

ANNEX 4. PROJECT *MYGEARS*: TECHNICAL SPECIFICATIONS OF MEDITERRANEAN TRAWL GEARS

1.1 Introduction

1.1.1 Critical review of literature on Mediterranean gear- and vessel-metrics

The technical characteristics of both fishing vessel and trawl nets used in Mediterranean have been collected through an accurate review of the literature. According to the specific objectives of the project the following outcomes have been achieved during the first part of the project:

- collection of information from various literature sources (*e.g.* peer review as well as grey literature, reports, etc.), relevant for describing the different types of Mediterranean trawl gears and fishing vessels;
- identification and selection of appropriate gear metrics to be used in the direct measurement of the trawl size and in the succeeding definition of relationships among gear-metrics and between gear- and vessel-metrics;
- collation and harmonization of the collected information obtained from literature review into an existing technical database that can be used as a first basis for a quali-quantitative analysis.

The critical review of the available information was essential in order to define the gear characteristics which are needful for the estimation of the overall gear size. The technical overview was preparatory for the development of reliable models and relationships between different parts of the fishing gear as well as between some of these parts and otterboard size or vessel metrics. These features have been reviewed by project partners and discussed with fishing-nets makers and door manufacturers involved in the project in order to evaluate their reliability and feasibility.

Standardization of terms used was of great importance, because from the literature review, it was clear that gear descriptions and metrics varied from one country to another. The initial collection of information was therefore concentrated on the data presented in the Table 1, afterwards more gear metrics parameters have been evaluated with the support of tools for calculation already developed in the technical database.

Literature collection covered almost all the Mediterranean GSAs. Data from the Mediterranean EU countries (*e.g.* Italy, Spain, France and Greece) were relatively abundant.

Table 1. Main information collected during the literature review.

Vessel	Length over all
	Gross tonnage
	Engine power
Doors	Types
	Length
	Height
	Weight
Net	Headline length
	Flotation devices
	Footrope length
	Trawl Net Sinkers
	Complete and detailed net plan

1.1.2 Direct in-situ measurements on fishing gears and vessels

The main objective of field data collection was to cover the lacks and gaps resulting from the literature review in any trawling technique. The new data have been directly gathered with the collaboration of fishing-nets makers, door manufacturers, and fishermen.

1.1.3 Definition of fishing gear categories

Information on the technical aspects of the gear types used in the Mediterranean countries have been collected according to a standard format developed in the project. Common rules for the measurement of gear parameters have been set in order to standardize the data collection.

The information on fishing gears have been stratified by **trawling technique** and **gear typology** on the basis of the available information obtained by interviewing some Mediterranean netmakers and door manufacturers. This approach has also facilitated and rationalized first the field direct measurements and secondly the further development of the models/calculations in the existing technical database and all the other succeeding relationships among different parts of the fishing gears as well as between some of these parts and the otterboard size and the vessel metrics.

1.1.4 Trawling technique

The **single trawl technique**, commonly used to target demersal species, which are herded by the doors and the sweeps and bridle, is the most widespread demersal trawling technique. In such fisheries, the door spread and wingend opening are important parameters affecting catchability, but also vertical opening can be important for demersal fish species that have been shown to exhibit upward escapement behaviour when approaching the mouth of the trawl e.g. European hake, and red mullet. Single trawls are also used for shrimp and French pelagic trawling, where focus can be made on both horizontal and vertical opening of the trawl, depending on the fishing situation and the target species^[15].

The main benefit from using the **twin trawl 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, in which case the drag resistance would inconveniently increase. This is done by deploying two juxtaposed smaller trawls rather than a larger single trawl with increased horizontal opening. In other words twin trawls enable to increase wingend spread (by approximately one third) without also increasing vertical opening and towing resistance^[15,16]. This exercise is most useful in trawl fisheries targeting species closely associated to the bottom, which are not necessarily herded by the sweeps and due to their sedentary behaviour are not liable to escape over the headline of the trawl. Species such as Nephrops and monkfish fall into this category and shrimp trawls are also often fished as twin-rigs by Danish, Norwegian, Icelandic, Canadian and recently also by Southern Italian Adriatic fishermen^[15-17].

1.1.5 Fishing gear typologies and corresponding target species groups

Based on Eigaard et al.^[17] and personal communications with Mediterranean net makers as well as knowledge of how trawl geometry, in Mediterranean **five conceptual trawl typologies** can be defined as follows and detailed with technical net drawing in the paragraph §*Technical specifications of Mediterranean trawl gears*. Each inventory observation was assigned to one of the five trawl typologies according to the nominated target species:

1. **Demersal/bottom 2-panel trawls (OTB2)**. They tend to have long sweeps and bridles with large wingend spread and low vertical opening (1-2 m). Typical Italian OTB2-trawls are the “*Tartana*” and “*Volantina*” or the Spanish *Cadenero*, *Huelvano*, *Minifalda*, etc. They are usually used to target mixed demersal species, such as European hake (*Merluccius merluccius*), red mullet (*Mullus barbatus*), whiting (*Merlangius merlangus*), poor cod (*Trisopterus minutus capelanus*), monkfish (*Lophius* spp.) and Nephrops (*Nephrops norvegicus*). They are commonly entirely made up of knotless PA-netting (Figure 1).

2. **Demersal/bottom 4-panel trawls (OTB4).** OTB4 trawls are generally used to target crustaceans such as deep-water rose shrimp (*Parapenaeus longirostris*), deep water red shrimp (*Aristaeomorpha foliacea*), and Nephrops (*Nephrops norvegicus*). All shrimp species are predominantly captured by a process of filtration. These trawls are characterised by having two bridles of 10-15 m to increase the vertical opening, which can be of around 2-4 m. Typical OTB4 are the Italian *Americana* trawl; the Spanish *Cuadrado*, *Dos Bocas*, *Espada*, *Tangonero*, *Semitangonero*; and the French *Jumeaux*, *Filet a chains*. Manufactured mainly with knotted polyethylene netting, can have sometimes knotless polyamide netting in the lower panel (Figure 1).
3. **Pelagic 4-panel trawls (PTM4).** They are designed to catch shoaling pelagic fish that are off the bottom, such as anchovies (*Engraulis encrasicolus*), sardine (*Sardina pilchardus*), mackerel (*Scomber scombrus*), and horse mackerel (*Trachurus trachurus*). PTM-trawls are generally large trawls (e.g. “*Volante*” in Italian), with a high vertical opening, constructed with very big meshes (600-3200 mm) or ropes in the forward part of the trawl that herd fish towards the centre of the body of the trawl constructed in much smaller mesh size (Figure 1).
4. **Semi-pelagic 2-panel trawls (OTM2).** They are designed for the Tyrrhenian fisheries to catch demersal fish such as gilthead sea bream (*Sparus aurata*), sea bass (*Dicentrarchus labrax*), and silver scabbardfish (*Lepidopus caudatus*) which are generally close to the seabed but exhibit an upward migration. The volume swept by the relatively large meshes (120-1600 mm) is what determines the capture efficiency and OTM2-trawls are typically constructed for having a mean vertical opening around 3-4 m. This trawl typology has always a 4-cable rigging (Figure 1).
5. **Semi-pelagic 4-panel trawls (OTM4).** As for the OTM2, they are designed for the Tyrrhenian fisheries to catch demersal fish. Compared to the OTM2 it has a higher vertical net opening and is more efficient for the catching pelagic species. OTM4-trawls are designed for having a mean vertical opening around 4-10 m. This trawl typology has always a 4-cable rigging (Figure 1).

"Trawl nets means nets which are actively towed by the main boat engine and consisting of a cone- or pyramid-shaped body (as trawl body) closed at the back by a codend and which can extend at the opening by the wings or can be mounted on a rigid frame. Horizontal opening is either obtained by otterboards or provided by a beam or frame of variable shape and size. Such nets can be towed either on the bottom (bottom trawl net) or in midwater (pelagic trawl net)".

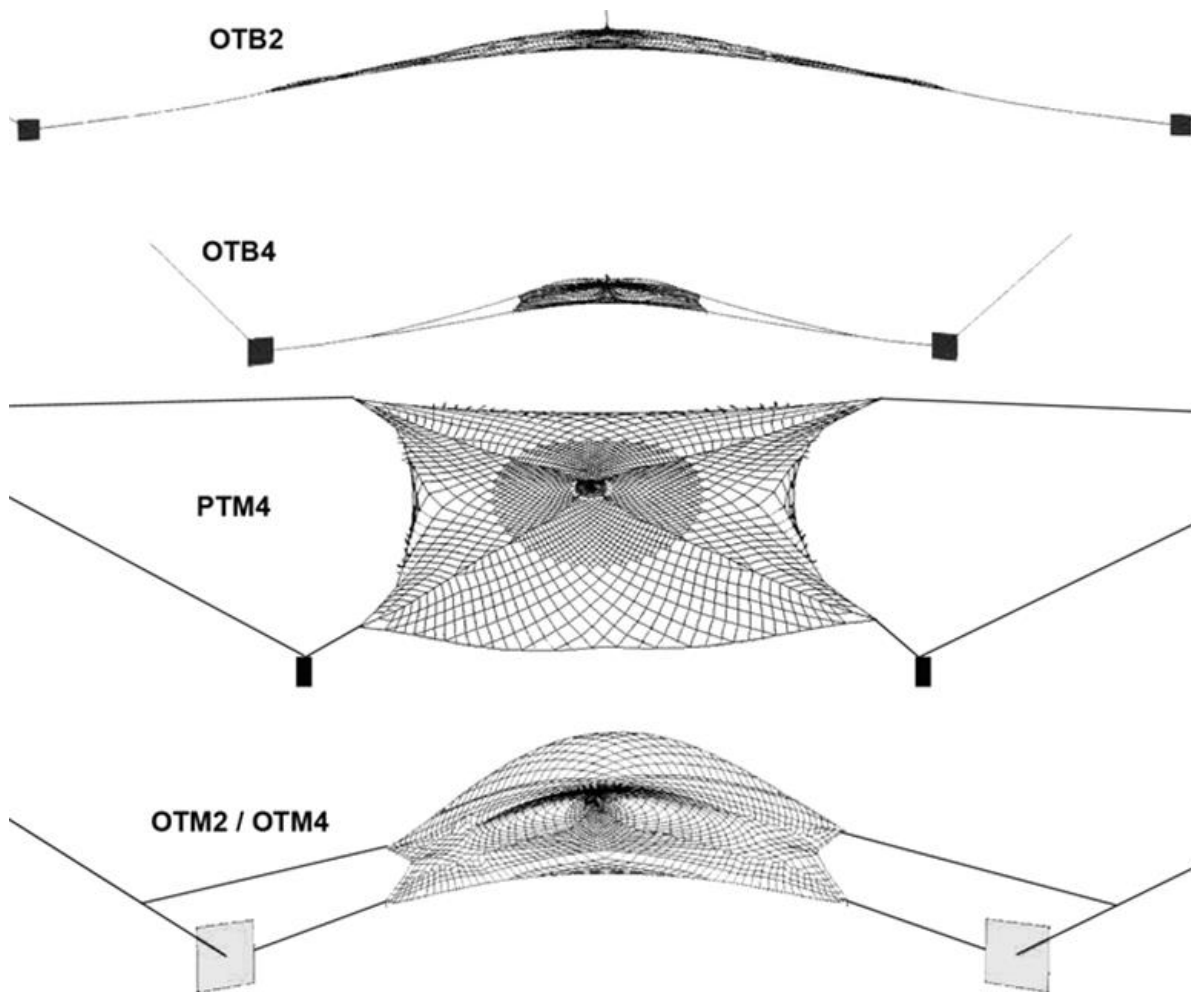


Figure 1. The five trawl types defined: Demersal/bottom 2-panel trawls (OTB2), Demersal/bottom 4-panel trawls (OTB4), Pelagic 4-panel trawls (PTM4), Semi-pelagic 2-panel trawls (OTM2), Semi-pelagic 4-panel trawls (OTM4).

