facing upwards. The lift net is left submerged at a certain depth for a certain period, during which time lights or bait are employed to attract fish over the opening; then it is lifted out of the water. Two types of lift nets can be distinguished in the Mediterranean and Black Sea: portable lift nets (hand-operated) and stationary lift nets (shore-operated). The latter often require one or several winches to be set and hauled in. These types of lift nets are used both at sea and in lagoons. Nevertheless, this technique is mainly used in recreational fishing.

In France, the lift nets operated from the shore are found in the channels connecting the lagoons to the sea or near the mouths of rivers (e.g. Rhône, Hérault). The *carrelet* is formed by a square horizontal sheet maintained by two cross poles suspended from a fixed lifting installation located along the shore. After submersion, it is lifted by hand or using a winch. The net is held in place by a metal tube frame. Portable or permanently fixed, the dimensions vary from 1.30 m to 5 m and the mesh size varies between 15 mm to 30 mm (stretched). The so-called *globe* consists of a rectangular sheet mounted on four ropes whose side ropes (*armains*), perpendicular to the shore, are weighted (Figure 94). The *globe* is 20–40 m long, 10–20 m wide and 10 m high. The technique consists of placing the *globe* at the bottom of the water from one bank of the river (or one of its channels) to the other and raising it by hand or by means of a fishing reel located on one of the banks to trap seabass, eels or mullets swimming up or down the river (Quignard and Autem, 1983). The largest of these types of lift nets have tended to disappear, including the *calen*, of which there would have been more than three types, employed in particular to catch mullet – especially the thicklip grey mullet (*Chelon labrosus*), called *poutarguier* – which is prized for its salted and dried eggs used in the manufacture of *bottarga*. The 90 m long and 20 m wide net, made of 36 mm mesh, is used mainly between June and August.

FIGURE 94
***Globe* used in France**



Notes: 1. shore mooring; 2. tail line; 3. side anchors; 4. headline; 5. fisher's boat; 6. main netting panel (15 mm mesh bar); 7. small netting panel (8 mm mesh bar).

Source: redrawn from **Quignard, J.P. & Autem, M.** 1983. Description de quelques pêcheries d'estuaire et paralagunaires du Languedoc (Globes, carrelets, ganguis). *Science et Pêche*, 323: 1–21.

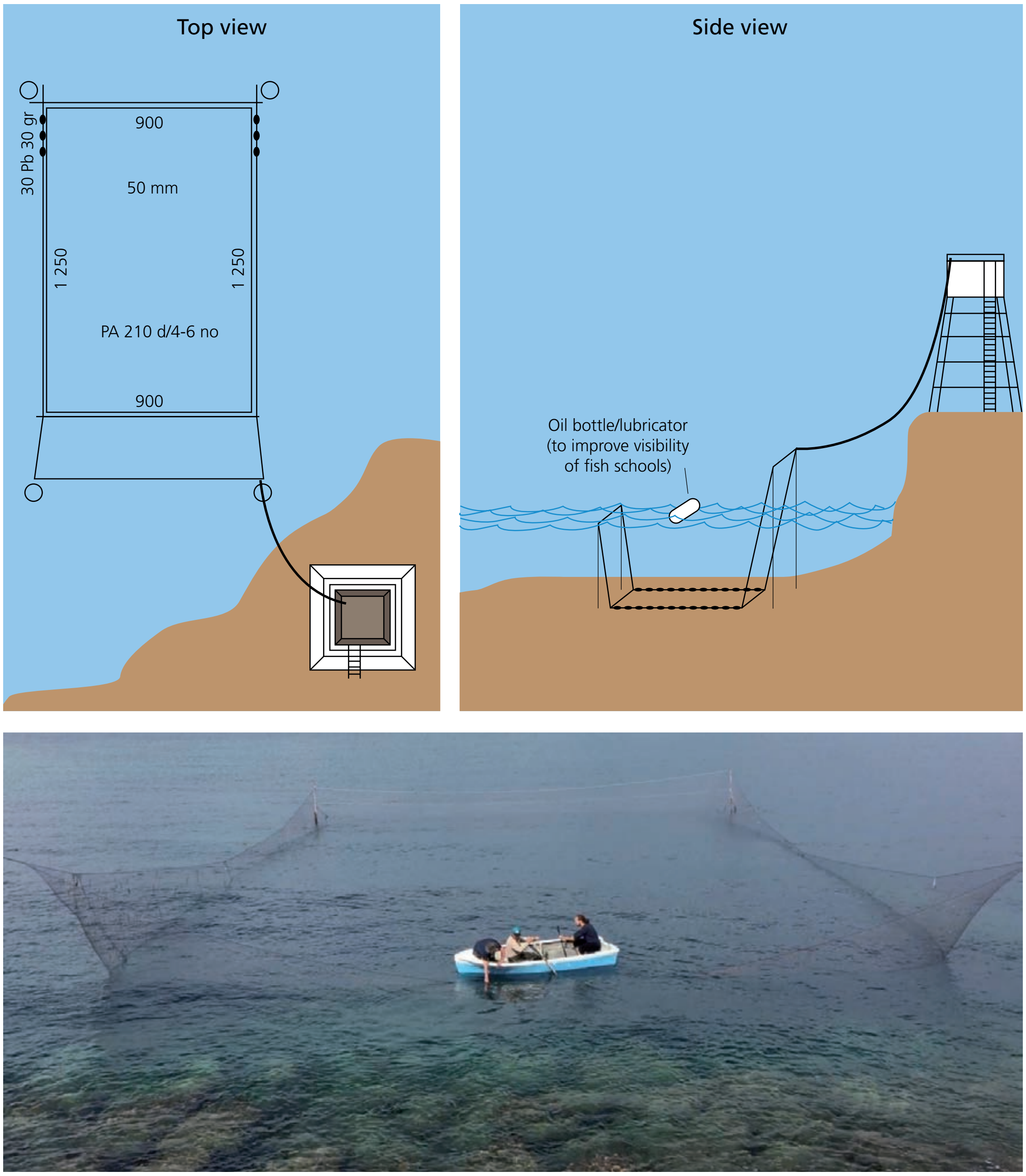
In Italy, the shore-operated stationary lift nets are called *trabucco*, *trabocco* or *bilancia* (Plate 70). They were used commonly in the southern Adriatic Sea (GSA 18), but now are employed for recreational fishing or tourism or have been transformed into restaurants. Similar lift nets are also used in lagoons, rivers and channels for recreational purposes.

PLATE 70
***Trabucco* shore-operated stationary lift net used on the Italian Adriatic coast**

In Türkiye, especially in the Aegean Sea (GSA 22), the lift net is used in commercial fishing to catch grey mullet and seabream (Figure 95 and Plate 71). It is operated in a similar manner as the Italian lift net.

PLATE 71
Shore-operated stationary lift net used in Türkiye

FIGURE 95
Technical specifications of a stationary lift net (top) and its operation (bottom)

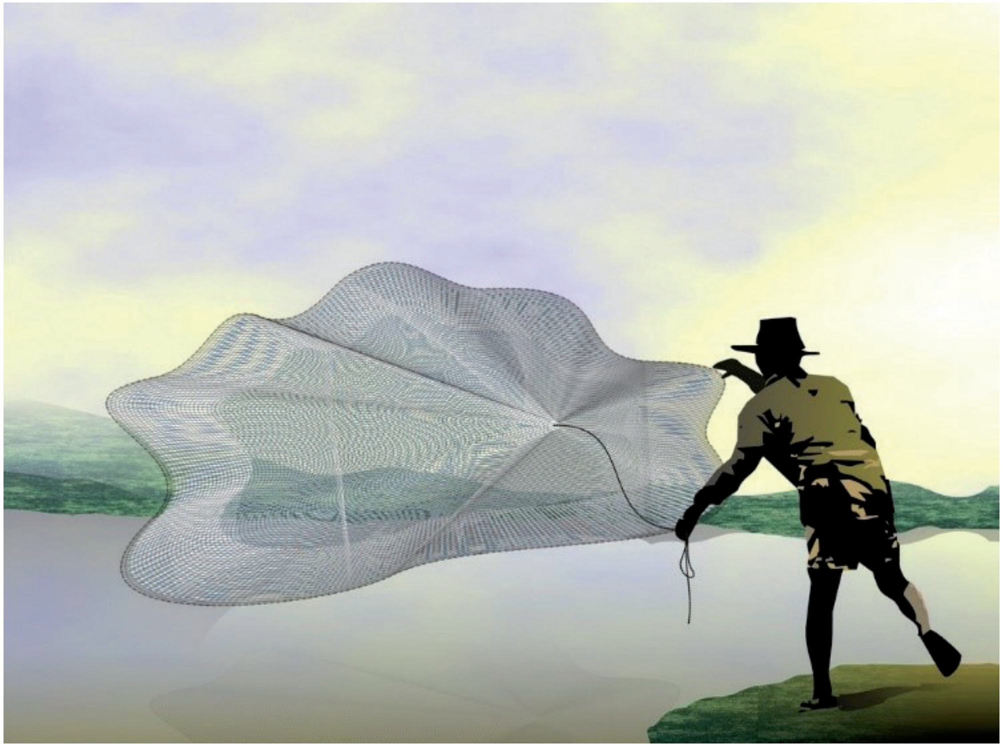


Source: redrawn by Koen Ivens from G. Gokce.

6.4 Falling nets

This type of net is mainly used for sport fishing near river mouths at very shallow depths. It consists of a panel of net with weights at each end. Once the target species (mainly mullets) have been sighted, the net is thrown by hand over the prey, so that it opens in the air, and once it is in the water, the weights make it sink from top to bottom to catch the fish below (Figure 96). Once the cast is finished, the fisher retrieves a line connected to the ends of the netting panel and thus bags the catch, which is then hauled in.

FIGURE 96
Falling net casting



Source: **He, P., Chopin, F., Suuronen, P., Ferro, R.S.T & Lansley, J.** 2021. *Classification and illustrated definition of fishing gears.* FAO Fisheries and Aquaculture Technical Paper No. 672. Rome, FAO. https://doi.org/10.4060/cb4966en

In Algeria, falling nets, called *eparvier*, are used along the coast in shallow waters and especially on foot. This net is composed of two panels: an internal netting panel with a mesh of around 18–30 mm in length and an external panel playing the role of a pocket, with a larger mesh (mesh size around 60–80 mm). These two panels are mounted on a rope that has a diameter of 6–8 mm with 7–10 kg lead weights. The lower part of the net is picked up at a single point.

In Palestine, hand-cast nets, locally called *shabaka*, are circular nets with a central line and small weights distributed around their edge. They are used by fishers to catch mullets in shallow waters near the coast (Ali, 2002). The mesh size is 20 mm.

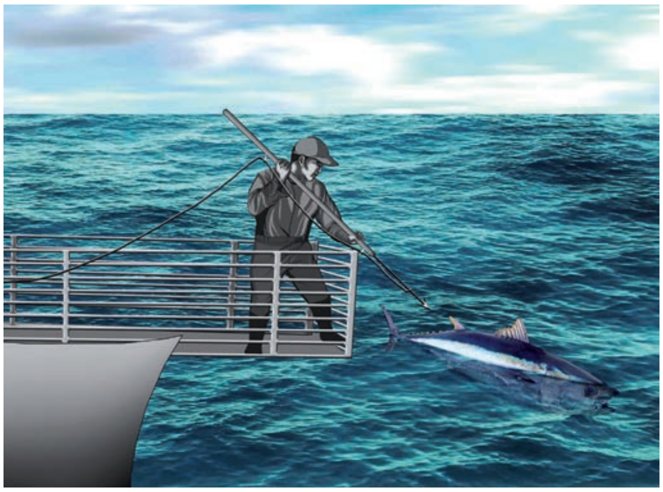
In Ukraine, cast nets are used mainly to target grey mullets and horse mackerels.

On the Black Sea coast of Türkiye, cast nets are also commonly used, usually targeting grey mullets near river mouths.

6.5 Harpoons

This type of fishing gear is simply composed of a long pole, generally made of wood, and armed at its end with one (spear) or more points, suitable for piercing the prey (Figure 97).

