MANAGEMENT PLAN FOR

BOTTOM TRAWL

FISHERIES

Draft version (for internal use only)

February, 2013
Schematic presentation of preparation and contents of the management plan

ARRANGMENT AND HARMONIZATION OF ACTIVITIES WITH ALL STAKEHOLDERS

- Defining the framework
- Defining the objectives of the plan
- Defining indicators and reference points
- Determining measures and deadline to achieve the objectives
- Establishment and control of measures implementation
- Monitoring
- Short-term evaluation of effect of measures and their adjustment
- Long-term evaluation of effect of measures and their adjustment

EVERY 3 TO 5 YEARS

ANNUALLY
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MANAGEMENT PLAN FRAMEWORK

In the Republic of Croatia, there are two types of bottom trawlers: bottom trawl net - trawler and coastal trawler (tartan). Although according to the European regulation both of these gears fall into the category of bottom trawling (otter bottom trawl - OTB), in the legislation of the Republic of Croatia only the first (bottom trawl net - trawler) is called a trawl in the true sense of the word.

Bearing in mind that tartan belongs to coastal gears, and also, given the fact that this type of net cannot exist according to the EU regulations (due to minimum mesh size, distance from coast, work on the seagrass meadows), and that the Republic of Croatia did not even seek exemption for their retention during negotiations, this Management Plan is not related to tartana nets.

In the Republic of Croatia, two types of bottom trawlers are used: trawler for fishing demersal species and a special trawler for catching cephalopods. Trawl net for catching cephalopods has the mesh of 14 mm (from knot to knot) and its use is limited to the marine fishing in Croatia (only in the spring period and only in the part of the Northern Adriatic Sea); it is intended for catching small specimens of black musky octopus (*Eledone moschata*). Bearing in mind the fact that according to the provisions of GFCM and EU regulations (EC No. 1967/2006), that trawl mesh smaller than 40 mm is banned and that for the above it is not possible to get an derogation, the Republic of Croatia has committed to abolish this type of fishing gear before the entry into the EU. For this reason, the Management Plan does not apply to this bottom trawl either.

The said two trawlers (tartan and trawl for catching cephalopods) will be abolished before the accession of the Republic of Croatia to the EU, because derogations for the size of the mesh cannot be obtained, and if the mesh is increased to about 40 mm they lose their purpose.

This Management Plan applies to bottom trawl net for catching bottom species used in Croatia, and the minimal size of the mesh that is prescribed is 24 mm if used in the inner fishing sea, or 20 mm in outer fishing sea.

The area covered by this Management Plan is the entire fishing sea of the Republic of Croatia, which, according to the GFCM division, includes GSA 17, and only a small part of GSA 18.
1. INTRODUCTION

In accordance with Article 19 of the Council Regulation (EC) no. 1967/2006, the Republic of Croatia shall adopt management plans for fishing in its territorial waters for the following types of fishing: trawl nets, surrounding nets - purse seine, shore seines and dredges.

The legal basis for the adoption of measures in fisheries management in the Republic of Croatia is the Marine Fisheries Act (Official Journal 127/2010, 55/2011 and 50/2012), and as of the date of the accession to the EU the provisions of the EU acquis are directly applicable, taking into account the provisions of the transitional periods and exceptions that are retained in the Treaty of Accession to the EU (Official Journal 2/2012).

In the fishing fleet register and the register of licenses for fishing of the Republic of Croatia, all fishing vessels and granted fishing licences are entered, and here it should be kept in mind that all fishing vessels do no participate in fishing activities since the register includes all boats, and fishing may be performed only by those with an issued licence. The situation with the licences is similar because not all of them are active, as they can be stored in the periods when the beneficiary cannot be engaged in fishing (e.g. for carrying out seasonal fishing activities, temporary cessation of activities, incapacitated vessel, etc.). It is evident from the records that most of the fishing fleet is less than 12 m in length overall (81.29%). According to the division of the fleet as per basic tools, the total share of the bottom trawlers is 13.59%.

Fishing vessels, covered by this Management Plan, may conduct commercial fishing solely based on fishing license (hereinafter referred to as: licence) with registered bottom net - trawler as a fishing tool. Each fishing vessel can be issued only with one licence stating the fishing zones and the fishing gear and equipment that can be used by the vessel to perform fishing activities, and which holder of the licence (legal or natural person) can use the vessel for fishing.

The holder of the licence is required to provide data on fishing in the prescribed manner and within the set form. The data, among other things, include information about the fishing zone in which certain fishing activity is performed, which fishing gear and equipment is used and at what time.

This Management Plan applies to all fishing vessels engaged in fishing with bottom trawl in the fishing sea of the Republic of Croatia and applies from the date of the Croatian accession to the European Union.

The marine area to which the Management Plan relates is defined as a fishing sea consisting of the territorial sea (outer part of the fishing sea), and the inner fishing sea. For the implementation of measures of the management of biological resources of the sea and collection of the necessary data, the fishing sea is divided into sections and boundaries of fishing zones and subzones within it are prescribed as well as boundaries of fishing sea in the
rivers that flow into the sea (Ordinance on boundaries in fishing sea of the Republic of Croatia, Official journal 5/2011). The fishing sea does not include areas protected in the categories of national parks, strict reserves and special reserves in which the provisions of a special law on the protection of nature applies, and in these areas commercial fishing is generally banned, including the types of fishing for which the management plans are made.

Trawl fishing, along with the catch of small pelagic fish is the most important part of the Croatian marine fishery. The catch in 2011 amounted to 4086 tons, and the fishing activities involved a total of 483 active ships.

Since 1996, the Republic of Croatia has established monitoring of bottom settlement within the EU MEDITS programme, and monitoring of the commercial fishery was established as of 2002/03 through the DemMon project. The above programme was initially funded by the Kingdom of Norway, and afterwards by the Directorate of Fisheries. This project includes the analysis of catches and by-catches on commercial vessels, as well as the analysis of catch at landing sites. During sampling, the fishery biological data are collected as well as general socio-economic indicators in the trawl fishery. The sampling dynamics has varied through the years, depending on funding, and in some years the sampling in certain fishing areas was on a monthly basis, and later on the two-month or seasonal basis. Also, the PHARE 2004/5 project made an analysis of the state of trawlers fishing at the Adriatic Sea, as well as monitoring of demersal settlements through FAO AdriaMed Trawl survey projects. From 2012/2013, in the Republic of Croatia, the monitoring of demersal resources (as well as other segments of fishing) has been established in accordance with DCF, as in other EU countries.

Although previous studies have not been entirely consistent with the DCF, they do give an objective picture of the demersal settlements, as well as of trawlers fishing in the RH and they can serve as a basis for assessing the situation and making recommendations for the adoption of measures of regulation and protection of fisheries resources. Also, it should be noted that, in addition to these recent data, Croatia has information about the state of demersal resources from the time before the start of a typical commercial trawling, i.e. from the time when the resources were in the "virgin state." These data were collected during the expedition "Hvar" (1948/49) and covering more or less all of the open Adriatic Sea.

Considering the above, we can say that the state of demersal fishery resources in the Croatian fishing sea has been well-researched, and that existing information can be the basis for the development of a quality Management Plan. The problem mainly concerns data on commercial catch and fishing effort. Even though this type of data exist, they should be taken with great caution because historically there was no uniform method of collecting this type of data, and recently a few revisions of licences and changes in the collection of catch data were performed. Therefore, the data sets from different periods are neither fully comparable with each other nor compatible. Only during 2012/2013, the collection of catch and fishing effort in accordance with EU directive DCF was established and these data will only be true indicators of catch and fishing effort.
Also, in the trawl fishery there was no systematic collection of data on social and economic aspects of this type of fishing. Some basic data have been collected through the DemMon project, but they are not sufficient to provide an overall picture of socio-economic status of the Croatian trawler fishing.
2. ECOLOGICAL CHARACTERISTICS OF THE ECOSYSTEM IN WHICH THE MANAGEMENT PLAN IS CARRIED OUT

The Adriatic Sea is a semi-closed, elongated basin of the central Mediterranean Sea and, because it is set deeply into the land mass and is of low depth, it can be considered a closed, inland sea. Some of the important physical and biological properties of the North Adriatic stem from the fact that it is the northernmost part of the Mediterranean Sea (it reaches 45º47' N). The Adriatic is connected to the other parts of the Mediterranean basin through the Strait of Otranto, which is approximately 40 Nm wide and 741 m deep, and the strait has an important role in water mass circulation and exchange between the Adriatic and the Ionian Sea. The length of the Adriatic Sea is approximately 870 km, and the width oscillates from 90 to 220 km. Its area, including the islands, is 138,595 km², which is approximately 4.6% of the total area of the Mediterranean Sea. For practical purposes, the Adriatic Sea is usually divided into North, Central and Southern Adriatic. The geomorphological characteristics of the Adriatic basin, the geopolitical changes on its eastern seaboard, the existence of national statistics directorates, and the distribution of fishery resources have lead to the division of the Adriatic area into two Geographical Sub-Areas: GSA 17 (North and Central Adriatic) shared by Italy, Croatia, Slovenia, and Bosnia and Herzegovina; and GSA 18 (South Adriatic) shared by Croatia, Montenegro, Albania, and Italy. These management plans pertain to GSA 17.

The Adriatic is a shallow sea with an average depth of 252 m. The continental shelf with depths below 200 m covers 74% of the sea's total area. The northern part is extremely shallow, with the deepest point being 70 m (south of Cape Kamenjak). Depth gradually increases from north-west towards the south-east. Depths below 200 m are found in the Jabuka Pit (273 m) and the South Adriatic Pit (1330 m) in the south part of GSA 17.

Most of the Adriatic seabed is covered with sediment of various structure and mineralogical-petrographic composition. Due to the physical structure and varied seabed facies, the seabed can be rock, gravel, shells, sand and silt. The sand and silt sediments cover most of the Adriatic continental shelf. Sand sediments are formed in the coastal area (of up to 10 m in depth) and are mostly of terrigenous or biogenic origin. Silt sediments are formed where there is no substantial seawater motion, and they cover nearly the entire area of South Adriatic, most of Central Adriatic, the north-eastern Adriatic channels, the Gulf of Trieste, and the 30-40 km wide area along the north-western coast of Italy.

The seabed sediment structure, in combination with other environmental factors, influences the composition and distribution of biocenoses. Due to the prevalence of the silt sediment, the most widespread biocenoses of the Adriatic are those of coastal terrigenous silts, detritic seabeeds of open-water island areas and open waters, and open-water silt seabeeds. The particularly abundant and resident fish species found in the coastal terrigenous silt biocenosis of channels are Spicara flexuosa, Serranus hepatus, Mullus barbatus, Pagellus erythrinus and other benthopelagic species. The species of the Gadidae family, like Merluccius merluccius, Trisopterus minutus capelanus, Trachurus trachurus and others, are characteristic for the open
water silt seabed biocenosis of the open water areas of Central and South Adriatic, with their typical loam and clay sediments. However, it is the sedentary or sessile invertebrate species (sponges, cnidarians, molluscs, echinoderms, crabs, etc.) and not fish that delineate the true character of these biocenoses.

According to temperature relations, it can be concluded that the Adriatic Sea is a warm sea: the water from its deepest layers is almost always warmer than 11-12°C. Surface waters show a clear seasonal temperature cycle, with maximum values in summer and a maximally mixed layer in winter. The surface temperature of the open waters of the Adriatic in summer usually ranges between 22-25°C, while the bottom temperature drops to 11.5°C (Jabuka Pit) or 12.7°C (South Adriatic Pit). In winter, South Adriatic is warmer than North or Central Adriatic, and the open Adriatic waters are warmer than the coastal waters. In the warmer part of the year, especially in summer, the thermocline forms at a depth of approximately 10-30 m, and in Central and South Adriatic it descends down to 50 m. In winter, due to the cooling of the surface layer, the thermocline weakens until it gradually dissolves into the isotherm.