1.2 Technical specifications of Mediterranean trawl gears

On the basis of the literature review and the direct *in-situ* measurements, technical specifications of trawl gears used in different Mediterranean fisheries (benthic, demersal and pelagic) have been collected. Particular attention was given to the headline, footorpe dimensions, circumference or perimeter at various levels of the net as well as to otterboards along with the number of nets in multi-rig trawl nets. Information have been independently collected through net makers, door manufacturers and fishermen. The information have been clustered by trawl typology as defined in the paragraph §*Definition of fishing gear categories*, however in the present report only the demersal and bottom trawls currently used in the Western Mediterranean have been presented.

1.2.1 Demersal/bottom 2-panel trawls (OTB2)

Figure 2 shows a general OTB2 design, left side of the drawing represents the upper panel (UP), while the right part represents the lower panel (LP). In the information collection of the present project several regional OTB2 typologies have been found. They are reported and discussed in the text below.

UP LP

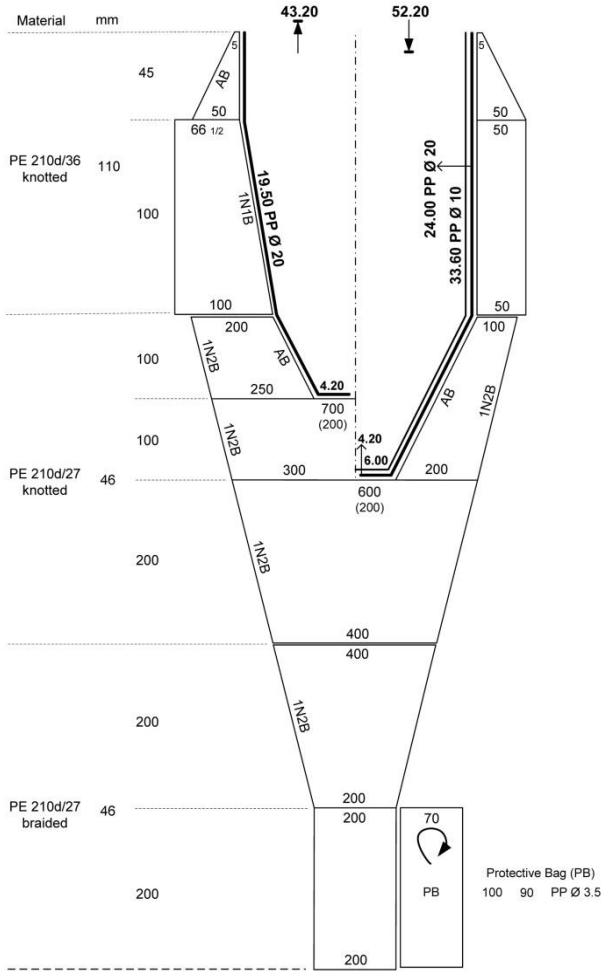
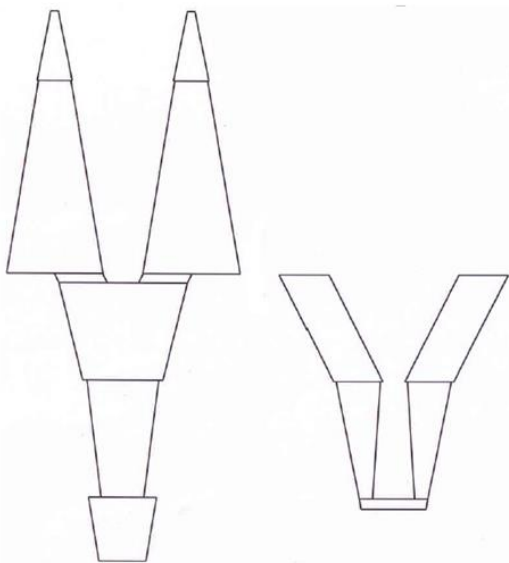
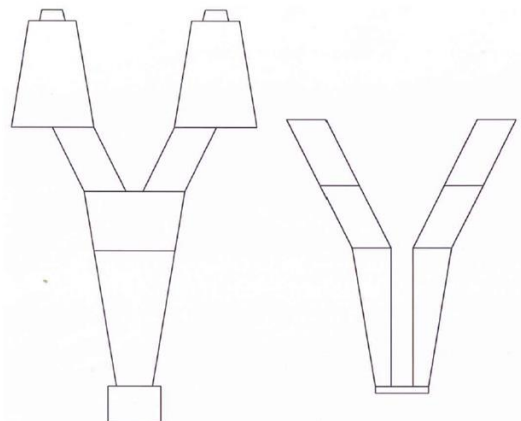


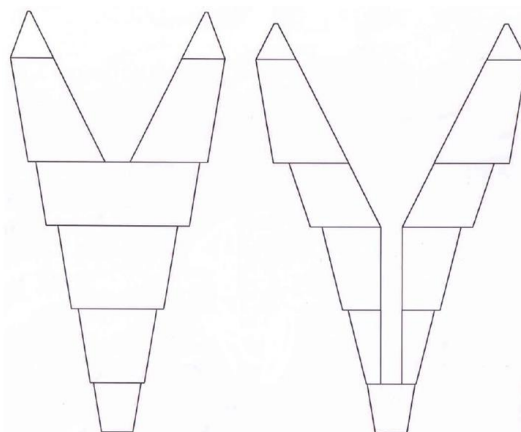
Figure 2. Typical demersal/bottom 2-panel trawl (OTB2).



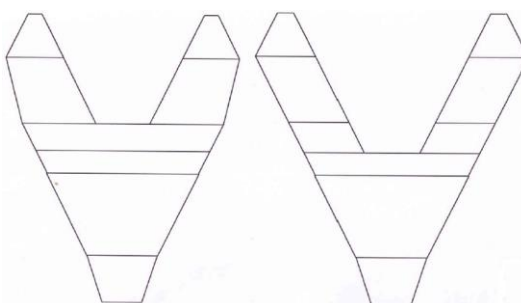
Cadenero (OTB2). Generally used on sandy and muddy bottoms near the coast at about 35-60 m. Several chains are mounted to the ground rope in order to increase the bottom contact. The length of the sweep is around 150 m and bridles are typically not used. The vertical opening is about 1 m and the horizontal opening 15-30 m.



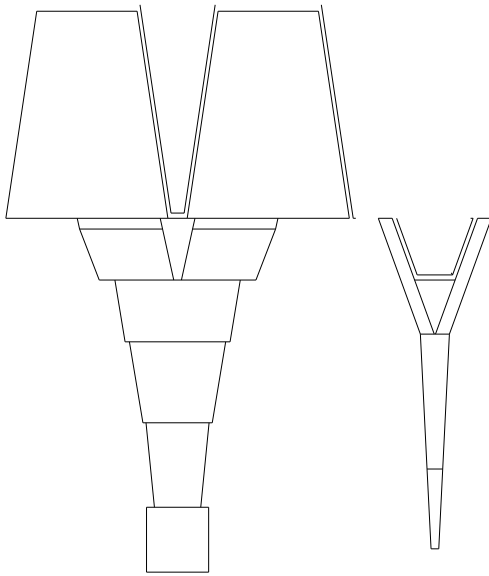
Huelvano (OTB2). Mostly used on flat and muddy seabed. This net is rigged for the prevalence of horizontal net opening (30-40 m) instead of vertical opening (1.2 - 1.5 m). For that purpose bridles are not present and sweeps are very long (40 m).



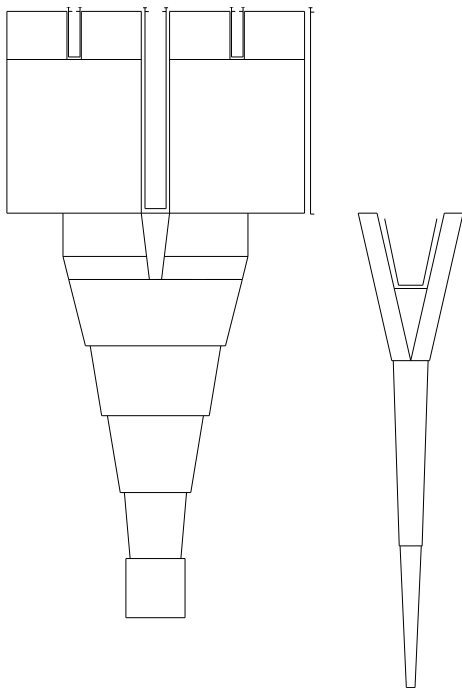
Minifalda (OTB2). This is an old type of net mostly used in middle and deep fishing grounds. The net is rigged with double wings in order to get a high vertical opening (about 2.5 m). The length of the bridles is around 50 m the length of the sweep is around 300 m.



Pescado fondo duro (OTB2). Small trawl type (vertical opening about 1.5 m; horizontal opening 15-25 m) mostly used on sandy and rocky bottoms between 50-100 m. The target species are gastropods, cephalopods, crustaceans and demersal fishes in general. Both sweeps and bridles are present in the rigging.



Tartana (OTB2). The most traditional (old) Italian trawl net; it is used on a wide depth range, from shallow coastal waters to the deep fishing grounds. The target are mixed demersal species like shrimps fishes and cephalopods that live in contact with muddy bottoms. The net is equipped with long and heavy sweeps (200-250 m) without bridles. With this rigging the vertical opening is not so high (1 m) and the horizontal opening is kept around 18 m.