FIGURE 97
Harpoon

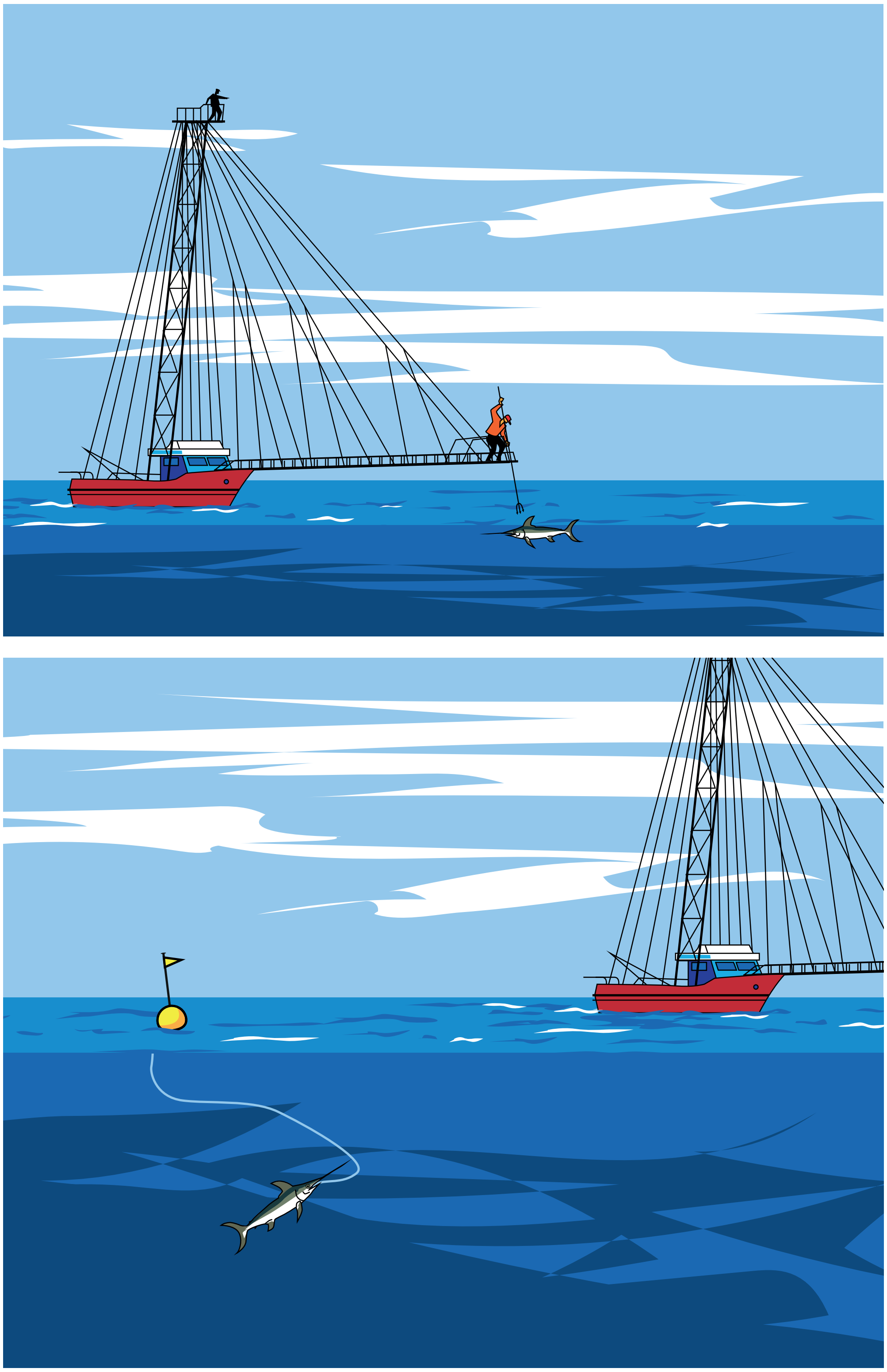


Source: **He, P., Chopin, F., Suuronen, P., Ferro, R.S.T & Lansley, J.** 2021. *Classification and illustrated definition of fishing gears.* FAO Fisheries and Aquaculture Technical Paper No. 672. Rome, FAO. https://doi.org/10.4060/cb4966en

In several Mediterranean regions, the harpoon is equipped at its end with several points (usually three or five) and is generally used by boats in shallow waters to catch common octopus (*Octopus vulgaris*), sea urchins and, more rarely, common cuttlefish (*Sepia officinalis*). Basically, prey such as octopus and sea urchins are identified from the sea surface by means of a mirror using a sort of bucket equipped with a glass bottom that, once placed on the sea surface, allows a certain depth of visibility. Once located, the prey is pierced by means of the harpoon. In very clear waters, an experienced fisher is able to identify prey even without the aid of the mirror. At night, the harpoon is often used with lights.

In the Italian Strait of Messina (eastern Sicily), the harpoon is still used by some vessels to catch adult swordfish (*Xiphias gladius*) at the surface during the daytime in late spring or summer, during the reproductive period (Battaglia *et al.*, 2018). A unique boat locally known as a *feluca* is used (Figure 98). This boat, up to 20–25 m long, has a central mast up to 25–30 m high used to detect swordfish on the surface and to coordinate the boat's movements during the catching process. The steering controls are also on top of the mast and are used to manoeuvre the boat in pursuit of swordfish. A long bowsprit, extending up to a length of 40 m from the bow, is used by the fisher holding the harpoon ready to spear the fish; the footbridge is also used so that the noise of the engine does not frighten the fish. Once a swordfish is spotted, the boat is quickly directed towards it and the harpooner throws (by hand) the spear into the water and catches the fish. The harpoon is attached to a line and after the swordfish is caught, the crew immediately retrieves this line and then the fish skewered by the harpoon. Sometimes, the swordfish is not hauled on board immediately but is left attached to a float by the harpoon and hauled up afterwards (Figure 98). This is a highly selective fishing activity, with swordfish being the only target.

FIGURE 98
***Feluca* boat used for swordfish in the Strait of Messina (top) and a swordfish attached to a float after the catch (bottom)**



Source: redrawn by Koen Ivens from A. Lucchetti.

6.6 Hand implements, including wrenching gear, clamps, tongs, rakes and spears

Hand implements are types of gear that are operated by hand in shallow water from a boat or by wading in the water (Figure 99). They are small-scale forms of fishing gear, rarely used in professional fishing but quite common for recreational purposes or in subsistence fishing.

FIGURE 99
Hand implement

Source: redrawn by Koen Ivens from **He, P., Chopin, F., Suuronen, P., Ferro, R.S.T & Lansley, J.** 2021. *Classification and illustrated definition of fishing gears.* FAO Fisheries and Aquaculture Technical Paper No. 672. Rome, FAO. https://doi.org/10.4060/cb4966en

The rake employed to catch sea urchins is a fishing gear similar to the harpoon and is included in some legislation in this "hand implements" group.

In Italy, sea urchin fishing is practised in several Italian areas characterized by shallow rocky bottoms and/or *Posidonia* meadows, and in particular it is very common along the Apulian coast (Guidetti, Terlizzi and Boero, 2004), and northwestern Sardinia (Pais *et al.*, 2007). From on board the boat and in shallow waters, sea urchins are spotted by means of a mirror, i.e. a kind of bucket fitted with glass that, when placed on the surface of the sea, allows one to see down to the bottom. Once spotted, the urchins are caught using a spear or a rake with a long handle. Professional sea urchin fishing is only allowed by authorized fishers and each fisher has a daily quota of harvestable sea urchins.

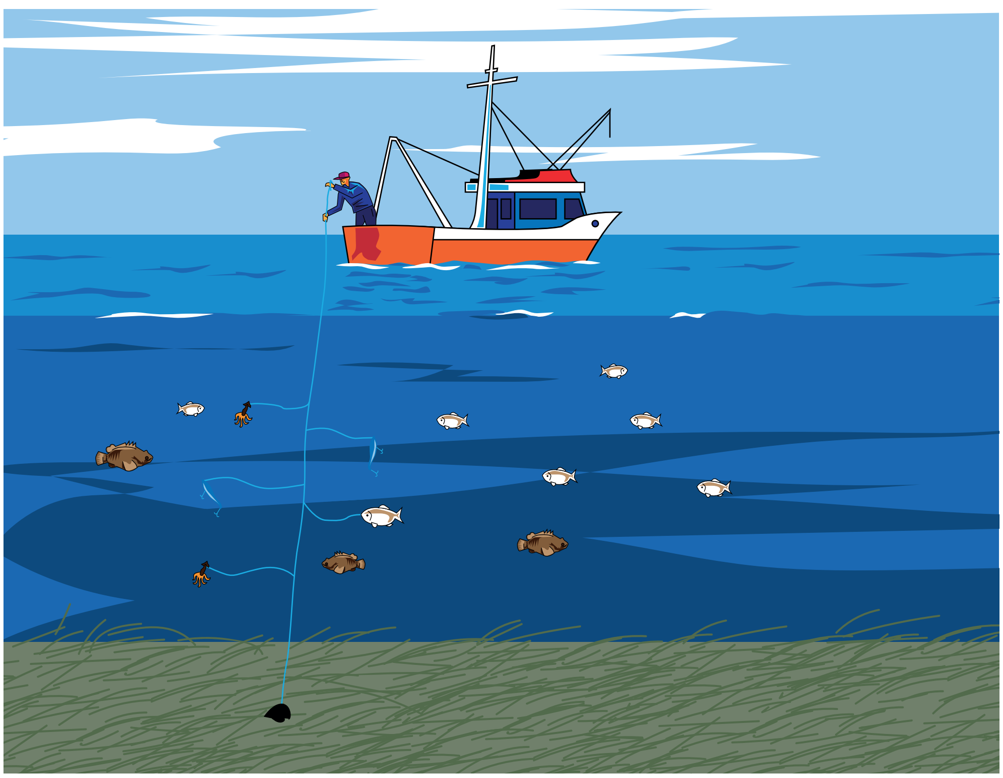
6.7 Hooks and lines, including hand-operated and mechanized hooks and lines

These types of fishing gear are rarely used at a professional level, but in some cases, they allow a good catch to be obtained. The line is characterized by one or more hooks tied together with a single line. In relation to use, it is possible to identify different types of lines. Some general characteristics will be presented in this section, as these types of gear have dozens of variations in the different areas in which they are used.

6.7.1 Handlines

The line is used by holding it directly with the hand and is therefore kept under constant and direct control by the operator (Figure 100). As such, the handline is a type of gear that targets a very large number of species. It acts as a substitute for more important types of fishing gear (e.g. trammel nets, longlines, driftnets) when their yields are low. Handlines are used with various types of bait (usually poor-quality fish, bread, etc.) in practically all countries and in both professional and recreational fishing. A few characteristic types of handlines are described below.

FIGURE 100
Handline



Source: redrawn by Koen Ivens from A. Lucchetti.

In Mediterranean Morocco, handlines are widely used (Box 12), with two types distinguished based on the target species and the size of the hook and line (Darasi, 2014; Darasi, Awadh and Aksissou, 2019). Both types employ a mainline with a weight at the end and one or more branch lines ending with baited hooks. The handline with smaller hooks is used in the sites of Belyounech, Fnideq, Martil and Kaa Asras. Fishers use this gear all year round to depths of about 200 m to target fish belonging to the Sparidae family – bogue (*Boops boops*), sargo breams (*Diplodus* spp.), pandoras (*Pagellus* spp.). The handline with larger hooks is generally used in the sites of Belyounech, Martil and

Fnideq. It is employed all year round at average depths of 8–70 m up to 120 m to target seabreams and serranids. A third type of handline specifically targets common octopus and is employed all year round in Fnideq, Martil and Kaa Asras at depths ranging from 8 m to 70 m. It has no branch lines and the weight is directly placed in the treble hook.

Box 12
Different types of handlines used in Mediterranean Morocco


© A. Petetta

Handline with small hooks.

Target species: sparids
Area: Belyounech, Fnideq, Martil and Kaa Asras
Mainline: 100 m long, 0.60–0.70 mm in diameter
Branch lines: 0.5 m long, 0.40 mm in diameter
Hooks: 3–5 per boat, 2–3 cm long
Bait: sardines
Setting: set on the bottom and left for 6–12 hours before retrieval
Period of use: all year round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Handline with thicker lines for larger hooks.

Target species: large sparids and serranids
Area: Belyounech, Martil and Fnideq
Mainline: 150–350 m long, 1.8 mm in diameter
Branch lines: 0.5 m long, 1.2 mm in diameter
Hooks: 3–10 per boat, 4.5–6.5 cm long
Bait: sardines, cuttlefish, squids
Setting: set on the bottom and left 6–12 hours before retrieval
Period of use: all year round


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Mouchtra handline for octopus.

Target species: common octopus (*Octopus vulgaris*)
Area: Fnideq, Martil and Kaa Asras
Mainline: 20–100 m long; 1.3 mm in diameter
Branch lines: 0.5 m long, 0.40 mm in diameter
Hooks: 3–10 per boat; 5–6.5 cm long
Bait: sardines, cuttlefish, squids
Setting: set on the bottom and left 1–1.5 hours before retrieval
Period of use: all year round except for April, May and August

Other handlines are employed in Dikky (Morocco), in the Strait of Gibraltar (FAO ArtFiMed, 2011). One type, locally called *chambil*, mainly targets sparids – pandoras, pargo breams (*Pagrus* spp.), sargo breams. This line is 150–350 m long, with one or two hooks around 5 cm long (for pargo breams) or 4 cm long (for pandoras and sargo breams). The diameter of the mainline is 1.30 mm, while that of the branch lines is 0.90 mm. The branch lines are 0.5 m long and set 0.5 m apart. The weight at the end of the line is 0.20–0.25 kg. From three to ten lines are employed in each boat (length overall 5–7 m, engine 15–45 hp) reaching a maximum depth of 350 m. These lines are retrieved every ten minutes, and the hooks are baited with sardines, cuttlefish, squids or artificial lures. The *chambil* is used all year round. In Dikky (Morocco), another handline is used that specifically targets Atlantic bluefin tuna and more rarely swordfish and little gulper shark (*Centrophorus uyato*). This line is 200–500 m long, with two or three hooks each around 9 cm long. The diameter of the mainline and branch lines is 2.0 mm. The branch lines are 3 m long and set 3 m apart. The diameter of the mainline and that of the branch lines is 2.0 mm. At the end of the line, there is a 3–4 kg weight or a 10–15 kg ballast with a breakable end. One or two of these lines are employed for each boat (length overall 5–7 m, engine 15–45 hp) reaching a maximum depth of 400 m. These lines are retrieved every time a fish is hooked, and the hooks are baited with octopus. This kind of handline is employed in July–September.

In Algeria, handlines are also employed all year round in certain areas (Algiers, Chlef, Tlemcen). A handline with smaller hooks is used to catch sparids (bogue, sargo breams, pandoras, etc.) in mixed bottoms up to 200 m depth. Meanwhile, a handline with larger hooks is used to target Atlantic bluefin tuna, swordfish and other species such as little tunny (Sahi and Bouaicha, 2003).