The salinity of the Adriatic Sea is rather high, with the average salinity being 38.3 ‰, which is lower than in the East Mediterranean (39 ‰), and higher than in the West Mediterranean (37 ‰). Generally speaking, salinity in the Adriatic decreases from South to North, and from the open waters to the shore. Salinity can be explained with the inflow of the saltier East Mediterranean water into the Adriatic and the influence, or inflow, of rivers in spring and summer. Less saline waters are always easily and well differentiated from the open waters in all seasons. A strong salinity front can be easily detected, especially along the western Adriatic seaboard. In addition to the normal annual oscillations, there are also multi-annual oscillations of salinity in the Adriatic, caused by the differences in water mass exchange between the Adriatic and the East Mediterranean. In those years, the saltier East Mediterranean waters penetrate into the Adriatic more strongly, thereby increasing the salinity, influencing overall productivity and the occurrence of some new and/or rare organisms in the Adriatic.

The general water mass circulation in the Adriatic shows typical cyclonic movements. Water masses inflow into the Adriatic along the eastern seaboard from the East Mediterranean through the Strait of Otranto, and outflow along the western seaboard. That is primarily due to geomorphological, meteorological and hydrographic characteristics. The Adriatic Sea can be divided into three separate horizontal layers according to water mass movement - the surface layer, the intermediate layer, and the demersal layer - with relatively independent current systems, although, of course, those systems do interact. Baroclinity differentiates between currents and vortices with pronounced seasonal strength and occurrence, and between changes on a spatial scale in different seasons. Winter conditions are characterised in the topmost 100 m of depth by a wide field of north-west currents, probably connected with the intensive but shallow currents along the western seaboard, while the coastal currents in other seasons, especially in autumn, form on the eastern seaboard. Branches of intense currents occur on the western side of the Adriatic basin, divided into three sub-basins in spring and summer.
Autumn conditions show the overall cyclonic circulation with the intensification of three cyclonic vortices in the sub-basins. Due to those pronounced seasonal differences, inflow currents dominate in winter, and outflow currents in summer, while in spring and autumn, when the horizontal water density gradients are lower, neither current direction dominates, but rather, stronger transversal currents occur between the seaboards. This seasonal rhythm is further influenced, mostly positively, by winds - mistral in summer and sirocco in winter. In the channel, coastal areas, the influence of winds and tidal currents is more prominent. The inflow current is prevalent in the intermediate layer throughout the year, but mostly in summer, when it appears as a compensating current for the outflow current in the surface layer. Transversal currents between the eastern and western seaboard also frequently appear in that layer. The least is known of the demersal layer currents. Outflow currents dominate, and are especially prevalent in winter, as compensating currents for the increased water inflow in the surface and intermediate layers. Those waters form in the Adriatic in winter, from the mixing of the cold and heavy North Adriatic water with the saltier water from the intermediate layer, and are very important for the for the productivity of both the Adriatic and the entire Mediterranean.

According to productivity, the Adriatic Sea is classified as an oligotrophic sea, characterised by relatively low productivity. However, due to the great diversity of its biocenoses, the Adriatic has a high level of biodiversity, but its low population densities determine its relatively low level of sustainable exploitation. The basic inflow of nutrients into the Adriatic occurs via the rivers which raise the primary productivity. Eutrophication is particularly pronounced in the North and Central Adriatic, where it influences all the links in the food chain and ultimately leads to higher fish stock quantities, especially in the North Adriatic. It is precisely for that reason that the Adriatic is considered to be one of the most productive areas of the Mediterranean when it comes to fishing.

In summer, when the maritime meteorological conditions are favourable (high temperatures; long calm periods without wind; freshwater inflows; stratification separating the warmer water with lower salinity from the deeper, saltier, colder and more productive water; ...), algal blooms can often occur, which can cause hypoxia and anoxia. That can have negative or lethal effects on demersal resources, primarily on sedentary species like molluscs, especially in North Adriatic.

Demersal resources are apparently more associated with belonging biocenosis than depth, although it is certain that biocenosis, their location and distribution in the Adriatic, are the result both of the depth and type of sediment. There is a big difference in the distribution of species, of which numerous species are distributed only in small areas, although for certain species in seasonal migration, mainly for spawning, the range spreads. Many species can complete their life cycle within the entire Adriatic basin with fish hatcheries along the Italian coast (cuttlefish, gurnard, ...) or the Croatian coast (sole). Juveniles of many species are collected along the Italian coast in the summer and when they grow up, after two or three
months, they migrate to the open sea for less extreme weather conditions on the open sea during the autumn and winter.

Also, it should be noted that the abundance of resources, the distribution and structure of demersal communities and observed fluctuations found in the change of biomass and low middle trophic species, such as pelagic species, invertebrates and medium-sized demersal fish species can be significantly influenced by environmental factors and climate anomalies as well as by direct and indirect effects of fishing.
3. STRUCTURE OF THE TRAWLER FLEET IN THE REPUBLIC OF CROATIA

According to the official data, Croatia has 790 licenses to conduct trawler fishing. The number of licences for fishing with bottom trawl per counties is shown in Figure 1.

However, a large part of the vessels have a licence for trawling and a licence for some other type of fishing. 66% of vessels with the licence for trawler fishing have trawler fishing as their primary activity. The second group consists of vessels that use primarily the purse seine, but they also have the licence for trawl fishing, and they account for 12% of ships. The third group consists of those vessels that have different coastal fishing gears, but also for bottom trawling net (Figure 2) and such vessels make 22%. The boats that have licences for the trawl fishing per counties are shown in Figure 3.
Fishing licence can be issued for one or more fishing zones. An overview of the number of licenses for each fishing zone is located in Figure 4. The greatest number of privileges is entered for the zones of the open sea, and the least for zones F and G (Figures 4 and 5).
The future analysis is done only for vessels which have registered the trawl net as the main fishing gear; 503 of those were active in 2010 and 483 in 2011.

According to the length, the trawlers can be divided into three categories. The first consists of small boats (up to 12 meters), which are characterized by the fact that they operate in a narrow coastal area near the home port. The second group are vessels from 12 to 18 meters, and they consist of vessels that fish in the coastal area and on the high seas. A special subgroup within this group of vessels are vessels up to 15 metres that are more similar to small boats by area and the dynamics of operation than to large vessels. Large vessels are those over 18 meters and they typically fish in the open sea for a few days and they are less connected to the home port. In the first category there are 36% trawlers, in the second category 49% and in the third there are 15% (Figure 6).
The medium length of trawlers in Croatia is 14.39 meters. It is important to emphasize that there is a big difference in the longitudinal structure of the fishing fleet by individual fishing zones in different counties. The smallest vessels are in the Lika-Senj County (10.81 m), the County of Istria (13:02 m), the Primorje-Gorski Kotar County (13.51 m), the Zadar County (13.78 m), the Šibenik-Knin County (15.27 m), the Dubrovnik-Neretva County (16.87 m) and the Split-Dalmatia County (16.99 m). Most vessels are in the range of 10 - 16 m (63%), while 6% of vessels are larger than 24 meters.

![Figure 7. Trawlers by LoA by counties](image)

Average engine power of the Croatian trawlers in the Republic of Croatia is 142.82 kW. As in the case of length, there is a big difference in the average power of the engine in a particular fishing zone. The trawlers in the Lika-Senj County have the minimum power (65.61 kW), then in the Zadar County (109.12 kW), and the Primorje-Gorski Kotar County (118.77 kW). Those are mostly small vessels operating in the channels of the northern Adriatic. The average power in the Istria County is 138.51 kW. In the middle and southern part of the Adriatic there are vessels with more power and most of them fish in open water, primarily in area of Jabuka pit. The average power in the Dubrovnik-Neretva County is 175.68 kW, while in the Split-Dalmatia County average power is 180.28 kW. In the Šibenik-Knin County the average power is 180.10 kW. The largest number of trawlers falls into the category of engine power between 50 kW and 200 (82%), while only 10% of vessels have power over 250 kW (see Figure 8).

![Figure 8. Structure of trawler engine power by counties](image)
The GT (Figure 9) shows that the boats of the small value of GT dominate in Croatia. Most of the trawlers, around 55%, have a GT in the range of 5 to 15, while only 10% of vessels have over 50 GT. The mean value of GT for trawlers in Croatia is 23.87 GT. As in previous cases, the vessels in the northern Adriatic are the smallest. The mean GT in the Lika-Senj County is 7.77 GT followed by the County of Istria with 13:02 GT, the Zadar County (20:02 GT) and the Primorje-Gorski Kotar County (22.60 GT). Vessels from the central and southern Adriatic, which operate mainly in the open middle Adriatic have the highest GT values. The mean value of GT for the Šibenik-Knin County is 33.10 GT, the Dubrovnik-Neretva County 33.34 GT and the Split-Dalmatia County 37.05 GT.

Dynamics of operation of the trawler in Croatia is described by the average number of working days, and by the number of hauls in the working day and the duration of an average haul.

According to the data collected during the DemMon project, the average number of working days of trawlers in Croatia is 136.86 days in a year. These are the days when the vessel is at sea. In addition to working at sea, fishermen have on average an additional 84.61 days (preparation for fishing activities and maintenance of the boat), which amounts to a total of 221.47 fishermen working days. Number of working days of a vessel and a fisherman varies from county to county (Figure 9), and to a large extent depends on the weather conditions and measures in spatial and temporal fishing bans in the areas where they work. Trawlers in the Zadar and Šibenik Counties have the minimum number of working days in the year (on average about 117 days). The average number of working days in a year for a trawler in Istria is 132 working days, where the intensity of fishing activity is highly seasonal. Trawlers in the Split County have about 146 working days, and apart from the weather conditions extremely restrictive spatial prohibition of fishing for a half of the year in the channel areas of the central Adriatic is also of great importance for the total number of fishing days in this zone. Vessels in the Rijeka (153) and Dubrovnik County (157) have the largest number of working days in the year, due to the large size of vessels that operate more in the open sea (Figure 9).
The average number of hauls in a single fishing day of the trawler in Croatia is 2.65 per day with an average duration of 4.67 hours per individual haul, amounting to approximately 11.61 hours of trawling in an average day. The number of hauls and their duration (Figure 10 and Figure 11) are different in certain counties. The greatest number of hauls in a day is in the fishing Zone A (3.96), but the hauls there are also the shortest (about 2.58 hours / haul), which makes an average of 10:22 hours per fishing day. The amount of by-catches that prevents long hauls has the crucial importance for the length of hauls in this fishing zone. The greatest number of fishing hours in a day is in the fishing zone B (14.47 hours) with an average of 3.11 hauls lasting 4.66 hours. In the fishing zones C and D, due to the small amount of catches, the duration of hauls are the longest with an average of 5.67 hours and with an average of 2.15 hauls in a day, the daily fishing duration is 12.22 hours. Due to the small amounts of by-catches, the hauls in the channel areas of the central and northern Adriatic are also relatively long (in zones E and F average of 4.79 hours and in the zone G averaged 4.76 hours). As the fishing in zone G is only allowed during the day, while in the zone E fishermen mostly operate during the night, the number of hauls in the working day is small (in the zone G 2.2 hauls/day, in the zones E and F 2.23 hauls/day), thereby resulting in an average of 10.70 hours of trawling in the zones E and F and 10.46 hours of trawling in the fishing zone G.
Figure 10: Average number of hauls per day per fishing zones

Figure 11: Average duration of hauls per fishing zones

Trawl fleet has specifically inconvenient structure (LoA, kW and GT) in Northern Adriatic in the area around Istria. Majority of the vessels small, old and poorly equipped that fish in the narrow coastal area. Figure 12 shows that majority of the Istrien fleet (95%) consists of vessels smaller than 18m LoA, while 46% of them is smaller than 12m LoA. Engine power of the vessels is also small – over 89% of boats has engine power below 200 kW (Figure 13). Similar situation is also with GTs – 86% of the vessels has GT less than 20.
Figure 12: Length structure of the trawl fleet along Istrian coastline

Figure 13: Trawl fleet structure along Istrian coastline regarding engine power

Figure 14: Trawl fleet structure along Istrian coastline regarding GT
The total number of days at sea for particular vessels significantly depends on geographical and meteorological characteristics in their fishing area. In the region of Northern Adriatic the number of fishing days is extremely susceptible to weather conditions which predominate in this area. The number of days with sea condition of 3 or more (weather conditions in which smaller vessels cannot operate, except in narrow coastal area) has been researched in 2009 and amounts to 40% of the time in Northern Adriatic. Considering that average number of fishing days for vessels in Istria is around 132, as well as aforementioned 40% of days with sea condition of 3 or more, number of fishing days for this fleet would drop to 79 annually, if they were to operate more than 3 NM from the coast. That would mean total loss of profitability and cessation of fishing activities for almost all fleet.

