



REPORT

Guidelines for the definition of operational management units

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*Andrés Uriarte
Lucía Zarauz
Martín Aranda
M. Santurtún
A. Iriondo
P. Berthou
J. Castro S. Delayat
J.M. Falcón
J. García
M. Gaspar
J.F. González
S. Jiménez
C. Lordan
G. Morandeu
F. Sanchez
M.T.G. Santamaría
N. Villegas*



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1 Introduction

In the European Union (EU) the concept of management unit (MU) has not been formally introduced neither defined in the Community's regulatory framework for fisheries. Fisheries management has been usually based on the Total Allowable Catch (TAC) defined for single stocks. Thus, it can be said that the basic unit for comprehensive management in the EU has been the stock, being the TAC the core of fisheries management tools applicable to a management unit (e.g. TAC for the anchovy stock in subarea VIII in a given year). In some cases the management unit is split in subunits where sub-TACs are established for given group of ICES divisions (e.g. northern hake on which the TAC is split in sub-TACs by areas), though the objectives of the management are set at the overall Management Unit definition.

TACs and other management measures are set up in a decision-making process (tactical or based on Management Plans), where managers use information on the fishery and the resources coming from a monitoring system, and where the achievement of management objectives is assessed through performance indicators. Agreed measures are implemented and enforced by law (Aranda et al. 2006; Frost et al. 2010).

At present, the EU is facing major challenges with the implementation of the Directive 2008/56/EC, known as the Marine Strategy Framework Directive (MSFD), and the Regulation 1380/2013 on the Common Fisheries Policy (CFP). The MSFD introduces the concept of the Good Environmental Status (GES), to be achieved by 2020. The Directive defines GES as "The environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive". As stated in the directive, an ecosystem based management approach should be applied to achieve and maintain the GES. The CFP highlight the role of multiannual plans to achieve the objective of sustainable exploitation of marine biological resources, and states that those multiannual plans should, where possible, cover multiple stocks when those stocks are jointly exploited. The initiatives to launch multiannual plans, up to now, have been done at the single stock level (e.g. recovery plan for Northern hake). It is worth highlighting that although some multiannual management plans were/are in place, recent Commission's proposals of multiannual plans have not been adopted yet (e.g. plans for western Atlantic horse mackerel and Bay of Biscay anchovy). In early April, consensus was achieved by the Parliament, the Council and the Commission on what future multiannual plans shall contain. This agreement has been negotiated by an interinstitutional "task force", the final result is a report containing a proposal of the main elements of multiannual plans. The common elements include a target MSY, a conservation reference point to trigger safeguards and a procedure for their implementation; a mechanism to adapting for unforeseen changes in the scientific advice; and a review clause. The CFP emphasises

also the need of further regionalization, with improved regional cooperation within MS and a greater role of Regional Advisory Councils (RACs) to incorporate the knowledge and experience of stakeholders. It is worth highlighting that the aforementioned proposal of multiannual management plans recommends taking into account regional specificities through a regionalized approach.

The above mentioned challenges may require changing the basis for definition of management units for EU fisheries, moving from a single stock to fish communities, or multifleets, or ecosystems; and finding ways to conciliate different objectives of management at different scales and levels. As an example of how things can be done, it is worth mentioning the mixed-fisheries approach for management which tries to match the respective single-stock management objectives in the context of a fishery exploiting these stocks together.

The purpose of this document is to make a definition of management units which are operational and sustainable. This definition aims to overcome the limitations of current single stock based MU, and to move towards the ecosystem based management introduced by the MSFD and the CFP.

2 Management unit definition

2.1 Management unit definition

The objective of fisheries management is the sustainable exploitation of the fish resources over the extent of their spatial distribution. Along with the Common Fisheries Policy (CFP) objectives, the socio-economic viability of the fisheries exploiting the resource is also to be achieved. To reach these aims, managers need to define the management units they are going to work with.

For the purpose of GEPETO project, we define a management unit (MU) as the set of fishing fleets exploiting a common pool of fish resources with strong spatial overlapping and sharing of habitats, which make them being typically fished together. In other words, a MU is the set of fishing fleets exploiting a common fish community over their spatial distribution. MUs have to be defined by the fish community, by the spatial range of distribution of the fish community, and by the set of fishing fleets sharing the exploitation of the fish community (Figure 1).

In order to allow a sustainable fisheries management, MUs should ensure the matching of biologically relevant processes and management actions (Reiss et al. 2009). This means that the MUs have to comprise within their borders much of the life cycle of the species in the community being managed, in order to assure that the auto-regeneration of the resources can be linked to the management measures adopted on the MUs. This requires a good definition of the stocks being exploited, their geographical distribution and biological characteristics.

The proposed MUs will therefore rest on three pillars (living resources, spatial dimension and fishing fleets) and should include within its borders the biological processes needed to link the auto-regeneration of the resources with the management actions.

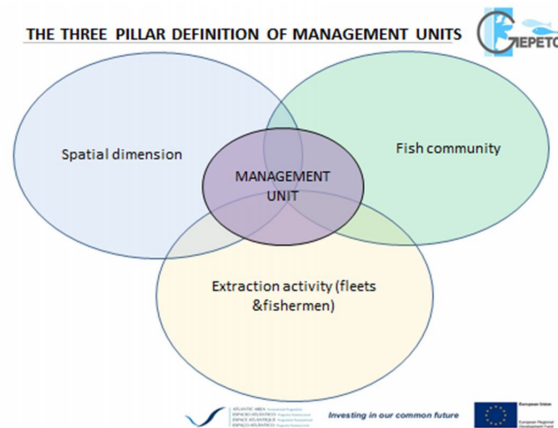


Figure 1. The three pillar definition of management units

This definition may be difficult to apply when the stocks exploited by the same fleet, in the same geographical area, have different geographical distributions. In order to solve this conflict and determine the scope of a management unit, three categories of species are proposed:

- **Object Species:** target species for which most of their range of distribution falls into the borders of the MU. These species should be included in the definition of the MU, as they will constitute the resources to be managed through the specific management measurements adopted at the MU scale.
- **Conditioning species:** target species whose range of distribution is wider than the borders of the MU, and by-catch species which are subject to regulation in other MU. These species will be regulated at a different spatial scale than the current MU, but in mixed fisheries they will interact with the management of the object species included in the MU. Therefore, these species may condition the activities of the fleets in the MU but no specific management measurements will be adopted for them at the scale of the MU (other than allowing compatible – harmonized-- fishing of object and conditioning species).

For these conditioning species, coordinated management with other MUs will be needed. This coordination will need to be defined in a case-by-case basis. Some of the possible options might be the following:

- a. To get a subTAC of the conditioning species for the area, or quota for fleets comprised by the MU. This option is being applied already for hake, for which the overall stock TAC is split by regions.

- b. To request an autonomous management of the conditioning species in the MU area, within certain limits. This could be justified either by the sufficient local autoregeneration mechanisms or by the limited movility of the resource. This change has to be accepted by the scientific community.
 - c. To ask for an exemption for unregulated catches, when the catches in the management units are so low, that their impact on these stocks is negligible. This change has to be accepted by the scientific community.
- Other target species for which not enough information on their biology and spatial distribution is available to determine whether they should be considered object or conditioning species. They could be considered as object species, but the outcomes of the management are unsure. In order to improve future management it is important to highlight this lack of information.

One other point of discussion is that the areas defining management units are often defined due to administrative and political reasons. This fact may cause problems, especially if the area definition does not sufficiently covers the spatial extension of the life cycle of the exploited resources as to assure their auto-regeneration.

2.2 Management subunits

Each MU can be further divided in subunits such as biological (species within the fish community), spatial (smaller regions/areas within the MU) and exploitation subunits (fishing fleets, fleet segments, métiers etc.). Several criteria can be used to define these subunits, such as the distinction of different habitats or ecosystems (to which the species are linked), or the fleet dependency to certain areas or stocks.

Management subunits can be convenient to set specific management actions, such as technical measures. They can also help to establish the sharing of the TAC or Total Allowable Effort (TAE) with which the resource is being managed. However, by themselves alone these subunits cannot achieve a sustainable management of the fisheries. The latter can only be attained by considering the MU's complete dimension (fish community, spatial distribution and fishing fleets) and by covering a sufficient spatial extension of the life cycle of the exploited resources as to assure their auto-regeneration. Thus, management measures are needed at the global scale of the MU definition, and may cover measures for conservation (catch limitations, selectivity, etc.) and for access regulations (fishing licenses, maximum efforts by métiers, etc.) (Boncoeur et al. 2006).