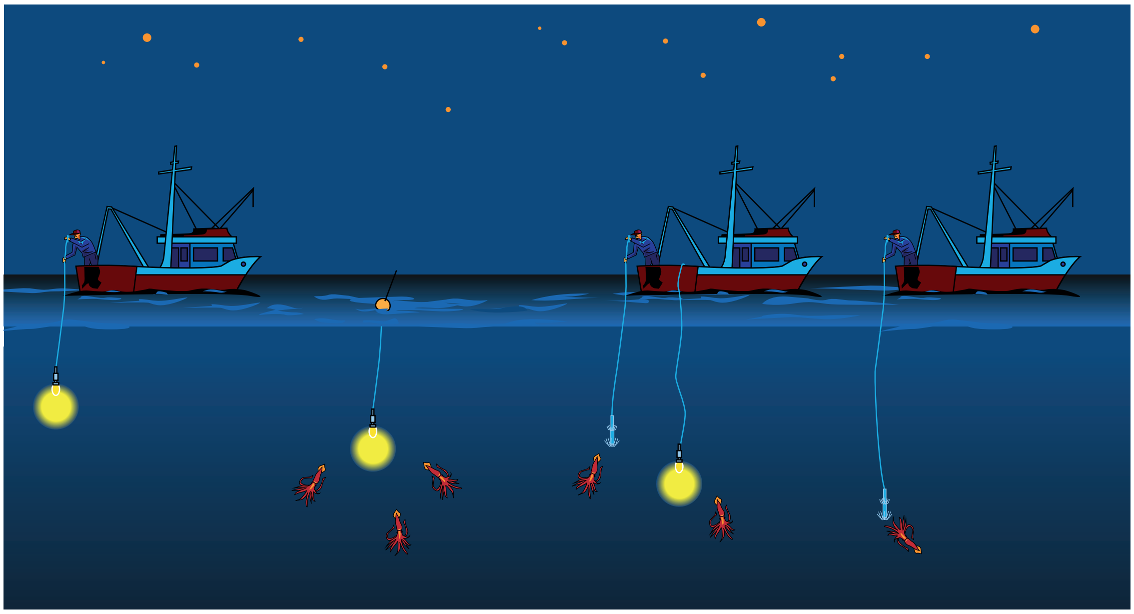
In France, the *palangrotte* is a small vertical longline typical of the Mediterranean (Sacchi, 2008); it is 100 m to 150 m long, equipped with a few branch lines, wound on a reel and uses 30–60 g lead weights. The line is held by the fisher, who can thus feel the bites. In addition, the *filancioni* handline, used in the Ligurian region, is employed to catch blackspot seabream (*Pagellus bogoraveo*) in deep waters.

In Italy, traditional lines are commonly used in the Tyrrhenian Sea to target European flying squid (*Todarodes sagittatus*) and European squid (*Loligo vulgaris*). The lure used is commonly called a squid jig, and the Italian common name for this type of gear is *totanara* (Plate 72). It is a sub-cylindrical device about 10 cm or more in length equipped with one or more crown(s) of hooks, which is controlled by hand from the boat; it is therefore the skill and experience of the fisher that determines the efficiency of the tool. The *totanara* can be equipped with a light used to attract squid. Alternatively, lamps and the *totanara* can be deployed separately at a certain depth to practise the so-called squid jigging technique (Plate 73 and Figure 101). Usually, the flashing lamps are set in the water column for nearly three hours from 6 p.m. to 4 a.m. at a depth of 400–800 m (depending on the depth at which the squid are found). Later, the lamps are hauled in by hand or by means of a winch. The total number of lights per fishing session ranges from four to ten per fishing vessel. The spacing between light signals is about 250–500 m. A 70 m nylon line is connected to the traditional hook (*lontro*), used to fish in the proximity of each light signal. An additional lamp can be used at the sea surface at about 1.5 m depth as an additional attractor (Figure 101). The bait used is commonly poor-quality fish such as Atlantic horse mackerel (*Trachurus Trachurus*), round sardinella (*Sardinella aurita*) and sardine (*Sardina pilchardus*). This type of line is handled by releasing and recovering the line with a rhythmic vertical movement that is particularly attractive to squid.

PLATE 72
Lamps for squid jigging used in southern Italy

PLATE 73
Modern lamps used for squid jigging in Croatia

FIGURE 101
***Totanara* handline used in Italy**



Source: redrawn by Koen Ivens from A. Lucchetti.

Other types of handlines used in Italy include: the *tonga*, which is used in shallow water from boat or shore; the *correntina*, which is used in marine or lagoon waters and consists of a main line equipped with three or more small leads, between which the secondary lines with their hooks are attached; and the *bolentino*, which is a type of line with a terminal sinker, held perpendicular to the bottom. Each of these lines is used almost exclusively by recreational fishers and only in the presence of species of interest by professional fishers.

In Croatia, the use of handlines is very common (Cetinić and Soldo, 1999a). A handline called *lignjar* is made of monofilament twine with two squid jigs. This is thrown into the sea and the twine is released long enough for the jigs to be just above the bottom of the sea. Very powerful modern lights are currently used for this type of fishing (Plate 74).

PLATE 74
Modern lamps used for squid jigging

In Türkiye, the use of handlines is widespread in small-scale fisheries. Methods for the handline, as well as hook size and shape selection vary according to the target species. For serranids and sparids, J-hooks from 7 to 13 cm in size are used with bait, as well as the jig method with lures being frequently employed around reefs in deeper waters. For pelagic species, fishing gear made of a large number of J- and C-hook sizes are used with white or red hen feathers as lures. Pelagic species such as horse mackerels, bonito, mackerels and sand smelt (*Atherina presbyter*) are captured with these lures. In addition, the octopus handline (locally called *parangula*), which is used to catch octopuses (*Octopus* spp.) in the Aegean Sea, is frequently employed. In squid fishing, different coloured squid jigs specially produced for squids are used on board boats. Two or three jigs per boat are used in this fishery.

In Romania, hand-operated and mechanized handlines, as well as pole and lines are widely used, mainly to catch gobids, such as knout goby (*Mesogobius batrachocephalus*) and Mediterranean horse mackerel, at 12–15 m depth. From two to ten J-hooks, each 1–3 cm long, baited with artificial lures are employed. A monofilament mainline (0.1–0.6 mm diameter) is used, which is connected to monofilament branch lines that are 4–10 cm long, 0.1–0.4 mm in diameter and spaced 5–10 m apart. The lead weight varies from 40 g to 100 g (Radu and Radu, 2008).

In Lebanon, a handline called *boulis* is used for medium-sized demersal species (Sacchi and Dimech, 2011).

6.7.2 Pole-lines (manual)

A pole-line is a line whose support wire is manoeuvred by a pole that may or may not be equipped with a reel to unwind or wind the line itself. Currently, the rods are made of synthetic materials and are often telescopic. This fishing technique is mainly used in recreational fishing or sometimes used by professional fishers opportunistically during other activities when species of interest are detected.

In France, a limited number of artisanal fishing vessels target Atlantic bluefin tuna with rod and reel; this technique is practised during the day, drifting or anchored, using short (1.70 m) fibreglass rods fitted with spinning reels and short-shank baited hooks around 6–8 cm long. This activity is subject to obtaining a European Fishing Authorization (European Parliament and Council of the European Union, 2016; European Commission, 2022) and to a limitation on the Atlantic bluefin tuna quota (harvest quotas of Atlantic bluefin tuna are established annually by the International Commission for the Conservation of Atlantic Tunas [ICCAT] based on scientific evidence and allocated among the different fisheries by the contracting parties).

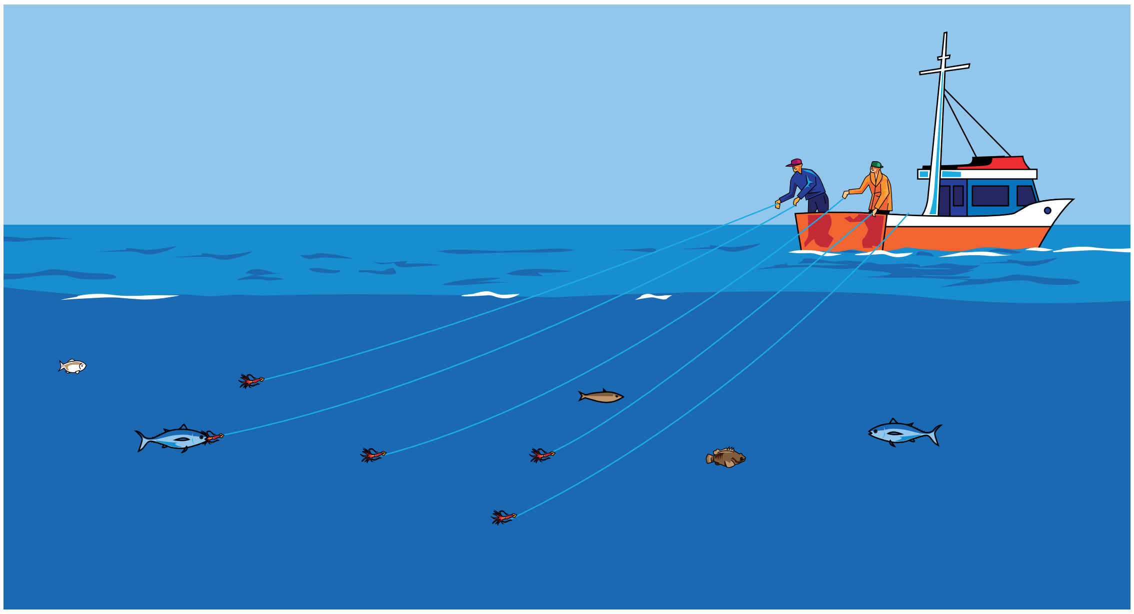
6.7.3 Pole-lines (mechanized)

This is a type of line that, when the fish bites the hook and pulls, automatically hauls the fish on board by means of a machine. The line does not need the direct control of the operator, who only intervenes after each capture to rebait the hook and reset the machine for subsequent capture. This fishing technique is almost exclusively used in recreational fishing.

6.7.4 Trolling lines

This is a line towed at an appropriate speed to simulate the movement of a fish and thus facilitate the bait being attacked and bitten by the target species. A trolling line consists of a line ending with natural or artificial baited hooks that is towed by a vessel near the surface or at a certain depth. Several lines may be towed at the same time using outriggers to keep the lines away from the wake of the vessel (Figure 102). The line can be towed by hand, or multiple lines can be towed at the same time. This fishing technique is mainly used in recreational fishing and only rarely used in professional fishing or sometimes used opportunistically during other activities when fishers detect species of interest.

FIGURE 102
Trolling line



Source: redrawn by Koen Ivens from A. Lucchetti.

In Mediterranean Morocco, trolling lines are employed as an ancillary fishing practice to those using set nets and longlines in Belyounech, Fnideq and Kaa Asras (Darasi, 2014). Used to target sparids, including common dentex (*Dentex dentex*) and gilthead seabream (*Sparus aurata*), European seabass (*Dicentrarchus labrax*) and large serranids, including groupers (*Epinephelus* spp.), the mainline is usually 400–500 m long with a diameter of 1.8 mm, while branch lines are 1 m long and 1.2 mm thick. The branch lines are 2–5 m apart, while the number of hooks per boat is 120–150 and the hooks are around 5 cm long. Sardines are used as bait and the line is left from 6 hours to 12 hours before retrieving. This gear is employed all year round.

In Algeria, trolling lines are employed by small boats to catch semi-pelagic and pelagic fish using live bait (squids, cuttlefish, garfish, etc.) or artificial lures (spoons, minnows, etc.). The mainline is from 70 m to 150 m long and has a twine diameter ranging from 0.35 mm to 1.8 mm. The leader is connected with two to six branch lines each 10 cm long and spaced 20 cm to 25 cm apart. The branch lines end with hooks ranging from 3 cm to 7 cm long (Laid, Lamri and Kadri, 2001).

In France, several types of trolling lines with winches are used either at sea or in lagoons for mackerel, seabass, bonito, mullet, and seabream. Coastal fishing boats occasionally employ single or multiple (*mitraillette*) trolling lines to catch mackerel, bonito or Atlantic bluefin tuna, generally using lures of various shapes and weights; these techniques are mainly practised by recreational fishers.

In Croatia, trolling lines are quite commonly used (Cetinić and Soldo, 1999a).

In the Strait of Messina (Italy), a traditional activity with trolling lines is still carried out and specifically targets Atlantic bluefin tuna (Di Natale *et al.*, 2005). A fleet of very small wooden vessels (between 5 m to 8 m in length), variable in number from year to year, usually with two fishers on board, are employed. The autumn–winter fishery is carried out either during the day or the night, using handlines with single hooks. The day fishing is undertaken by trolling the line behind the vessels, at slow speed, particularly in autumn. Hooks are generally medium-sized, with white chicken plumes or, in the past, a wooden fish acting as a lure. The night fishing is carried out by keeping the line vertical, passively using the current of the strait; the fishing depth is between

40 m to over 200 m and the hooks are large, using live Atlantic horse mackerel or European eel (*Anguilla anguilla*) as bait. The spring–summer fishery is undertaken mostly at night, employing a bigger hook and the same type of bait as used in winter. The fishing depth is usually shallower compared to the winter activity. The day fishing is carried out in the same manner as in winter, although the plumes are substituted with fish bait. Due to the size of the vessels, the large-sized tunas are usually kept along the side and the vessels return to the village after each relevant catch; only small- and medium-sized tunas are kept on board. For the same reason, fishing is carried out only during good weather conditions and according to the direction of the strong currents of the strait. The home harbours are located in Messina and in the nearby villages of Pace, St. Agata, Ganzirri and Torre Faro along the Sicilian side of the Strait and in Punta Pezzo, Catona, Villa San Giovanni and Scilla along the Calabrian side. The fishing grounds include the southern part of the strait off the Calabrian coast and the true strait between Calabria and Sicily, but not the area north of Capo Peloro (Sicily).

In Malta, hand trolling lines are used mainly to catch common dolphinfish and greater amberjack.