Volantina (OTB2). This type of net is usually made of polyamide and is so common in the Italian Adriatic Sea. In the Northern area is towed also with the twin trawl rig. There are long sweeps (100-200 m) and bridles (15-30 m). This net has a medium vertical opening about 1.5 m and a horizontal opening between 10 and 25 m.

1.2.2 Demersal/bottom 4-panel trawls (OTB4)

Figure 3 represents a general 4-panel trawl: left panel is the upper panel (UP), the right panel is the lower panel (LP) and the panel in the middle represents the two side panels (SP). In the information collection of the *myGears* project, several regional OTB4 trawl typologies have been found. They are reported and discussed in the text below.

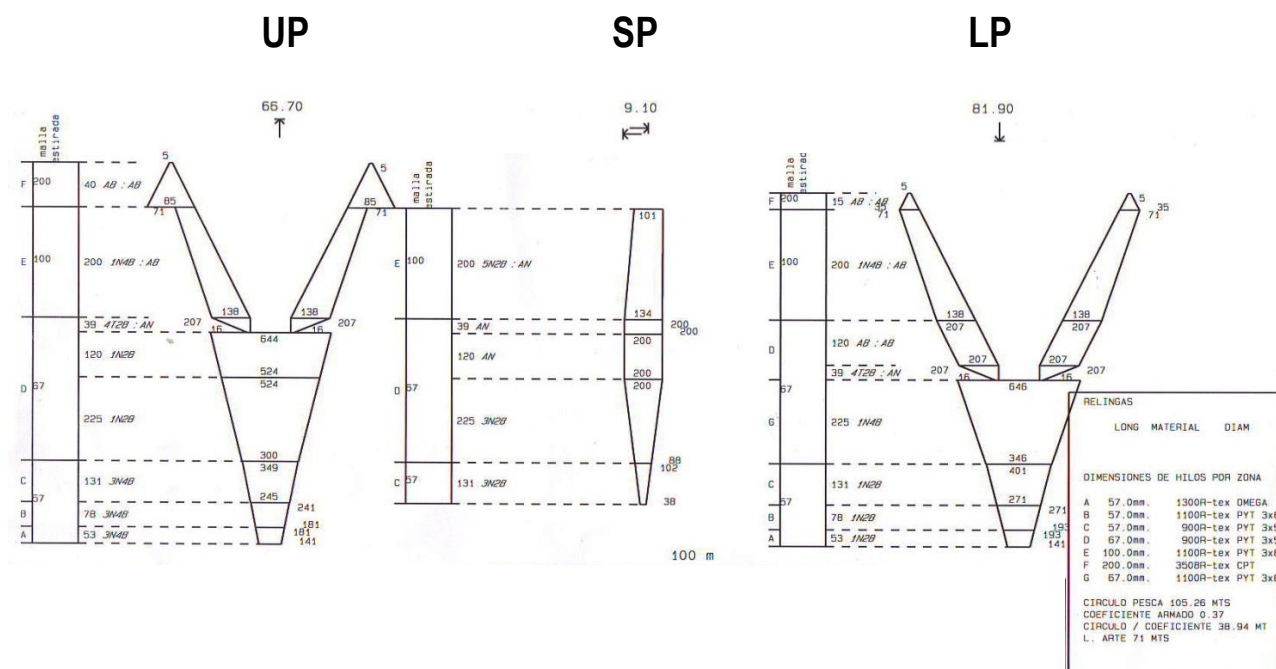
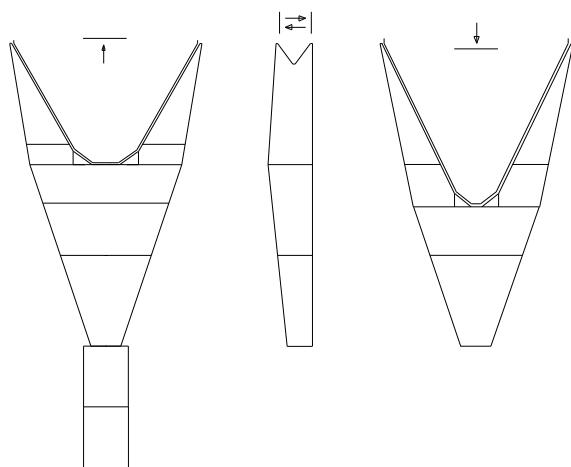
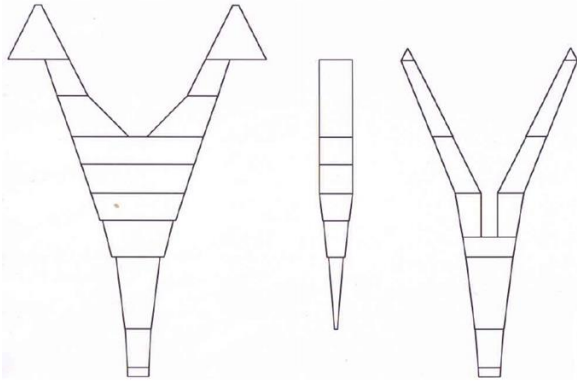


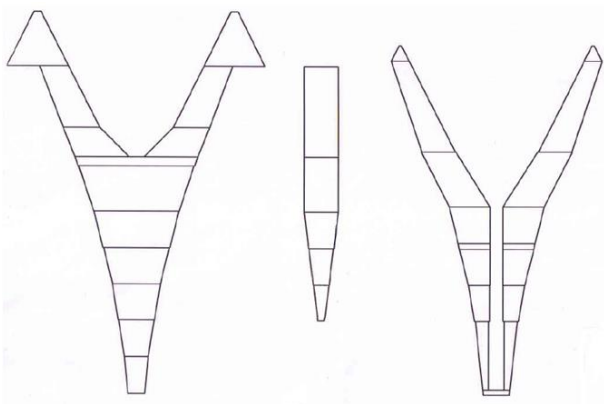
Figure 3. Typical demersal/bottom 4-panel trawl (OTB4).



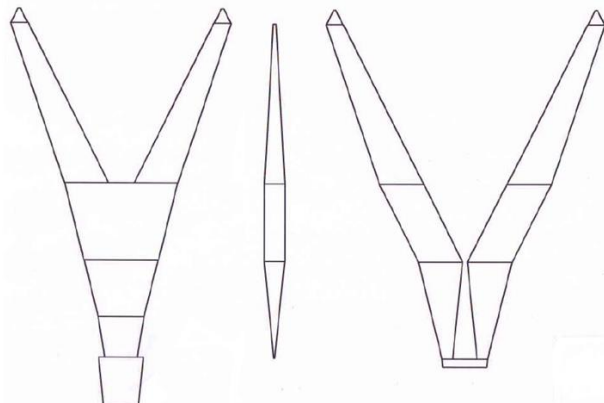
Americana (OTB4). Known as *Americana*, is a polyethylene trawl usually rigged with sweeps and bridles. The groundgear is often equipped with a fishing line and a tickler chain in order to catch mixed demersal species. In the middle Adriatic is common the twin rigging with a central clump weight.



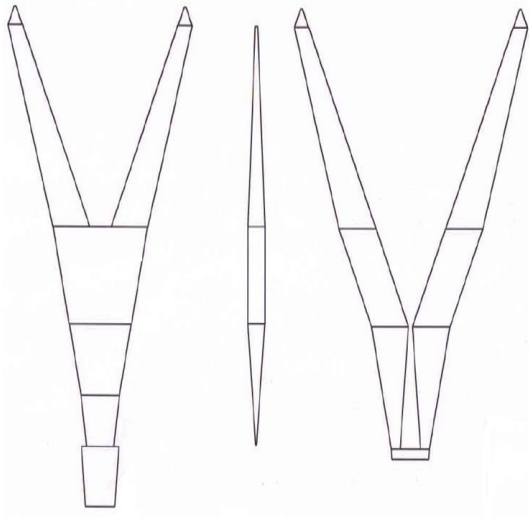
Cuadrado gamba (OTB4). The geometry is similar to the Cuadrado pescado but the target species are the deep water shrimps (more than 500 m depth). The trawling speed is around 3 knots. This net is used on highly variable sea depth, so that, in order to control the net during trawling, sweeps are not used. The vertical opening is obtained by using long bridles.



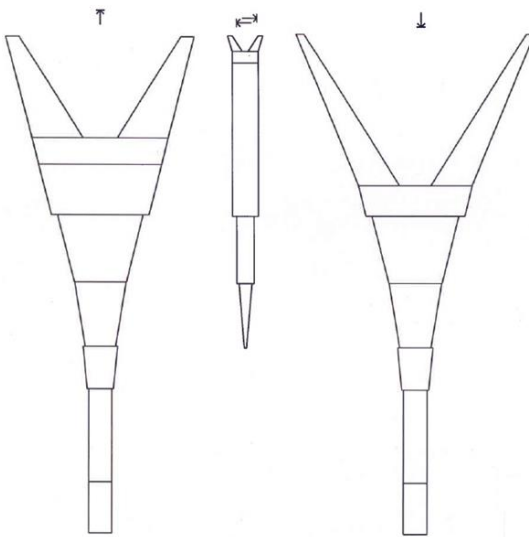
Cuadrado pescado (OTB4). The adjective "pescado" refers to the demersal fish which represents the main target of this gear. For that purpose high vertical opening (up to about 3.5 m) is obtained by long bridles (up to 50 m) and sweeps (up to 200 m), while the towing speed is around 3.5 knots.



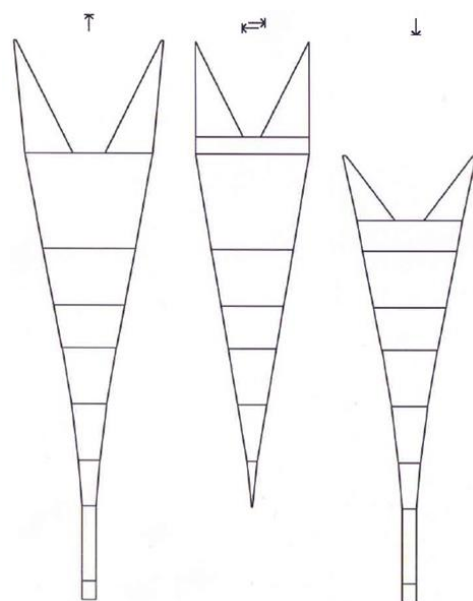
Dos bocas (OTB4). Two chains from the wings to the middle of the lower bosom give to this net a strong bottom contact and high horizontal opening. The length of the bridles is around 50 m the length of the sweep is around 200 m.