According to the data available, in G fishing zone 103 trawlers are active, of which half are smaller than 15 meters. Vessels smaller than 15 meters are generally active in colder part of the year (when channel areas in Central Adriatic are opened for trawl fishing) and extremely small number of ships length between 12 and 15 m LoA have technical capabilities for operating at open sea (which is opened for fishing throughout the year). The situation is similar with other fishery zones in channel areas E and F. Vessels smaller than 15 m LoA do not have technical capabilities for leaving coastal area. Moreover, forcing such vessels to additionally move away from the coast creates safety problems with sailing and operating, also drastically reducing economic efficiency of their operations.

It should be emphasized that trawl fishing in the majority of Central Adriatic channels is possible between 1st November and 31st March only, which reduces annual number of work days to 100 (5 days a week when trawling is permitted). In parts where trawl fishing is permitted only on Wednesdays and Thursdays, available number of days drops to 40. In reality the actual number of days is even smaller due to bad weather during winter, amounting to maximum 75 to 85 days annually.
4. LEGAL REGULATION OF TRAWL FISHING

The regulation of bottom trawl net fishing is contained in:


   - Article 3, paragraph 1 (minimum size of cod-end in the inner sea)
   - Article 4 (spatial regulation considering the power of propelling engine)
   - Article 5, paragraph 1 (permanent ban for certain zones)
   - Article 6 and 7 (spatial-temporal ban to protect immature fish and other marine organisms)
   - Article 8 and 9 – regulation in E zone
   - Article 10 – regulation in F zone
   - Article 11 – regulation in G zone
   - Article 32 - ban on the issuance of new licences and entry of new types of fishing (fishing tools and equipment) to the valid licences.

2. Ordinance on fishing gear and equipment for commercial fishing in the sea (Official Journal, no. 148/2010, 25/2010) in parts which provide design and technical characteristics of the fishing gear and equipment, and the amount of gear that can be used in fishing (if it is not regulated by EC Regulations).

3. Ordinance on privileges for commercial fishing at the sea and the register of issued privileges (Official Journal no. 144/2010, 123/2011, 53/2012 and 98/2012.) which defines the conditions for transfer of rights from one valid licence to another valid licence and the terms of transfer of licences from one fishing vessel to another.


5. The decision on the authorization of licences for fishing with bottom trawl nets - trawl fishery in the Croatian sea (to be adopted!)
6. The decision on the authorization of licences for fishing with bottom trawl nets - trawl fishing in parts of the Croatian sea for vessels smaller than 15 meters in length at depths greater than 50 meters at a distance of at least 1 nautical mile from shore (to be adopted!)

7. The decision on the authorization of licences for fishing with bottom trawl nets - trawl fishing in parts of the fishing sea in the Republic of Croatian for vessels that are registered and operate only in the area defined in the Agreement (Western Istria) at depths of less than 50 meters at a distance of at least 1.5 nautical miles from coast (to be adopted!)

Above regulations are contained in Annex 1 of this Management Plan and form its integral part.

Croatian fishing sea consists of two parts (Figure 15): inner fishing sea with an area of 12,461 km², encompassing inner sea from coastland to starting line, and outer sea consisting of territorial sea (area of 19,267 km²) and Protected environmental fishing zone – ZERP/PEFZ (area of about 25,000 km²).

![Figure 15: Administrative classification of the fishing sea in the RC](image)

Inner fishing sea is divided into three fishing zones (E, F and G), territorial sea into four fishing zones (A, B, C and D) and PEFZ into four fishing zones (H, I, J and K).
A different minimum mesh size of a bottom trawl net applies for different parts of the fishing sea: 24 mm (from knot to knot) in inner fishing waters and 20 mm in outer fishing sea. Also, the maximum engine power is limited to 184 kW in inner fishing sea (except in certain parts of the Northern Adriatic channels, where the limit is 110 kW), while in the outer fishing sea it is limited to 662 kW.

For the majority of commercially important species the minimum fishing length (minimum landing size) is prescribed (Table 1), i.e. the length below which the organisms must not be fished or placed on the market.

Table 1 Comparison of minimal fishing lengths of sea organisms according to valid RC regulations with the ones valid in EU, according to the Regulation EC-1967/2006.

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<thead>
<tr>
<th>SCIENTIFIC NAME</th>
<th>CROATIAN NAME</th>
<th>Smallest size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>RC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EU (EC-1967/2006)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Fish</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Dentex dentex</em></td>
<td>zubatac</td>
<td>30 cm</td>
</tr>
<tr>
<td><em>Dicentrarchus labrax</em></td>
<td>lubin</td>
<td>23 cm</td>
</tr>
<tr>
<td><em>Diplodus annularis</em></td>
<td>špar</td>
<td>15 cm</td>
</tr>
<tr>
<td><em>Diplodus puntazzo</em></td>
<td>pic</td>
<td>15 cm</td>
</tr>
<tr>
<td><em>Diplodus sargus</em></td>
<td>šarag</td>
<td>15 cm</td>
</tr>
<tr>
<td>Fish Species</td>
<td>Species Name</td>
<td>Length 1</td>
</tr>
<tr>
<td>---------------------------</td>
<td>--------------</td>
<td>----------</td>
</tr>
<tr>
<td>Diplodus vulgaris</td>
<td>fratar</td>
<td>15 cm</td>
</tr>
<tr>
<td>Engraulis encrasicolus*</td>
<td>inčun</td>
<td>9 cm</td>
</tr>
<tr>
<td>Epinephelus spp.</td>
<td>kirmje</td>
<td>45 cm</td>
</tr>
<tr>
<td>Lithognathus mormyrus</td>
<td>ovčica</td>
<td></td>
</tr>
<tr>
<td>Lophius spp.</td>
<td>grdobine</td>
<td>30 cm</td>
</tr>
<tr>
<td>Merluccius merluccius</td>
<td>oslić</td>
<td>16 cm</td>
</tr>
<tr>
<td>Mugil cephalus</td>
<td>cipal bataš</td>
<td>20 cm</td>
</tr>
<tr>
<td>Mugil spp., Liza spp.</td>
<td>cipli</td>
<td>16 cm</td>
</tr>
<tr>
<td>Mullus spp.</td>
<td>trlja</td>
<td>11 cm</td>
</tr>
<tr>
<td>Pagellus acarne</td>
<td>batoglavač</td>
<td></td>
</tr>
<tr>
<td>Pagellus bogaraveo</td>
<td>rumenac okan</td>
<td></td>
</tr>
<tr>
<td>Pagellus erythrinus</td>
<td>arbun</td>
<td>12 cm</td>
</tr>
<tr>
<td>Species</td>
<td>Name</td>
<td>Length 1</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>------------</td>
<td>----------</td>
</tr>
<tr>
<td><em>Pagrus pagrus</em></td>
<td>pagar</td>
<td>30 cm</td>
</tr>
<tr>
<td><em>Polyprion americanus</em></td>
<td>kirnja glavulja</td>
<td></td>
</tr>
<tr>
<td><em>Sarda sarda</em></td>
<td>palamida</td>
<td>45 cm</td>
</tr>
<tr>
<td><em>Sardina pilchardus</em>**</td>
<td>srdela</td>
<td>10 cm</td>
</tr>
<tr>
<td><em>Sciaena umbra</em></td>
<td>kavala</td>
<td>30 cm</td>
</tr>
<tr>
<td><em>Scomber spp.</em></td>
<td>skuša, lokarda</td>
<td></td>
</tr>
<tr>
<td><em>Scomber scombrus</em></td>
<td>skuša</td>
<td>18 cm</td>
</tr>
<tr>
<td><em>Seriola dumerili</em></td>
<td>gof</td>
<td>45 cm</td>
</tr>
<tr>
<td><em>Solea vulgaris</em></td>
<td>list</td>
<td>20 cm</td>
</tr>
<tr>
<td><em>Sparus aurata</em></td>
<td>komarča</td>
<td>20 cm</td>
</tr>
<tr>
<td><em>Spondylosoma cantharus</em></td>
<td>kantar</td>
<td>18 cm</td>
</tr>
<tr>
<td>Fish Species</td>
<td>Local Name</td>
<td>Length</td>
</tr>
<tr>
<td>----------------------------</td>
<td>------------</td>
<td>----------</td>
</tr>
<tr>
<td><em>Sprattus phalearicus</em></td>
<td>papalina</td>
<td>8 cm</td>
</tr>
<tr>
<td><em>Tetraprurus belone</em></td>
<td>iglan</td>
<td>120 cm</td>
</tr>
<tr>
<td><strong>Thunnus thynnus</strong>*</td>
<td>tunj</td>
<td>30 kg (8 kg)</td>
</tr>
<tr>
<td><em>Trachurus spp.</em></td>
<td>šarun, šnjur</td>
<td>15 cm</td>
</tr>
<tr>
<td><em>Xiphias gladius</em></td>
<td>iglun</td>
<td>120 cm</td>
</tr>
</tbody>
</table>

**2. Crabs**

<table>
<thead>
<tr>
<th>Crab Species</th>
<th>Local Name</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Homarus gammarus</em></td>
<td>hlap</td>
<td>24 cm TL, 300 mm TL</td>
</tr>
<tr>
<td><em>Maja squinado</em></td>
<td>rakovica</td>
<td>10 cm TL</td>
</tr>
<tr>
<td><em>Nephrops norvegicus</em></td>
<td>škamp</td>
<td>7 cm, 20 mm CL</td>
</tr>
<tr>
<td><em>Palinuridae</em></td>
<td>jastog</td>
<td>24 cm, 90 mm CL</td>
</tr>
<tr>
<td><strong>Parapenaeus longirostris</strong></td>
<td>kozica</td>
<td>20 mm CL</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>3. Shellfish</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Arca noae</em></td>
<td>kunjka</td>
<td>5 cm</td>
</tr>
<tr>
<td><em>Mytilus galloprovincialis</em></td>
<td>dagnja</td>
<td>6 cm</td>
</tr>
<tr>
<td><em>Ostrea edulis</em></td>
<td>kamenica</td>
<td>7 cm</td>
</tr>
<tr>
<td><em>Pecten jacobaeus</em></td>
<td>Jakovljeva kapica</td>
<td>10 cm</td>
</tr>
<tr>
<td><em>Ruditapes decussatus</em></td>
<td>kućica</td>
<td>2,5 cm</td>
</tr>
<tr>
<td><em>Venerupis spp.</em></td>
<td>kućice</td>
<td>25 mm</td>
</tr>
<tr>
<td><em>Venus spp.</em></td>
<td>kokoš, prnjavica</td>
<td>2,5 cm</td>
</tr>
</tbody>
</table>

TL – total length; CL – carapace length

(*) European anchovy: Member states can recalculate smallest size in 110 specimens per kilogram.

(**) European pilchard: Member states can recalculate smallest size in 55 specimens per kilogram.
(*** Bluefin tuna: Minimum mass is 8 kg, if harvested for further farming.

By accession to the EU, the RC will fully adopt minimum fishing lengths as prescribed by Council Regulation (EC No 1976/2006).

The most important regulation measures in Croatia are temporal and spatial trawl fishing restrictions (temporary or permanent prohibition in certain areas). This is a complex system created as a consequence of long-lasting evolution process in balancing exploitation needs with necessity for the protection of demersal resources. That is why his sudden change would have incalculable consequences for trawl fishing, as well as for protection.