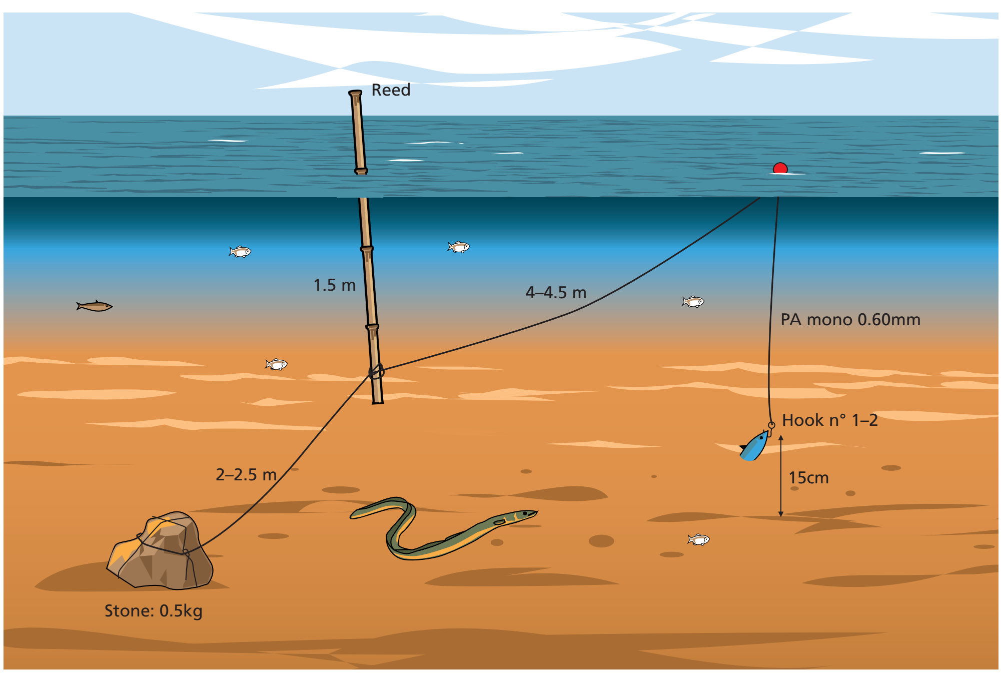
In Türkiye, trolling lines are mainly used to catch European seabass. The lures are made of many different materials, models and shapes for trolling behind the boat.

In Lebanon, fishers use trolling lines called *jarjaras* for medium- and large-sized pelagic fishes, such as bonito and Atlantic bluefin tuna from mid-March to May and mid-July to mid-October (Sacchi and Dimech, 2011).

6.7.5 Anchored lines

These are lines made up of several hooks and anchored to the seabed. The line is then placed on the vertical support between the anchor and the float, which is used as a signal. This type of line is therefore not kept under constant control by fishers. This fishing technique was used in the past in many areas to catch fish near the bottom, but it has been effectively replaced by bottom longlines, which are much more efficient. It is now mainly used in recreational fishing.

FIGURE 103
***Croc* anchored line used in France**



Source: redrawn by Koen Ivens from A. Lucchetti.

In France, the *croc* is an anchored line mainly used in lagoons and shallow waters (Figure 103; Marty, 1993). It is connected to a sunken stone of around 0.5 kg; a reed or a piece of bamboo about 1.5 m long indicates its location. The line is maintained in mid-water by a small float; the line is a polyamide monofilament of 0.5–0.6 mm diameter and the length of the hook is around 3 cm. The bait is generally half a young eel or live bait, such as small wrasse (Labridae). Set in several units, this fishing gear is used to catch large eel, called *ressots*, European seabass and gilthead seabream.

6.8 Underwater fishing, including diving

Underwater fishing is practised with or without breathing systems to catch different species. The use of spear guns is rarely used in professional fishing.

Professional underwater fishing in the Mediterranean is usually allowed by those in possession of a licence and is practised to target several rocky benthic invertebrate species. This is the case, for example, of the purple sea urchin (*Paracentrotus lividus*), the red coral (*Corallium rubrum*), some sponge species (genera *Spongia, Hippospongia*), sea cucumbers, bivalves, crustaceans, and some edible ascidians of the genus *Microcosmus*. The collection of these species occurs through diving (often in apnoea, that is without the use of auxiliary breathing devices) and through the use of axes, scrapers or hand-rakes to detach them from the substrate – they can also be collected directly by hand.

6.8.1 Sea urchins

The purple sea urchin is considered to be a gastronomic delicacy in many Mediterranean areas and is intensively collected from shallow subtidal rocky reefs along the coasts of the Mediterranean Sea (Boudouresque and Verlaque, 2001).

In France, purple sea urchins are collected on hard bottoms and in *Posidonia* meadows from 0 m to 30 m depth along the coast of Corsica, Provence and Roussillon and in lagoons in the Gulf of Lion. Sea urchins were traditionally caught with a fish spear (*grapette*) handled from a boat. This type of fishing is now being replaced by snorkelers or scuba divers from November to April. Small fishing units (often using an inflatable boat with an outboard engine) are involved in this fishery with two divers per unit and a watchman for scuba fishing. This fishery is overseen by national regulations limiting the number of fishers and the duration of the fishing season (from 15 September to 15 April). More restricted limitations may be locally implemented by fishers' organizations and/or marine protected areas.

In Italy, professional underwater fishing is only permitted for those fishers with a specialization and may only be practised in apnoea, without the use of a breathing apparatus. These authorizations are only permitted for purposes other than fishing or for the collection of coral, molluscs, crustaceans and sea urchins.

6.8.2 Red coral

Red coral has been an important Mediterranean resource for centuries, with some countries boasting a long tradition of collecting it (e.g. Italy; Cattaneo-Vietti *et al.*, 2016). Today, it is still exploited for its skeleton of calcium carbonate, which is used as a gemstone to manufacture coral amulets and necklaces. For centuries, red coral was collected by trawls and unselective types of gear such as a St Andrew's cross or similar methods. These types of gear were banned in the European Union in 1994 (Council Regulation (EC) No 1626/94) due to the high impact on coral habitats (Council of the European Union, 1994). Harvesting by scuba divers is considered more selective and less impactful on the red coral habitats and colonies. Since the 1980s, due to the high vulnerability of red coral to fishing activities (i.e. harvesting a sessile animal with slow growth), the GFCM has always included red coral in its programme of work and discussed measures to ensure its sustainable harvesting. Since 2011, multiple recommendations addressing red coral harvesting have been adopted by the GFCM, including Recommendation GFCM/43/2019/4 on a management plan for the sustainable exploitation of red coral in the Mediterranean Sea (FAO, 2020). Among the main provisions, it is stated that the only gear allowed to harvest red coral is a hammer used by a scuba diver. Moreover, red coral harvesting from 0 m to 50 m depth is forbidden so as to allow the recovery of shallow populations, and it is prohibited to harvest red coral colonies with a diameter less than 7 mm, measured within 1 cm from the base of the colony. Although the GFCM has established these measures, each region can issue local regulations, quotas and fishing periods (Cau *et al.*, 2013). The countries where harvesting of Mediterranean red coral is/was carried out are Albania, Algeria, Croatia, France, Greece, Italy, Malta, Montenegro, Morocco, Spain and Tunisia. However, in some of these countries, harvesting of red coral is not yet practised (e.g. Malta) or it has been (temporarily) forbidden (e.g. Algeria). In 2010, the Mediterranean Sea produced 50.5 tonnes of red coral from nine countries (Cau *et al.*, 2013).

In France, since the ban on any type of harvesting by dredging, red coral collection is practised exclusively by scuba diving on hard bottoms off the coast of Corsica and Provence from 30 m to 150 m depth (Plate 75). Diving for red coral today requires compressed air up to 80 m deep, while below 100 m it requires gas mixtures or semi-closed circuit rebreathers. Collecting on the bottom takes about 20 minutes and the ascent often exceeds three hours. These constraints have led the maritime authorities to demand that the practice of red coral harvesting be subject to obtaining an approved professional diving certification. In addition, the boat must be more than 12 m in length and must be equipped for scuba diving; some of them have a decompression chamber (Plate 76). The search for suitable red coral sites is facilitated by echo sounders. Since 2014, on the other hand, using a remotely operated vehicle to check for the presence of coral before diving has been prohibited by the European Union (Plate 75).

In Italy, the fishing effort is limited to the deep banks off the Sardinian coast and in the Strait of Sicily, where scuba divers carry out selective harvesting (Cattaneo-Vietti *et al.*, 2016). By contrast, the banks off Liguria, the Tuscan Archipelago, Lazio, the Gulf of Naples, the Gulf of Salerno, Calabria and the Ionian Sea, wich once produced a significant amount of red coral, have been abandoned due to yields becoming negligible. Boats today are equipped with technologically advanced systems that allow diving in relative safety (Plate 77). Coral harvesting may only take place using a hammer (similar to an ice axe) at depths of no less than 50 m. In Sardinia, harvesting may be carried out by authorized persons from 1 June to 30 September. Each fisher has a daily quota and can harvest only corals with a base diameter of 10 mm or more. The basal part of the colonies must be taken into account for the measurement. The use of remotely operated underwater vehicles to search for and/or exploit coral reefs, which a few years ago made it possible to easily locate reefs, is prohibited.

PLATE 75
Red coral diver

PLATE 76
Modern fishing vessel used for underwater fishing with decompression chamber (a) and remotely operated vehicle for prospection (b)

PLATE 77
Vessel for coral harvesting used in Sardinia

In Tunisia, red coral professional underwater harvesting is subject to special authorization issued by the competent authority to fishers trained in scuba diving by approved institutions. Cylinders are filled with compressed air for depths less than 60 m or with a helium mixture beyond 60 m (Romdhane *et al.*, 2014). The only fishing gear authorized to collect red coral is the pointed hammer (35 cm long) to facilitate cutting. Red coral harvesting is banned in several fishing zones and only allowed for specimens greater than 7 mm in diameter. The main important area of red coral is the northern Tunisian coast.

6.8.3 Sponges

A large proportion of the commercial sponges (genera *Spongia* and *Hippospongia*) that are harvested are used as bath sponges or in the cosmetics industry. Significant numbers of sponges are also used in decorative art and in alternative medicine. The most important centres of sponge harvesting and processing are in the Greek Dodecanese archipelago (Kalymnos island), in Tunisia (Zarzis and Sfax) and in the Turkish Aegean Sea (Pronzato, 1999; Toklu and Cimsit, 2009), but intensive sponge fishing has been also practised along the southern Italian, Libyan and Egyptian coasts.

In France, *Spongia lamella* are harvested by apnoea or scuba divers.

In Tunisia, sponge fishing, which is a traditional activity, is only authorized by free diving. Sponge fishing is prohibited from 1 April to 31 May of each year. The minimum size of the sponges is 15 cm except for the sponges of the *Spongia* genus (locally called *hajami* and *zimoca)* (Romdhane *et al.*, 2014).

In Greece, according to the Sponge Fishers Association of Kalymnos, qualified active divers have an annual production of approximately 4 tonnes (bath sponge dry weight). The diving apparatus employed to harvest the sponges has evolved over the last century into the modern system used in scuba diving, called *narghile* by the Greek fishers (also known as hookah). It consists of an air compressor and a medium-pressure air tank, both housed on board, which provide air to the diver, thus extending their time underwater (Voultsiadou *et al.*, 2011).

6.8.4 Molluscs

In Algeria, it is common to fish by hand or using other common tools from the shore, especially in the intertidal zone. For example, mussels and other molluscs are detached from the rocks with the help of a knife (Laid, Lamri and Kadri, 2001).

In French lagoons, the traditional métier of hand dredging (*arseillère*) for burrowing bivalves, such as Japanese carpet shell (*Ruditapes philippinarum*) and grooved carpet shell (*Ruditapes decussatus*), as well as common edible cockle (*Cerastoderma edule*), has been replaced over the past two decades by manual harvesting through apnoea, exclusively with a knife or a fork having three curved teeth at its end and less than 40 cm in length (15 cm generally). The use of the palm of the hand is prohibited. The fisher dives down to 5 m depth for four to five hours per day. Fishing is done by sight: divers will look for small holes betraying the presence of clam siphons. For shellfish fishing, the use of diving cylinders is authorized, in particular for mussel spat in the Bouches-du-Rhône department. Scuba or apnoea divers also harvest the Mediterranean mussel (*Mytilus galloprovincialis*).

In certain areas of the Italian Adriatic Sea, underwater fishing is used to harvest natural populations of Mediterranean mussel, which locally sustain professional fishing activities. Sometimes, mussels are also taken by divers from the legs of dismissed gas platforms.

In Croatia, the striped venus clam (*Chamelea gallina*) is present in the Neretva river estuary. However, fishing activity is practically negligible and most of the catch is harvested manually.

In Montenegro, it is only allowed to collect edible shellfish manually, without the use of dredges.

In Lebanon, divers usually harvest bivalve molluscs, such as thorny oysters (*Spondylus* spp.; Sacchi and Dimech, 2011).

In Türkiye, diving methods (scuba and snorkelling) are extensively used in both the Aegean Sea and the Marmara Sea to harvest bivalves with high economic value. The main target species are Mediterranean mussels, European flat oyster (*Ostrea edulis*), grooved carpet shell, Japanese carpet shell, striped venus clam, warty venus (*Venus verrucosa*) and pecten scallops (*Pecten* spp.).

In Türkiye, Romania, Bulgaria and Ukraine, harvesting of rapa whelk (*Rapana venosa*) in the Black Sea is also carried out manually by divers, especially in the areas where the bottom structure does not allow for beam trawling (Danilov *et al.*, 2018).

6.8.5 Other species

In Algeria, a hand net with fine meshes is used in the intertidal zone to catch crabs and shrimps during low tide (Laid, Lamri and Kadri, 2001).

In France, apnoea divers also harvest tunicates, such as grooved sea squirt (*Microcosmus sabatieri*), sea worms or peanut worms (Sipunculidae) to use as bait in recreational fishing.

In the Turkish Aegean Sea, the hand fishery, using diving equipment to harvest sea cucumbers, mainly belonging to the genus *Holothuria*, is subject to authorization (González-Wangüemert, Aydin and Conand, 2014). These species are exploited for different edible subproducts, created from salted intestines, dried internal muscle bands and dried body walls.

In Lebanon, there is an important diving fishing activity targeting groupers, large Sparidae and crustaceans, such as the Mediterranean slipper lobster (*Scyllarides* latus; Sacchi and Dimech, 2011).

In Palestine, swimmers and divers use different fishing techniques (Ali, 2002). Bottles or jars, or a plastic bottle with a lateral cut, are used by swimmers to attract small fry fish such as the sand steenbras (*Lithognathus mormyrus*) near the beach. In addition, fishing with a speargun is a technique used by many divers to catch fish as a hobby around the rocks of Deir al Balah and Khan Younis. This method is legal if the fishers do not use oxygen tanks.

