Sampling Trawls Used for Demersal Resource Assessment in the Mediterranean

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Abstract

In the Mediterranean several scientific bottom trawl surveys have been conducted for many years in an attempt to assess the demersal fishery resources. In Italy, in particular, two projects have been carried out every year: a national survey (GRUND) and an international survey (MEDITS). Different fishing gears are used as sampling trawls: the GRUND's teams use the local Italian commercial trawls; the MEDITS teams use only one particular kind of standardized trawl. Fiorentini *et al.* (1999a) assessed the efficiency of the MEDITS sampling trawl relative to that of a typical Italian commercial trawl. The study results showed that the MEDITS trawl was the less efficient for benthic species, and the more efficient for the pelagic species. A new research project, financed by MIPAF, is being carried out by the fishing technology team of ISMAR-CNR-Ancona (formerly, IRPEM) to develop a standardized sampler trawl for Mediterranean benthic and demersal resources. The preliminary results have shown a good performance of the sampler prototype. The next trials will be carried out in order to test the sampler trawl on different fishing grounds and at the greatest depths.

Introduction

Trawling has a long tradition in the Mediterranean where bottom species constitute a considerable fraction of the landings; therefore several scientific bottom trawl surveys have been conducted for many years to attempt to assess the demersal resources in this area (Relini and Piccinetti 1996; Bertrand *et al*. 1997).

In Italy, in 1985, a national survey programme (GRUND), covering the whole Italian coast, was started (Relini and Piccinetti 1996) and is still in progress. It has been carried out by 11 teams, each of them using a trawl that is typically employed in their respective local fishing area. Although these trawls are similar in design, since they all derive from the original commercial Italian trawl (Cosimi *et al.* 2001), they are not identical. The fishing technology team of Ancona (Fiorentini and Cosimi 1981; Fiorentini *et al.* 1994; 1998; 1999b) has studied the performance and geometry of these trawls. Recently, for all GRUND trawls, a standardized cod-end, with a stretched-mesh size of 20 mm (Leonori *et al.* 2003), has been introduced into the sampling protocol (same depths, fishing periods, etc.).

Since 1994, the Mediterranean International Trawl Survey (MEDITS) programme (Bertrand *et al.* 1997) has been carried out yearly in the Mediterranean to assess the benthic and demersal resources along the coasts of the western and northern part of the basin. The sampling protocol (Anon. 1998; 1999) required the same standardized gear to be used throughout the study by all teams. The sampling trawl (Dremière *et al.* 1999) was designed by the IFREMER (Sète) fishery technologists, based on specifications provided by the biologists involved in the programme.

An IFREMER, ISMAR-CNR-Ancona (formerly IRPEM), fishing technology team has been associated with the programme since its beginning and monitors the MEDITS trawl efficiency and

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performance (Dremière et al. 1999; Fiorentini et al. 1996; 1999a; Bertrand et al. 2002). The efficiency of sampling trawls has been extensively studied. Comparative fishing trials with different trawls or gear arrangements have been described by several authors (Ehrich et al. 1994; Engås et al. 1988; Engås et al. 1989; Sissenwine et al. 1978; Walsh et al. 1984; Wilderbuer et al. 1998).
As In the work "Efficiency of the bottom trawl used for the Mediterranean International Trawl Survey" (Fiorentini *et al.* 1999a), the catch efficiency of the MEDITS sampling trawl was assessed by comparing the catch data with those obtained with a typical Italian commercial trawl.

Catch data were converted into abundance per swept area before comparing the trawls. For each haul, the numbers and weight of each species were converted into number and kilograms per km² based on horizontal net opening (measured by the Scanmar system), vessel speed (measured by the vessel's Doppler Log) and tow duration.

The catch data analysis showed that the MEDITS trawl was less efficient than the commercial Italian trawl, for benthic species, and more efficient, for pelagic and semi-pelagic species.