Trawl fishing is permanently prohibited within 1 NM from mainland and island coast, 2 NM around islands Palagruža, Galija, Lastovo, Lastovnjaci, Vrhovnjaci, Glavat, Kopište, Mljet, Vis, Barjak Mali, Barjak Veli, Ravnik, Budikovac, Paržan Veli, Paržan Mali, Greben, Sušac, Svetac, Biševo and Brusnik, and 3 NM around Blitvica and Jabuka. Trawl fishing is prohibited in numerous bays and channels, e.g. Cres bay, Osor bay, Vinodol and Velebit channel, Novigrad sea, part of Zadar And Pašman channels, Kaštela bay, most part of the Split and Brač channels, part of the Hvar channel, part of the Neretva channel and part of the Koločep channel.

Moreover, in numerous parts of the fishing sea the trawl fishing is prohibited for certain part of the year or of the week. Figure 16 shows complex system of trawl fishing regulation in terms of time and space in the RC, while details can be found at www.izor.hr.

Figure 16: Trawl fishing regulation in terms of time and space in the RC
According to the existing regulations, trawl fishing is permanently prohibited in approximately 30% of the territorial sea of Croatia, with additional around 10% is prohibited between 100 and 300 days annually. Overview of areas under various fishery regulation measures in terms of time and space is shown in Table 2.

Table 2 Areas under different regimes for fishery regulations in terms of time and space

<table>
<thead>
<tr>
<th>Type of restriction</th>
<th>Description</th>
<th>Area in km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanently</td>
<td>Up to 1 NM</td>
<td>6895</td>
</tr>
<tr>
<td>Permanently</td>
<td>Up to 2 NM</td>
<td>551</td>
</tr>
<tr>
<td>Permanently</td>
<td>Up to 3NM</td>
<td>123</td>
</tr>
<tr>
<td>Permanently</td>
<td>Channels and bays</td>
<td>728</td>
</tr>
<tr>
<td>Permanently</td>
<td>Disposal sites for explosives</td>
<td>266</td>
</tr>
<tr>
<td><strong>PERMANENTLY TOTAL</strong></td>
<td></td>
<td><strong>8563</strong></td>
</tr>
<tr>
<td>Temporary</td>
<td>Temporary trawl fishing prohibitions (between 100 and 300 days annually)</td>
<td>3761</td>
</tr>
<tr>
<td><strong>TOTAL AREA SUBJECT TO REGULATIONS</strong></td>
<td></td>
<td><strong>12324</strong></td>
</tr>
</tbody>
</table>
Furthermore, trawl fishing is prohibited above seagrass beds, coralligenous habitats and maerl.

It should also be emphasized that, considering technical characteristics of vessels and geomorphological configuration of the Adriatic sea, trawl fishing in Croatia is dominantly performed up to 350 – 400 m depths (primarily at Southern Adriatic).

Simulation of various trawl fishing prohibitions in Croatia

According to the Regulation EC 1967/2006 trawl fishing is prohibited within 3 NM from coastline or 50 m isobath, should that depth be reached at shorter length. If the criteria for fishing prohibition further than 3 NM from coastline should be applied, it would mean trawl fishing prohibition over 14,797 km², which means almost entire inner fishing sea (Figure 17).

![Figure 17: Trawl fishing prohibition simulation within 3 NM in the fishery sea of the RC](image)

According to Article 13 of the Regulation EC 1967/2006, minimum distance for trawl fishing is 1.5 NM from the coastline, regardless the sea depth. Considering this, as well as afore mentioned (3 NM and 50 m depth), applying such prohibition regime would prohibit trawl fishing on the area of 11,634 km², as shown on Figure 18.
Figure 18: Trawl fishing prohibition simulation within 3 NM distance and 50 m depth, as well as 1.5 NM in the rest of the fishing sea of Croatia

Article 13 enables derogation for trawl fishing under strictly defined conditions up to the 0.7 NM distance from the coastline at parts of the sea with depths more than 50 m. Should such regulation be applied in the fishery sea of the RC, that would mean fishing prohibition over 6,520 km², as shown on Figure 19.

Figure 19: Trawl fishing prohibition simulation within 3 NM distance and 50 m depth, as well as 0.7 NM in the rest of the fishing sea of Croatia
According to the EC 1967/2006, maximum possible derogation obtaining for trawl fishing is minimum distance from the coastline of 1.5 NM and 50 m depth, and within 0.7 NM at more than 50 m depths. Should such regulation be applied in Croatia, that would mean fishing prohibition over 5,631 km², as shown on Figure 20.

Figure 20: Trawl fishing prohibition simulation within 1.5 NM distance and 50 m depth, as well as 0.7 NM in the rest of the fishing sea of Croatia

Considering all afore mentioned, as well as criteria that are to be fulfilled for obtaining certain derogation, during the negotiations with EU Croatia advocated for the obtaining a derogation for trawl fishing permission at 1.5 NM distances at parts of the sea deeper than 50 m, primarily along the Istrian coastline. Also, in the rest of the fishing sea (parts deeper than 50 m) Croatia requested derogation at 1 NM minimum distance from the mainland, while keeping recent regulations in terms of time and space. This refers to vessels smaller than 15 m.

EU accepted the Croatian argumentation and explanations and enabled temporary derogation for minimum distance from the coastline as afore stated and up to 1st July 2014. Also, there is a possibility for this derogation to become permanent, under condition that management plan shows that such fishing regulation type is long-term sustainable. Overview of the areas for which derogations obtained apply is shown on Figure 21. This enlarged the area under total trawl fishing prohibition for additional approx. 800 km².
Figure 21: Overview of recent trawl fishing regulations in terms of space and time with derogations in Istrian area, up to 50 m depth.

Additional elements with impact on trawl fishing activities

Bottom trawl fishing takes place in parts of the fishing sea in which the bulk of the catches of demersal species is caught by that fishing gear, and much less with bottom set nets, traps (for large crustaceans and norway lobster), hooks (bottom set long-lines and hand lines) and dredges. Given the spatial - temporal regulation of fishing as well as the characteristics of the bottom where the bottom trawl fishing in reality is carried out, there is little interaction between these demersal trawlers and mentioned fishing gears, as they are used mainly near the coast in areas which provide better catch and are prohibited for bottom trawlers or on seaboards where demersal bottom trawlers are not operating due to danger off entanglement on the bank or rocks and e.g.

Depth and configuration of the sea bed

Trawl fishing is extremely dependent on bathymetry and sea bed configuration, which is along the eastern Adriatic coastline (mainly within inner fishing sea) markedly unfavourable for bottom trawling. Fishing sea of Croatia has relatively small coastal platform and the depth of 50 m is often reached within 1 NM from the coastline, as is the case with majority of the inner fishing sea part and in the part of the territorial sea as well. The area of sandbank below 50 meters is 11.074 km² (20%), while fishing sea area with depth above 50 m is approximately 44.425 km² (Figures 22 and 23).
Limitations of areas with trawl fishing possibility

Except in areas where trawl fishing is prohibited under the Marine Fisheries Act, trawling has been rendered impossible due to many other factors, such as navigable routes, underwater cables, water supply systems, oil platforms, explosives landfills, obstacles, routing and e.g. (figures 24 and 25).
Figure 24: Examples of fishing sea areas with trawl fishing disabled
Weather impact on trawl fishing

According to the data on weather and wave height collected by the Croatian Hydrographic Institute of the platform Ivana in the open northern Adriatic sea, sea condition 3 or more was recorded during 40% of the time over the year (Figure 26). The sea condition 3 is the limiting factor for smaller vessels operating at distances greater than 1 NM from the coastline. The situation is similar at open Central Adriatic, where 25-35% of the time sea condition is 3 or more.
5. TRAWL CATCH IN THE REPUBLIC OF CROATIA

Total marine fish catch in recent years in Croatia amounts to approximately 50,000 tones, where small pelagic fish account for most of the catch (over 80%). Catch of demersal species is more or less stable and amounts to 5-6,000 tons per year (Figure 27). Of this amount, the total catch in coastal fisheries accounts for approximately 1,000 tons, and the rest is trawling catch.

![Graph showing annual catch of demersal species in Croatia](image)

Figure 27. Annual catch of demersal species in Croatia

Taking into account the technical characteristics of the trawl fleet in Croatia (small, old and poorly equipped vessels), it is logical that the majority of the catch is realized in the coastal areas, while trawling done outside territorial waters (H, I, J, and K zones) is almost negligible and makes up to only 0.6% of the total catch (Figure 28). The bulk of the catch comes from the open central Adriatic Sea – the wider area of Jabuka pit (fishing zone C) and accounts for about 38% of the total catch. The most important commercial species in this area are hake, Norway lobster and hornet octopus. The next fishing zone with biggest annual catch is the zone A (15%) and the structure of the catch depends significantly on the season, but it is dominated by octopodes, squid, whiting, mullet and sole. There is a similar structure of the total catch in the fishing zone B (14.5%), where the most important species are red mullet, hake and octopodes. The catch in channel areas of northern Adriatic (E and F zones) constitutes about 11.5%, and the dominant species are hake, mullet, Norway lobster and octopodes. Trawling in central Adriatic channels (Zone G) makes up to 10% of the total catch, and the dominant species are hake, red mullet, monkfish, octopodes and similar. The smallest part of the catch comes from the fishing zone D (open southern Adriatic), because this is a
relatively deep area used by a small number of fishing vessels. Its share in the total catch is 8%, and the most important species are hake, mullet and shrimp (Figure 28).

By comparing the total biomass (according to MEDITS expedition) with the catch realised in each fishing zone (logbooks and catch reports), results show a disproportionate exploitation of resources. The highest level of exploitation occurs in fishing zones C and A, and the most favourable situation is in the channel areas (E, F and G zones) (Fig. 29).

Trawling activities in the Republic of Croatia are highly seasonal; therefore the total catch as well as catch composition depend on the period when the catch was made. Maximum value of the catch occurs in the autumn, as the result of the arrival of large quantities of red mullet to Croatian fishing sea from western Adriatic. Decline in the catch occurs during winter months due to poor weather conditions and small number of fishing days. Catch increases during the spring period are due to hake, octopodes and Norway lobster catch. This is followed by a decline in catch and fishing activities during the summer period (Figure 30).
Figure 30. Trawl catch by month, species and years. (Total trawl catch, hake catch, Norway lobster catch, red mullet catch)

The most important species in trawl catches, according to the official statistics, are red mullet (26%), hake (19%), octopodes (15%) and Norway lobster (10%), whereas all other species make up about 30% of trawl catches (Figure 31)

Figure 31. Trawl catch composition according to species (average for 2008 – 2011 period)
When describing the trawl catch of the Republic of Croatia in the Adriatic Sea, one should always bear in mind that almost all exploited stock are biologically unique populations exploited by fishing fleets of various countries. Therefore, it is necessary to have a complete picture of the state of exploitation in the Adriatic Sea (i.e. in GSA 17) in order to explain the situation (Figure 32).

Croatian fishing sea (including Ecological and Fisheries Protection Zone (ZE RP)) constitutes about 61% of the GSA 17, but it should be noted that the Croatian fishing fleet exploits mainly the inner and territorial waters (which together account for about 34% of the GSA 17).

Of the total number of trawlers in GSA 17, Croatian vessels account for about 40%; 31% of the total kW and 27% of the GT. Croatian trawl catch accounts for only 14% of the trawl catch in GSA 17. Bearing that in mind, one can see huge differences in the level of fishing effort, exploitation and catch in GSA 17, resulting in a different condition of the resources. However, due to the fact that the most commercially important stocks of biologically unique populations are subject to migration, over-exploitation in one area will soon be reflected in other parts of the sea.