6.9 Miscellaneous gear

In Croatia (GSAs 17 and 18), a traditional and unique fishing method, called *tramata,* has been used since 1300 CE (Basioli, 1984). *Tramata* has some similarities with Danish seine fishing carried out in northern Europe. The name of this fishing practice originates from the Latin word meaning to "tremble" or "to be afraid" (Hirtz, 1956). This technique, which is one of the main commercial methods to target sparids, is used in shallow waters and was often forbidden or restricted. *Tramata* fishing is used to target a wide range of sparid species: saddled seabream (*Oblada melanura*), sargo breams, common dentex, salema (*Sarpa salpa*), sand steenbras, black seabream (*Spondyliosoma cantharus*) and gilthead seabream. This fishing method uses ropes to surround an area. Depending on the enclosed area, the length of the enclosing rope, the length of the decorations and fishing gear used, there are three main types of *tramata* net: *ludar*, *zagonica* and *fruzata* (Soldo and Cetinić, 2009). Currently, the *tramata* net is permitted in limited areas and during certain periods.

Cetinić *et al.* (2002) have provided a detailed description of *tramata* fishing. *Ludar* is the method of *tramata* fishing with the greatest range (Figure 92). The length of the ropes for surrounding the area can be up to 4 000 m with a maximum operating depth of 50 m. The *ludar* begins by closing a large area of the sea with the ropes connected in a single line. At the centre, a net can be fixed with vertically positioned wooden plates, without a leadline and floatline. The role of the net is not to capture, but to produce tensile strength, in order to maintain the traction speed, the height of the rope above the bottom and to produce stronger mechanical and sound vibrations. The length of this net can reach 300 m. About 200 m-long ropes on both sides of the net are decorated with white plastic strips, wooden plates or other white materials as an additional method to scare the fish. Every 100 m, the buoys are joined to a buoy line to allow the fishers, who are in the boats, to lift and adjust the rope to prevent it from sticking to the bottom. The height of the ropes above the bottom must not exceed 1 m for it to function properly.

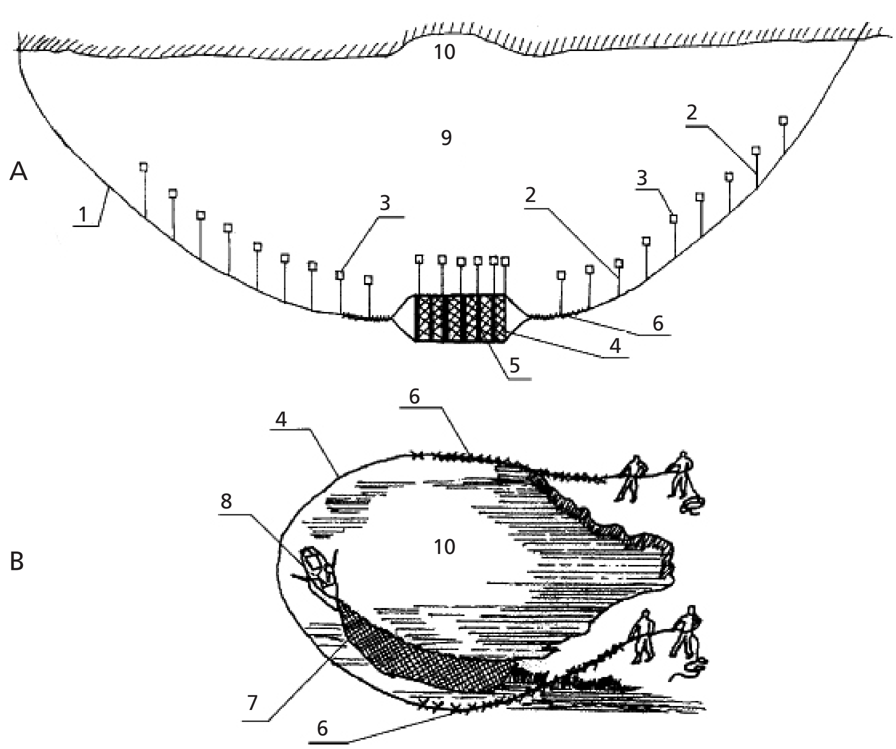
The second phase begins when both sides of the rope are on the shore. Then the fishers start pulling the ropes towards the shore. The traction must be constant to produce continuous rope vibrations as *tramata* fishing is based on fish behaviour. The efficiency of this method derives from the mechanical and sound vibrations that result from the constant traction of the ropes. These vibrations affect the sense organs (ear, lateral line and contact organs) of fish who swim far from the source of the vibrations. Recently, most of these ropes and cord ropes have a white colour, because it has been noticed by divers that the colour white also scares fish.

The third phase begins when the closed area has been brought near the shore to the harvesting point. Gillnets are set up to surround fish that have been herded by the ropes. The reduction of the surrounded area does not occur by pulling the gillnets onto the shore, but rather by constantly crossing them to maintain the cage shape of the gillnets. The final collection is carried out with a special net on four sides (10 m by 10 m) with a leadline, though without a floatline, or with a common gillnet that is pulled manually by a fisher inside the cage under the fish, and then used as a bubbling bag. Due to the heavy weight, extraction from this bag on the boat deck or on the ground is usually undertaken by a brail net (i.e. a small net used to draw the fish into the boat).

Fruzata is a fishing method on a smaller scale. It also begins by closing the area, but with gillnets instead of ropes. The inner end of the gillnets is on the shore while the outer end of the gillnets is a rope that pushes the fish towards the gillnets. The length of the rope can be up to 2 000 m. There are also decorations and buoys with buoy lines. The final collection process is similar to the *ludar* method, except that it is performed with the same gillnets used to enclose the area.

Zagonica is a fishing method of the same size as *fruzata*. The area is closed by the beach seine with the rope attached to the external wing. The length of the rope can be up to 2 000 m. On the inner wing of the beach seine, whose end is located 100 m from the beach, a rope is attached with the other end on the shore, allowing fishers to pull the trawl from both sides. In this case, there are also decorations and buoys with buoy lines. The same method, similar to the previous ones, has been used to catch fish near the coast. The final harvest is competed with the beach seine being pulled out onto the shore or on the boat moored near the beach. The duration of fishing with the *tramata*, starting from the closure of the area to the final collection, varies between 3 and 12 hours, and sometimes even longer due to the time dedicated to selecting the fish.

FIGURE 104
The *ludar* method of *tramata* fishing used in Croatia



Notes: A. first phase, B. final phase; 1. main line; 2. buoy line; 3. buoy; 4. net with plates; 5. wooden plates; 6. decorated rope; 7. gillnet; 8. boat; 9. sea area surrounded by ropes; 10. area of gathering and fishing.

Source: **Cetinić, P., Soldo, A., Dulčić, J. & Pallaoro, A.** 2002. Specific method of fishing for Sparidae species in the eastern Adriatic. *Fisheries Research*, 55(1–3): 131–139.

7. Fishing gear used in lagoons

Lagoons are defined by Cataudella, Crosetti and Massa (2015) as "the typical zones between the continent and the sea where the existence of ecological gradients, due to the transition from the continental to the marine domain, creates the peculiar ecological conditions that characterize these ecosystems." As a result of sedimentological, hydrological and biological gradients, coastal lagoons create intricate mosaics of various habitats where significant environmental heterogeneity can be seen both between and within individual lagoons (e.g. food web connectivity and interfaces with the lagoon's watershed and the nearby sea). Rich fish assemblages are frequently hosted by these highly productive ecosystems due to their efficient trophic transfer and composite structure and functions. Therefore, since ancient times, fisheries have been traditionally carried out in Mediterranean and Black Sea coastal lagoons, which have provided an important source of food and income for local communities.

Around 400 coastal lagoons are present in the Mediterranean and Black Sea region, covering a surface of over 641 000 ha and differing in both their typology and use (Cataudella, Crosetti and Massa, 2015). At present, capture fisheries in lagoons can still be considered as forms of artisanal fisheries that target more than one species (multispecies fisheries) and make use of a wide variety of fishing gear. The most used are V-shaped fish traps and fyke nets (fixed), trammel nets, gillnets, pots (not fixed), dredges, longlines, harpoons and other minor types of fishing gear. As such, fishing gear designs are highly diversified and specific, based on a deep knowledge of lagoons and species biology (e.g. reproduction timing, migrations and seasonal or daily movements due to tides, among other factors). Indeed, fishing activities are specific to regions and to individual lagoons.

7.1 V-shaped fish traps

V-shaped fish traps are also called barriers (e.g. *lavorieri* in Italy, *bordigues* in France) because they are set in the communication channels between a lagoon and the open sea or between two basins within the same lagoon. These traps allow juvenile fish to enter the lagoon while preventing their exit once they have grown up and try to return to the sea. Along the structure, there is one or several consecutive chambers divided by openings that are equipped with grids. The grids consist of vertical and parallel metal rods, and based on the distance between the rods, a selection process takes place, as only fish under a certain size are able to pass through. Fish trapped in the chambers are then caught using nets. The main target species are gilthead seabream (*Sparus aurata*), European seabass (*Dicentrarchus labrax*), mullets (Mugilidae) and European eel (*Anguilla anguilla*). The structure (shape and number of chambers), size, design and building materials (reeds, concrete or metal) of these fixed traps have greatly evolved over the centuries and differ among countries according to local traditions and technologies (Plate 78); however, the fishing efficiency of any of these structures can reach 100 percent (Cataudella, Crosetti and Massa, 2015).

In Algeria, V-shaped barriers (or *bordigues*) are employed to catch euryhaline species in their migratory phase to prevent them from migrating back to sea (Laid, Lamri and Kadri, 2001). In the Mellah Lagoon (eastern Algeria), the *bordigues* are made with iron, wood and reeds; a plastic netting delimits some areas, called fish ponds, where the fish are trapped in the evening. The *bordigues* are installed at the channels in the form of corridors; one door faces the mouth of the lagoon, and the other faces the lake, so as to trap the fish that follow the current entering and leaving the lake. For this purpose, only the door facing the direction of the current remains open. This type of gear is used to catch mullet, seabream and seabass, among others.

In the Ebro Delta (eastern Spain), a traditional type of gear called *pantene* is used that creates labyrinths that drive fish into a central lagoon through an artisanal form of fishing known as *encañizadas* used in the Albufera of Valencia, a freshwater lagoon and estuary on the Gulf of Valencia coast. This type of fishing gear is not frequently employed today, and its use is almost exclusively for recreational activities (Cataudella, Crosetti and Massa, 2015).

In Italian lagoons, the *lavorieri* were originally made of reeds and other plant materials; today most of them are constructed in concrete with plastic or metal grids. The design can be more or less complex and generally includes V-shaped chambers to facilitate movement of the fish towards the point of capture. Their position in the tidal channels, by communicating with the sea, and their management allow capture of fish when they migrate from the lagoon back to the sea during reproductive migrations. In other cases, however, fish barriers can also enable the capture of fish moving from the sea towards the lagoon, as often practised in Sardinia during summer. The dimensions of the grids of the *lavorieri* are such that the entry of young fish fry is always possible in order to support fish recruitment to the lagoon (Cataudella, Crosetti and Massa, 2015).

PLATE 78

V-shaped fish trap used in Lesina Lagoon (top) and surrounded by additional fences and barriers (bottom)

Source: **Li Veli, D., Lucchetti, A., Virgili, M., Petetta, A., Scirocco, T., Specchiulli, A., Lago, N., Lillo, A. & Cilenti, L.,** eds. 2021. *Attrezzi e tecniche di pesca della laguna di Lesina.* Foggia, Italy, Claudio Grienzi Editore.

In Tunisia, the *bordigue* used in the lagoon of El Bibane is the longest existing fixed fishing gear in the Mediterranean, at 2 km long. This gear is employed to catch fish of high commercial value such as seabass, seabream, leerfish (*Lichia amia*), bluefish (*Pomatomus saltatrix*), annular seabream (*Diplodus annularis*) and sand steenbras (*Lithognathus mormyrus*) (Cataudella, Crosetti and Massa, 2015).

In Albania, fish barriers (called *dajlan*) are installed in front of water currents. These types of artisanal gear are composed of natural and/or plastic cans and wooden poles. Their construction and use are regulated by law, according to the fishing periods, while the areas close to fishing barriers are forbidden to external users (Cataudella, Crosetti and Massa, 2015). In the Vaini and Patogu lagoons, fishers also employ fixed articulated fishing traps along the coast; these act as an obstacle net system in which the fish are captured in several cone- or pyramid-shaped chambers.

In the traditional Turkish lagoon fishery, a stationary barrier trap, called a *kuzuluk*, is also used, though the barrier is not V-shaped. These traps are set in front of the inlet of the lagoon systems in spring. In the past, they were usually made of cane sticks (Plate 79), but nowadays they are constructed of iron bars (Plate 80). Target species are seabass, grey mullet, seabream, European eel, shrimps and blue crabs.