An example of spatial subunit is the Case Study of Capbreton (Anexo I). Most of the fish species inhabiting the area (hake, monkfish, sea bass, bars...) have a far wider spatial distribution associated to their life cycle. As such, if there is an agreement in the need of specific measures for this area, it could be a spatial subunit inside a broader management unit. This subunit could be further justified based on its singular characteristics (cross-border area, relevant geologic structure, high biodiversity,

enhanced fishery production, and a number of different fleets competing within a limited space).

3 Categorization of management units

In some cases the habitat of the adult phase constitutes the major feature leading to the definition of a group of resources object of a common management unit (for instance estuarine communities, coastal-shallow waters, demersal shelf species, pelagic species and/or highly migratory pelagic species, deep water fish resources, etc.). In other cases, however, the fish community can be characterized by sharing a similar trophic level in the ecosystem they inhabit (demersal piscivorous, forage pelagic species, etc.). In some cases the management unit should be monospecific and in others multispecific.

In this section an attempt has been done to categorize all possible management units in five broad groups. In each group, reference to the GEPETO case studies is done and how they fit in this framework. It is worth recalling that any management unit, irrespective of its category, should rest on three pillars defined above (living resources, spatial dimension and fishing fleets) and should include in its geographical scope the relevant biological processes to link the auto-regeneration of the resources with the management actions. Each of the defined categories will require a management body at a specific spatial scale. This point is further discussed in the following section

3.1 Littoral management unit (including small bays, lagoons, and estuaries)

For littoral MUs, the area is usually defined by geographical features, such as small bays, lagoons and estuaries. Targeted littoral fish and shellfish are usually sedentary or low mobility species (as bivalves, crustaceans or cephalopods) which have the 100% of their life-cycle in these zones within the defined area. All the different fleets and fishing gears exploiting object resources are taken into account. Management objectives and measures can be taken globally or on biological subunits (species by species), according to the seasonality of their life cycle and of the harvest coupled to the different métiers.

Among the case studies considered in GEPETO, the Aveiro Estuary is a typical example of an estuarine MU (Annex II). Along the French coastal area there are several good candidates matching the former definition such as Arcachon Bay, Gironde estuary, Golfe du Morbihan, Pertuis Charentais, etc.

3.2 Coastal management unit

These MUs include fish resources with a limited spatial distribution, such as gobids, scorpaenidae, octopus, etc. The geographic dimension of the MU is difficult to define, it should comprise coastal habitats associated to the mentioned species. Within the defined area, all the different fleets exploiting object resources are taken into account. These coastal management units can present conflicts between artisanal and more industrial fleets. If we want to set up differentiated management measures for these two types of fishing, management subunits may be defined. This option is better than defining specific management units for industrial and artisanal fleets because if we want to manage one coastal species, we need to join data about all fisheries targeting this species in a defined area, and set a management target for all of them. The differentiation between artisanal and industrial fisheries can be used at the next stage, for instance to distribute the TAC or quota, or to set up specific technical measures.

The Specific-targeted Octopus fleets in the Iberian Northwest in Galicia and the Canary islands considered as Case Studies in GEPETO could be a good example of this type of MU (Annex III and Annex IV).

3.3 Small pelagic management unit

Given that the pelagic fisheries are basically seasonal and that sequential fisheries take place at different seasons; there is no need of establishing a single MU for all small pelagic species. Instead, mono-specific MUs can be valid, each of them with different boundaries and management measures.

In some cases, the main problem with small pelagic management units may be the determination of the spatial limits of the MU. In some cases, as anchovy, management can be restricted to a well-defined area (ICES subarea VIII). But in other cases, as sardine, this is more complicated. The distribution of sardine may reach the northern region (in particular ICES subarea VII, as well) and there are also connections with the southern stock (ICES subarea IXa and VIIIc) at the eastern part of the VIIIc region (subdivision VIIIc East). The exact number of sardine stocks and their boundaries are uncertain and thus it is difficult to determine a proper MU.

3.4 Widely distributed species or highly migratory species management units

Widely distributed and highly migratory species require management at a far larger scale than the MUs mentioned previously (which only comprise 1,2 or 3 contiguous ICES subareas) , as for instance tunnidae, sharks, mackerel, horse mackerel, etc. These species should have their own management units matching their spatial distribution. When interacting with other management units of smaller geographic scale (i.e. in mixed fisheries), they can be considered as conditioning species (i.e. horse mackerel).

3.5 Sea basin-demersal management units

As all the other MUs, management units of this type should be defined according with the three pillars (fish community, spatial dimension and fishing fleets), and should fulfill the condition of assuring the auto-regeneration of the resources within their geographical scope. However, due to the mixed fisheries nature of many of the fisheries included in this group, the definition of management units present higher complexity, and different approaches may be necessary for different regions and fisheries.

Here we present three examples of demersal management units which were proposed following the above three pillar definition:

3.5.1 Iberian Mixed Fisheries (Annex V)

The Atlantic Iberian continental shelf (over ICES IXa and VIIIc subdivisions) is particularly narrow, and the spatial overlap of the fisheries do not allow discriminating different exploitation patterns among them. Additionally, the fleets operating in this area share a large number of target species, which limits the success of current EU management measures based on single stocks. The management unit in this case can be defined by the 12 métiers targeting demersal species over the narrow continental shelf of subdivisions IXa and VIIIc (i.e. the fleets, the shared demersal object species and the area where they operate and interact). Pelagic stocks exploited by these fleets in this areas, can be treated as conditioning species. Main species object of this MU would be southern hake, megrim, monkfishes and *Nephrops* (Norway lobster).

This definition results in an integrated multi-fisheries multi-stock management unit, which needs of a mixed fisheries management system based on multispecific TAC management tools (i.e. Fcube mixed-fisheries forecast method Ulrich *et. al.*, 2011).

Questions might arise on the degree of homogeneity of the regions along the coast, and, as such, on whether it needs to be managed as a whole area or not. However, as far as the object species are part of common stock in the Atlantic Iberian continental shelf, this remains at the edge of the scientific knowledge on population dynamics, and the whole area can be considered as a management unit.

3.5.2 Bay of Biscay (Annex VI)

The Bay of Biscay is characterized by a broad and well defined continental shelf, which influences the distribution of species and their life stages, and therefore determines different patterns of exploitation along the shelf. This fact suggested

that different management units might be considered along the continental shelf till the shelf break. As a prospective, a high resolution spatial data analysis (based on Vessel Monitoring System data) were used by IFREMER to discriminate different habitats, and the fleets and species related to them. The idea was to test the potential definition of subareas within the Bay of Biscay as management units for fisheries and ecosystem management. However, this approach of using subregions in the bay of Biscay as management units was not adopted because: (1) these subareas defined within the Bay did not assure the auto-regeneration of the resources within their geographical boundaries; (2) There was a relevant overlapping of target species across the different fleets operating on the different subareas across the Bay of Biscay; (3) new assessment methods and management tools would be needed to achieve independent management of this subareas within the bay for such overlapping of fleets and species; and finally, (4) the stakeholders were not in favor of such a high spatial resolution management and preferred a more operational approach based on fleets

Among the subareas considered, the best candidate seemed to be that of the Grande Vasière in the Bay of Biscay. This area is especially relevant for the management of *Nephrops*, which is exploited in majority by a particular fleet (Chalutiers langoustiniers and Ln_peu_dep) operating in a well-defined zone. The area covered by the Grande Vasière cover most of the life cycle of the *Nephrops* population, and potentially it could be considered as a spatial management unit for the *Nephrops* fishery. However, given the overlapping of the species caught by this fishery with others métiers operating in the same area and in other areas, the Grande Vasière could better be considered as a management subunit within the big demersal MU of the Bay of Biscay.

The alternative to the former approach was to define a management unit comprising demersal species and the demersal fishing fleets operating in ICES division VIIIabd. Demersal species included would be: sole, *Nephrops*, hake, monkfish, pollack, whiting, megrim, blue whiting, seabass, red mullet, The limitation of this approach is that the spatial distribution of some of these species (i.e. hake, monkfish, megrim, whiting and blue whiting) surpasses division VIIIabd, reaching subareas VII (and for some of them area VI).