These results were confirmed by most MEDITS programme teams (Baino 1998; Bertrand *et al,* 1997), too. The comparison was performed on ten fish species, one crustacean and four molluscs, all on the MEDITS main list of reference target species. The MEDITS trawl was significantly less efficient in terms of both weight and numbers of individuals fished, for hake (*Merluccius merluccius*), common sole (*Solea vulgaris*) and Norway lobster (*Nephrops norvegicus*). A highly significant difference in favour of the commercial trawl was found in the weight, but not the numbers, of common pandora (*Pagellus erythrinus*). The differences in catch efficiency between the two trawl nets were negligible with respect to the red mullet (*Mullus barbatus*), whereas the MEDITS trawl was significantly more efficient for the numbers of Atlantic horse mackerel (*Trachurus trachurus*). Regarding the size of individuals caught, the catch efficiency of the MEDITS trawl was especially low for small size-classes of *N. norvegicus* (Dremière *et al.* 1999).

The different bottom contact of the two trawls accounts for their different benthic-species efficiency. The Italian trawls are characterized by close bottom contact: not only the footrope but also the whole lower panel is towed in close contact with the sea bed. This difference is a result of their different designs. The Italian-trawl body consists of two asymmetric panels, the upper panel is larger and shorter than the lower one; the lower panel has a greater amount of slack (20–30%) to maximize bottom contact. The MEDITS trawl (Dremière *et al.* 1999) consists of two panels and sides, symmetrical in pairs. It has been observed that the lower panel, just above the footrope, rises completely from the sea bed, and nor does the footrope stay in close contact with the sea bottom (Dremière *et al.* 1999). By contrast this trawl has a higher vertical opening (2.4–2.9 m) than that of most Mediterranean commercial trawls.

The problems of determining the efficiency of a sampler trawl net, such as the MEDITS trawl, on the Mediterranean bottoms, have lead most of the GRUND scientists to look for a new one-of-a-kind standardized sampler trawl, to be employed by all the survey teams in the Italian national programme. Within GRUND, a research project has been developed to plan a standardized sampler trawl for Mediterranean benthic and demersal resources, which are typically multispecific in their depth assemblages. The MIPAF project "Development of a standardized sampler trawl for demersal resource assessment" has been carried out by the fishing technology team of Ancona since 2000 and is still in progress.

Materials and methods

The prototype STDB (Figure 1) of a standardized sampler trawl is based on the technological characteristics of the commercial trawls used in many Italian trawl fisheries, in accordance with the various requests of the scientific teams that wanted to employ it in their surveys. The main sampler specifications were: (i) ability to work in all the areas and at all the depths envisaged by the programme; (ii) lowest possible selectivity, so as to obtain good descriptions of the populations sampled and (iii) ability to sample efficiently a great variety of species. This last feature is important, since even though few species, mainly benthic, account for a considerable proportion of the value of the fish landings, the great species diversity found in the Mediterranean requires careful fishery management. The netting in the cod-end has a stretched-mesh size of 20 mm. The final part of each of its wings is split in two; this results in a slightly higher vertical opening and, consequently, improves the catches of demersal species. Although the final part of its wings is split in two, unlike most of the other GRUND trawls, it is similar in design to the trawls used for the Italian programme. Moreover, the mouth-opening sizes of the sampler trawl are a compromise based on the openings of all the trawls used by the Italian teams for the GRUND programme. To study the performance of the new sampler trawl, several sea trials (haul duration: 1 h) were undertaken with the CNR research vessel "Dallaporta" which is equipped for scientific trawling experiments. All trips were carried out in the central Adriatic Sea at different depths, from 10 m down to 250 m. An underwater monitoring system was used to measure the trawl performance and geometry; it shows changes in vertical and horizontal net openings, in the spread of the trawl doors, and many others technological parameters. On the first trip, in September 2001, a first prototype of the standardized net was tested and some improvements were made to it. On the second trip, in May 2002, the catch efficiency of the sampler trawl STDB developed was compared to a typical Italian commercial trawl (Figure 2). The trawls were alternated daily, so that both nets were tested on the same fishing ground and at the same depth.