PLATE 79
Traditional *kuzuluk* barrier trap made of cane sticks used in Turkish lagoon fishery

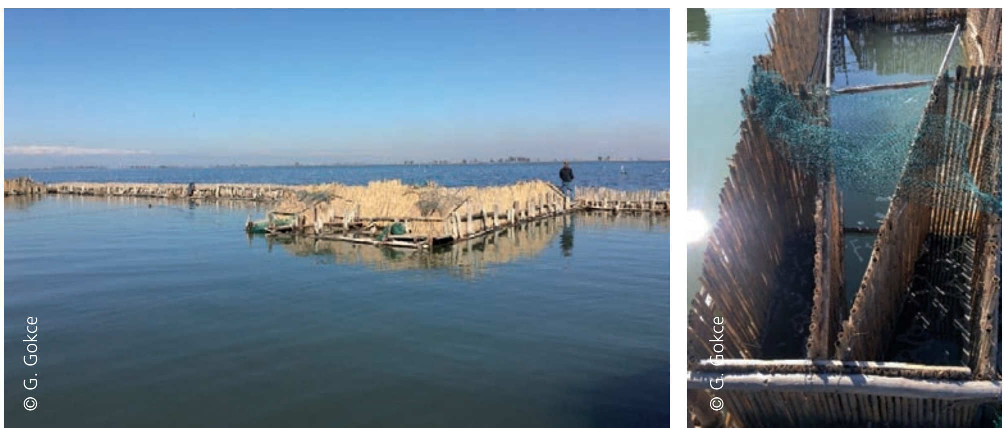
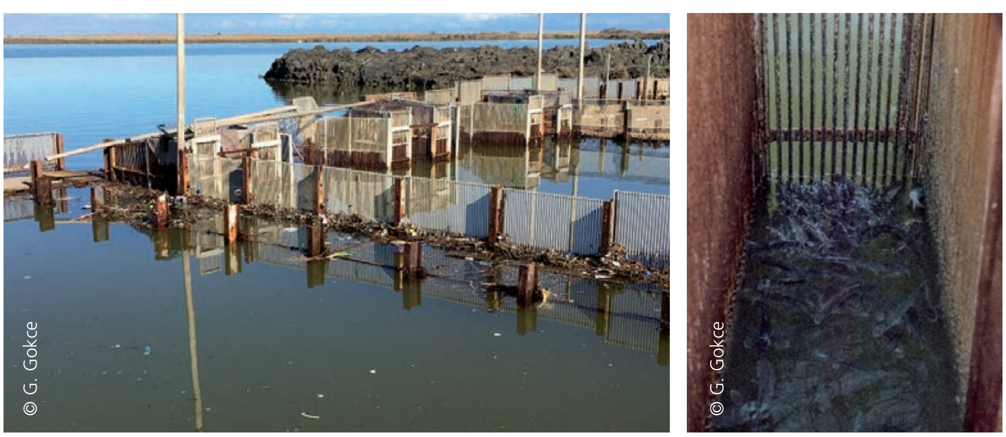


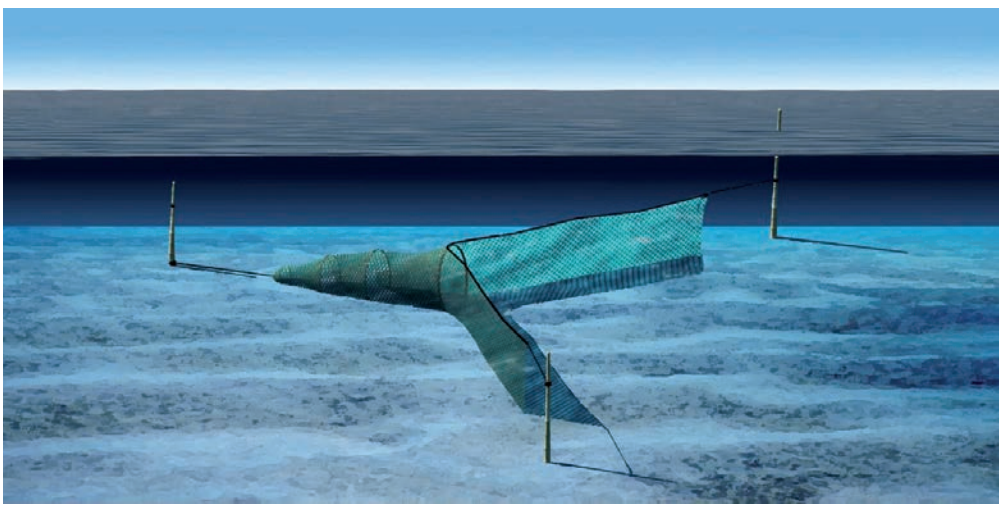
PLATE 80
Modern *kuzuluk* barrier trap made of iron bars used in Turkish lagoon fishery



7.2 Fyke nets

Fyke nets are removable or, more often, semi-permanent fixed systems of traps (trapnets) constructed with wings of netting joined to each side of the entrance in order to guide the fish into a long cylindrical netting bag (Figure 105). This bag is usually made of several netting cones fitted inside the netting cylinder to make entry easy but exit difficult. The fyke net can be associated with a series of barriers or leaders built of poles and netting panels (i.e. gillnets on stakes as described in Section 7.7), whose main function is to guide the prey towards the terminal part of the trap. This is the proper fyke net, made of several and consecutive funnel-shaped entrances of decreasing size that connect the chambers, up to the final one, called the death chamber (Plate 81). These cylindrical- or cone-shaped netting bags are mounted on rings or other rigid structures with a non-return entrance at one end. The target species are the same as those caught in the V-shaped fish traps. Only the terminal part of the fyke net (i.e. the death chamber) is hauled in, with the help of a pole, to collect the catch. The terminal part of these traps is similar to, if not the same as, the pots employed in marine coastal areas, such as the *cogolli* used in the Italian Adriatic Sea to target common cuttlefish (*Sepia officinalis*), described in the pots section (Section 4.2.2). The fyke nets are fixed on the bottom by anchors, ballasts, stones or stakes; they may be used either separately or in groups to form a complex system.

FIGURE 105
Fyke net used in lagoons



Source: illutrated by A. Lucchetti.

In Algeria, they are called *verveux*; manufactured artisanally (circles of wood, plastic, metal or netting), they are generally intended to catch sedentary and benthic species. In Lake Mellah, a typical fyke net is composed of three capture chambers in the form of large conical pockets. Each pocket is divided into compartments with a small opening between them (Cataudella, Crosetti and Massa, 2015).

In Spanish lagoons, fishers use a system of weir nets that funnel target species to a complex of fyke nets. Specifically, in each trap, two side wings of netting converge to form a V-shape that is effectively the fyke net mouth (Plate 82). They are inspected daily and only the last chamber, secured to the bottom by a long stick, is hauled out to take the catch.

PLATE 81

Terminal part of a fyke net, the death chamber

Source: **Li Veli, D., Lucchetti, A., Virgili, M., Petetta, A., Scirocco, T., Specchiulli, A., Lago, N., Lillo, A. & Cilenti, L.,** eds. 2021. *Attrezzi e tecniche di pesca della laguna di Lesina.* Foggia, Italy, Claudio Grienzi Editore.

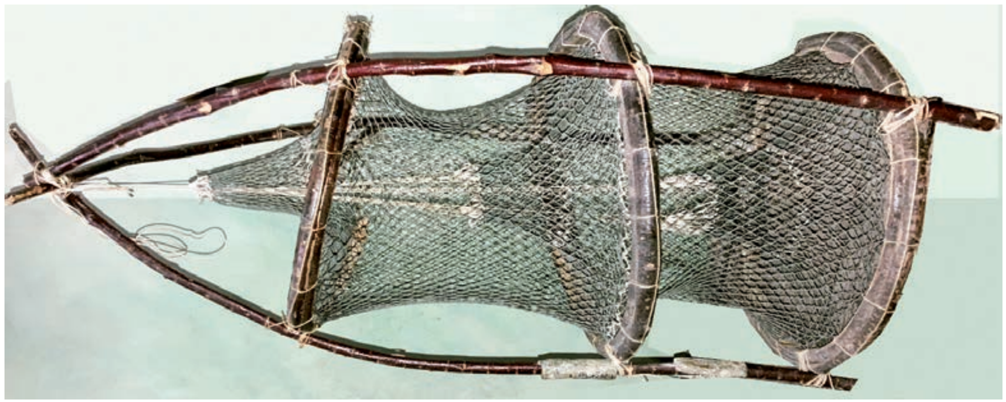
PLATE 82

V-shaped mouth of the fyke net (left) and hauling of the last chamber (right)

In France, the fyke net is the basic element of a variety of gear types used in lagoons and channels, ranging from the simplest, the *jambin*, *bertoullet* or *bergelle*, to the triangle passing through the *gangui*, the *capéchade* and the *maniguière* (Quignard and Autem, 1983; Giovannoni, 1995).

The *jambin, bertoullet* and *bergelle* are small conical hoop nets less than 1 m long, without wings and set in a fleet (*andana*) of 15 to 20 units spaced every 3 or 4 m in seagrass beds to catch small labrids that are then used as bait for longlines (Plate 83). They are baited with mussel debris or crushed crabs.

PLATE 83
***Bertoullet* fyke net used in France**



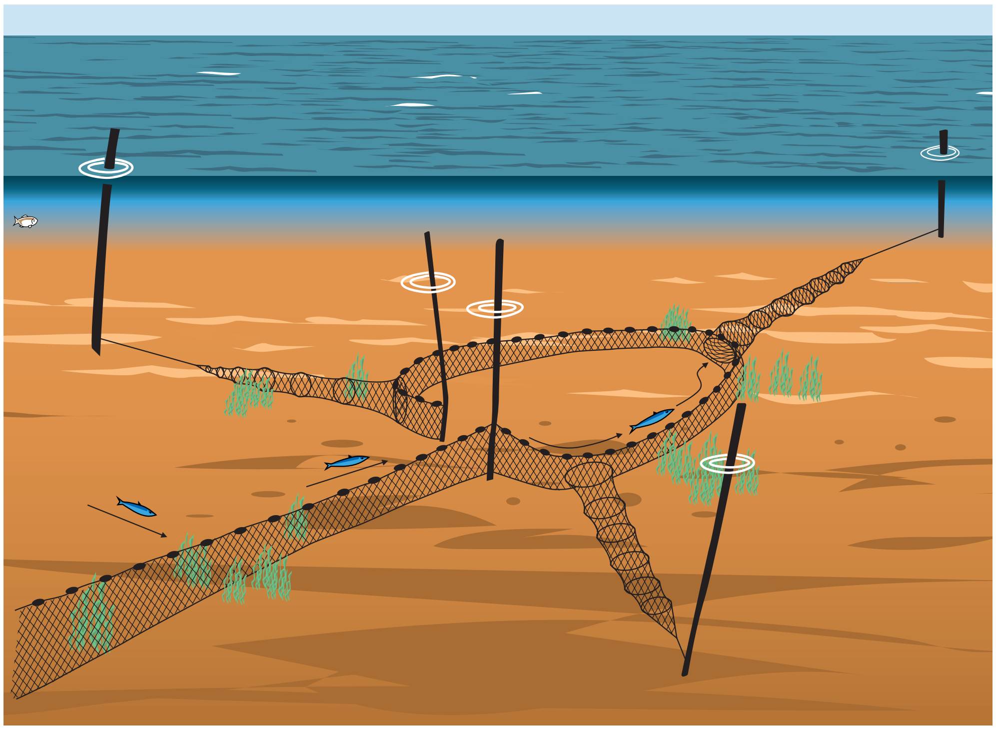
Source: J. Sacchi from "Musée Ethnographique de l'Etang de Thau".

The *gangui* consists of a conical hoop net (*verveux, enfile, segui* or *quiouletta*) with a pair of divergent wings 16 m long and 11 m high. The fyke net has a 14–16 mm mesh size supported by seven to nine polyvinyl chloride (PVC) hoops of decreasing diameter, with the largest diameter exceeding 1 m. Every second hoop supports a truncated net cone inside the cylinder. These *ganguis* are set with cables and weights (30–50 kg) connected to the bank. Their length can reach over 30 m. The mesh size of the trap ranges from 14 mm to 16 mm for eel fishing. The *gangui* is set in deeper waters of the lagoon or in the channels connecting the lagoons to the sea (called *graus*) to allow seabream to be caught from 1 July to 31 March and eel all year round (mainly during dark winter nights). This type of gear catches fish coming out of the lagoons, as the nets work with their mouths open towards the lagoons. The *ganguis* are most often set behind each other, with a passage of 2–3 m being provided along the banks to enable the circulation of small boats. The work requires one or two fishers.

In addition to the two wings, the *capéchade* has a rectilinear net (*paradière*) 35 m long and from 4 m to 12 m high, depending on the setting depth (Figure 106). This net is set perpendicular to the shore and held by evenly spaced stakes to lead the fish to a net enclosure *(tour)* towards three fyke nets. The fyke nets are formed from a series of three to five truncated net cones supported by PVC hoops and covered with black nylon braided netting of decreasing mesh size from 24 mm to 16 mm. The mesh size of the *paradière* and the *tour* is 30 mm. The fyke net, which is facing the entrance (*drecha*), has six hoops, while the two others (*revers*) are built with only four hoops. The *capéchade* is set anywhere in the lagoon in shallow or deeper waters to catch eel, small fish, including small labrids and gobies, and other species, such as big-scale sand smelt (*Atherina boyeri*) and pink shrimps (*Palaemon* sp.), as well as juveniles and young eel.

The *manière* or *maniguière* is similar to a *capéchade*, but with larger dimensions, having a leader (*paradière*) 35 m long, a height of approximately 5.5 m, 180 to 245 meshes of 36 mm mesh size according to the setting depth, a *tour* of 50 m and three nylon net fyke nets without knots whose mesh size gradually decreases from 24 mm to 16 mm at the end of the bag. The fyke net facing the *paradière* and known as the *drecha* has eight hoops from 50 cm to 80 cm in diameter, while the other two fyke nets called *revers* are made of seven hoops of 50 to 70 cm in diameter. The whole gear is fixed to the bottom by wooden stakes, anchors or weights behind a triangle, or instead to only one of them. The *manières* are set by fishers in selected areas, following an annual draw: from July to October, they mainly target gilthead seabream, from October to the end of February downstream European eel and sand smelts (*Atherina* spp.) and in November and December sole and European seabass.