The TAC for hake, monkfish and megrim, which relevant target species for this mixed demersal fishery, are already split by regions VIIIabd and VII(+VI, IV, III and II for hake), so they could be integrated in the Bay of Biscay management unit as a conditioning species. This, together with the election as primer object species of sole, *Nephrops* and sea bass (whose population stock units are comprised within the Bay of Biscay VIIIabd) would allow the definition of a MU on the mixed fishery at the level of the Bay of Biscay (VIIIabd). Nevertheless, there are still some other conditioning species for which no subTAC for the area is defined (as blue whiting, horse mackerel, etc), whose harmonized management and exploitation is a challenge.

3.5.3 Celtic Sea (Annex VII)

Between 2010 and 2011 the NWWRAC developed and approved a framework and objectives for a mixed demersal fisheries management plan in the Celtic Sea (ICES Divisions VIIfg). Fishing effort in VIIfg is dominated by Ireland and France, using otter trawls targeting *Nephrops* and mixed roundfish (cod, haddock and whiting) and/or benthic species (monkfish, megrim, hake). The UK and Belgium dominate the beam trawl fisheries in VIIfg targeting sole, plaice, monkfish and megrim. There are lesser amounts of effort using various forms of gill nets and longlines in VIIfg, and also other important shellfish fisheries (pot and dredge) and pelagic fisheries (mainly pelagic trawl) fishery operating in VIIfg. While these fisheries are not the main focus of the management plan they do interact with demersal fisheries in the area.

The general aim of the plan is to address the high level CFP objectives by applying management measures at an appropriate region scale. The plan should be very much bottom up, such that management objectives, tools, costs and trade offs are developed and applied in a transparent and considered way in consultation with key stakeholders. During GEPETO meetings different management measures have been discussed and proposed including effort control (without quotas), Real Time Incentives RTIs (Kraak, et al. 2012), mesh size and TCM changes and additional closed areas.

4 Framework definition for a management strategy based on proposed new management units

This proposal of new MUs will require a revision of the actual management strategy and perhaps of the institutional framework. This would be needed in order to set up management objectives at the MU scale, performance indicators concerning the exploited resources and the fishing fleets; implementation measures (coupled or not with the traditional TACs by species) and the proper monitoring systems.

In particular, it is proposed that the following key points are taken into account in the definition of a management strategy. The utility of these points has been tested in the templates provided (Annex I to VII):

1. Description of the management unit proposed based on the three pillars (fish/shellfish communities included, fleets included, spatial dimension).
2. Objectives of the management.
3. Management tools.
4. Monitoring system.
5. Assessment and advisory system.
6. Regional management bodies where decisions are taken.

7. Implementation and enforcing system.

If accepted, the new MU may require adapting the current legal management framework at the EU level to the spatial dimension of the new management units. In fact, the Commission's COM (2011) 425 recognized that a centralised, top-down approach makes it difficult to adapt the CFP to the specificities of the different sea-basins in the EU. According to the new CFP (EC Regulation 1380/2013) Member States will take more responsibility for resource management at fisheries level, as well as for the coherence of such management with other actions in each sea basin. Article 18 of the new CFP enhances regionalizations and defines roles and obligations of each actor, bringing decisions closer to the fishing grounds. Member States responsibilities, however, are apparently limited to providing recommendations to EU decisions on conservation on regional issues.

Adapting the CFP to the specificity of regionally exploited fisheries may require to consider the creation of Regional Management Bodies (RMB), which are regional bodies empowered to propose and implement conservation and management measures. They should be composed of Member States, the EC and stakeholders representatives; and they should cover sufficiently large areas, as to embrace most of the MUs on which their fleets operate, minimizing the spatial overlapping of the MU with neighbor RMBs. It is worth pointing out that the current spatial RAC definition could give a rather appropriate approximation of the spatial dimension required for such regional bodies. The creation of these institutional structures may require the devising of complementary EC regulations to the basic regulation of the CFP.

RMB can set up general management measures for the whole MU and also particular measures for different biological, spatial or exploitation subunits. It may well be that a RMB set a catch limit for a mixed fishery at the MU spatial scale (always in the frame of the existing TAC and quotas); and that at the same time it establishes a set of management measures for smaller spatial subunits, such as the amount of effort by métiers which can be applied in one area, Marine Protected Areas (MPA), or restricted areas (Sanchez et al. 2013), which should be considered as a complementary technical measures for the management of a MU. MPA or restricted areas could be set up by the RMB through a pool of management measures regulating a particular spatial subunit.

There will be some MU units not fitting well in the spatial framework outlined above since they are associated with areas under the jurisdiction of a given Member State, or they are associated with large oceanic areas under the purview of a Regional Fisheries Management Organization (RFMO). These are the very local inshore or coastal MUs, which may be set up and regulated by a single Member State at the level of National Management Bodies (NMB); and the MU for highly migratory stocks which probably should stay under RFMOs, where the management of these fisheries is currently carried out (such ICCAT for Tuna, NEAFC for mackerel, etc.), as they have the required spatial dimension, far wider than the regional bodies we are speaking about.

RMB should harmonize and could interact with higher and lower management bodies, for instance, they might request regional TACs to the RFMOs/EU for the highly migratory and straddling stocks, affecting the region of the RMB competence. They could also set up management measures on some exploitation subunits, or for particular areas, etc.

In terms of objectives and management measures, it is likely that pelagics fisheries may still work by species to define objectives, and individual TACs may still be the basic management regulatory measure. This is consistent with the fact that most of those fisheries employ selective gears and are seasonal, following the migration routes of species, which result in rather pure (non mixed) fisheries on the target species compared to the demersal fisheries. On the other hand, demersal fisheries are rather mixed fisheries, composed of several species caught at the same time. The demersal MU might consider objectives more on the community level than on a species by species basis. Consequently, TACs or TAE by fleets might become management tools to better assure community sustainable status and economic viability of the fleets. The required changes in the monitoring system (surveys, fleet based monitoring systems, etc.) will be a matter of further developing, but may not diverge much from the current monitoring systems already in place.

5 References

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6 Anexo I: Management unit definition template: Case Study: “Capbreton”

6.1 Introduction.

Capbreton is a cross-border area which comprises a singular geologic structure. It is characterized by a high biodiversity, enhanced fishery production, and a number of different fleets competing with a limited space.

The study area is subject to different types of fishing and in the past the use of different gears in the same fishing grounds has led to conflicts between fishermen (Sanchez et al 2013). A restricted area was established in 1985 to resolve conflicts between French bottom longliners and gillnetters, while sustaining the practice of bottom longline hake fishing. The surface of this box enclosure was reduced in 1999 at the request of gillnetters and trawlers (Fig 1). Since then, the competition to access this space has been reduced and the conflict between French longliners and gillnetters has been resolved.

However, although most of the restricted area is under French control, the rest is within the Exclusive Economic Zones (EEZ). And French fishermen complain about the presence there of foreign gillnetters who are permitted under the EU law to use gears otherwise forbidden to the French. In this context, in 2009, the local fishing committee requested application of the French regulations to foreign vessels entering the EEZ part of the restricted area. The French proposal was discussed in the South Western Waters Regional Advisory Council (SWWRAC) and was answered by another request of the Federation Cofradias from Guipuzkoa.

In this context, the area of Capbreton was proposed by the fishermen as a Case Study for GEPETO project. The aim of this CS is to characterize the fishing activity of both French and Spanish fleets, and to improve the coexistence of métiers, working to solve the above described conflicts.

6.2 Description of the management units proposed based on the three pillar

In the present document, the study area of Capbreton has been described under the three pillar criteria (reference “On the definition of management Units”), and the question of whether this area could constitute a separate management unit has been discussed.

6.2.1 Spatial dimension

The Capbreton area defined for this Case Study is the area covered by the statistical rectangles ICES 16E8, 16E7, 15E8 and 15E7, which are part of ICES divisions VIIIb and VIIIc. The total surface of these 4 rectangles represents 8,733 km².