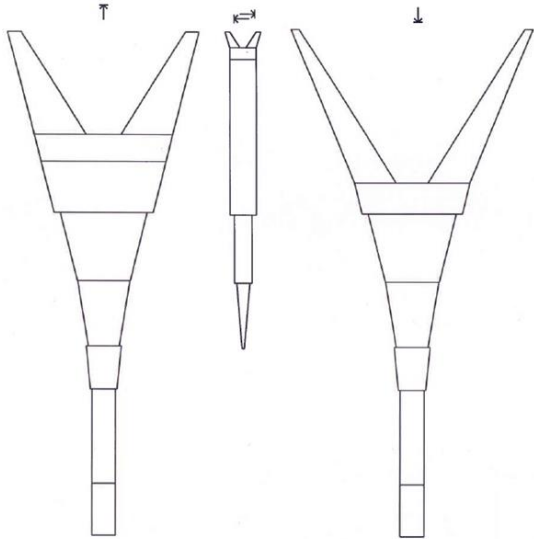
Espada (OTB4). Espada trawl towed at 4.2 knots on muddy bottoms but in slightly deeper areas (60-70m). This net is characterized by high vertical opening (up to 1.5 m) because of small bridles (10 m of spreading wire named "vientos") and a reduced number of chains.



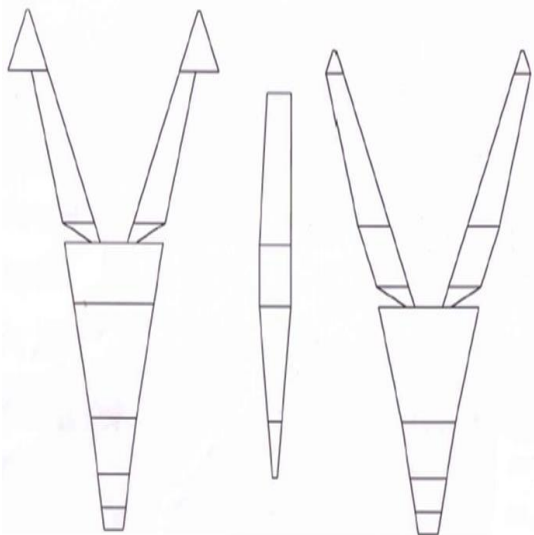
Filet a chains (OTB4). Bottom trawls equipped with high quantity of chain in order to obtain a strong contact with the seabed.



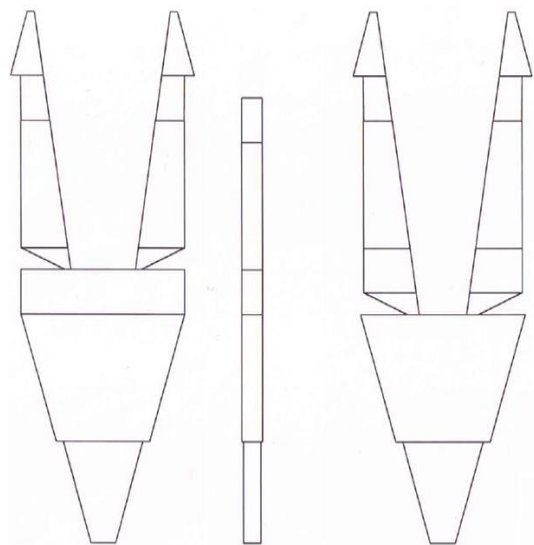
Four panel (OTB4). High vertical opening trawl (semipelagic) used to catch demersal fish.



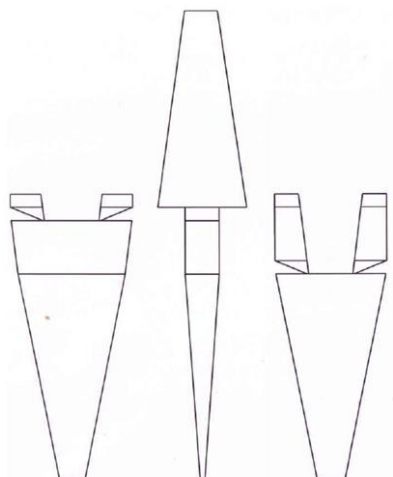
Jumeaux (OTB4). Multirigged nets used to catch demersal species in order to increase the overall swept area.



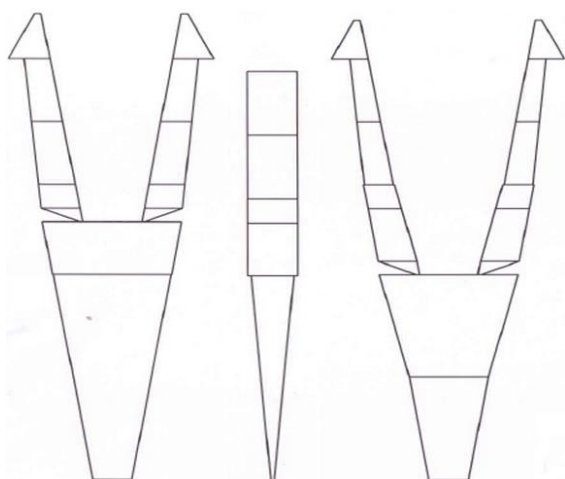
Semitangonero (OTB4). This net should be considered as an hybrid between *Huelvano* and *Cuadrado*. It is characterized by the presence of large meshes in the wings and the first section of the belly; it is rigged to catch mixed deep fish species and shrimps as well. For this reason long sweeps (300 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 about 4 m (OTM4) and since the bottom is irregular the sweeps are not used.



Tangonero (OTB4). Towed on deep waters (about 250 m) to catch mixed species (fish, shrimp and cephalopods). The length of bridle is 45 m. And the trawling speed 2.5 knots.



Tangonero clasico (OTB4). The net is characterized by long wings, presence of danleno, sweeps without bridles. The net is similar to the Huelavano used in the Balears. The length of the heavy sweep is around 180 m. A towing speed of 3 3.2 knots is maintained to take a lot of mud.



Tangonero cuchilla (OTB4). The net is characterized by the presence of two danleno made of netting, joined with two spreading wire or "vientos" (6 m long). The presence of the vientos is important for a high vertical opening and catch good quantity *Merluccius merluccius*. The length of the sweep is around 180 m.

1.3 Mediterranean regional areas classified by gear characteristics

The four Mediterranean countries investigated (e.g. Italy, Spain, France, Greece) have been divided in several regional areas on the basis of the characteristics of the fishing gears utilised by the fleet (Figure 4). In Spain, it was possible to distinguish four regional areas: 1) Catalonia, 2) Balears, 3) Levante, 4) Andalucía and Alboran. In Italy, five specific areas can be defined: 1) Ligurian, 2) Tyrrhenian, 3) Sicilian, 4) Northern and Central Adriatic, 5) Southern Adriatic and Western Ionian. The Northern and Central Adriatic area is shared with the Croatian fisheries. In Greece, there is not any clear gears localisation or characteristic trawl typologies by area. All the Greek trawls, traditionally named *τράτα* (trawl in Greek), have been therefore classified by three geographic regions: 1) Eastern Ionian; 2) Western Aegean; 3) Levantine basin. The latter area is shared with the Turkish fisheries. In the current project, the first objective was the information collection on the characteristics of trawl nets used in different Mediterranean European fisheries, with a view to identify the rigging and the maximum dimensions of trawl fishing gears within each trawl typology by Mediterranean EU Member State, however information have been collected also for Croatia, Cyprus, Turkey and Tunisia fisheries.

1.3.1 Spain

Note that in Spain the demersal/bottom trawl typology (OTM2) is not used and the pelagic trawls (PTM4) have been all along forbidden. A kind of Mediterranean bottom beam trawl typology (TBB) has been found in the Catalonia area targeting gastropods. Such Spanish TBB can have a maximum width of 3 m and it is permitted only at vessels with LOA<12 m. Each vessel can tow maximum two TBB rigged in series not in parallel and it is also not permitted at vessels with trawling licenses. The only trawling technique allowed is the single-trawl technique, while twin- or multi-rig trawls is forbidden. In each regional Spanish area, the fishing gear typologies and corresponding target species groups have been discerned in the following different sub-typologies (see Table 2 for detailed gear specifications).

Catalonia (Table 2a)

- Cadenero (OTB2)
- Espada (OTB2)
- Tangonero (OTB4)
- Cuadrado pescado (OTB4)
- Cuadrado gamba (rosso) (OTB4)
- Dos bocas (OTB4)
- Butterfly (OTM4)

Baleares (Table 2b)

- Huelvano (OTB2)
- Fondo duro (OTB2)
- Semitangonero (OTB4)
- Cuadrado (OTB4)

Levante (Table 2c)

- Cadenero (OTB2)
- Espada (OTB2)
- Minifalda (OTB2)
- Cuadrado (OTB4)
- Dos bocas (OTB4)
- Butterfly (OTM4)

Andalucía and Alboran (Table 2d)

- Tangonero clasico (OTB2)
- Tangonero cuchilla (OTB4)
- Semitangonero Andalucía (OTB4)
- Semitangonero Alboran (OTM4)
- Cuadrado (OTB4)

1.3.2 Italy

In each regional Italian area, the fishing gear typologies and corresponding target species groups have been discerned in the following different sub-typologies (see Table 3 for gear specifications):

Ligurian

- Volantina (OTB2, OTB4)
- 4 cables (OTM2, OTM4)

Tyrrhenian

- Tartana (OTB2)
- Volantina (OTB2, OTB4)
- 4 cables (OTM2, OTM4)

Sicilian

- Tartana (OTB2)
- Volantina (OTB2)
- 4 cables (OTM2, OTM4)

Northern and Central Adriatic

- Volantina (OTB2, OTB4)
- Pair trawling (PTM4)
- Rapido trawl (TBB)

Southern Adriatic and Western Ionian

- Tartana (OTB2)
- Volantina (OTB2, OTB4)
- Pair trawling (PTM4)

1.3.3 Greece

According to Greek legislation pelagic trawls (PTM4, OTM2, OTM4) and beam trawls (TBB) are forbidden. The main fishing gear used throughout Greece is therefore the bottom otter trawl, traditionally attributable to OTB2 gear typology. In each Greek regional area (Figure 4), only the target species groups might be different as shown in Table 4.

Eastern Ionian

North Ionian Sea ports of Preveza and Kerkira (Corfu); Central Ionian Sea islands (Lefkada, Zakynthos);

Western Aegean

Area around Peloponnesus (South Greece) from the ports of Korinthos to Argolida; area from ports around Evoia Island; area of middle Cyclades Islands; ports from Lesbos Island, Thessaloniki, Khalkidhiki, Alexandropoulos and Kalymnos Island;

Levantine Mediterranean waters

Cyprus and Rodi islands; Turkish coast.