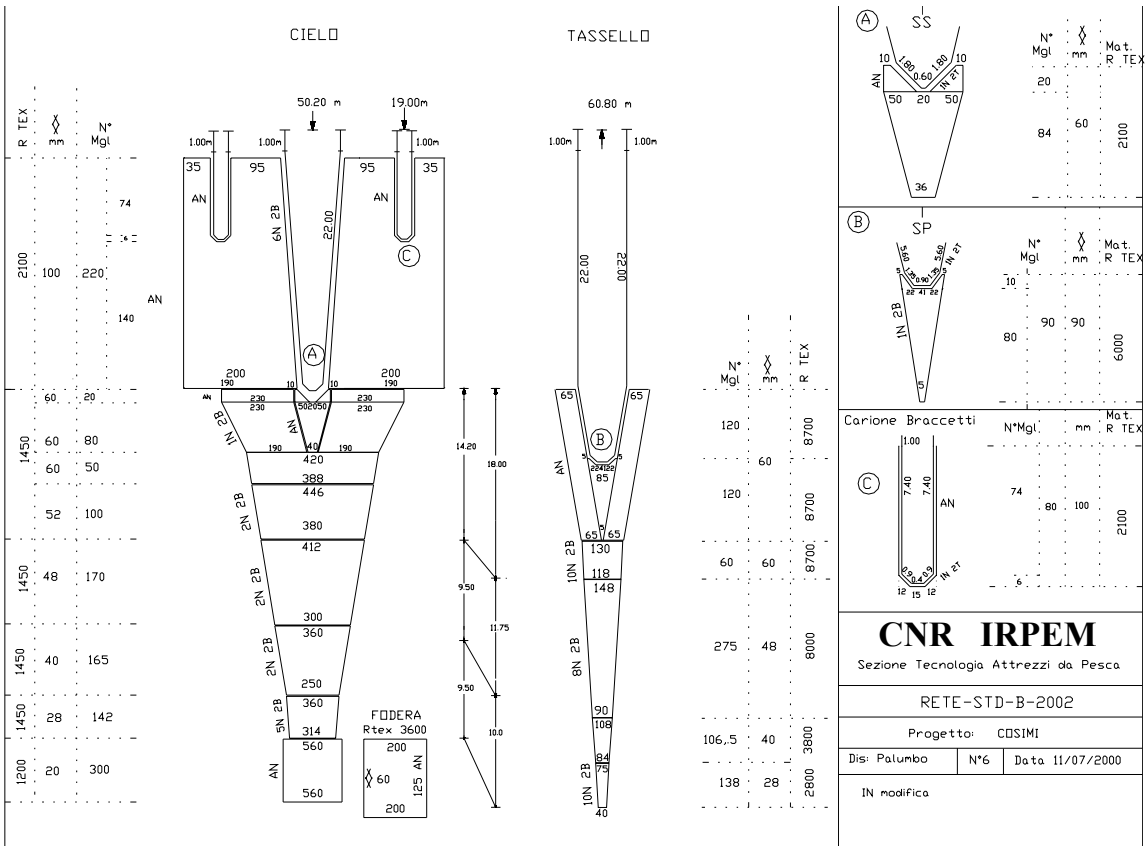

Figure 1. Design of the new standardized STDB sampler trawl.