The area is located in the southern part of the Bay of Biscay, which is characterized by a narrow shelf with a sandy bottom along the Landes plateau and a rocky littoral on the Basque coast. The continental slope is deeply incised by the Capbreton canyon which extends from east to west, parallel to the Spanish coast for over 250 km. It is known to be an active canyon with an important reworking sediment process (Gaudin et al., 2006). Influenced by the plume of major rivers, it favors a wide variety of benthic, demersal, pelagic fauna and birds and marine mammal concentrations (Aguirrezabalaga et al., 2006; Castège et al., 2009; Reveillaud et al., 2008). Due to its border configuration, this area is under French and Spanish control. So, the fishing activity in this area depends on several levels of management: regional, national and international (Figure 2 and Figure 3). Thus, the maritime accessibility surface for each métier is different (Table 1).

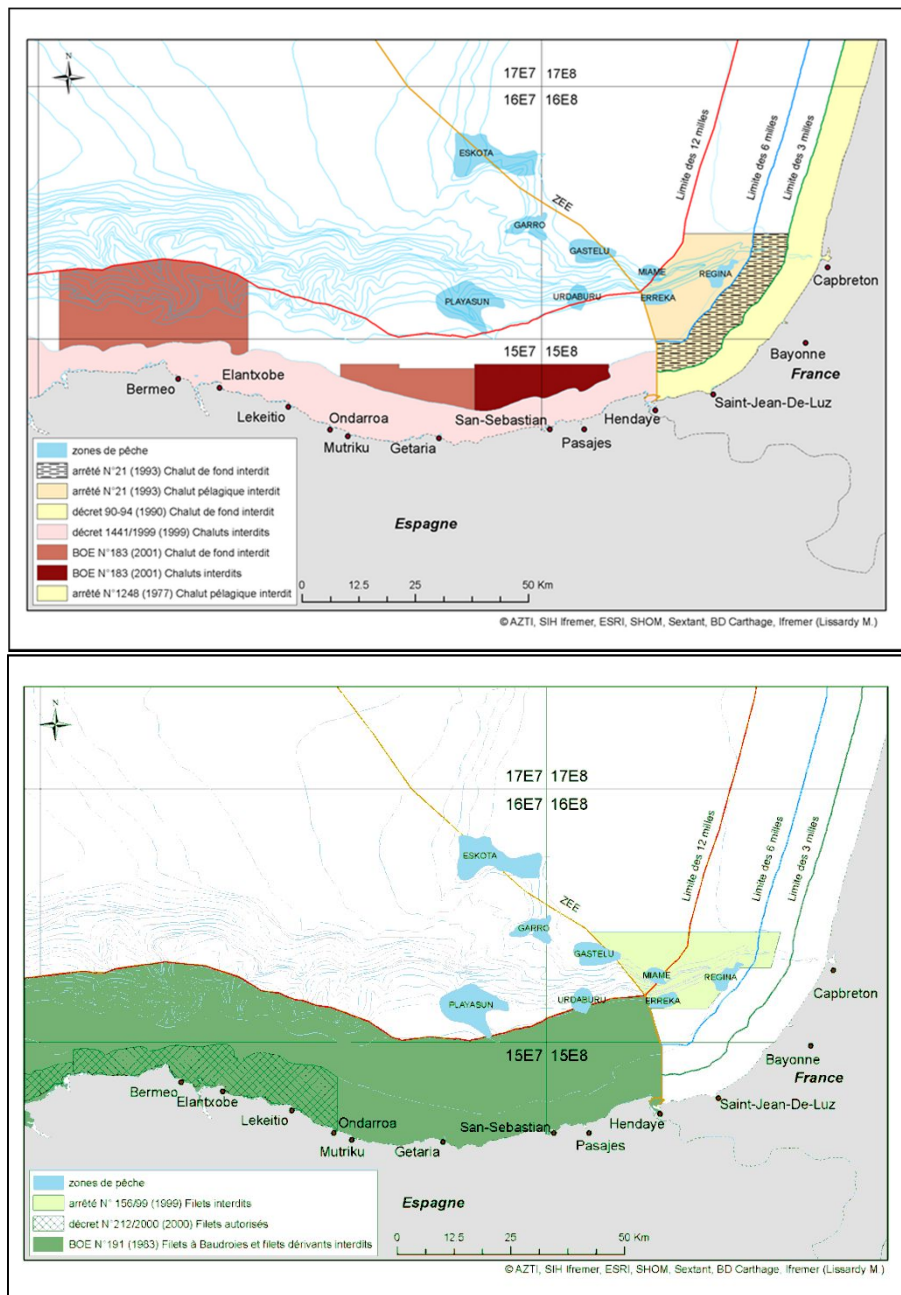


Figure 2. Regulation measures affecting trawlers (A) and gillnetters (B) in internal, territorial waters (12 nm) and Exclusive Economic Zone (200 nm) in the southern part of the Bay of Biscay (source: Sanchez and Santurtun, 2013)

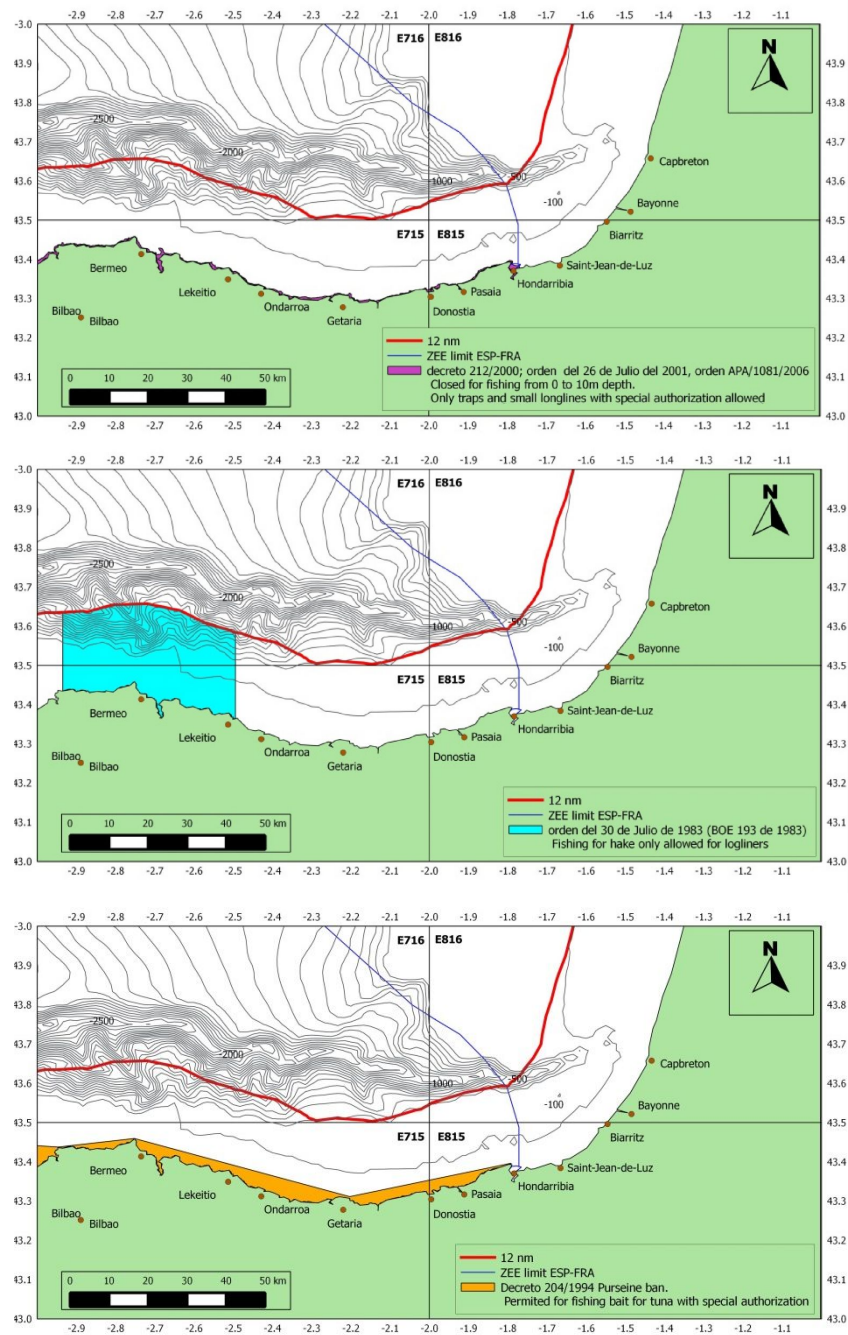


Figure 3. Regulation measures affecting artisanal fleet (A), longliners (B) and purseiners (C) in internal, in Spanish territorial waters (12 nm) and Exclusive Economic Zone (200 nm) (source: Sanchez and Santurtun, 2013, modified by Quincoces).