According to the results of the commercial monitoring (DemMon), most of the trawl catch consists of bony fish (72%), followed by cephalopods (13%), crustaceans (8%), cartilaginous fish (6%), and shellfish with approximately 1% share (Figure 32). The main species in catches in 2011 were red mullet (24%), hake (15%) and cephalopods (9%). (Figures 33 and 34)
The most abundant species in the fishing zone A were whiting (Gadus merlangus) 25%, musky octopus 25%, red mullet 20%, queen scallop (Chlamys opercularis) 9% and squid 5%. These 5 species accounted for 84% of the total catch. In fishing zone B, five most abundant species accounted for 77% of the catch. The most abundant was squid (41%), but this information should be taken with a grain of salt as considerable number of samples in this zone were relatively small and caught during winter months when squid is a dominant species in these areas. The following most abundant species is red mullet (19%) followed by hake (7%), shark (5%) and common pandora (5%). In the fishing zone C, five most abundant species accounted for 63% of the total catch, and the predominant species are hake (24%), Norway lobster (14%), red mullet in shallow areas (9%); horse mackerel (9%); broadtail shortfin squid (7%). The most abundant species in the fishing zone D was shrimp (24%), followed by hake (14%), horse mackerel (9%), red mullet (7%) and broadtail shortfin squid (7%). Other species made up 39% of the catch. In the northern Adriatic channel areas (zone E and F) the most abundant species accounted for 86% of the catch. Five most abundant species in this fishing zone are: red mullet (49%) due to dominance in the colder part of the year in zone F, hake (20%), poor cod Trisopterus minutis capelanus (9%), norway lobster (4%) and musky octopus (4%). Channel areas of the central Adriatic constitute a zone. Five most
abundant species accounted for 66% of the total catch, and the most abundant species is hake with a share of 30%. It is followed by red mullet (15%); musky octopus (10%), poor cod (6%) and thornback ray (5%). In extraterritorial waters, in the Ecological and Fisheries Protection Zone (ZERP), the structure of the catch is quite similar to the fishing zones D and C, which is logical, given that most of the catch in the ZERP is realized in the zones J and K. Five most abundant species comprised 54% of the total catch, and most abundant species were shrimp (23%), hake (10%), hornet octopus (8%), red mullet (7%) and squid (6%) (in zone H) (Figure 35).

Figure 35. Trawl catch composition according to fishing zones
6. BYCATCH STRUCTURE IN TRAWL CATCHES

Any part of the trawl catch which cannot be commercially used and which is not retained on board but thrown back into the sea is considered bycatch. Bycatch mostly consists of unmarketable species of invertebrates, but also of non-commercial fish. Significant part of the bycatch is made up of commercially unimportant or less marketable species. Fishermen due to a lack of market interest do not retain or land these species. Furthermore, bycatch also includes juvenile specimens of commercially important species as well as specimens damaged during fishing activities.

Content and the amount of bycatch vary greatly with respect to the trawling area, but also with respect to the season and the time of day when fishing is done. Also, various tools modifications have a major impact on the amount of bycatch.

The highest amount of bycatch occurs in the fishing zone A (up to 45 kg/hour). Majority of bycatch in this zone consists of various types of invertebrates (Figure 36). In other fishing zones, bycatch is mainly dominated by non-commercial fish and juveniles of commercial fish. The least amount of bycatch occurs in the open sea and the ZERP area.

![Figure 36. Bycatch structure according to each fishing zone](image)

The most important species in the bycatch in the fishing zone A (Figure 37) were shellfish of genus Aequipecten (24%) and Chlamys (16%), followed by sponge (13%), hydrozoans (8%), Phalusia mamilata (8%), and other species with a share of 31%. In the fishing zone B the dominant species in the bycatch were bullray fish (16%), various types of sponge (11%), small specimens of horse mackerel (18%) and bouge (9%). The share of other species was 47%. In the fishing zone C the most abundant species in the bycatch were commercially unimportant crustacean Munida banfica (31%), followed by horse mackerel (17%), poor cod (11%), various types of sponge (9%), forkbeard (9%) and other species (23%). There is a similar bycatch structure in the fishing zone D, with the main species in catches being
crustacean Munida banfica (28%), followed by horse mackerel (28%), small specimens of nursehound (8%), hake juveniles (6%), small shrimp (4%) and other species (26%). In the channels of the northern Adriatic dominant species in the catches are sponge (27%), crab Liocarcinus depurator (16%), hydrozoa Phalusia mamilata (15%), picarel (4%), and crab Munida rugosa (4%).

In the channel areas of the central Adriatic (zone G) dominant species are sea cucumber Stichopus regalis (21%); crab Liocarcinus depurator (14%); and fish horse mackerel 8% and bouge.

Figure 37. Most common species in the bycatch according to fishing zones
7. ECONOMIC BACKGROUND AND SOCIO-ECONOMIC EFFECTS OF THE MANAGEMENT PLAN

Bottom trawling takes place all along the Croatian coast (Figure a). Owners of enterprises or crafts that have a vessel licensed to use a bottom trawl net are equally distributed along the Croatian coast, as well as on the islands, and present an important activity of rural areas along the coast and islands.

Figure a. Distribution and concentration of owners of enterprises and crafts with vessels licensed for bottom trawling
The bottom trawling fleet participates in the total catches of Croatia with some 10-15% at first sales, whereas the value of this catch accounts for more than 45% of value at first sales. Fishermen using bottom trawl net sell their products on the market for demersal species where they represent the largest share on Croatian market. A significant part of the bottom trawl catches is exported as fresh product (over 60%). The prices of bottom trawl catches at first sales are determined by a multiplicative intermediation between the producer and the final consumer, which significantly decreases the price obtained by the fishermen. While the average price of bottom trawl catches from the Adriatic on European markets reaches between 7,5 and 8,5 EUR per kilo, Croatian fishermen obtain an average price of 3,5-6 EUR. Decrease of catches of 30% over the last four years as well as the drop in overall size structure of Norway lobster in the Middle Adriatic have both significantly contributed to a decreased rentability of bottom trawling.

The variation of prices at first sales for bottom trawl catches is the consequence of different catch compositions. When the bottom trawler operates on grounds where dominant catches are Norway lobster and shrimp, average price is higher due to higher value of these species and their dominance in the catch. On the other hand, operating on grounds where dominant species are hake and mullet results in lower average prices but higher quantities. Larger vessels have significant costs, which is the reason why under the conditions of Croatian market having underrated process they try to obtain as many fishing days targeting shrimp and Norway lobster.

According to the available research, the status of resources in Croatian territorial waters is significantly better than in other parts of the Adriatic. Despite this, catch per unit effort does not show the same relationship. The reason for such a situation is that Croatian bottom trawling fleet is old and technically and technologically rather obsolete. Most of Croatian vessels licensed for bottom trawling fisheries come from a time when the catches were – both in size and structure – sufficient to cover the costs, although the costs were high even in those times. This primarily relates to a low energy efficiency of the engine (fuel consumption) and efficacy of the gear. Almost 60% of bottom trawlers are older than 30 years (year of construction precedes 1980.), while the average age of the vessels is 38 years (average construction year is 1975.). Smaller vessels have higher efficiency rates per unit effort, and despite technological inefficiency are still operational under the multi-gear usage regime and a limited number of days at sea, which is a direct consequence of the relationship of the size of the vessel and weather and sea conditions. Majority of the fleet has retained the same technological characteristics over the years, but the resources are exploited by different fleets with much higher efficiency rates.

Smaller vessels (less than 12m), which are multi-purpose vessels in most cases, employ an estimated 240 people (22,43% of total number of people employed on bottom trawlers). Vessels of 12-15 meters employ an estimated 400 people (37,38% of the total number of employees on bottom trawlers). Vessels of 15-18 m in length employ some 180 people (16,82% of the total number of employees on bottom trawlers). Vessels of 18-24 employ
some 150 people (14,02% of the total number) and vessels over 24 m employ some 100 people (9,35% of total number of people employed on bottom trawlers).

Differentiation of activity as per size of the vessel and engine power, which determine the possible number of days at sea and hence the participation in the impact to resources, in combination with the number of people employed, provides for a more holistic picture of the structure of the bottom trawl fisheries (tables a and b).

Table a. Length classes of vessels and their participation in % in total fishing effort expressed as kW/days of bottom trawl fleet

<table>
<thead>
<tr>
<th>Length Class</th>
<th>14,70%</th>
<th>15,37%</th>
<th>15,09%</th>
<th>16,36%</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 12 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-15 m</td>
<td>27,07%</td>
<td>26,87%</td>
<td>25,98%</td>
<td>26,22%</td>
</tr>
<tr>
<td>15-18 m</td>
<td>17,27%</td>
<td>17,34%</td>
<td>15,85%</td>
<td>14,75%</td>
</tr>
<tr>
<td>18-24 m</td>
<td>23,31%</td>
<td>21,79%</td>
<td>22,06%</td>
<td>20,25%</td>
</tr>
<tr>
<td>over 24 m</td>
<td>17,66%</td>
<td>18,62%</td>
<td>21,02%</td>
<td>22,41%</td>
</tr>
</tbody>
</table>

Table b. Power classes of vessels and their participation in % in total fishing effort expressed as kW/days of bottom trawl fleet

<table>
<thead>
<tr>
<th>Power Class</th>
<th>3,16%</th>
<th>3,1%</th>
<th>2,94%</th>
<th>3,14%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plovila do 85 kW (prosj. 10,8m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plovila 85 – 184 kW (prosj 13,5 m)</td>
<td>51,01%</td>
<td>50,68%</td>
<td>48,39%</td>
<td>48,75%</td>
</tr>
<tr>
<td>Plovila &gt;184 kW (prosj. 20,6 m)</td>
<td>45,83%</td>
<td>46,22%</td>
<td>48,68%</td>
<td>48,75%</td>
</tr>
</tbody>
</table>
Comparing the estimated number of employees with the length class, it is evident that the number of employees per kW/day decreases as the length increases. If combined with the rentability (table c), socio-economical analysis of social benefits per cost of resources indicates that the best values are obtained in middle and small size vessels.

The advantage of large vessels is a larger catch, higher number of days at sea, and hence better market stability for the fishermen. With smaller vessels this could be compensated through organization of the market channels, and particularly through mechanisms available to the fishermen through the producer organizations.

Table c. Costs and revenues in bottom trawling for certain categories in Istria and Middle Adriatic.

<table>
<thead>
<tr>
<th>Srednji Jadran</th>
<th>Istra</th>
</tr>
</thead>
<tbody>
<tr>
<td>DULJINA PLOVILA</td>
<td>21,60</td>
</tr>
<tr>
<td>SNAGA/Kw</td>
<td>179,00</td>
</tr>
<tr>
<td>BROJ RADNIH DANA</td>
<td>220,00</td>
</tr>
<tr>
<td>POTROŠNJA GORIVA/l</td>
<td>78,000,00</td>
</tr>
<tr>
<td>ULOV/kg</td>
<td>25,000,00</td>
</tr>
<tr>
<td>ULOV/kn</td>
<td>900,000,00</td>
</tr>
<tr>
<td>DOPRINOSI</td>
<td>112,200,00</td>
</tr>
<tr>
<td>GORIVO/kn (6,40)</td>
<td>499,200,00</td>
</tr>
<tr>
<td>GORIVO-PDV</td>
<td>399,360,00</td>
</tr>
<tr>
<td>PLAĆE BRUTO</td>
<td>228,700,00</td>
</tr>
<tr>
<td>ODRŽAVANJE</td>
<td></td>
</tr>
<tr>
<td>RIBOLOVNIH ALATA</td>
<td>35,000,00</td>
</tr>
<tr>
<td>ŠKVER</td>
<td>20,000,00</td>
</tr>
<tr>
<td>POLICA OSIGURANJA</td>
<td>16,000,00</td>
</tr>
<tr>
<td>VARIJABLNI TROŠKOVI (hrana za posadu)</td>
<td>44,000,00</td>
</tr>
<tr>
<td>UKUPNO TROŠKOVI</td>
<td>855,260,00</td>
</tr>
<tr>
<td>prihod po l goriva (kn)</td>
<td>11,53846154</td>
</tr>
<tr>
<td>bruto razlika prihodi - rashodi</td>
<td>44,740,00</td>
</tr>
<tr>
<td>ulov po KW/dan</td>
<td>0,63</td>
</tr>
</tbody>
</table>

Results indicate that the basic characteristics of the bottom trawl fleet are obsolete and old technology and a non-regulated market. In order to economically stabilize this fishery, it is necessary to continue the implementation of market organization measures. It is also important to enhance the energy efficiency of these vessels, and to allow for a compensation for withdrawal from this fishery for those vessels that can not meet ecological or economical
criteria. Detailed economical analysis as well as the analysis of the impact of this management plan shall change with the accession of Croatia to the EU. New market circumstances could have a strong impact on this type of fisheries as well as on the management measures in the future.