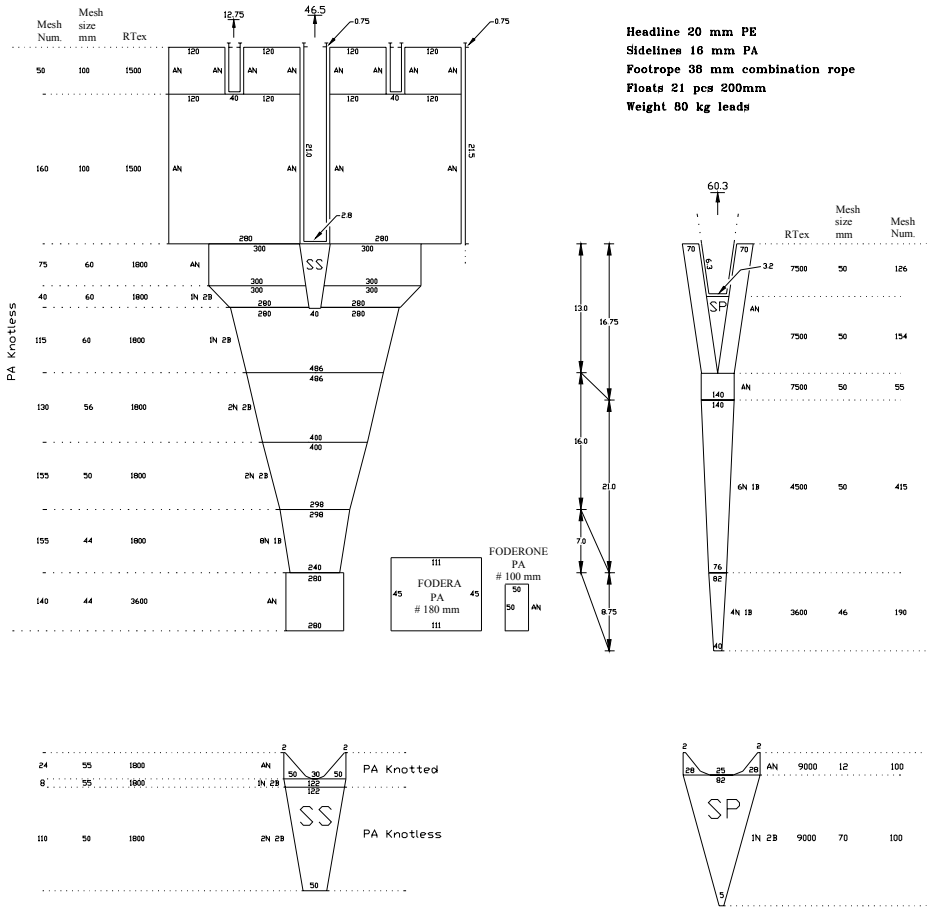

Figure 2. Design of the Italian commercial trawl employed for comparison with the STDB trawl (Figure 1).

Preliminary results

The sea-trial results showed a good performance of the STDB sampler trawl in terms of the key geometrical parameters during the hauls (Table 1) and the net's good stability under different fishing conditions.

The main species caught on the second trip are reported in Table 2. Catch data were converted into abundance per swept area before comparing the trawls. The mean size of the species caught with STDB was slightly smaller than that for the commercial trawl, except for *Merlangius merlangius*. It is an expected result, bearing in mind the difference in the cod-end mesh size between the sampler trawl and the commercial trawl. The mean size–frequency distributions of some economically important species, hake for example, are similar in both trawls with a larger range for the STDB than for the commercial trawl. For each GRUND target species, a catch efficiency coefficient (STDB/Comm) was computed (Figure 3) as the ratio of the mean catch of the STDB trawl to that of the commercial trawl, both in number of individuals and in weight per km^2.

Table 1. Main technological parameters monitored during the hauls carried out with the STDB and commercial trawls.