1.3.4 France

In the Mediterranean fisheries there were not evident differences among the trawls used in the different regional French areas. Therefore, on the basis of the characteristics of the fishing gears utilised by the French fleet, the fishing gear typologies have been discerned in several different sub-typologies and summarised in the *myGears* report^[7]. Only one area named Gulf of Lions has been defined (Figure 4).

1.3.5 Turkey

The most abundant trawl typology in Turkish part of the Mediterranean Sea is the OTB2^[7]. According to Turkish fishery regulation beam trawl (mostly used in the Sea of Marmara) is allowed to be used to catch rose shrimp (*Parapenaeus longirostris*) in waters deeper than 50 m, with maximum codend length of 11 m and a Minimum Mesh Size (MMS) of 32 mm. Every fishing vessel is allowed to tow a twin-beam trawls with two codends and maximum beam length of 15 m or three beam trawls each with maximum beam length of 5 m^[7].

1.3.6 Croatia

Croatian trawl nets have a technical design similar to the Italian trawls, in general they also target the same fish species. The most common trawl typology is the OTB2 while PTM4 (unlike to the Italian coast) is very seldom. *Rampone* gears, which are in the Croatian legislation defined as mechanical dredges with maximum width of 4 m, are allowed only in the Northern Adriatic Sea. These gears, even if they are classified as mechanical dredges, are hereby reported because they are similar to the Italian *Rapido* trawls.

Northern Adriatic

- Tartana (OTB2)
- Romanjola (OTB2)
- Volantina (OTB2, OTB4)
- Pair trawling (PTM4)
- Rampon (TBB)

Central and Southern Adriatic

- Tartana (OTB2)

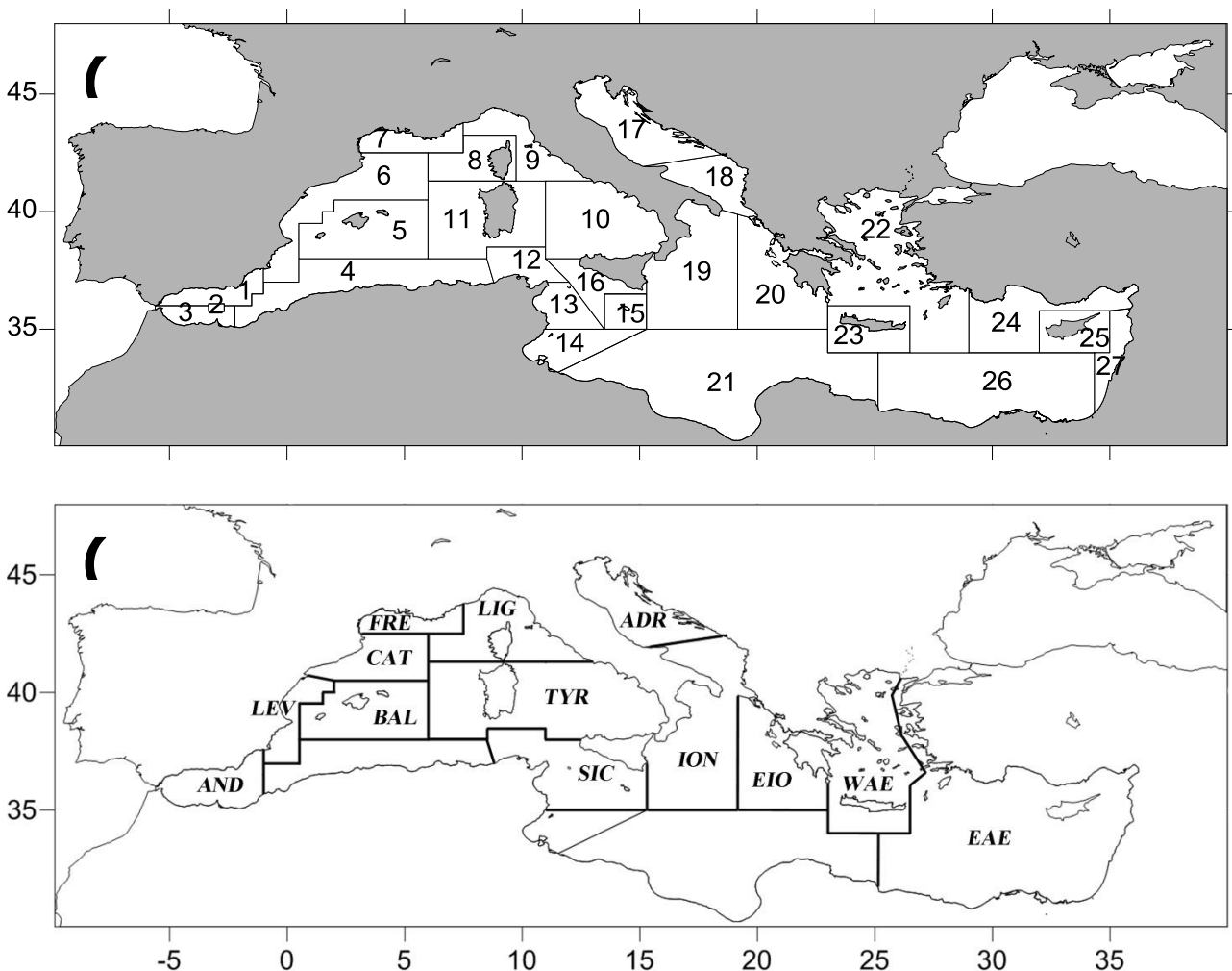


Figure 4. Mediterranean Geographical Sub-Areas (GSAs) in the GFCM area (a) as defined by the GFCM/33/2009/2 amending the Resolution GFCM/31/2007/2 and (b) Mediterranean regional areas classified by gear characteristics as defined in the myGears project. Andalusia and Alboran (AND); Balears (BAL); Catalunya (CAT); Levantine Basin (EAE); Eastern Ionian (EIO); French Mediterranean (FRE); Levante (LEV); Ligurian (LIG); North-Central Adriatic (ADR); Southern Adriatic and Western Ionian (ION); Sicilian (SIC); Tyrrhenian (TYR); Western Aegean (WAE).

Table 2a. Spanish Catalonia area. Fishing gear typologies (Type) and corresponding target species groups (MTSC) discerned in different sub-typologies (Sub-Type). BSD: Bottom sea depth [m]; Sed: sediment type; LOA: vessel length over all [m]; TS: trawling speed [kn]; VNO: vertical net opening [m]; HNO: horizontal net opening [m]; SWL, BRL: Sweep and Bridle length [m] respectively.

Area	Sub-Type	Type	Fishing ground	BSD	Sed	LOA	TS	VNO	HNO	Rigging	SWL, BRL	MTSC
Southern Catalonia	Cadenero	OTB2	Shallow water, close to rivers	35-60 (>35)	Sand-mud	18-22	4.2	1.0	15-30	Chains	SWL: 150 BRL: No	BOY, CTC, OCC, MTS, MUT, TGS, SOL
Southern Catalonia	Espada	OTB2	Slightly deep water Close to rivers mouth	60-70 (>60)	Sand-mud	18-22	4.2	1.5	15-30	Short bridle as spreading wires ("vientos")	SWL: 150 BRL: 10	BOY, CTC, OCC, MTS, MUT, TGS, SOL
Northern Catalonia	Tangonero	OTB4	Continental slope	>250	Soft mud	20-25	2.5	2-2.5	15-32	Higher bridle length than previous nets	SWL: 120 BRL: 45	ARA, DPS, HKE, MNZ, NEP, WHB
Central Catalonia	Cuadrado pescado	OTB4	From continental shelf to the beginning of continental slope	100-300	Soft mud	15-25	3.5	4.5	15-30	Rigged for a high vertical opening in order to catch demersal fish	SWL: No BRL: 70	DPS, HKE, MAS, MNZ, NEP, WHB
Central-Northern Catalonia	Cuadrado gamba (Shrimp)	OTB4	Deep waters with irregular seabed topography	500	Soft mud	15-25	3.0	4.5	15-30	Without sweep to keep a good control of the net on irregular seabed	SWL: No BRL: 70	ARA
Catalonia	Dos bocas	OTB4	From continental shelf to the beginning of continental slope	100-350	Mud	15-25	3.0	3.0	20-35	Presence of two chains from the wings to the middle of the bosom	SWL: 200 BRL: 50	DPS, HKE, MNZ, NEP, WHB
Northern Catalonia	Butterfly	OTM4	Deep waters	500	Soft mud	15-25	2.5	5.0	20-30	Rigged for high vertical opening	SWL: No BRL: 50 (three)	ARA

ANE: *Engraulis encrasicolus*, ARA: *Aristeus antennatus*, ARS: *Aristaeomorpha foliacea*, BOY: *Bolinus brandaris*, CTC: *Sepia officinalis*, DPS: *Parapenaeus longirostris*, HKE: *Merluccius merluccius*, MAC: *Scomber scombrus*, MTS: *Squilla mantis*, MUT: *Mullus barbatus*, NEP: *Nephrops norvegicus*, OCC: *Octopus vulgaris*, PIL: *Sardina pilchardus*, SBG: *Sparus aurata*, SFS: *Lepidopus caudatus*, SJA: *Pecten jacobaeus*, SOL: *Solea solea*, TGS: *Penaeus kerathurus*, WHB: *Micromesistius poutassou*, MNZ: *Lophius* spp., MAS: *Scomber japonicus*, SQC: *Loligo* spp.

Table 2b. Spanish Balearic area. (*Continues*). Fishing gear typologies (Type) and corresponding target species groups (MTSC) discerned in different sub-typologies (Sub-Type). BSD: Bottom sea depth [m]; Sed: sediment type; LOA: vessel length over all [m]; TS: trawling speed [kn]; VNO: vertical net opening [m]; HNO: horizontal net opening [m]; SWL, BRL: Sweep and Bridle length [m] respectively.