Given that the accession of Croatia to the EU is expected to bring significant changes, primarily in the organization of the markets and marketing channels, and given that the socio-economical data gathering is the integral part of the National Plan for Data Collection which is conducted in line with the acquis, socio-economical analysis of this segment of the fleet shall be revised and updated, and relevant changes shall be made in this plan.
8. STATUS OF DEMERSAL FISHERY RESOURCES IN GSA 17

As for most demersal stock in GSA 17, classic assessments of demersal resources were not done, and status assessment for resources in Croatian fishing sea can be made based on the movement of the biomass index calculated according to MEDITS programme. In fact, MEDITS programme represents a long series of data on the status of resources in the Adriatic Sea, collected using unified methodology, which as such provides a real picture of the status of resources. Bearing in mind the fact that almost all commercially important stocks for trawling in the Adriatic Sea are biologically unique populations exploited by fishing fleets of different states, the correct picture of the situation can be obtained only when the resource status describes the entire area. Therefore, the text that follows shall provide parallel description of resources in Croatian territorial waters and in the rest of the Adriatic (ZERP, Italian continental shelf and Italian territorial waters). This division was made keeping in mind that the exploitation of demersal resources in Croatian territorial waters is done only by the Croatian fishing fleet, while in the rest of the Adriatic exploitation is done almost exclusively by the Italian fishing fleet. In fact, as previously mentioned, the Croatian trawl catch in the ZERP accounts for only 0.6% of the total Croatian catch.

When describing the status, the biomass index, i.e. biomass of species or groups per unit area (kg/km²) shall be used, as well as percentage distribution of individual species biomass in Croatian territorial waters and in the rest of the Adriatic. In these analyses, and when interpreting the data one should keep in mind the surface of Croatian territorial waters and the rest of territorial waters, with the ratio of 34%: 66% (Figure 38).

![Figure 38. Croatian territorial waters – other parts of the Adriatic ratio](image)

Biomass index for species harvested during MEDITS expeditions shows extreme fluctuations for the study period, with two periods marked by distinctly negative trends: first in late nineties and second in recent years. Distinct decrease in biomass index in recent years is evident in Croatian territorial waters, as in the rest of the GSA 17 (Figure 39). The mean biomass index for Croatian territorial waters was 625 kg/km² and for the rest of the Adriatic
was 386 kg/km², i.e. biomass index ratio was 1.62:1. During the study, 50% of the biomass was typically located in Croatian territorial waters; however the percentage varied between years from 40-60% (Figure 39).

Much better picture of the status of demersal resources can be obtained if one studies the MEDITS programme target species biomass index, i.e. commercially important species biomass index (Figure 40). As in the previous case, pronounced inter annual variations of biomass index can be noticed, with a pronounced negative trend in recent years. The mean biomass index for Croatian territorial waters was 435 kg/km² and for the rest of the Adriatic it was 169 kg/km², i.e. biomass index ratio was 2.57: 1. During the research, majority of the total target species biomass was located in Croatian territorial waters and averaged about 60%.

Biomass index analyses were made for a group of 6 commercially important species for trawl fisheries (octopuses, hake, mullet, common pandora and Norway lobster), i.e. for DemMon programme targeted species (Figure 41). Biomass index for these species shows a decrease in recent years throughout the entire GSA 17. The mean biomass index for the territorial sea of the Republic of Croatia amounted to 153 kg/km², and for the rest of the Adriatic sea it was 62 kg/km², i.e. biomass index ratio of 2.45:1. On average, during the study period, about 60% of the biomass was located in Croatian territorial waters, and that percentage was more or less constant throughout the study period.
Figure 41. DemMon programme target species biomass index (left) and percentage of their spatial distribution (right) in GSA 17 (according to MEDITS)

So called BOI species – species that live on or close to the seabed, are usually taken as status indicators for demersal settlements. Population density of such species is much higher in Croatian territorial waters than in the rest of the Adriatic, and the mean value was 88 kg/km² in Croatian territorial waters, and 21 kg/km² in the rest of the Adriatic. Biomass index ratio was 4.13:1, and almost 70% of their total biomass was located in Croatian territorial waters (Figure 42).

Figure 42. BOI species biomass index (left) and percentage of their spatial distribution (right) in GSA 17 (according to MEDITS)

Trawl fishery main target species population status

Description of population status of main target species is based on MEDITS expedition data, for the entire GSA 17 area, as well as for Croatian territorial waters.

During the study period, hake biomass (Figure 43) shows a sharp decline in the late nineties, as well as in recent years. These declines are mainly related to low recruitment during the mentioned period. Biomass index in Croatian territorial waters was 56 kg/km², and 29 kg/km² in the rest of the Adriatic Sea.
Red mullet (Figure 44) biomass was stable in GSA 17, as well as in Croatian territorial waters and in the rest of the Adriatic. Biomass index in the Croatian territorial waters is 42 kg/km², and 10 kg/km² in the rest of the Adriatic. Such distribution is partly due to the species migration and period when samples were taken.

Common pandora (Figure 45) also shows no significant decline in biomass during the study period in GSA 17. However, these data should be taken with caution, as weak intensity of recruitment was noticed in recent years for this species, and bearing in mind that common pandora is a protogynous hermaphroditic species, a decline in biomass could easily occur in the foreseeable future. Majority of its population is located in Croatian territorial waters, where an average biomass index is 21 kg/km², while in the rest of the Adriatic it is ten times lower (1.70 kg/km²).
John dory population (Figure 46) shows large biomass index oscillations, and relatively low values in recent years. As in previous case, the bulk of the population is located in Croatian territorial waters (mean biomass index of 8.63 kg/km²), and the species has become sporadic in the rest of the Adriatic (0.62 kg/km²).

Musky octopus (Figure 47) mainly inhabits shallower areas in GSA 17, with higher density of population in Croatian territorial waters (23 kg/km²) than in the rest of the Adriatic (9 kg/km²). This species shows large fluctuations in biomass index, which is expected with short-lived species. Biomass indices in recent years have been extremely low.
The situation regarding Norway lobster population (Figure 48) is extremely unsatisfactory: during the targeted study period, negative trends were observed in Croatian territorial waters, as well as in the rest of the Adriatic. Decline of biomass index is observed with regard to adult specimens as well as recruits. With regard to this population we can speak of typical overfishing of adults and recruits, with a threat of a collapse of the population.

Distribution of demersal species in GSA 17

The largest number of demersal stocks are distributed across the Adriatic Sea (depending on their preferred habitat) (Figure 49) and we can say that almost all of them are biologically unique populations shared by fishing fleets of different countries. This is further complicated by migrations and the fact that hatcheries, feeding areas and growing areas are often found in parts of the sea under different jurisdictions and different protection regimes. This is why harmonisation of management plans and regulation measures for fisheries and protection is a prerequisite for achieving sustainable management.
A typical example of a species that migrates across all GSA 17 countries is a common sole (Solea vulgaris). Migrations and population status of this species have been studied using a joint project SoleMon as part of AdiriaMed project (Figure 50). For a number of years a joint assessment of the condition of the population in the Adriatic Sea is done based on collected data, providing recommendations for future management measures for the entire distribution area. Evaluation results are presented before various scientific and professional bodies (SAC GFCM, SGMED, ICES).
Figure 49. Distribution of some demersal species in GSA 17

Figure 50. Distribution of different age classes for sole and schematic overview of the species migration in the northern Adriatic (Project SoleMon)
In addition to a description of distribution of demersal species, it is also possible to locate critical areas for certain species in the Adriatic Sea through joint research that covers the entire area of the GSA 17. One such place is the open middle Adriatic - wider area of Jabučka kotlina is a hatchery and growing area for a large number of the most important demersal species (hake, monkfish, octopuses, norway lobster ...). As the largest part of this area is located in the extraterritorial waters of the Adriatic (ZERP and Italian continental shelf), there is an initiative, through AdriaMed project, to declare this area a protected fishing area (Figure 51).

![Figure 51. Jabučka kotlina area and proposals for fishing regulation measures](image)

The mentioned project describes the state of the resources in this area and contains detailed proposals with measures for future fishing regulation and regulation for protection of fishing resources in this critical area. Proposed measures include declaring a total fishing ban zone. Proposed measures were forwarded to Croatian and Italian administrations and are awaiting a joint meeting at which modalities for future activities should be agreed upon. Cooperation in area of Jabučka kotlina and possible instituting of a protected fishing area, should serve as a pilot project for future joint activities in the entire Adriatic.

**Status of population of commercially most important species in the Adriatic Sea**

As previously stated, majority of commercially important species in the Adriatic Sea are biologically unique populations exploited by fishing fleets of different countries with different intensity. Also, the largest number of species extensively migrates, and their hatcheries, feeding and growing areas are located in different parts of the Adriatic Sea under different jurisdictions. Because of all this, a stock state assessment is pointless only for certain parts of
the Adriatic, and therefore scientists have drafted a stock assessment documents for a significant number of pelagic and demersal shared stocks at the GSA 17. Assessments and preliminary assessments were made within WG AdriaMed, WG Demersal GFMC as well as within SGMED.

a) Stock assessments for most species

Recently, scientists have made stock assessments for six commercially important species in the Adriatic Sea. These species were chosen because of their commercial importance, but also because of their distribution in the Adriatic. Sole, hake and red mullet are species that inhabit the entire GSA 17 and extensively migrate across the entire GSA. Norway lobster population inhabits open middle Adriatic (territorial and extraterritorial waters), while sea bream population and small-spotted catshark population are primarily associated with eastern seaboard of the Adriatic. Complete assessment documents can be found in an Annex of this management plan, and what follows is a brief summary of the results.

The longest series of assessment data in the Adriatic Sea exists on a common sole population (population assessment for the northern Adriatic common sole has been done for 5 years already.) During the mentioned period the population was overfished. The latest assessment made using XSA, SURBA and SCAA shows a permanent decline in SSB and fluctuations in recruitment without a clear negative trend. The current value of fishing mortality is greater than F 0.1, so this can be considered as overexploitation of stock. Proposed measures to reduce fishing mortality are directed towards the reduction of fishing effort, primarily along the west coast where about 90% of the catch of this species is generated. These measures include a recommendation to reduce beam trawl fishing effort, and introduction of an additional closed season for this species (after the end of the usual summer closed season) for additional 2 months.

Assessment of red mullet was made using LCA, SURBA and XSA analysis and it shows a stable SSB for the last four years which is about 6000 tons. Analyses show stable recruitment during this period, with highest values recorded in 2011. According to steady state perspective, the current fishing mortality is equal to F0.1, and the stock can be considered sustainable. However XSA method indicates potential overexploitation. From a management point of view it is important to bear in mind the different levels of species exploitation in Croatia and Italy, as well as the fact that the Italian fishing is mainly based on juvenile harvesting and Croatian on harvesting of mature specimens.

Assessment of hake was made using SURBA and XSA methods and it shows a decline in SSB in recent years. Recruitment has fluctuated during the study period, and it shows a decline in recent years. The current value of fishing mortality is greater than F0.1 which indicates overfishing. Recommendation in the assessment document is to reduce fishing effort, but also, as in the case of common sole, one should bear in mind the great differences in the level of exploitation.
Preliminary assessment of Norway lobster was made using SURBA model for the stock inhabiting the open central Adriatic (Jabučka kotlina). Analyses showed a strong decline in SSB, a strong decrease in recruitment and increased fishing mortality. Present value of fishing mortality is well above F0.1 and the population is overfished. Implementation of urgent measures to reduce fishing mortality is recommended.