Table 1. Marine accessible surface of French fleets in the study area (4 rectangles).

Métiers	Accessible surface in % of total rectangles in 2011	
	French fleet	Spanish fleet
Netters	81%	55% ("Rasco")
Bottom trawlers	74%	65%
Pelagic trawlers	74%	73%
Liners, potters	84%	84%
Baitboaters, purse seiners	84%	80%

6.2.2 Fleets included

In 2011, an estimation of 285 vessels (187 Spanish and 98 French) operated, at least part time, in the study area. Both French and Spanish fleets are typical mixed fisheries with a large variety of species exploited by a wide range of fishing gears. This variety is also reflected in the technical characteristics of the vessels, including small artisanal vessels below 12m, and larger and more industrial vessels.

Spanish fleet operate mostly with hand lines (22%), gillnets (19%), purse seine (19%) and trolling lines (17%). There can also be found vessels operating with "rasco" gillnets, artisanal longlines (bottom and semipelagic), and pole lines targeting hake.

From the 98 French vessels operating in the study area, gillnetters represent 40%, bottom longliners 18% and bottom trawlers 16%. In this area, others métiers as purse seiners, pelagic trawlers, potters and baitboaters are also practiced and represent 26% of the total boats. Dredges and trolling lines are also used by French fleets.

6.2.3 Fish/shellfish communities included

The variety of species landed by the spanish fleet is high. However, four of these species represent the 85% of the total landings: mackerel (*Scomber scombrus*), albacore (*Thunnus alalunga*), horse mackerel (*Trachurus trachurus*) and hake (*Merluccius merluccius*). Anchovy (*Engraulis encrasicolus*), blue whiting (*Micromesistius poutassou*) and conger (*Conger conger*) are also important species for this fleets. From the point of view of the landed value, the most important species are red mullet (*Mullus surmuletus*), sea bass (*Dicentrarchus labrax*), sole (*Solea soela*) and scorpion fishes

(*Scorpaenidae*). These species represent the 60% of the landed value. Other important species are monkfish (*Lophius spp*), albacore hake and sparids (*Sparidae*).

For French fleets, the main landed species in 2010 (in volume) are mackerel, hake, Spanish mackerel (*Scomber japonicus*), horse mackerel, sardine (*Sardina pilchardus*), common sole and sea bass (representing 77% of total landings). In value, hake, common sole, mackerel, monkfishes, meagre (*Argyrosomus regius*), Spanish mackerel and Atlantic bonito (*Sarda sarda*) represent 76% of total landings.

The Bay of Biscay is known to have the biggest nurseries of European hake with adult concentrations in canyons and on the rocky seabed of the shelf break area (Sanchez and Gil, 2000). In the case of the Capbreton Canyon, the fishing grounds are very localized, particularly for European hake (Sanchez et al. 2013).

Apart from the fish resources, the canyon's geomorphological and hydrological characteristics favor species diversity and biological production of plankton and micronekton aggregations (D'Elbeé 2001, Albaina et al 2007), as well as megafaunal and scleractinian diversity (Aguirrezabala et al 2006, Reveillaud et al 2008) and bird and marine mammal concentrations (Valeiras et al 2007; Castège and Hémerly 2009).

All the species exploited in the study area belong to stocks which have a spatial distribution which exceeds the limits of the study area. This is a key point, because a management unit should comprise within their borders much of the life cycle of the species in the community which is being managed, in order to assure that the auto-regeneration of the resources can be linked to the management measures adopted on the management units.

Thus, we consider that the case study Capbreton should not be considered as a management unit itself. Alternatively, it could be seen as a **spatial management subunit**.

6.3 Management objectives

1. Cohabitation of different métiers
2. sustainability of the stocks and the fleets operating there
3. Preserve biodiversit

6.4 Management tools

These tools are to be defined. Here we present some ideas which have come up during the development of the project. As Capbreton is proposed as a management subunit, all these measures will have to be in line with the measures defined at the scale of the corresponding management unit:

- Internal agreements among fishermen organizations;
- establishment of a committee of Spanish and French representatives;
- closure of certain areas to certain gears;
- elaboration of a list of vessels which are allowed to fish in certain delimited areas;
- definition of areas of closure to any fishing activities for a MPA.

6.5 Regional management bodies

French professional fishermen are organized nationally and locally: the National Committee of Marine Fisheries and Aquaculture (CNPMM) as well as their regional committee (in this case, CRPMM Aquitaine) and their local office (in this case, CIDPMM Pyrénées Atlantiques Landes) . Membership is mandatory for professionals. Their committee members integrate all sea workers such as fishermen, ship-owners, others representing fish traders and the processing industry. These committees are under the authority of the French State. Their role is to improve coexistence between métiers and includes allocation of fishing rights (licenses, quotas ...), supervision of fishing effort (gear and authorized areas, fishing period...). The local fishing committee has a **consultative role** in fisheries management applying regional decisions and **making propositions about sensitive issues** in their circumscription that are forwarded to regional level.

In the case of Spanish fisheries in the southern Bay of Biscay, their management is slightly different from France. There is an overlap of competences in Spanish territorial waters between the Spanish government, the Basque government (Autonomous Regional Authority) and the Fishermen Organizations. The Basque fishing inshore sector is traditionally organized in *cofradías* of fishermen. These are institutions that represent their members and protect their interests. The *cofradías* gather both the vessel owners and their crews. They are also collaborative and consultative bodies for the autonomous government of the Basque Country. The 14 Basque *cofradías* of fishermen are gathered under two federations of *cofradías*: Gipuzkoa and Bizkaia. In recent years, the inshore fishing sector has also adopted the producer organization (PO) model. POs for the inshore sector are OPEGUI and OPESCAYA representing the inshore fishing sector of Gipuzkoa and Bizkaia, respectively. Vessel owners in the Basque offshore sector organize under the umbrella of POs. The two POs of the offshore fleet are NORPESC and OPPAO. Besides their usual market attributions, POs can manage the rights of their associated vessels.

At a larger scale, the Regional Advisory Councils (RACs) composed by a wide range of stakeholders (fishermen, ONG) has currently a **consultative role** in CFP. In the context of a new management of the Capbreton subunit, **SWWRAC composition and powers could be evolved: possibility to make proposal for management in this area**. As example of the Bay of Granville (in the channel), this type of cross-border fishery management had already been negotiated between France and the United Kingdom. An agreement was concluded in 2004. Application of this treaty is placed under the control of a Joint Advisory Committee (JAC) composed of representatives of fishermen, officials and scientists from each state and also a Joint Management Committee (JMC) reduced to officials of both governments and scientific advisers (Fleury, 2011). The main function of JMC is to check the validity of the JAC according to agreement goals.

For Capbreton management, this type of committee (Joint Management Committee) could be created and composed by the same stakeholders (officials, scientists) and also an European representative.

6.6 Monitoring system

- The on-going sampling covered by DCF can be enough to get landings information, but it is important to ensure that this sampling covers the small artisanal fleet
- Fine resolution spatial data are essential to set up any spatial management measures. For vessels above 15m VMS are collected, but there will be a need of collaboration with the National Administrations in order to use these data. For vessels below 15m, a sampling will need to be done. For this, the collaboration of the fishing sector is decisive.
- Observations on board commercial vessels, socio-economic interviews on same protocols, with a cross-border approach could be relevant.

6.7 Assessment and advisory system

The assessment and advisory system is to be defined. Here we present some ideas which have come up during the development of the project:

- CPUE analysis
- A survey every X years
- An ad hoc group can be set every X years to define indicators and assess the results obtained

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Sharing knowledge for sustainable fisheries

Sanchez F. and Santurtun (coords), 2013. Synthèse et Analyse des données existantes sur un écosystème profond transfrontalier: Le gouf de Capbreton. Rapport technique final du projet SYNTAX. Fonds Commun de Coopération Eurorégion Aquitaine/Euskadi, 224p.