Haul	Date	Trawl Type	Shooting Time	Bottom Depth [m]	Warp Length [m]	Sweep Length [m]	Vessel Speed [knt]	Shaft Power [HP]	Warp Loads [kg]	Horizontal Net Opening [m]	Vertical Net Opening [m]	Door Spread [m]
4	21/05/02	STDB	09:23	30.5	300	100	3.12	261.5	2,769	18.50	1.56	71.26
5			11:22	30.5			3.13	252.1	2,844	18.41	1.58	69.57
6	21/05/02	Comm.	15:23	31.5	300	100	3.23	232.5	2,706	17.34	1.51	74.28
7			17:19	30.5			3.13	230.3	2,785	17.93	1.47	78.80
8	22/05/02		08:47	31.5			3.15	248.2	2,925	19.66	1.39	82.99
9			11:08	32.0			3.21	244.1	2,864	18.21	1.31	84.12
10	22/05/02	STDB	15:10	31.0	300	100	3.17	231.0	2,697	18.37	1.62	69.97
11			17:33	31.0			3.10	216.2	2,587	18.52	1.62	70.02
12	23/05/02	STDB	08:38	50.0	400	100	3.04	259.2	2,666	20.21	1.53	93.94
13			10:49	50.0			2.96	269.2	2,610	18.60	1.55	69.29
14	23/05/02	Comm.	15:03	50.5	400	100	3.14	295.4	2,904	19.19	1.24	104.10
15			17:07	50.5			3.16	308.2	3,025	20.15	1.15	103.05
16	25/05/02	STDB	08:52	74.0	400	100	3.11	270.8	3,033	20.78	1.43	81.43
17			10:52	74.0			3.07	274.6	3,083	21.02	1.42	80.44
18	25/05/02	Comm.	15:10	74.0	400	100	3.27	273.9	3,081	19.80	1.15	82.03
19			17:07	74.0			3.18	255.7	2,804	19.76	1.19	82.02
20	27/05/02		09:02	74.0			3.15	272.7	2,927	19.91	1.17	111.49
21			10:59	74.0			3.19	271.7	2,956	18.53	1.11	80.95
22	27/05/02	STDB	14:47	74.0	400	100	3.14	259.0	2,912	21.32	1.39	81.84
23			16:49	74.0			3.11	262.9	2,938	21.08	1.43	80.95
24	30/05/02	STDB	07:33	209.0	800	150	3.18	279.6	3,159	22.43	1.23	104.35
25			09:56	215.0			3.12	275.9	3,175	22.20	1.27	100.56
26			15:02	216.5			3.19	280.6	3,289	22.94	1.09	107.94
29	31/05/02	Comm.	08:13	215.0	800	150	3.16	279.7	3,109	21.17	1.12	107.59
30			10:28	216.0			3.11	270.5	3,109	21.22	1.18	104.13

Table 2. Comparison of the results for the main species caught in the central Adriatic Sea: mean size (in centimeters, of individuals); percentage presence in the hauls; geometric mean and coefficient of variation (*CV*) of number and weight per km^2, Student's *t* test results (to compare the catch efficiency on the species) and the coefficient of efficiency. *G*: GRUND target species. *Boldface type*: species very important economically in the central Adriatic (the size–frequency distribution was taken into account only for these species).

Species	Size		Presence		N/km^2						kg/km^2					
	STDB	Comm.	STDB	Comm.	STDB Mean	STDB CV	Comm. Mean	Comm. CV	*t* test (P≤0.05)	Coeff. STDB/Com	STDB Mean	STDB CV	Comm. Mean	Comm. CV	*t* test (P≤0.05)	Coeff. STDB/Com
	(cm)	(cm)														
Gobius niger (G)	-	-	54%	50%	6,6	99%	4,3	110%	0,64	1,55	0,4	123%	0,4	120%	0,90	1,08
Lophius spp. (G)	-	-	54%	67%	5,4	100%	6,7	84%	0,80	0,81	0,9	131%	0,5	131%	0,42	1,77
Merlangius merlangus	9,7	9,4	77%	83%	117,4	60%	100,2	55%	0,89	1,17	2,6	80%	2,0	92%	0,64	1,33
Merluccius merluccius **(G)**	11,8	16,3	100%	100%	824,2	18%	484,8	10%	0,18	1,70	35,0	21%	29,2	13%	0,48	1,20
Micromesistius potassou	13,6	14,5	23%	17%	3,9	190%	2,6	234%	0,81	1,49	1,0	190%	0,9	234%	0,90	1,17
Mullus barbatus **(G)**	13,4	13,7	54%	50%	7,5	111%	8,2	112%	0,94	0,91	0,9	165%	1,1	124%	0,84	0,86
Pagellus erythrinus (G)	-	-	54%	50%	3,6	98%	2,7	109%	0,71	1,35	0,2	122%	0,2	137%	0,56	1,40
Trisopterus minutus capelanus **(G)**	6,5	6,8	100%	92%	358,0	27%	140,1	54%	0,29	2,56	2,0	90%	1,9	111%	0,95	1,05
Eledone moschata (G)	-	-	62%	25%	8,3	92%	2,0	195%	0,19	4,18	1,7	134%	1,0	223%	0,58	1,77
Loligo vulgaris (G)	-	-	15%	25%	0,5	247%	0,8	181%	0,52	0,62	0,1	249%	0,1	183%	0,85	0,84
Sepia officinalis (G)	-	-	54%	67%	8,2	98%	6,7	79%	0,13	1,23	0,2	164%	0,1	93%	0,22	2,69
	(mm)	(mm)														
Nephrops norvegicus **(G)**	26,2	28,8	62%	58%	41,3	90%	31,6	98%	0,85	1,30	4,6	87%	4,2	99%	0,91	1,09
Squilla mantis (G)	-	-	46%	50%	6,7	115%	8,8	110%	0,80	0,76	0,7	130%	0,8	119%	0,79	0,84