FIGURE 106
***Capéchade* and *manière* fyke nets used in the Gulf of Lion**



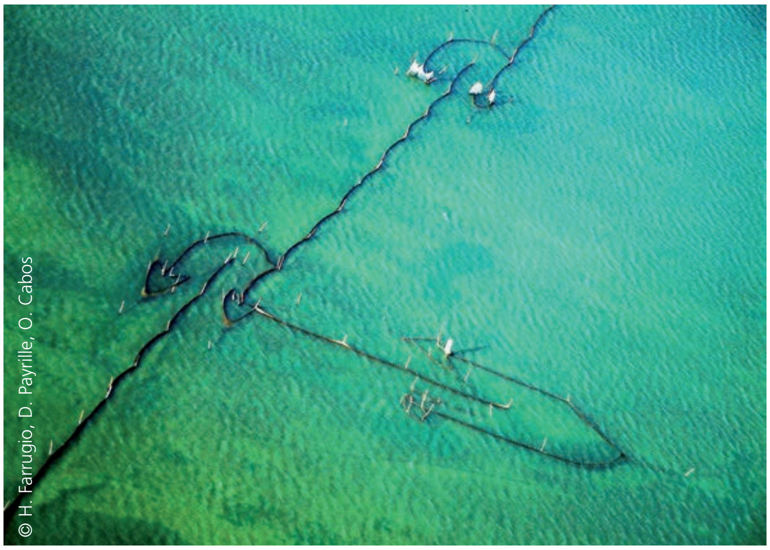
Source: redrawn by Koen Ivens from **Farrugio, H., Payrille, D. & Cabos, O.** 2007. *Mesure de l'efficacité de la règlementation Française de la pêche à l'Anguille dans la Lagune Méditerranéenne de Bages-Sigean*. Sète, France, Ifremer.

The *brandine* consists of assembling two *capéchades*, each placed at one end of a *paradière* 35 m long (*doublis*) or as an extension of a previous one (*penet*). These nets are cast from the shore in such a way that their headline does not reach the surface. To facilitate their setting, the *paradière* of the *brandines* is united with the *tour*; the *paradière* is about 1 m high and has a 32 mm mesh size; the fyke nets are made up of six hoops for the *drecha* and four hoops for the *revers*; their mesh size is 28 mm, 24 mm, and then 16 mm or 20 mm at the end. These *brandines* are used in selected areas following an annual draw or in a free setting to fish seabream, flatfish, eel and mixed fish species that are sold to be cooked in soup from 1 July to 30 September.

The *triangle* has seven fyke nets, all assembled at the same end of a *paradière* 5.5 m high and about 90 m long (Plate 84). The fyke net set opposite the *paradière* is called *droite* or *drecha* and has two 35 m-long wings, each of which leads to the entrance of a *manière* with three fyke nets (*revers*). The *paradière*, the wings and the *tour* of each *manière* are the same height and have the same mesh size of 32 mm. The *drecha* fyke net is made of eight hoops, starting at 80 cm in diameter for the largest (*rey de cape)* and decreasing to 50 cm in diameter for the last one of the bag. The *revers* are made of six hoops decreasing from 70 cm to 55 cm in diameter. These hoop nets are covered by knotless netting with mesh sizes decreasing from 24 mm to 16 mm. These types of gear target the same species as the *manières*. Their setting is authorized exclusively in areas drawn by a lottery and must be about 90 m apart. While the c*apéchade*, *manière* and *triangle* occupy the entire water column with their floatlines reaching the surface, the *gangui* and the *brandine* are set completely submerged.

In order to catch seabream, seabass and flatfish, specifically at the end of summer, fishers preferentially use *manières, brandines* and *triangles* with a larger mesh size (68 mm) for the *paradière*, wings and *tour*, as well as for fyke nets (ranging from 60 mm to 36 mm at the ends).

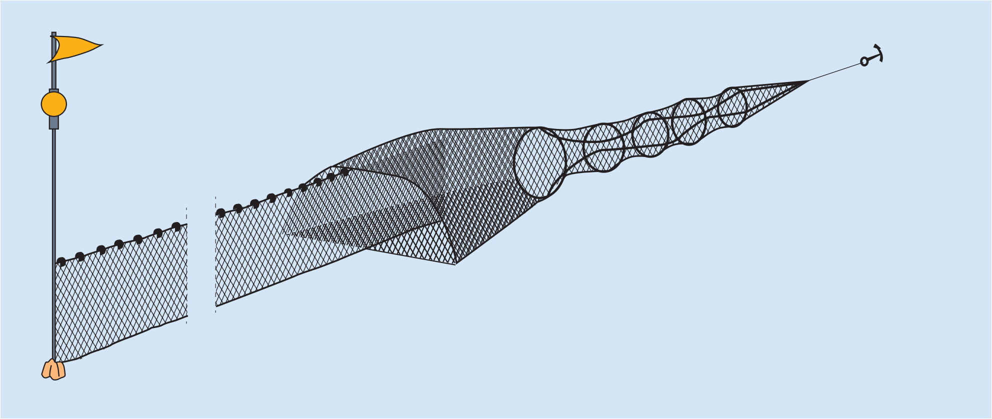
PLATE 84
Combinations of several triangles used in lagoons of the Gulf of Lion



Source: **Farrugio, H., Payrille, D. & Cabos, O.** 2007. *Mesure de l'efficacité de la règlementation Française de la pêche à l'Anguille dans la Lagune Méditerranéenne de Bages-Sigean.* Sète, France, Ifremer.

It is also possible to observe, but to a lesser extent, a kind of fyke net without a wing, called a *cerf-volant*; this fishing gear is mainly used to catch eel and sand smelts (Figure 107). This gear is supported by five or six PVC hoops decreasing in diameter from 60 cm to 45 cm, preceded by a net funnel (cape), whose opening is supported by a PVC hoop 2 cm in diameter, 120 cm in width and 80 cm in height. This fyke net is provided with a 9–11 m long *paradière* (a leader net) in nylon or polypropylene, starting from the inside of the cape, which divides into two parts. The opening of the trap is D-shaped and can be weighted down either by a leadrope or by a metal bar. The wing and the front part of the fyke net have the same mesh size of 20 mm. Only the tail of the fyke net is made of 10 mm mesh size. *Cerf-volants* are generally set in pairs in a row and oriented in the direction of the current to prevent risk of clogging by floating debris.

FIGURE 107
***Cerf-volant* used in the mouth of the Aude River**



Source: redrawn by Koen Ivens from **Quignard, J.P. & Autem, M.** 1983. Description de quelques pêcheries d'estuaire et paralagunaires du Languedoc (Globes, carrelets, ganguis). *Science et Pêche*, 323: 1–21.

The typical Italian fyke nets (called *bertovelli*) are employed to catch eel, gobids and other fish; they consist of a series of capture chambers of decreasing mesh size and have dimensions, shapes and structures that are extremely variable from region to region and among different lagoons. They are often used in sequence, with numbers and dispositions varying from a few nets to large systems, such as the *giostre* in Sardinia and the *paranze* in the Lesina lagoon (northern Apulia), which are endowed with net walls that often connect two sides of the lagoon (Plate 85; Li Veli *et al.*, 2021). The *tresse* used in the Venetian Lagoon also employ fyke nets: net walls 130–140 cm tall, with a minimum mesh size of 16 mm, ending in fyke nets, locally called *cogolli*. Furthermore, in the Venetian Lagoon, the total number of fyke nets varies throughout the year from a minimum of 1 283 nets to about 5 000 nets (Provincia di Venezia, 2009).

PLATE 85
Paranza **used in Lesina lagoon, southeastern Italy**

Source: **Li Veli, D., Lucchetti, A., Virgili, M., Petetta, A., Scirocco, T., Specchiulli, A., Lago, N., Lillo, A. & Cilenti, L.,** eds. 2021. *Attrezzi e tecniche di pesca della laguna di Lesina.* Foggia, Italy, Claudio Grienzi Editore.

In the northern Adriatic Sea, Italian fishers also use a fyke net similar to the French *cerf-volant* with a leader gillnet joined to the middle of the fyke net mouth to drive fish toward the fyke net from both sides (Plate 86).

PLATE 86
Fyke net with leader used in northern Adriatic Italian lagoons

In all Albanian lagoons, fyke nets are a very common fishing gear for catching eel and are called *gogola* (Cataudella, Crosetti and Massa, 2015).

In Croatia, there are two types of fyke nets (called *kogol*) employed to catch big-scale sand smelt and European eel.

In Egypt, fyke nets are used at a depth of 1.5–5 m on sandy–muddy bottoms to catch catfish and *Tilapia* sp. These pots have a cylindrical shape (collapsible), with polyamide (PA) netting and metal frame.

In Türkiye, the fyke nets are called *pinter* (Plate 87). They are manufactured in an artisanal way (circles made of plastic-coated iron bars 50–55 cm in diameter) and are generally intended to catch European eel, seabream, grey mullets and shrimps. A typical fyke net is composed of one D-shaped frame in the front and three or four circle rings behind. The capture chamber is in the form of a large conical pocket. The fyke nets are used as two sets with a guiding net in the middle.

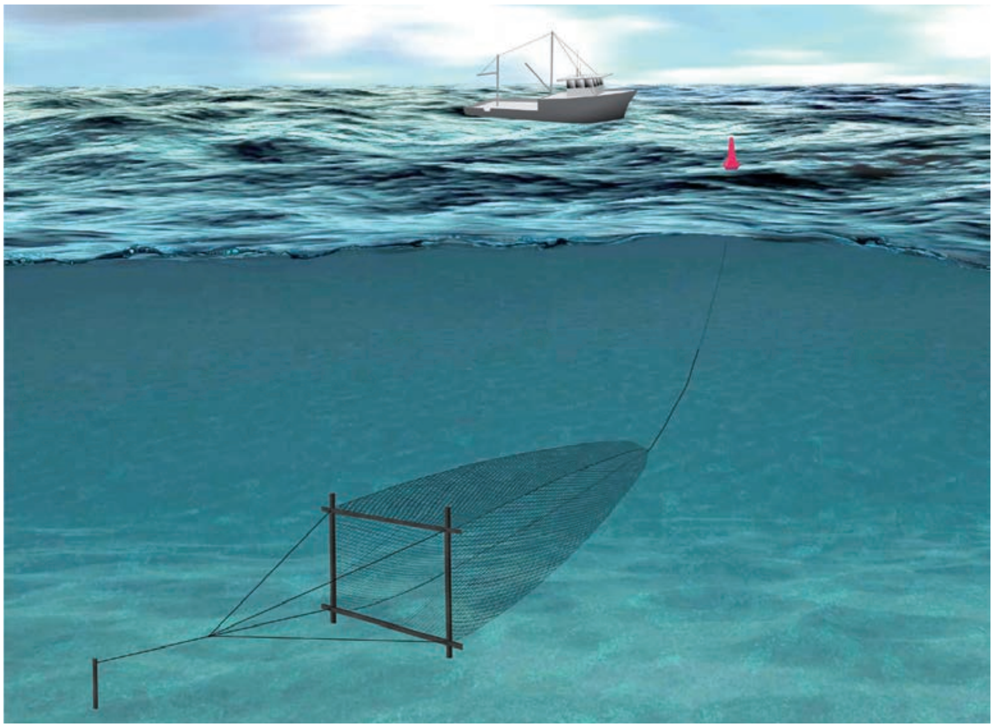
In the Ukrainian Azov Sea (GSA 30), the fyke net is used to catch gobids (with a mesh length of 32 mm) and caridean shrimps (with a mesh length of 13–20 mm) in shallow waters (3–5 m).

PLATE 87
Fyke net used in lagoons in Türkiye (left) and its last chambers set in the fishing ground (right)

7.3 Stow nets

This is a stationary type of gear fixed in places with a strong permanent water current by means of anchors or stakes (Figure 108). It consists of a netting cone or pyramid kept open by the current, while the mouth is held open by a frame. Stow nets can be fixed for a long time at the same place, as well as in rows. Only the final part of the net (the bag) is usually hauled in and emptied on board small vessels, while the body is left in position. The catching method is through water filtering.

FIGURE 108
Stow net



Source: **He, P., Chopin, F., Suuronen, P., Ferro, R.S.T & Lansley, J.** 2021. *Classification and illustrated definition of fishing gears.* FAO Fisheries and Aquaculture Technical Paper No. 672. Rome, FAO. https://doi.org/10.4060/cb4966en

In the Ebro Delta, Spain, this gear is mainly employed to catch glass eels, an intermediary stage in the complex life history of European eel between the leptocephalus stage (i.e. the flat and transparent larva) and the juvenile (elver) stage, when the eels start to move from sea to freshwater. No bait is used, but a light is placed inside the trap that attracts the eel during night hours (Lopez and Gisbert, 2009).

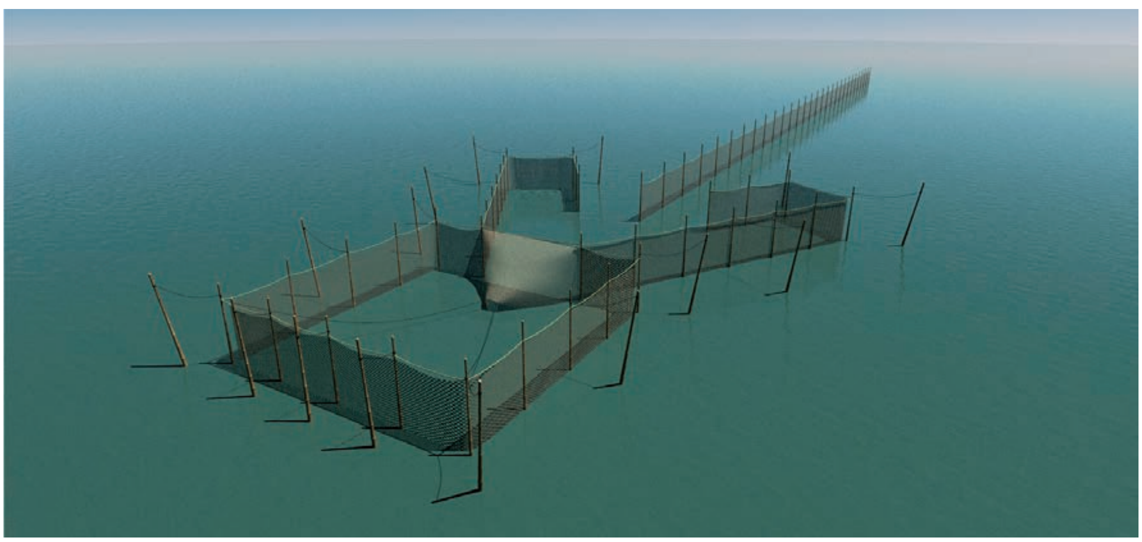
7.4 Aerial traps

These are nets usually set on the surface to catch jumping fish (such as mullets) that are frightened by fishers who get them to jump out of the water. The setting and use of such type of gear is done by hand and does not require specific equipment. They are usually employed from small-sized boats. No such type of gear is reported in any specific area of the Mediterranean and Black Sea.