Preliminary assessment of common pandora was made using SURBA model and it shows SSB increase during the study period. Recruitment in recent years shows a decline. Fishing mortality trend is declining, however as the current fishing mortality is higher than F0.1, F and reduction of fishing mortality is recommended. However, keeping in mind the stable SSB, the decline in recruitment may be related to environmental factors.

Preliminary assessment of small-spotted catshark was made using SURBA methodology. SSB and recruitment show obvious fluctuations without a negative trend, and the fishing mortality rate shows a negative trend. Bearing in mind that the current fishing mortality is higher than F0.1, the population is overfished and reduction of fishing mortality is recommended.

a) TRAFFIC LIGHT APPROACH METHOD (AdriaMed)

From all of the above stated it is clear that there is little point in making separate assessments for different countries in the Adriatic Sea. Also, due to historical differences in data collecting methodologies for catches and realised fishing effort, and the fact that lately there were many changes in data collection methods, data from the official statistics are not suitable for use in stock assessment. Therefore, through FAO AdriaMed a system was developed for status assessment of demersal population through biological indicators using data from uniform long series of scientific surveys (MEDIT), which have been continuously implemented since 1996 throughout the entire GSA 17 area. A large number of indicators were established, and following were used in this work:

- Frequency of occurrence
- Biomass index
- Abundance index
- Recruitment index
- Spawner density index
- Mean body length

The mentioned indicators fully describe population status, from distribution, through oscillations of population density index to basic recruitment characteristics and spawning stock status. According to the methodology accepted by demersal WG AdriaMeda, the geometric mean and the 75th percentile are used as estimators for an individual indicator, except for occurrence (percentage) and for a mean body weight (arithmetic average).
For purpose of status assessment, values of individual indicators have been classified into 3 categories according to the defined benchmarks:

- Annual value of indicators over the 66th percentile in time data series indicates „satisfactory condition“
- Annual value of indicators between the 66th and 33rd percentile in time data series indicates „moderate condition“
- Annual value of indicators below the 33rd percentile in time data series indicates „unsatisfactory condition“.
- If appropriate colours are assigned to mentioned states (green, yellow and red) we achieve so called „traffic light approach“.

Similar system has been developed for socio-economic aspects of fishing, but because of the aforementioned problems with the statistics for catch and fishing effort, it will probably be in operation only after the full implementation of DCF in all of the GSA 17 states.

We shall apply the aforementioned methodology to three most commercially important species for trawling in the Adriatic Sea: hake, red mullet and Norway lobster.

Calculation for the entire GSA 17 shall be used when calculating the reference values for individual indicators, however in order to better understand the situation of the population, data shall be presented separately for Croatian territorial waters (which is exploited solely by Croatian fishing fleet) and for the rest of the GSA 17, including the ZERP, extra-territorial and Italian territorial waters, where exploitation is predominantly done by the Italian trawl fleet (Croatian trawl catch in the ZERP makes up about 1% of the total Croatian trawl catch).

**HAKE (Merluccius merlucius)**

Distribution of hake in the Adriatic Sea is spread through much of its area, except for certain parts of the northernmost Adriatic (Figure 52). Hake is the most commercially important species for trawling and the Croatian catch is around 600-700 tons per year, while the Italian catch is 4000 tons per year (although it dropped to 1.500 tons in 2011).
Figure 52. Distribution of hake in the GSA 17 according to MEDITS 1996-2011 expedition

Percentage of species frequency of occurrence in GSA 17 was in average 87.8%, and in recent years it shows a significant downward trend, and for the last three years it is considered to be “unsatisfactory”, i.e. its values are below the 33rd percentile for the GSA 17. It is also noted that the decline in the frequency of occurrence is due to a significant decrease in distribution outside of Croatian territorial waters.

Figure 53. Hake frequency of occurrence

Also, Hake biomass indices show a strong decline in recent years, with values below the 33rd percentile viewed as the geometric mean and as the 75th percentile values (Figure 54). This decline is evident throughout.
Significant decrease in value can also be observed with abundance index and values’ indicators, which are significantly below the 33rd percentile in the Croatian territorial waters, as well as in the rest of the Adriatic (Figure 55).

Recruitment indices also show a long-time decline and constant decrease from satisfactory condition. In recent years, they have been below the 33rd percentile. The situation is equally unsatisfactory in the Croatian territorial waters as in the rest of the Adriatic (Figure 56).

Spawner index (Figure 57) maintained moderate condition until the last two years when it fell below the 33rd percentile. Such a decline is logical if a drop in recruits is evident in previous figures, which in turn lead, in two years’ time, to a decline in adult specimens. Negative situation applies for the entire GSA 17.
In recent years there has been an increase in body weight index for hake over the 66th percentile as a result of a sharp decline in the recruitment index (Figure 58). However, this is not a positive change, but a case of recruit overfishing.

In general, it can be said that the condition of hake population is unsatisfactory and indicators suggest that this is due to overfishing of juveniles. The population condition is unsatisfactory in the entire GSA 17, and the most negative condition is in the open central Adriatic area, in extraterritorial waters, where the main hatcheries and growing areas for this species are situated.

RED MULLET (*Mullus barbatus*)

Red mullet is widespread over the entire GSA 17, except in the deepest parts of the open Adriatic (Figure 58). During the colder part of the year, the majority of the population is situated along the east coast, and for the rest of the year it is widespread across the entire Adriatic. Growing areas are located in the coastal waters in the west Adriatic Sea, and after recruitment (autumn) the population migrates towards the open sea and the Adriatic east coast. In recent years, the Croatian annual catch has been about 800 to 1000 tons, while the Italian was about 3000 tons.
Frequency of occurrence in the GSA 17 for this species, according to MEDITS expedition data (Figure 59), shows considerable smaller oscillations from year to year, but there is no significant negative trend. For 2011, indicator values are considered to be in „moderate condition“.

No significant negative changes were noticed for the Croatian territorial waters or for the rest of the GSA 17.

In recent years, red mullet biomass index (Figure 60) has been satisfactory (above the 66th percentile) in analyses for the entire GSA 17, as well as for the territorial sea of the Republic of Croatia and the rest of the Adriatic.
Figure 60. Red mullet biomass index

Stable condition of the red mullet population with index values over 66th percentile can also be seen in species abundance index (Figure 61). Incline in abundance index is especially evident if one observes fluctuations of the 75th percentile of its value over the years.

Figure 61. Red mullet abundance index

There is no point in looking into recruitment index for this species, as the recruitment occurs during the autumn and the research is done during the spring, when the population mostly consists of adult specimens/spawners. Therefore, spawner index (Figure 62) presents the same situation as an index for an entire population—situation is stable in the entire GSA 17 area, and values have been satisfactory and above 66th percentile in recent years.

Figure 62. Red mullet spawner index
Mean biomass of individual fish in red mullet population shows a decline in recent years, primarily outside Croatian territorial waters (Figure 63), and those values are under 33rd percentile.

![Figure 63. Red mullet body weight index](image)

Bearing in mind the distribution of the species, biomass and abundance condition, the aforementioned decline in recruits' mean body length can be attributed to intense recruitment in recent years (which resulted in exceptionally large catches in 2011), and therefore the condition of the population in Croatian territorial waters can be described as stable.

**NORWAY LOBSTER (Nephrops norvegicus)**

Norway lobster in the GSA 17 mostly inhabits muddy sediments in open central Adriatic (Jabučka kotlina, then wider muddy sediment area before Ancona, one subpopulation is located in channel areas in northern Adriatic). A smaller settlement is situated in channels of the central Adriatic (Figure 64). The Croatian catch for this species is about 300 tons per year, and the Italian catch is 2000 tons.
Figure 64. Distribution of Norway lobster in the GSA 17 according to MEDITS 1996-2011 expedition

Distribution of the species in the GSA 17, with occasional oscillations, shows a distinct negative trend and in 2011 it reached its minimal value far below the 33rd percentile (Figure 65). Negative trends are observed in Croatian territorial waters and in the rest of the Adriatic. According to this data, species distribution (occurrence) area has halved during the fifteen years period (with over 40% positive stations at approximately 20%).

Figure 65. Norway lobster occurrence index

Biomass index also shows inter annual oscillations with strong negative trend, and the indicator values are below the 33rd percentile (Figure 66). Extremely negative changes are observed throughout the GSA 17, and in Croatian territorial waters minimum values have been recorded in recent years over the entire study period.
Figure 66. Norway lobster biomass index

Parallel with the biomass index decline, a strong decline in norway lobster abundance index is observed, especially in recent years (Figure 67), and its values are markedly below the 33rd percentile and unsatisfactory. The situation is unsatisfactory in Croatian territorial waters, as well as in the rest of the Adriatic.

Figure 67. Norway lobster abundance index

Recruitment index showed fluctuations during the study period, with an increase in late nineties, and from 2004 to 2006. That year is followed by significant decrease in the recruitment index and it reaches its minimal values in recent years which are in unsatisfactory zone, well below the 33rd percentile (Figure 68).
Figure 68. Norway lobster recruitment index

Also spawner index (Figure 69) shows a permanent downward trend (especially looking at the 75th percentile of indicator values), and in recent years in the GSA 17, it was situated below the 33rd percentile, in unsatisfactory condition.

Figure 69. Norway lobster spawner index

Beside large fluctuations during the study period, the body weight index (Figure 70) for the study period shows an exceptionally positive trend and in recent years it is above the 66th percentile.

Figure 70. Norway lobster body weight index
However, increase in body weight index with a concurrent decrease in all other indices (biomass, abundance, juvenile, spawner) indicates that there is a marked overfishing of recruits, and we can say that the population is in extremely poor condition.
9. AIM OF THE MANAGEMENT PLAN

Bearing in mind the decline in biomass index, in recent years, for a considerable number of demersal species throughout the Adriatic Sea, and in Croatian territorial waters, as well as a decline in the total catch of commercially important species in the trawl fisheries in the Republic of Croatia, the aim of the management plan for trawling is to bring into proportion the intensity of exploitation with the condition of the resources, thus creating conditions for the establishment of long-term sustainable management and conservation of renewable resources.

Unsatisfactory condition of demersal resources in the Adriatic is a consequence of high intensity exploitation associated with unfavourable hydrographic conditions in the sea. In the last few years, the above stated has led to a reduction in the intensity of recruitment followed by a decline in resources' biomass. The following is planned in the management plan for trawling:

- measures to reduce the intensity of exploitation, and
- establishment of additional measures for the protection of resources.

However, bearing in mind that biologically unique populations commercially shared by fishing fleets of different countries, are exploited by the Croatian trawl fisheries, the establishment of long-term sustainable management is not possible without the cooperation, agreement and coordination of measures regulating fishing and protection of demersal resources. As the Croatian trawl fishing effort and catch constitute only a small part of the total catch in the GSA 17 (14%), it is unlikely that measures undertaken only by the Republic of Croatia will have a positive impact, primarily due to migration of species and the effect of diffusion of populations from higher density areas (small fishing effort) to low density areas (high fishing effort).

Therefore, it is necessary to define a common goal with regard to condition of renewable resources throughout the GSA 17, because it is impossible to properly manage certain parts of the stock in different stages of its life. As several estimates of the condition of resources have been made so far for the entire GSA 17 as part of AdriaMed, it is necessary to continue with the work. For those stocks for which complete assessment was made (through GFCM), benchmarks and regulatory measures should be adopted by all countries that fish in the GSA 17. For the remaining main stocks, until true assessment is made, we would propose a use of a system of indicators and benchmarks developed and proposed through AdriaMed project.

The responsibility for the current state of resources in the GSA 17 lies on all the countries participating in the fishing, however their share of responsibility is not equal but proportional to a fishing effort and catch realized by an individual fishing fleet harvesting the unique
biological resources. Future restrictions should therefore be proportional to responsibility for the existing situation.