Area	Sub-Type	Type	Fishing ground	BSD	Sed	LOA	TS	VNO	HNO	Rigging	SWL, BRL	MTSC
Balearic Islands	Huelvano	OTB2	All Balearic waters; especially in flat seabed	50-700	Sand-mud	15-25	2.5-2.8	1.2-1.5	30-40	Presence of Danleno, absence of bridles, huge horizontal opening	SWL: 400 (heavy) BRL: No	ARA, BOY, CTC, DPS, HKE, MNZ, MTS, MUT, NEP, OCC, SOL, TGS, WHB
Balearic Islands	Fondo duro	OTB2	All Balearic waters, mainly coastal areas	50-100	sand-rocky	15-25	3.5	1.5	15-25	Small net used at a high speed	SWL: 270 BRL: 45-50	BOY, CTC, MTS, MUT, OCC, SOL, SQC, TGS
Balearic Islands	Semitangonero	OTB4	All Balearic waters from medium depth to deep waters	200-700	Soft mud	15-25	3.0	2-2.5	25-35	Hybrid net between Huelvano and Cuadrado, large meshes in the wings and belly	SWL: 300 BRL: 50	ARA, DPS, HKE, MNZ, NEP, WHB
Balearic Islands	Cuadrado	OTB4	Deep waters with irregular seabed topography	>500	Soft mud	15-25	3.0	3.5-4	15-25	-	SWL: 250 BRL: 50	ARA

ANE: *Engraulis encrasicolus*, ARA: *Aristeus antennatus*, ARS: *Aristaeomorpha foliacea*, BOY: *Bolinus brandaris*, CTC: *Sepia officinalis*, DPS: *Parapenaeus longirostris*, HKE: *Merluccius merluccius*, MAC: *Scomber scombrus*, MTS: *Squilla mantis*, MUT: *Mullus barbatus*, NEP: *Nephrops norvegicus*, OCC: *Octopus vulgaris*, PIL: *Sardina pilchardus*, SBG: *Sparus aurata*, SFS: *Lepidopus caudatus*, SJA: *Pecten jacobaeus*, SOL: *Solea solea*, TGS: *Penaeus kerathurus*, WHB: *Micromesistius poutassou*, MNZ: *Lophius* spp., MAS: *Scomber japonicus*, SQC: *Loligo* spp.

Table 2c. Spanish Levante area. (Continues). Fishing gear typologies (Type) and corresponding target species groups (MTSC) discerned in different sub-typologies (Sub-Type). BSD: Bottom sea depth [m]; Sed: sediment type; LOA: vessel length over all [m]; TS: trawling speed [kn]; VNO: vertical net opening [m]; HNO: horizontal net opening [m]; SWL, BRL: Sweep and Bridle length [m] respectively.

Area	Sub-Type	Type	Fishing ground	BSD	Sed	LOA	TS	VNO	HNO	Rigging	SWL, BRL	MTSC
Northern Levante	Cadenero	OTB2	Coastal waters in front of rivers mouth, similar to Catalonia	35-60	sand-mud	18-22	4.2	1.0	15-30	Several chains are used to increase bottom contact	SWL: 150 BRL: No	BOY, CTC, MTS, MUT, OCC, TGS, SOL
Northern Levante	Espada	OTB2	Slightly deep water, close to rivers mouth	60-70	sand-mud	18-22	4.2	1.5	15-30	Short bridle as spreading wires ("vientos")	SWL: 150 BRL: 10	BOY, CTC, MUT, MTS, OCC, TGS, SOL
Levante	Minifalda	OTB2	Continental slope	200-700	mud	15-25	3.0	2.5	25-35	-	SWL: 300 BRL: 50	ARA, DPS, HKE, MNZ, NEP, WHB
Levante	Cuadrado	OTB4	Deep waters with irregular seabed topography	>500	mud	15-25	3.0	3.5-4	15-25	Rigged for high vertical opening	SWL: 250 BRL: 50	ARA
Levante	Dos bocas	OTB4	From continental shelf to the beginning of continental slope	100-350	mud	15-25	3.0	3.0	20-35	Presence of two chains from the wings to the middle of the bosom. Strong bottom contact	SWL: 200 BRL: 50	DPS, HKE, NEP, MNZ, WHB,
Southern Levante	Butterfly	OTM4	Deep waters	>500	soft mud	15-25	2.5	5.0	20-30	Rigged for high vertical opening	SWL: 200 BRL: 50 (three)	ARA

ANE: *Engraulis encrasicolus*, ARA: *Aristeus antennatus*, ARS: *Aristaeomorpha foliacea*, BOY: *Bolinus brandaris*, CTC: *Sepia officinalis*, DPS: *Parapenaeus longirostris*, HKE: *Merluccius merluccius*, MAC: *Scomber scombrus*, MTS: *Squilla mantis*, MUT: *Mullus barbatus*, NEP: *Nephrops norvegicus*, OCC: *Octopus vulgaris*, PIL: *Sardina pilchardus*, SBG: *Sparus aurata*, SFS: *Lepidopus caudatus*, SJA: *Pecten jacobaeus*, SOL: *Solea solea*, TGS: *Penaeus kerathurus*, WHB: *Micromesistius poutassou*, MNZ: *Lophius* spp., MAS: *Scomber japonicus*, SQC: *Loligo* spp.

Table 2d. Spanish Andalusia and Alboran area. (Continues). Fishing gear typologies (Type) and corresponding target species groups (MTSC) discerned in different sub-typologies (Sub-Type). BSD: Bottom sea depth [m]; Sed: sediment type; LOA: vessel length over all [m]; TS: trawling speed [kn]; VNO: vertical net opening [m]; HNO: horizontal net opening [m]; SWL, BRL: Sweep and Bridle length [m] respectively.

Area	Sub-Type	Type	Fishing ground	BSD	Sed	LOA	TS	VNO	HNO	Rigging	SWL, BRL	MTSC
Andalusia (Alboran waters)	Tangonero clasico	OTB2	Different fishing grounds	200-500	soft mud	15-25	3-3.2	1.20	45-50	A triangular piece of netting is mounted at the beginning of the wings for a greater bottom contact	SWL: 180 BRL: No	BOY, CTC, DPS, HKE, MNZ, MTS, MUT, NEP, OCC SOL, TGS, WHB
Alboran waters	Tangonero cuchilla	OTB4	Beginning of continental slope	200-500	soft mud	15-25	3-3.2	1.20	45-50	Danlenos joined to the wings by two spreading wires or "vientos" (6 m long). Higher vertical opening than T Classico	SWL: 180 BRL: No	BOY, CTC, DPS, HKE, MNZ, MTS, MUT, NEP, OCC, SOL, TGS, WHB
Andalusia	Semitangonero Andalusia	OTB4	Beginning of continental slope	200-700	mud	15-25	3.0	2-2.5	25-35	-	SWL: 200 BRL: 50	ARA, DPS, HKE, NEP, MNZ, WHB,
Alboran	Semitangonero Alboran	OTM4	Beginning of continental slope Irregular seabed topography	200-700	soft mud	15-25	2.5	4.0	30-35	Without sweep to keep a good control of the net on irregular seabed	SWL:No BRL: 70	ARA, DPS, HKE, MNZ, NEP, WHB
Andalusia	Cuadrado pescado	OTB4	Flat fishing grounds	200	mud	15-25	3.2	3.5	15-25	Rigged for a light contact with the bottom	SWL:No BRL: 50	MAC, MUT, HKE, WHB

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Table 3a. Italian Ligurian area. Fishing gear typologies (Type) and corresponding target species groups (MTSC) discerned in different sub-typologies (Sub-Type). BSD: Bottom sea depth [m]; Sed: sediment type; LOA: vessel length over all [m]; TS: trawling speed [kn]; VNO: vertical net opening [m]; HNO: horizontal net opening [m]; SWL, BRL: Sweep and Bridle length [m] respectively.

Area	Sub-Type	Type	Fishing ground	BSD	Sed	LOA	TS	VNO	HNO	Rigging	SWL, BRL	MTSC
Western and Central Ligurian	Volantina	OTB2	Beginning of continental slope	250-600	Sand-mud	15-22	1.8-2.5	1.0	10-20	Long combination ropes (100-200 m)	BRL: 15-30	ARA, CTC, HKE, NEP
Eastern Ligurian	Volantina	OTB4	Continental shelf	50-350	Sand-mud	15-22	3.0-3.6	1.5-2.0	15-23	Short combination ropes (10-80 m)	BRL: 10-25	CTC, HKE, MTS, MUT, NEP, TGS
Eastern Ligurian	4 cables	OTM2	Continental shelf	50-350	Sand-mud	15-22	3.3-4.2	1.8-3.0	12-18	2 combination ropes (60-100 m)	BRL absent	CTC, HKE, NEP, MTS, MUT, SBG, TGS
Eastern Ligurian	4 cables	OTM4	Continental shelf	50-350	Sand-mud	15-22	3.3-4.2	2.5-4.0	12-18	2 combination ropes (60-100 m)	BRL absent	ANE, CTC, HKE, MUT, SBG, SFS, TGS

ANE: *Engraulis encrasicolus*, ARA: *Aristeus antennatus*, ARS: *Aristaeomorpha foliacea*, BOY: *Bolinus brandaris*, CTC: *Sepia officinalis*, DPS: *Parapenaeus longirostris*, HKE: *Merluccius merluccius*, MAC: *Scomber scombrus*, MTS: *Squilla mantis*, MUT: *Mullus barbatus*, NEP: *Nephrops norvegicus*, OCC: *Octopus vulgaris*, PIL: *Sardina pilchardus*, SBG: *Sparus aurata*, SFS: *Lepidopus caudatus*, SJA: *Pecten jacobaeus*, SOL: *Solea solea*, TGS: *Penaeus kerathurus*, WHB: *Micromesistius poutassou*, MNZ: *Lophius* spp., MAS: *Scomber japonicus*, SQC: *Loligo* spp.

Table 3b. Italian Tyrrhenian area. (*Continues*). Fishing gear typologies (Type) and corresponding target species groups (MTSC) discerned in different sub-typologies (Sub-Type). BSD: Bottom sea depth [m]; Sed: sediment type; LOA: vessel length over all [m]; TS: trawling speed [kn]; VNO: vertical net opening [m]; HNO: horizontal net opening [m]; SWL, BRL: Sweep and Bridle length [m] respectively.

Area	Sub-Type	Type	Fishing ground	BSD	Sed	LOA	TS	VNO	HNO	Rigging	SWL, BRL	MTSC
Southern Tyrrhenian	Tartana	OTB2	From the coast to the deep fishing grounds	50-600	Sand-mud	15-24	2.5-3.2	1.0	15-25	Long combination ropes (200-250 m)	BRL absent	ARA, ARS, DPS, HKE, MUT, NEP
Tyrrhenian	Volantina	OTB2	Mainly on deep fishing grounds	250-600	Sand-mud	15-26	2.5-3.2	1.5	15-25	Long combination ropes (120-180 m)	BRL: 18-35	ARA, ARS, DPS, HKE, NEP
Tyrrhenian (but not frequent)	Volantina	OTB4	Continental shelf	50-350	Sand-mud	15-26	3.2-3.8	2.0-2.5	15-25	Short combination ropes (10-80 m)	BRL: 10-25	CTC, HKE, MTS, MUT, NEP, TGS
Tyrrhenian	4 cables	OTM2	Continental shelf	50-350	Sand-mud	15-22	3.3-4.2	2.5-3.5	14-22	2 combination ropes (60-100 m)	BRL absent	CTC, HKE, MTS, MUT, NEP, SBG, TGS
Northern and Central Tyrrhenian	4 cables	OTM4	Continental shelf	50-350	Sand-mud	20-27	3.3-4.7	4.0-15.0	12-25	2 combination ropes (40-100 m)	BRL absent	ANE, CTC, HKE, MUT, SBG, SFS, TGS

ANE: *Engraulis encrasicolus*, ARA: *Aristeus antennatus*, ARS: *Aristaeomorpha foliacea*, BOY: *Bolinus brandaris*, CTC: *Sepia officinalis*, DPS: *Parapenaeus longirostris*, HKE: *Merluccius merluccius*, MAC: *Scomber scombrus*, MTS: *Squilla mantis*, MUT: *Mullus barbatus*, NEP: *Nephrops norvegicus*, OCC: *Octopus vulgaris*, PIL: *Sardina pilchardus*, SBG: *Sparus aurata*, SFS: *Lepidopus caudatus*, SJA: *Pecten jacobaeus*, SOL: *Solea solea*, TGS: *Penaeus kerathurus*, WHB: *Micromesistius poutassou*, MNZ: *Lophius* spp., MAS: *Scomber japonicus*, SQC: *Loligo* spp.