7 Anexo II: Management unit definition template. Case Study: “Aveiro Estuary”

7.1 Description of the management units proposed based on the three pillar

7.1.1 Spatial dimension

Although the target species have an ample distribution along the Portuguese coast, these species only occurs in estuaries and coastal lagoons indicating that this species can not survive in exposed beaches where the environmental conditions are not adequate for the establishment of populations. All the four target species are gonochoric and are broadcast spawners, i.e. eggs and sperm are released into the water and fertilization is external presenting a larval stage during their life cycle. Although larvae can be transported by currents to other areas, larvae exchange between Ria de Aveiro and either estuaries or other coastal lagoons are unlikely to occur, considering the distance between Ria de Aveiro and the nearest lagoons and estuaries, the current regime within the Ria de Aveiro, the relatively short larval life and that the environmental conditions along on the coastal area does not favour the survival of the larvae of the target species. Therefore the stocks of the target species that occur along the Portuguese coast should be considered as independent stocks.

7.1.2 Fleets included

The target species are exploited by harvesters on foot or onboard fishing vessels. The harvesting techniques used in the fishery vary with the localizations of the beds. In intertidal flats the target species are harvested by hand or using rudimentary tools whereas in very shallow subtidal areas (ranging between 0.3 and 1.5 m depth) hand-dredging and bullraking are the techniques used. Hand-dredges and bullrakes can also be operated from boats in order to exploit deeper clam beds or to exploit any clam bed during high tide. There is not an activity segregation between harvesters on foot and onboard fishing vessels since the same clam beds are exploited. Within the Ria de Aveiro lagoon there are no other fisheries targeting cockles, the grooved carpet shell, the pullet carpet shell or the manila clam.

7.1.3 Fish/shellfish communities included

Although the target species have an ample distribution along the Portuguese coast, these species only occurs in estuaries and coastal lagoons indicating that this species can not survive in exposed beaches where the environmental conditions are not adequate for the establishment of populations. All the four target species are gonochoric and are broadcast spawners, i.e. eggs and sperm are released into the water and fertilization is external presenting a larval stage during their life cycle. Although larvae can be transported by currents to other areas, larvae exchange

between Ria de Aveiro and either estuaries or other coastal lagoons are unlikely to occur, considering the distance between Ria de Aveiro and the nearest lagoons and estuaries, the current regime within the Ria de Aveiro, the relatively short larval life and that the environmental conditions along on the coastal area does not favour the survival of the larvae of the target species. Therefore the stocks of the target species that occur along the Portuguese coast should be considered as independent stocks.

7.2 Management objectives

In this fishery, the management measures currently in place intend to reduce or limit effective fishing effort (input controls) as well as restrict the total catch to predefined limits (output controls). Management input controls include restricted entry to fishery (limited number of fishing licenses) whilst output controls comprise daily catch quota per vessel and/or harvester. In addition to the control measures described above, other technical measures are also in place, namely limits on gear specifications, minimum landing sizes and seasonal closures can be implemented if necessary.

The main management objective for the MU Ria de Aveiro fits with the **sustainability of the stocks**.

7.3 Management tools

The dynamics and life history of the target species impedes the implementation of traditional approaches such as MSY (e.g. B_{MSY} and F_{MSY}). Therefore, management of clam stocks may be based on daily catch quotas (DCQ). However to achieve this with success a monitoring program must be put in place in order to adjust yearly DCQ to the conservation status of the target species.

7.4 Regional management bodies

The responsibility for implementing domestic fisheries policy lies with the Ministry of Agriculture, Rural Development and Fisheries and it is delegated to the Deputy State Secretary for Fisheries who is assisted by DGRM. It is worth to note that this is a typical top-down management fishery with low intervention of the sector. In this type of fisheries it would be desirable to change the management philosophy to a bottom-up regime since it would be more effective than a top-down management. Indeed, legitimacy of management regimes can be improved by transferring greater responsibility to user-groups by including them in the decision-making process. Therefore, it is proposed to for the Ria de Aveiro MU the constitution of a Regional Advisor Committee.

7.5 Monitoring system

Harvestable wild clam stocks are dependent on recruitment that can vary widely from year to year. There is currently no assessment program that measures stock status of the target species. IPMA conducted a single monitoring survey of the clam beds in 2006/2007 (Maia & Pimenta, 2010). Basic information is lacking for all species but *Venerupis corrugata*. Indeed, description of growth and reproductive cycle is only known for this species (Maia *et al.*, 2006a,b). Therefore, the information available until date is not enough to support the design of a sustainable harvesting strategy for the clam harvesting fishery.

In order to overcome the lack of information during the GEPETO project it was carried out a monitoring survey within Ria de Aveiro in order to assess the distribution and abundance of the target species. Moreover, a monthly sampling was put in place in order to describe the reproduction and growth of the target species.

7.6 Assessment and advisory system

At a national level, the Portuguese Institute of Sea and Atmosphere (IPMA) has the role of proposing management measures to the Administration in order to protect and maintain fish stocks. The assessment of the stock status should be carried out through the monitoring of clam beds. These surveys should be conducted by IPMA with the close collaboration of the sector. Within the framework of the GEPETO project it is proposed for the Ria de Aveiro MU the constitution of a Regional Advisor Committee composed by the Administration, Fishing Association, Producers Organization and other stakeholders.

8 Anexo III: Management unit definition template. Case Study: “Canary Island”

8.1 Introduction.

The Canary Islands are located at $27^{\circ} 36' - 29^{\circ} 25.2' N$ and $13^{\circ} 24' - 18^{\circ} 12' W$. The archipelago is composed by seven main islands and some small islands. The artisanal fisheries under analysis are carried out in the island of Tenerife (Figure 4), one of the seven main islands of the Canary Archipelago.

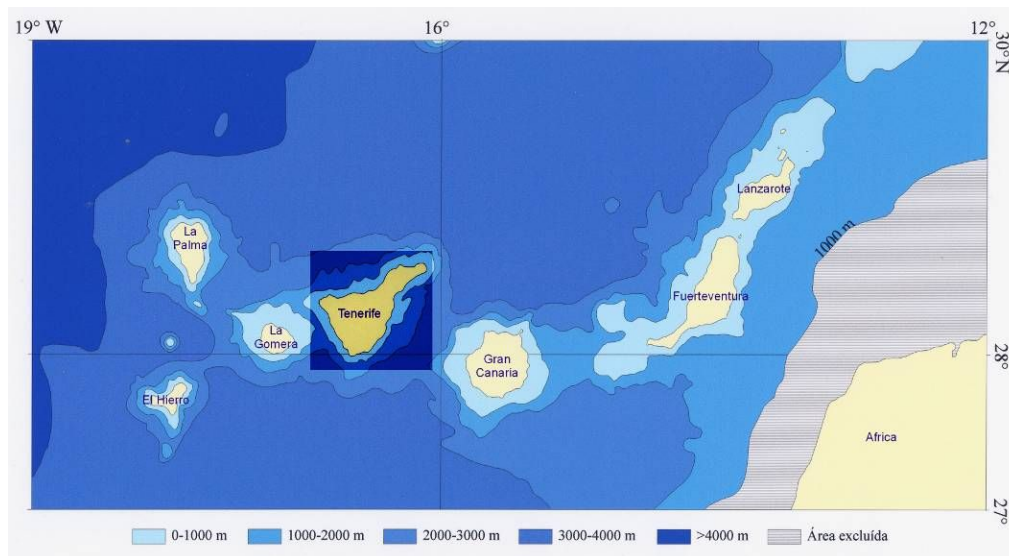


Figure 4. Location of the Tenerife Island

Among other aspects, the islands are characterized by having narrow shelves due to their strong slope close to the shore, limiting the surface that can be habitable by the coastal species, especially in the westernmost islands. In addition, the waters surrounding these islands are typically oceanic and oligotrophic. Therefore, they have a very limited overall productive capacity. Nonetheless, the pelagic component of the biota is relatively important, largely conditioned by many oceanic species that pass through the Canary Islands in their migratory routes. On the other hand, given the proximity of the high depths to the shore, many species of deep habitats are fully integrated into the dynamics of the island ecosystem, especially those that do vertical migrations toward surface waters. Finally, a wide variety of habitats can be found in the canary bottoms. These reasons contribute to a high diversity of ecosystems and species, but with small, fragile and vulnerable populations (Aguilera *et al.*, 1994).

Artisanal fishery activities in the islands are characterized by: a) a high heterogeneity of the units of the fleet; (b) the polyvalency of them, with few specialized vessels; c) a wide variety of fishing gears used (multi-gear fishery); and (d) a high number of target and secondary species (multi-species fishery) (Aguilera *et al.* , 1994; Balguerías, 2001; Santamaría *et al.* , 2013).