The synchronisation of Croatian, Italian and Slovenian management plans should be the first step in establishing harmonized regulating measures for fishing and protection of resources, and FAO AdriaMed project, in which all the countries of the Adriatic Sea are participating, could serve as a moderator and facilitator for this process, with the aim of establishing a long-term sustainable management through cooperation.
10. MEASURES FOR IMPLEMENTATION OF MANAGEMENT PLAN

The following measures are recommended in order to achieve the objective:

- **Trawling authorization.** In order to prevent a future increase in fishing effort by means of currently inactive vessels becoming active in trawling (or those whose activity was exceptionally minimal), an authorisation procedure for trawling will be implemented, with one of the key elements being the number of working days in the last 5 years. The criteria for authorization will be regulated by a separate legal act.

- **Reducing fishing effort by implementing measures of permanent suspension of fishing activities by permanently excluding certain fishing vessels from fishing for a fee.** The criteria for authorization will be regulated by a separate legal act.

- **Trawling restriction in fishing sea at depths greater than 500 meters in order to protect deep-sea habitats.**

- **In fishing sea it is necessary to stimulate use of more selective fishing techniques.** Bearing in mind that different tools have different selectivity characteristics, the plan is to promote and stimulate the use of more selective fishing gear, such as demersal long-lines or lobster pots.

- **Diversification of fishing activities – Creating foundations for fishing tourism.** Although so far there is a provision on recreational fishing in the Marine Fisheries Act, this activity needs to be further established, and all attendant problems need to be resolved when implementing this measure.

- **Intensification of regional cooperation and harmonization of management and conservation measures at the level of the GSA 17, and the entire Adriatic Sea – long-term sustainable management can only be established by using harmonised fishing regulation measures.** This includes joint assessments on the condition of resources and coordinating management plans.

- **Educating fishermen on sustainable fisheries and EAF – level of knowledge of Croatian fishermen on sustainable fisheries, Croatian and the EU legislation and on numerous current issues with regard to fisheries is very low, and there is a need for intensive education and dissemination of necessary information.**

In addition to the above measures, if necessary, will apply the following additional measures:

- **Reducing of a fishing effort by reducing the potential number of working days up to two days per week trawling ban, primarily on Saturdays and Sundays, when trawling is
banned along the west coast of the Adriatic. Implementation of this measure should be flexible, and provided adequate argumentation allocation of different days for a ban on fishing in different fishing zones may be exceptionally allowed (in relation to purchase and export of fish).

- Establishing closed season for trawling up to 30 days per year - Bearing in mind the closed season for trawling along the Italian coast in the summer, primarily to protect the recruitment of red mullet, it would be of great importance to establish a complementary measure along the eastern coast of the Adriatic. When implementing this measure, one also needs to be flexible and to examine the possibility of different periods of closed seasons in certain fishing zones, depending on the area and the season in which particular resource needs to be protected. Closed season could possibly be divided into two periods (e.g. in the case of protection for Norway lobster and hake in the open sea).

- Review and increase of the area under temporary and permanent trawling ban – the Republic of Croatia has enacted a very complex and restrictive system of spatial-temporal measures regulating trawl fishery. It is precisely this aspect of fishing regulation in the territorial sea of the Republic of Croatia that shows the best results. Therefore, spatial regulation in certain areas (primarily of canal areas of the northern Adriatic) should be reviewed and modified as necessary.

- More uniform spatial distribution of fishing effort – fishing effort in the fishing sea of the Republic of Croatia is not evenly distributed. There is excessive concentration of fishing effort in certain areas. One possible way is to make a redistribution of effort with regard to the length of the vessel - so that large vessels are prohibited from fishing in the coastal area and small vessels are prohibited from fishing in the open sea. The specific application of this measure should be agreed upon and adjusted for different parts of the fishing sea.

- Additional protection measures for critical areas (hatcheries and growing areas) – in territorial waters (marine phanerogam beds – ban on shore seine nets and coastal trawl nets – „tartane“), as well as in the ZERP (Jabuka pit) through establishing protected fishing areas with an non-take zone.
11. EXPECTED RESULTS

After establishing aforementioned measures the following is expected:

- The plan is to reduce the capacity of the active trawl fleet for about 10 to 15% using authorization procedure and permanent exclusion from fishing certain vessels with reimbursement.

- Reducing the potential number of working days for trawlers for 100-150 days per year as a result of two days a week fishing ban and 30 days of closed season during the year, and thereby significantly reducing the actual number of working days.

- Establishment of additional areas in which trawling will be banned or highly restrictive (protected fishing areas in the open sea – Jabuka pit approximately 10,000 km², with non-take zones of approximately 2-3,000 km²). Plus, increasing trawling prohibition zones to depths shallower than 50 meters (that have no derogations), as well as the trawling ban 1.5 NM along the Istrian coast (instead of current 1 NM) - which is about 1,000 km² of additional area together with the total trawling ban. Areas where trawling will be prohibited are to be increased due to trawl fishing ban at depths greater than 500 meters. Also, areas prohibited for trawling and coastal trawl net – „tartan“ fishing should be included in this.

- As a consequence of the reduction of fishing effort and of increase of protected areas (increased recruitment), within 3-5 years, an increase in biomass of demersal resources is expected as well as increase of other indicators of population condition, according to Traffic light approach methodology, (monitored using MEDITS expedition, the only long and credible data series) above the 66th percentile for individual indicators for commercially most important demersal species in Croatian territorial waters.
12. MONITORING, CONTROL AND SURVEILLANCE

In the Republic of Croatia the Vessel Monitoring System (VMS) was introduced in 2007 and it is in full accordance with the EU regulations governing the VMS (Commission Regulation (EC) 2244/2003 of 18 December 2003 on the implementation of satellite-based monitoring of fishing vessels; applicable regulations adopted by regional organisations on the fisheries (ICCAT, GFCM); and the Regulation on monitoring and control (EC 1224/2009). Currently 264 are installed on vessels of over 15 meters in length, and by the date of accession to the EU the VMS devices will be installed in all vessels, in accordance with the Regulation. Pursuant to the Ordinance on the monitoring and tracking systems for fishing vessels, all fishing vessels longer than 15 meters, all vessels longer than 12 meters that are fishing outside the territorial waters or that continuously fish for longer than 24 hours, as well as all vessels participating in the operations of tuna fishing, transport and farming and are registered under the Croatian flag must have a satellite vessel monitoring system installed, as well as devices for determining the vessel's location.

Due to the importance and efficiency of the VMS, and considering the costs of inspections at sea, the Republic of Croatia has reinforced the provisions of the Marine Fisheries Act regarding appropriate sanctions for violating VMS system provisions. If the provisions apply to the vessel, a fishing vessel may not leave port without a functioning blue box.

In order to improve the implementation of the bottom trawl management plan monitoring and control, the Republic of Croatia shall adopt the provision that, as of 31 December 2014, all vessels licensed for trawl fishing, regardless of size, must have a VMS device installed on board, regardless of the time when or area where they engage in fishing.

Republic of Croatia has introduced and harmonised a data gathering scheme for all requirements in accordance with the EU legislation.

All vessels engaging in trawl fishing must keep a catch register and fill in a landing declaration, regardless of the length of the vessel.

As of 1 January 2014, in order to provide easier and more efficient fishery monitoring and control, all vessels longer than 12 metres engaging in trawl net fishing shall have to have an e-logbook installed on board. This will ensure a better and timely inspection and monitoring of the fishery, and it will enable cross-referencing e-logbook data with the VMS data.

The first sale of fisheries products in the Republic of Croatia must take place at locations designated for first sales. As an exception, the first sale may take place outside the location designated only in the event if the first buyer is registered and submits the sales notes on first sales within 48 hours. The registered and defined first sale locations are required to submit first sale data to the MA within 48 hours from the time the first sale was concluded. In cases when the first sale takes place at locations that are not registered as first sale locations, the
first buyer is required to submit the first sale information before re-selling the goods, but no later than 48 hours after the first sale was concluded.

In accordance with the national legislation, all first buyers are required to digitally submit first sale data, regardless of the size of transactions, which enables cross-referencing of catch data with first sale data for over 95% of the fish unloaded from this type of fishing.

Furthermore, all vessels engaging in commercial marine fishing must unload their catch at specific ports of discharge (designated places), in accordance with the decision on the list of designated places. This will enable better control of the unloading of catches landed in this type of fishing. As of 1 July 2013, the number of where vessels engaging in this type of fishing will be permitted to unload their catch shall be regulated and list of these designated ports shall be issued (Annex 3.)

The annual inspection plan for 2013 is currently being drafted, and it shall include elements of monitoring of landing places. Based on risk assessments and available data, the plan will cover at least 10% of the registers, landing declaration, sales notes and catch reports. The controls will be implemented in major fishing ports and landing ports, as well as locations designated for first sales. The coverage will ensure a representative sample of catches and fishing activities, per fleet, gear and catch content segments.

Implementation of measures and resources monitoring

- Monitoring the implementation of measures planned to reduce the intensity of exploitation through the mechanisms of DCF, VMS and logbooks

- Monitoring of resources is planned to be performed by standardized monitoring of resources by MEDITS scientific research within the DCF.

- Control of enforcement and effectiveness of the measures will be carried out on an annual basis

- Assessments of resources every three years will be made to check the state of the resource and the need to redefine the objectives of the Management Plan, as well as measures for its implementation.
13. REQUESTED DEROGATIONS

Croatia seeks to turn the current temporary derogations to the minimum distance from the coast for trawling into permanent derogations, as agreed during the negotiation process and according to arguments set out in the Management Plan. The Republic of Croatia believes that this document shows that Croatia has met all the criteria for obtaining derogation to the minimum distance from coast:

- Limited size of coastal platform
- Spatial and temporal limitations of trawlable areas
- Limited size of the fishing fleet and small fleet capacities in kW and GT
- The existence of a trawl fishery management plan
- Trawling is not performed in areas covered with seagrass medow
- Mesh sizes are greater than 40 mm square or 50 diamond
- Established monitoring for fishing and the condition of resources
- There is no trawling interference or of and other types of fishing in the area for which the derogation was requested
- Fishing is regulated in such a way that the share of species listed in Annex III is minimal
- Cephalopods are part of the trawl catch, but they are not trawl fishers main target species and make up about 13% of the biomass.

Bearing in mind the structure of Croatian trawl fleet and geomorphological features of the eastern Adriatic (many islands and vast coastline) nonacceptance of derogations for the minimum distance from the coast would have disastrous consequences for Croatian trawlers because of large areas where trawling is prohibited. Namely, trawling is now permanently or temporary banned over 13,000 km2 area, and any further increase to the fishermen economically is unsustainable. In the case of nonacceptance of this derogation, Croatia will be forced to protect the survival of trawling fishery, open for fishing until now areas in inner and territorial sea, which is now under the spatiotemporal restrictions or banned as an extremely sensitive area (nurseries or spawning area) for a large number of demersal species.
ANNEXES

Annex 1: Extract from the legislation of the Republic of Croatia currently in force (to be submitted at a later date, after technical preparations)

Annex 3: List of designated ports (to be submitted at a later date after the decision is adopted)

Annex 4: List of vessels authorized for bottom trawl fishing (to be submitted at a later date after the decision is adopted)

Annex 5: List of vessels authorized (<15m) for bottom trawl fishing inside 1,5 nm line (to be submitted at a later date after the decision is adopted)

Annex 6: List of vessels authorized for bottom trawl fishing in Istrian waters (to be submitted at a later date after the decision is adopted)

Additional annexes (not mentioned in the text):

1. Stock assessment document for hake
2. Stock assessment document for mullet
3. Stock assessment document for Norway lobster
4. Stock assessment document for pandora
5. Stock assessment document for sole
6. Stock assessment document for catfish
7. Book – Review of current knowledge (a description of all research studies in the Adriatic sea)
8. Book – Recent state of demersal resources (on the state of stocks in the Adriatic sea)