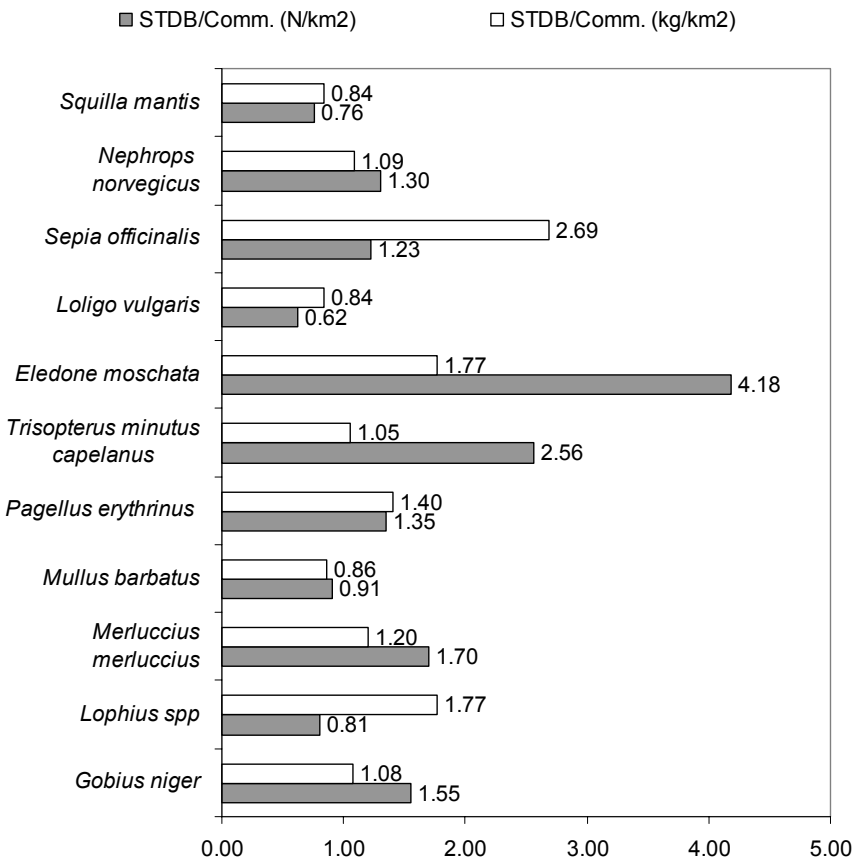

Figure 3. Coefficient of efficiency (ratio between the catches in numbers and weight per km² by the STDB and the commercial trawl) for the main GRUND target species.

Discussion and conclusion

Until now the STDB net has given a good performance in the central Adriatic Sea compared to the commercial net. In general, the STDB catches were higher than those of the commercial trawl. In terms of the mean size–frequency distributions of some economically important species, the STDB was similar to the commercial trawl and thus a good sampler of a wide range of sizes from the sampled stock. In the coming months this sampler trawl will be tested in the southern Adriatic and in the Tyrrhenian Sea, in order to assess its performance on different fishing grounds and at the greatest depths.

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