Table 3c. Italian Sicilian area. (*Continues*). Fishing gear typologies (Type) and corresponding target species groups (MTSC) discerned in different sub-typologies (Sub-Type). BSD: Bottom sea depth [m]; Sed: sediment type; LOA: vessel length over all [m]; TS: trawling speed [kn]; VNO: vertical net opening [m]; HNO: horizontal net opening [m]; SWL, BRL: Sweep and Bridle length [m] respectively.

Area	Sub-Type	Type	Fishing ground	BSD	Sed	LOA	TS	VNO	HNO	Rigging	SWL, BRL	MTSC
Sicilian	Tartana	OTB2	From the coast to the deep fishing grounds	80-600	Sand-mud	18-30	2.2-3.0	1.0-1.5	15-30	Long combination ropes (200-250 m)	BRL absent	ARA, ARS, DPS, HKE, MUT, NEP
Sicilian	Volantina	OTB2	From the coast to the deep fishing grounds	80-600	Sand-mud	15-30	2.5-3.2	1.5-2.5	15-25	Long combination ropes (120-180 m)	BRL: 25-40	ARA, ARS, DPS, HKE, NEP
Sicilian (but not frequent)	4 cables	OTM4	Continental shelf	50-350	Sand-mud	20-25	3.3-4.7	4.0-15.0	10-22	2 combination ropes (40-100 m)	BRL absent	ANE, CTC, HKE, MUT, SBG, SFS, TGS

ANE: *Engraulis encrasicolus*, ARA: *Aristeus antennatus*, ARS: *Aristaeomorpha foliacea*, BOY: *Bolinus brandaris*, CTC: *Sepia officinalis*, DPS: *Parapenaeus longirostris*, HKE: *Merluccius merluccius*, MAC: *Scomber scombrus*, MTS: *Squilla mantis*, MUT: *Mullus barbatus*, NEP: *Nephrops norvegicus*, OCC: *Octopus vulgaris*, PIL: *Sardina pilchardus*, SBG: *Sparus aurata*, SFS: *Lepidopus caudatus*, SJA: *Pecten jacobaeus*, SOL: *Solea solea*, TGS: *Penaeus kerathurus*, WHB: *Micromesistius poutassou*, MNZ: *Lophius* spp., MAS: *Scomber japonicus*, SQC: *Loligo* spp.

Table 3d. Italian Northern and Central Adriatic area. (Continues). Fishing gear typologies (Type) and corresponding target species groups (MTSC) discerned in different sub-typologies (Sub-Type). BSD: Bottom sea depth [m]; Sed: sediment type; LOA: vessel length over all [m]; TS: trawling speed [kn]; VNO: vertical net opening [m]; HNO: horizontal net opening [m]; SWL, BRL: Sweep and Bridle length [m] respectively.

Area	Sub-Type	Type	Fishing ground	BSD	Sed	LOA	TS	VNO	HNO	Rigging	SWL, BRL	MTSC
Northern Adriatic	Volantina	OTB2	All fishing grounds	10-200	Sand-mud	15-27	3.0-4.0	1.0-2.0	10-25	Long combined ropes (100-200m)	BRL: 15-30	CTC, HKE, MTS, MUT, NEP, TGS
Northern Adriatic	Volantina	OTB2 twin trawl	Shallow fishing grounds	10-60	Sand-mud	15-21	2.8-3.2	1.0-2.0	10-30	Short combined ropes (30-70m)	BRL: 10-15	CTC, HKE, MTS, MUT, NEP, TGS
Central Adriatic	Volantina	OTB4	All fishing grounds	10-200	Sand-mud	15-27	3.0-4.0	1.2-2.0	10-30	Long combined ropes (100-200m)	BRL: 15-30	CTC, HKE, MTS, MUT, NEP, TGS,
Central Adriatic	Volantina	OTB4 twin trawl	Shallow fishing grounds	10-120	Sand-mud	18-28	3.2-3.7	1.0-2.0	15-35	Short combined ropes (30-70m)	BRL: 10-15	CTC, HKE, MTS, MUT, NEP, TGS
Northern and Central Adriatic	Pair trawling	PTM4	Shallow fishing grounds	10-120	Sand-mud	20-28	4.0-5.0	7.0-12.0	30-45	Short combined ropes (20-40m)	BRL absent	ANE, PIL, MAC
Northern and Central Adriatic	Rapido trawl	TBB	Shallow fishing grounds	10-60	Sand-mud	20-28	5.0-7.0	0.3-0.4	2.0-4.2	Absent	BRL absent	CTC, BOY, SJA, SOL, TGS

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Table 3e. Italian Southern Adriatic and Ionian area. (Continues). Fishing gear typologies (Type) and corresponding target species groups (MTSC) discerned in different sub-typologies (Sub-Type). BSD: Bottom sea depth [m]; Sed: sediment type; LOA: vessel length over all [m]; TS: trawling speed [kn]; VNO: vertical net opening [m]; HNO: horizontal net opening [m]; SWL, BRL: Sweep and Bridle length [m] respectively.

Area	Sub-Type	Type	Fishing ground	BSD	Sed	LOA	TS	VNO	HNO	Rigging	SWL, BRL	MTSC
Southern Adriatic and Ionian	Tartana	OTB2	From the coast to the deep fishing grounds	40-600	Sand-mud	18-26	2.2-3.2	1.0-1.5	12-22	Long combination ropes (200-250 m)	BRL absent	ARA, ARS, DPS, HKE, MUT, NEP
Southern Adriatic and Ionian	Volantina	OTB2	From the coast to the deep fishing grounds	40-600	Sand-mud	15-27	3.0-4.0	1.0-2.0	10-25	Long combination ropes (100-200 m)	BRL: 15-30	ARA, ARS, HKE, NEP, DPS, MUT
Southern Adriatic (but not frequent)	Volantina	OTB4	Shallow fishing grounds	10-60	Sand-mud	14-19	2.8-3.3	1.2-1.7	10-18	Absent	BRL : 8-20	HKE, CTC, MTS, TGS, MUT
Southern Adriatic	Pair trawling	PTM4	Continental shelf	10-250	Sand-mud	20-28	4.0-5.0	7.0-12.0	20-30	Short combination ropes (20-40 m)	BRL absent	ANE, PIL, MAC

ANE: *Engraulis encrasicolus*, ARA: *Aristeus antennatus*, ARS: *Aristaeomorpha foliacea*, BOY: *Bolinus brandaris*, CTC: *Sepia officinalis*, DPS: *Parapenaeus longirostris*, HKE: *Merluccius merluccius*, MAC: *Scomber scombrus*, MTS: *Squilla mantis*, MUT: *Mullus barbatus*, NEP: *Nephrops norvegicus*, OCC: *Octopus vulgaris*, PIL: *Sardina pilchardus*, SBG: *Sparus aurata*, SFS: *Lepidopus caudatus*, SJA: *Pecten jacobaeus*, SOL: *Solea solea*, TGS: *Penaeus kerathurus*, WHB: *Micromesistius poutassou*, MNZ: *Lophius* spp., MAS: *Scomber japonicus*, SQC: *Loligo* spp.

Table 4. Greek areas. Fishing gear typologies (Type) and corresponding target species groups (MTSC) discerned in different sub-typologies (Sub-Type). BSD: Bottom sea depth [m]; Sed: sediment type; LOA: vessel length over all [m]; TS: trawling speed [kn]; VNO: vertical net opening [m]; HNO: horizontal net opening [m]; SWL, BRL: Sweep and Bridle length [m] respectively.

Area	Sub-Type	Type	Fishing ground	BSD	Sed	LOA	TS	VNO	HNO	Rigging	SWL, BRL	MTSC
Eastern Ionian	-	OTB2	-	250-400 300-400	Mud sand Sand	14-18 19-20	2.5	-	25-30 30-35	-	-	DPS, HKE, MUT, NEP
Western Aegean	-	OTB2	-	140-300 100-250 200-300	Mud Mud-sand Sand	20 22-25 22	2.5 2.5-3.0 2.5	-	25-35 24-28 22-25	-	-	DPS, HKE, MUT, NEP
Eastern Aegean	-	OTB2	-	250-300	Mud-sand	20-23	2.5-3.0	-	23-32	-	-	DPS, HKE, MUT, NEP

ANE: *Engraulis encrasicolus*, ARA: *Aristeus antennatus*, ARS: *Aristaeomorpha foliacea*, BOY: *Bolinus brandaris*, CTC: *Sepia officinalis*, DPS: *Parapenaeus longirostris*, HKE: *Merluccius merluccius*, MAC: *Scomber scombrus*, MTS: *Squilla mantis*, MUT: *Mullus barbatus*, NEP: *Nephrops norvegicus*, OCC: *Octopus vulgaris*, PIL: *Sardina pilchardus*, SBG: *Sparus aurata*, SFS: *Lepidopus caudatus*, SJA: *Pecten jacobaeus*, SOL: *Solea solea*, TGS: *Penaeus kerathurus*, WHB: *Micromesistius poutassou*, MNZ: *Lophius* spp., MAS: *Scomber japonicus*, SQC: *Loligo* spp.