The regulation of fishing activities is complex and is subject to regional, national and supranational legislations (European and transnational). Although, above all, the regional regulation considers the particular aspects of each island (and areas within them), many laws are issued without the consensus of all the actors and do not always reflect the reality of the canary artisanal fishery or their needs, taking time to adapt to them.

In this context, the artisanal fishery on the island of Tenerife has been proposed as a case study within GEPETO project, with the aim of attempting to reflect the current situation of this fishery and its needs, relying on the collaboration and expertise of the fishery sector, in addition to other partners belonging to regional and national fisheries administrations. On the other hand, this pilot experience is intended to be exported to the rest of the archipelago.

8.2 Description of the management units proposed, based on the three pillar.

In general, our methodological approach for the identification of potential management units consisted in applying multivariate analysis methods (PCO, Cluster and MDS) on the data matrix of the fleet. The aim was to find patterns of association (groupings) of vessels according to common factors (fishermen associations, home port, fishing zone, side of the island, etc.), based on a wide database of each unit of the fleet. This included: technical characteristics of the vessels, auxiliary equipment for fishing and detection, fishing gears used (14 possible gears), main fishing gears (6 main gears) and the relative importance of the resources (64 species, on a scale from 0 to 4). The differences between the groups were statistically tested using analysis of similarity (ANOSIM) or permutational analysis of variance (PERMANOVA), using different models or experimental designs according to the quality of the data (Anderson, 2001; Clarke & Warwick, 2001; Mcardle & Anderson, 2001; Anderson, 2003; Anderson & Ter Braak, 2003; Anderson, 2004; Clarke & Gorley, 2006; Anderson *et al.*, 2008).

As a result of the analysis, we have identified two Management Units (MU) (Figure 5):

- a. **Management Unit "Traíña (purse seiners)"** - a small part of the fleet, although very well defined, targeting on small pelagic fish resources with purse seine ("traíña").
- b. **Management Unit "Other artisanal fleet"**: the largest and most diverse fraction of the fleet, which mainly targets on a large variety of demersal resources and employs a wide range of minor fishing gears.

Normally, each boat is devoted exclusively to the exploitation of one of the two types of resources; there are only two units whose technical characteristics allow them to make a seasonal change. As it is explained below, despite the fact that the spatial dimension of the fishery is limited to the area of the island of Tenerife - very few boats

move to other islands -, the biological and ecological characteristics, as well as the distribution and abundance of the target species of each management unit, mean that there are no conflicts over the usage of the territory between the two.

It is necessary to emphasize that 23.5 % of the boats (32 boats) that are dedicated to fishing with other minor gears (MU "Other artisanal fleet") also targets on large migratory pelagic fish (tuna) when passing close to the island. The activity of these is well differentiated from the tuna fishing fleet with exclusive dedication, constituted by bigger boats that carry out longer trips and of a larger-scale spatial dimension. This latter fishery has not been included in the present study, because it is subject to other management units of greater spatial scale (national and international) and is annually assessed in the framework of the ICCAT.

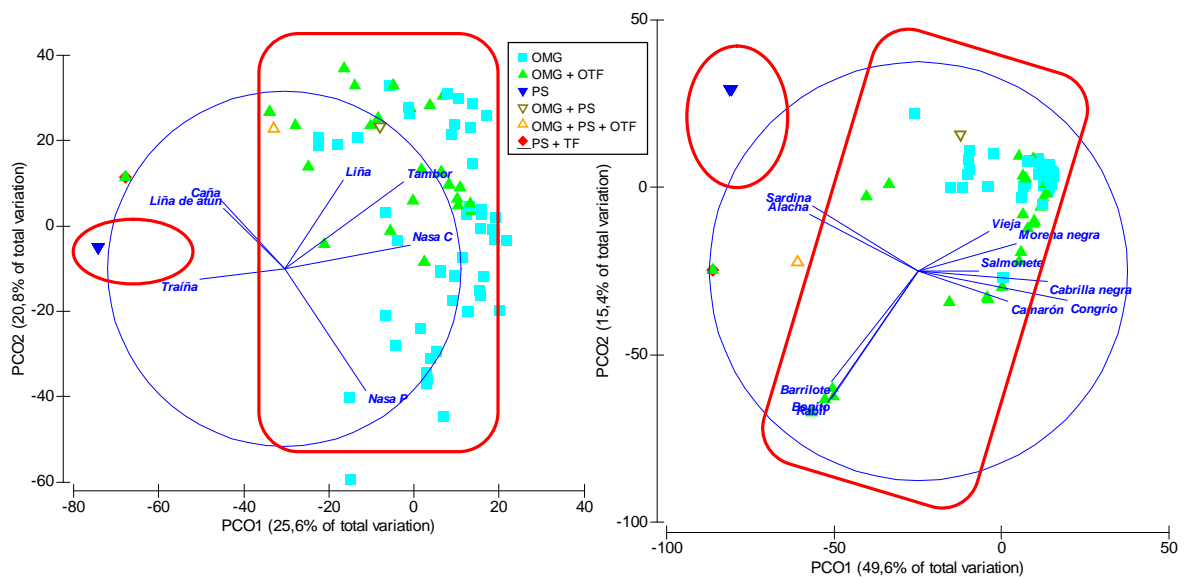


Figure 5. Results of the PCO analysis, based on gear data (left) and species data (right). Symbols represent units of the artisanal fleet (OMG = other minor gears; OTF = occasional tuna fishers; PS = purse seiners).

Artisanal fishery (excluding exclusive tuna fishing vessels) in the island of Tenerife is described in the following subsections. Each identified management unit is separately analysed under the criteria of the three pillars.

8.2.1 Spatial Dimension

The island of Tenerife is located at 28° - 28.6° N and 16° - 17° W, occupying a central position in the canary archipelago. Its coastal perimeter is 269 km and the shelf is only 315 km² (Aguilera *et al.*, 1994) (figure 1).

From an oceanographic point of view, the waters of the island of Tenerife, as of the rest of the archipelago, are oligotrophic (Braun & Molina, 1984), which determines that the overall productive capacity of the ecosystem is very limited. The influence of

the Northwestern African up-welling is very low, in contrast to what happens in the easternmost islands, where it slightly increases the productivity. On the other hand, due to the influence of the Canary Current, the surrounding waters of the archipelago are colder than they would be according to latitude. However, there are oceanographic differences around the island. This way, for example, the southwest area is protected against the dominants trade winds and currents most of the year, which is translated into a moderate-low hydrodynamism and gives particularly warm features within the general context of the island.

➤ Management Unit "Traíñas (purse seiners)".

The fishing activity of this fleet is developed in a wide area of the coast, which covers the eastern and western sides of the island, even though most of it is concentrated in the south and southwest area. In the northern side, coastal pelagic fishing is rare. There are some boats that sometimes move to other islands, particularly to La Gomera.

Although the target species (see chapter 1.2.3) are not strictly linked to the coast, they tend to come close to it, so that fishing is normally in the waters over the shelf or the slope. Therefore, it is not normally necessary to move too far from the coast, given the narrow shelf and the proximity of the edge of the slope to the coast.

The purse seine fleet accesses to the resources mainly from four ports: three located in the south/south-west sector of the island, and one in the north-east.

➤ Management Unit "Other artisanal fleet".

Its fishery activity is developed throughout the coastal perimeter of the island, usually on the bottoms of the insular shelf, but also on the adjacent bottoms to the shelf and the uppermost part of the slope, rarely exceeding 800-1000 m in depth.

The intertidal zone is exploited by some boats for the capture of limpets (*Patella* spp.). In regard to the shelf, the most interesting are the rocky bottoms and seagrass beds ("sebadales"), together with the *maërl* beds and the circalittoral biogenic detritic bottoms ("cascabullo"). Regarding the slope, mainly rocky and rocky-sandy bottoms are exploited.

It is possible to access to the demersal resources from around forty major and secondary ports and grounding beaches throughout the entire island (Figure 6).



Figure 6. Main ports (green), secondary ports (blue) and grounding beaches (red) of the island of Tenerife

8.2.2 Fleets included

Excluding tuna fishing vessels, the artisanal fleet on the island of Tenerife used in the analysis was of 146 boats, whose main technical characteristics are summarized in Table 2:

Table 2. Descriptive statistics table about the main technical characteristics of the artisanal fleet used in the analysis in the island of Tenerife (N = 146).