7.5 Stationary uncovered pound nets

This gear is similar in structure to the barriers and traps used in the open sea to catch migrating fish (e.g. tunas; see Section 6.2). Stationary uncovered pound nets usually consist of net walls anchored or fixed on stakes, reaching from the bottom to the surface, and thus composing a complex system of barrages (Figure 109). The nets are open at the surface and include various types of fish herding and retaining devices. They are mostly divided into chambers closed at the bottom by netting. This type of gear is usually hauled by hand or using small-sized boats. The fish enter voluntarily, but are hampered from leaving. Fishers visit the traps every day collecting those caught, while keeping the gear set in the same place for the whole season. This type of gear is mainly used to catch migrating species from estuarine and sea water, such as European seabass, gilthead seabream, mugilids and European eel, among others.

FIGURE 109
Stationary uncovered pound net



Source: **He, P., Chopin, F., Suuronen, P., Ferro, R.S.T & Lansley, J.** 2021. *Classification and illustrated definition of fishing gears.* FAO Fisheries and Aquaculture Technical Paper No. 672. Rome, FAO. https://doi.org/10.4060/cb4966en

On the Romanian and Ukrainian Black Sea coast (GSAs 29 and 30), stationary uncovered pound nets, similar to those described in Section 6.2, are used in the lagoons (Radu and Radu, 2008). In Ukraine, a mesh length of 40–60 mm is used to target mullets, while a mesh length of 110 mm is used to catch certain freshwater species (*Carassius* spp. and gobids).

7.6 Gillnets and trammel nets

These types of gear have been extensively described in Chapter 4. The degree of use of passive nets varies according to lagoon and season of the year (Cataudella, Crosetti and Massa, 2015). In addition, the technical specifications of gillnets and trammel nets strictly depend on the target species. Some modifications from traditional passive nets may be introduced for lagoon fisheries (e.g. height of the fishing nets, which may be reduced due to the shallowness of the lagoon) (Plate 88; Li Veli *et al.*, 2021).

PLATE 88
Gillnet used in Lesina lagoon, southeastern Italy

Source: **Li Veli, D., Lucchetti, A., Virgili, M., Petetta, A., Scirocco, T., Specchiulli, A., Lago, N., Lillo, A. & Cilenti, L.,** eds. 2021. *Attrezzi e tecniche di pesca della laguna di Lesina.* Foggia, Italy, Claudio Grienzi Editore.

In Algeria, different types of set nets are employed. The monofilament gillnet is composed of several 50 m-long panels attached to one another, forming a 200–350 m-long net. It has a mesh size of 32–40 mm. Meanwhile, trammel nets have two external panels with 100 mm mesh size, and the inner panel has a small mesh size (25 mm). It is 300 m long on average (six 50 m pieces), 3–5 m high and placed in the coastal belt because of the lack of oxygen in the central zone (especially in summer). Once fixed, this net forms a vertically maintained wall.

In Spanish Mediterranean coastal lagoons, encircling nets are used in ponds, channels or small areas to accumulate fish.

In France, the nets used in lagoons include gillnets and trammel nets, set or encircling, mainly targeting common species in coastal waters. Consequently, they have the same characteristics as the gear used in these areas, but with shorter lengths given the smaller dimensions of the boats (often without engines) and shorter heights adapted to the shallow lagoons. These characteristics are also defined by the local regulations of fishers' organizations (*prud'homies*).

In Italy, trammel nets and gillnets are generally used to catch mullet, seabass and seabream (Li Veli *et al.*, 2021).

In Albanian lagoon areas, gillnets and entangling (trammel) nets are commonly used (Cataudella, Crosetti and Massa, 2015).

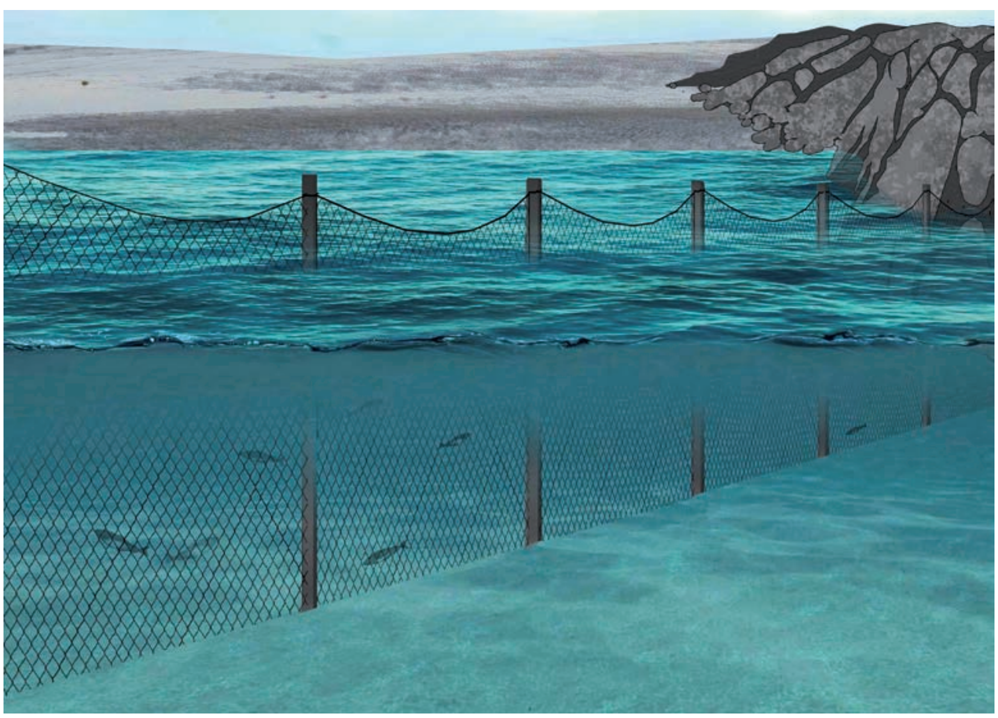
In Turkish lagoons, fixed nets are used to catch salema (*Sarpa salpa*), mullets, gilthead seabream and shrimps, such as caramote prawn (*Penaeus kerathurus*).

The Egyptian Mediterranean coast has six lakes or lagoons situated along the Nile Delta coast. The gillnet is used to catch Nile perch (*Lates niloticus*) and sometimes grey mullet or tilapia (Cataudella, Crosetti and Massa, 2015). It has a mesh size of 60–70 mm and a height ranging from 1.18 m to 1.24 m. Another type of gillnet is used to catch shrimps. In the North Delta Lake, two types of trammel nets are used. One type, locally called *daba*, is widely employed in most areas of the lake to catch tilapia. The other type, locally called *ballah*, is used to catch mullet on the surface; its use is restricted to the more saline northern area of the lake. In general, the design of these two trammel nets is similar in construction, except that the mesh size of the inner layer of the *ballah* is narrower and slacker than the *daba*; moreover, the depth of the net is lower and supplied with little weight on the leadline to enable it to operate on the surface. Among different fishers, the *ballah* trammel net has an outer panel with mesh sizes varying between 115 mm and 125 mm, while the inner panel has mesh sizes of around 35 mm. Another modified type of trammel net (the *saksook*) is used in Lake Burullus and acts as a stationary net. In addition, an encircling net called the *El-Gafsha* is employed in Egyptian lagoons to catch grey mullet: it is the largest of all nets and about 500 m to 1 000 m long and 4 m high, without floats or weights.

7.7 Gillnets on stakes

Gillnets on stakes are fixed gillnets stretched between a series of stakes inserted into the bottom in intertidal areas along the coast, estuaries, lagoons and shallow waters (Figure 110 and Plate 89). These nets are usually hauled in by hand, with the catching process analogous to a simple gillnet. Sometimes, they are used to drive the fish towards a fyke net, which represents the trap (e.g. as in the *paranza* system; Li Veli *et al.*, 2021); if bags and/or entrance structures are used together with the fixed gillnet, it becomes an uncovered pound net or a barrier, fence or weir in the trap category.

FIGURE 110
Fixed gillnet on stakes



Source: **Seafish.** 2023. Fishing gear database. In: *Seafish*. Cited 23 May 2023. Edinburgh. www.seafish.org/responsible-sourcing/fishing-gear-database/?t=docGear/

PLATE 89
Gillnet on stakes commonly used in shallow waters and lagoons, Spain

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7.8 Dredges

Dredges are employed in lagoons mainly to catch clams – grooved carpet shell (*Ruditapes decussatus*) and Japanese carpet shell (*Ruditapes philippinarum*). Rakes with teeth, or metal cages with blades, are towed by hand or by a small boat. All the categories of dredges described in Chapter 3 may be employed in lagoons. They are mainly used at depths greater than 1.5 m, when manual harvesting is not possible.

In the Venetian Lagoon (Italy), Japanese carpet shell harvesting is carried out mainly by means of a dredge locally called a *idrorasca*, which consists of an iron cage, 60 cm wide, and a net bag in which the clams are collected. The digging action is performed by means of an outboard engine propeller (25 hp), located on the side of the boat, that produces a water flow directed at the sediment (as described in Section 3.2.3). As a result, the propeller propulsion suspends bottom sediments and clams and creates a plume in the water column. The clams are then collected in the net bag.

In addition, some kinds of beam trawls (see Section 1.2.3) may be used to catch oysters (e.g. the *ostreghero* in the Venetian Lagoon), mussels and fish (e.g. the *ganguil* in the Albufera of Valencia), even if their use is limited due to the impact they have on the seabed.

In the lagoons of the Gulf of Lion (France), a multispecific towed dredge, called a *petite drague à coquillage* or *drague d'étang*, mainly targets the Mediterranean mussel (*Mytilus galloprovincialis*), but also oysters and sea urchins. The lower part of the metal frame consists exclusively of a flat non-cutting bar without teeth. The bar has a maximum width of 1.25 m. The total weight of the metal frame of the gear does not exceed 35 kg. The minimum mesh size of the netting bag is 75 mm. Each vessel tows only one dredge and must not have a power pull above 85 kW (PGM, 2014).

7.9 Other minor fishing gear and practices

A wide variety of minor types of fishing gear are employed in Mediterranean and Black Sea lagoons. Harpoons (see Section 6.5) are mainly employed to catch European eel, gobies and other fish at night, using an artificial light to see the prey (Plate 90). Seine nets are used to catch sand smelts or other fish species, while baited pots are employed to catch fish and crabs. Furthermore, handlines, small longlines and trolling lines are also used to target fish.

PLATE 90
Harpoon with 15 teeth used in Lesina lagoon, southeastern Italy

Source: **Li Veli, D., Lucchetti, A., Virgili, M., Petetta, A., Scirocco, T., Specchiulli, A., Lago, N., Lillo, A. & Cilenti, L.,** eds. 2021. *Attrezzi e tecniche di pesca della laguna di Lesina.* Foggia, Italy, Claudio Grienzi Editore.

In Spain, longlines are only used in the deepest areas of lagoons.

In French lagoons, fishers catch seabass, seabream and eel using bottom longlines, comprised of a 12 m long PA mainline supporting, at regular intervals, about 20 branch lines in PA monofilament approximately 1.5 m long. Each branch line is fitted with a hook around 3 cm long. A fisher sets between 30 to 40 hooks on each trip. The small labrids captured in the *capéchades* constitute the bait.

In some lagoons, peculiar fishing activities are carried out related to local traditions and/or local management strategies.

In the Venetian Lagoon (Italy), two activities are carried out: fishing for *moeche* and fry fishing. *Molechicoltura*, the collection and production of *moleche*, is a very traditional technique that targets a particular stage of the Mediterranean green crab (*Carcinus aestuarii*) immediately after moulting, which is a gastronomical delicacy. In contrast, fry fishing is a specialized fishery that consists of collecting juvenile fish from the open lagoon at the moment of their ascent from the sea, in order to be used as seed stock in precise areas of the lagoon (called *valli*) that function as nursery areas. Fishing for young fish is currently practised by fishers who operate in the Venetian Lagoon on a local basis, or fisher-traders moving along the Italian coast with trucks equipped with tanks and water oxygenation systems to transport live fish.

In the Tivat Salina lagoon (Montenegro), fishers periodically collect mud shrimps by hand, locally called *kanjoč*, such as Mediterranean mud shrimp (*Upogebia pusilla*); these crustaceans are excellent bait for catching sparids by longline fishing (Joksimović *et al.*, 2006).

In Egyptian lagoons, there is a particular practice called *hosha*. This is a manmade pond with shallow waters built by erecting low dykes made of mud and straw; it has one or more narrow openings connecting it with the lagoon. *Hosha* are periodically closed and the water is pumped out while the fish trapped in the pond are harvested. In addition, catching fish is carried out by simple methods: manually or using nets to surround fish concealed under aquatic weeds.

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The wide variety of marine species of the Mediterranean and the Black Sea, found in different geographical subregions and habitats, has led to the development of a highly diversified fishing sector characterized by a broad range of fishing gear. Over time, the harvesting of marine resources has gained efficiency due to a progressively improving understanding of the habits and behaviours of various target species. Further study of these different types of fishing gear is required to improve the conservation of fish resources and the marine environment, as well as to develop less impactful techniques. A comprehensive overview of fishing gear and methods in use in the Mediterranean and the Black Sea can contribute towards this end in a number of ways. For example, it can provide a basis for mitigating the incidental catch of vulnerable species and the adverse impacts of fisheries on juvenile fish and discards, as well as for decarbonizing fishing fleets through more energy-efficient gear, developing innovative gear to remove marine litter, and reducing lost, abandoned and otherwise discarded fishing gear.
This catalogue aims to provide such an overview and to describe the main technical characteristics and modes of use of fishing gear in operation in the region, considering specificities and differences not only at the regional level but also at the country and local levels.

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