1.4 Explorative analysis

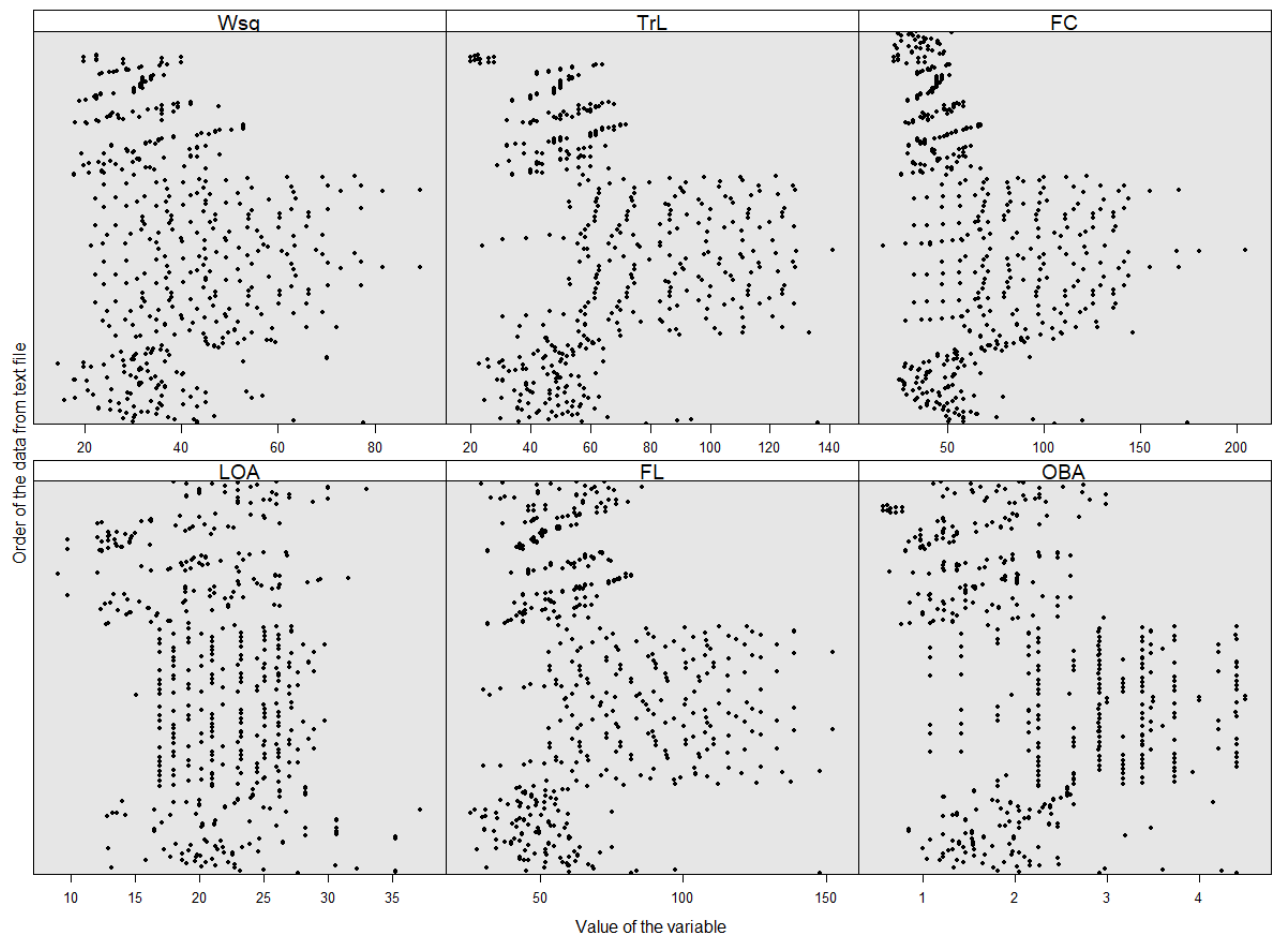


Figure 5.

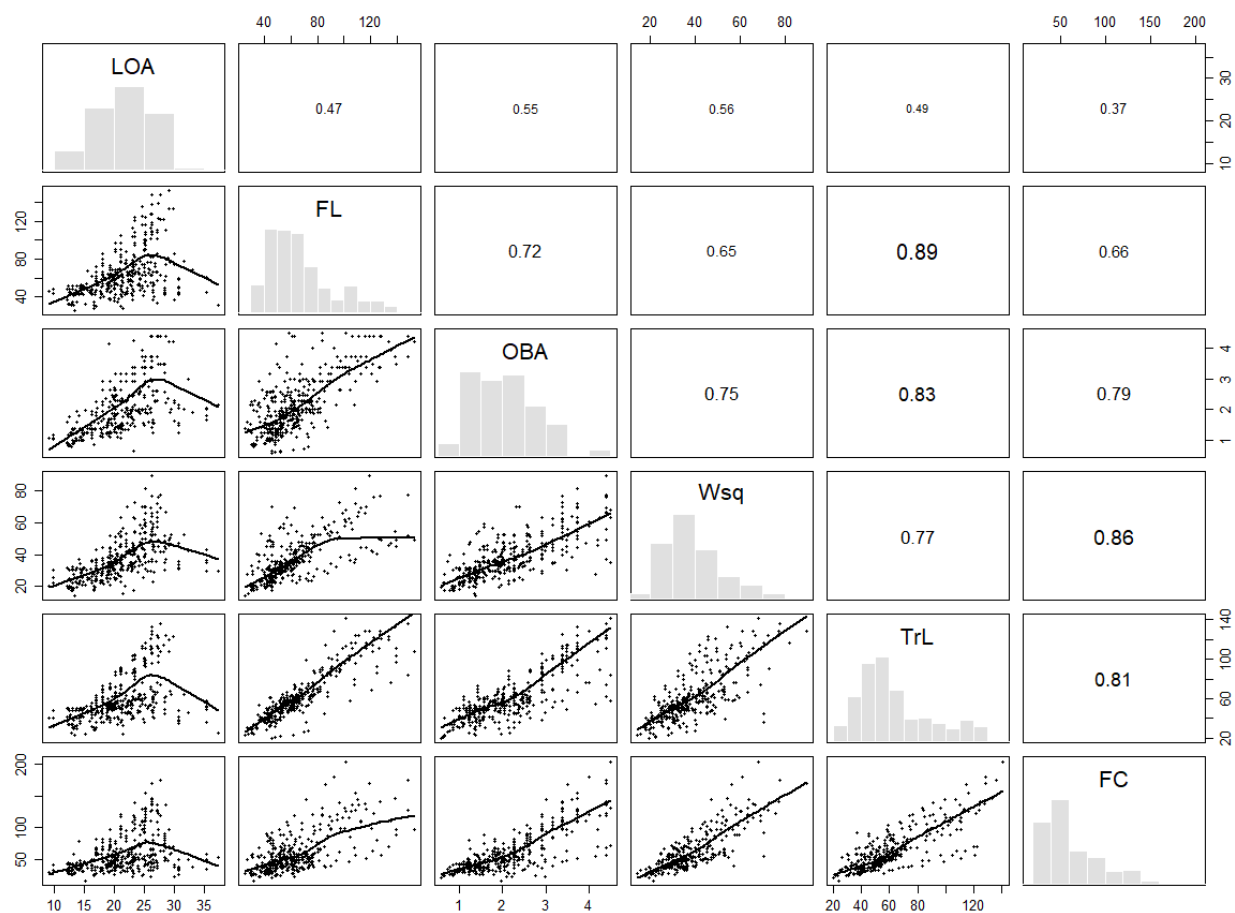


Figure 6.

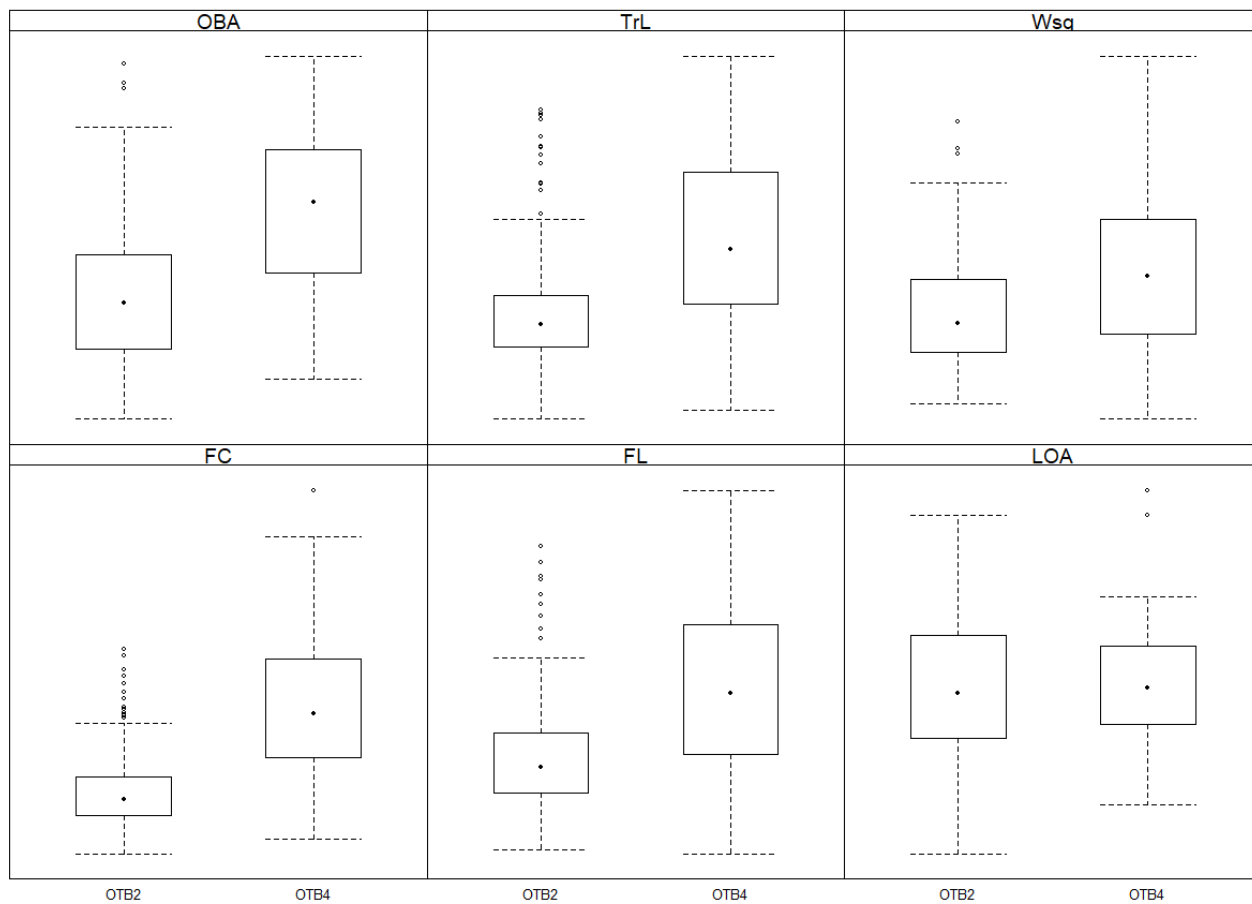


Figure 7.

1.5 References

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