	Mean	Std. Dv.	Min.	Max.
Year of construction	1974	22	1923	2010
GRT	4.13	4.35	0.47	23.28
GT	2.76	3.38	0.39	20.96
Power (hp)	34.26	39.08	4.00	200
Length (m)	7.28	2.32	4.20	14.48
Crew	1.82	1.18	1	8

➤ Management Unit "Traíñas (purse seiners)".

According to the information available, there are at least 9 specialized purse seiners (6.16% of the artisanal fleet). In addition, there are also three other vessels that alternate purse seine fishing with other minor gears and/or tuna fishing.

In general, the purse seiners are among the most modern and with the largest length and power of the artisanal fleet. Due to the fishing requirements, these are the vessels that need a greater number of crew members (Table 3).

Table 3. Descriptive statistics about the main technical characteristics of the MU "Traíñas (purse seiners)" fleet in the island of Tenerife used in the analysis (N = 12).

	Mean	Std. Dv.	Min.	Max.
Year of construction	1993	14	1971	2008
GRT	10.90	6.89	4.19	23.28
GT	8.55	6.27	2.58	20.96
Power (hp)	93.89	65.41	12.00	200.00
Length (m)	10.96	2.35	7.89	14.48
Crew	4.5	2.30	2	8

➤ Management Unit "Other artisanal fleet".

A total of 136 boats are included in this MU, which is equivalent to a 93.15 % of the census of the artisanal fleet of Tenerife. They are dedicated to fishing with other minor gears at least at some time during the year.

The gears and fishing practises of this MU are varied (multi-gear fishery). The most commonly used are the traps (for fish, shrimp or morays), but different hook and line-based gears are also used (handlines and pole lines, bottom long-lines, electric reel hook and line, trolling line, gillnets, lift nets and harpoon for wahoo, in addition to shellfish collection (Pascual, 1991; Aguilera *et al.*, 1994; Santamaría *et al.*, 2013). Which method is used depends on the ports, and also varies throughout the year depending on the availability of resources (opportunistic fishery). It is quite common for a boat to use several fishing gears during the same trip.

In general, this is a relatively old fleet, although the majority of the vessels have undergone reforms and have built-in auxiliary equipment for fishing (winch, etc.) and for detection and navigation (echo sounder, GPS, etc.), even though many of them still have no deck or bridge. In general, they are small or medium-sized vessels (average length: 6.98 m), of low-power and tonnage, which rarely carry more than two crew members on board. The vessels that alternate fishing with minor gears with tuna fishing tend to be a bit more modern and have a greater length, tonnage and power, as well as a larger number of crew members than the ones in the average fleet (see Table 4).

Table 4. Descriptive statistics of the main technical characteristics of the MU "Other artisanal fleet" in the island of Tenerife, used in the analysis. For the total (on the left) (N= 136) and for the occasional tuna fishers (on the right) (N = 32).

	Mean	Std. Dv.	Min.	Max.
Year of construction	1973/1980	22/22	1923/1931	2010/2009
GRT	3.54/5.35	3.46/3.90	0.47/1.25	17.01/17.01
GT	2.25/3.43	2.41/3.06	0.39/0.67	16.98/16.98
Power (hp)	29.72/38.40	31.52/33.01	4.00/4.00	160/135
Length (m)	6.98/8.24	2.02/1.94	4.20/5.10	14.05/14.05
Crew	1.62/2.09	0.72/0.86	1/1	4/4

8.2.3 Fish/shellfish communities included

➤ Management Unit "Traíñas (purse seiners)".

The most captured target species is the Atlantic chub mackerel (*Scomber colias*), followed by some clupeids, such as Sardine (*Sardina pilchardus*), Round sardinella (*Sardinella aurita*) and, to a lesser extent, Flat sardinella (*Sardinella maderensis*). Also important are the horse mackerels (especially *Trachurus picturatus*), which have seen an increase in the catch in recent years. Apart from the above-mentioned species, other pelagic species more linked to the shore, such as the palometa (*Trachinotus ovatus*), are also caught with the trawl. In general, the availability of these species in the waters around the island fluctuates considerably throughout the year, due to their own biological characteristics and to the differences between years.

Owing to the own target species and their habitat, this fishery does not usually come into conflict with the rest of the artisanal fishery of the island, nor with foreign longline vessels targeting on marlin/swordfish or pelagic sharks, nor with recreational fishing.

➤ Management Unit "Other artisanal fleet".

The number of target and by-catch or secondary species is greater than fifty. The majority are demersal fish from the whole shelf and edge of the slope, such as: Parrotfish (*Sparisoma cretense*), Combers (*Serranus spp.*), Salema (*Sarpa salpa*), Seabreams (*Diplodus spp.*), White-edged grouper (*Epinephelus marginatus*), Island grouper (*Mycteroperca fusca*), Barred hogfish (*Bopdianus scrofa*), Red porgy (*Pagrus pagrus*), Pink dentex (*Dentex gibbosus*), Striped red mullet (*Mullus surmuletus*), Triggerfishes (*Balistes capriscus* and *Canthidermis suflamen*), Planehead filefish

(*Stephanolepis hispidus*), Morays (*Muarena spp* and *Gymnothorax spp.*), Forkbeard (*Phycis phycis*), European conger (*Conger conger*), etc. Some semipelagic and pelagic species closely linked to the coast are also exploited. This is the case of the Amberjacks (*Seriola spp.*), the Yellowmouth barracuda (*Sphyraena viridensis*) or the Bogue (*Boops boop*), among others. With the decline in the captures of the mentioned species and the existence of better equipment on-board, deep demersal resources ("del veril" or "del alto") have been increasingly gaining importance, such as the Alfonsinos (*Beryx spp.*), Roudi escolar (*Promethichthys prometheus*), Wreckfish (*Polyprion americanus*), Black cardinal fish (*Epigonus telescopus*), Offshore rockfish (*Pontinus kuhli*), Blackbelly rosefish (*Helicolenus dactylopterus*), etc. Some of them already show signs of overexploitation. Among shellfish resources, some crustaceans (shrimps, prawns, crabs and lobsters) and cephalopods (octopus, cuttlefish and squids) can be highlighted, apart from the limpets. To all these species we would have to add tunas, which is occasionally captured by part of the fleet, mainly Skipjack tuna (*Katsuwonus pelamis*) and Yellowfin tuna (*Thunnus albacares*), from spring to autumn, and Bigeye tuna (*Thunnus obesus*) and Albacore (*Thunnus alalunga*, from autumn to spring (Aguilera *et al.*, 1994; Santamaría *et al.*, 2013).

The capture and importance that each species represents for fishermen varies among the ports. As a common denominator, it is always observed that the list is extensive and there is no clear difference between target and secondary species, typical of a clearly multi-species fishery.

According to the appreciation of fishermen, the captures of many species are declining, highlighting the shrimps, morays and combers, among others. On the contrary, some have experienced a recovery in recent years, as it is the case of parrotfishes.

Demersal fishery is the most severely affected by recreational fishing (angling from the shore, from boat or speargun fishing), since they share many target species and fishing areas. The conflict of interests is greater with respect to the resources inhabiting on shallower bottoms, but it also exists with those living on the slope, due to the increase in recreational boats equipped with modern systems for detection and positioning and powerful electric reels. The captures of recreational fishing are unknown, but there is a very widespread idea that, for many species, it can be higher than the one of professional fishing. The problem is greater when there is an illegal sale of fish. On the other hand, coastal habitat destruction and pollution are also activities contrary to the conservation of resources and their sustainable exploitation.

8.3 Management objectives

A strategy for the management and conservation consists of the development of a management plan that aims "To make the conservation of biodiversity and resources compatible with their sustainable exploitation". This way, the overall objectives would be:

- To assure the cohabitation of different *métiers*;
- To guarantee the sustainability of the stocks and fleets operating there;
- To preserve biodiversity.

8.4 Management tools

The marine ecosystem of the Canary Islands is very vulnerable due to the low abundance of a high number of species and to the complex relationships between them. The high number of target species and gears in the artisanal fishery, as well as the difficulties for monitoring and surveillance and the lack of scientific information, generate difficulties to establish management plans in the Canary Islands. However, regulations for the fishing activity (professional and recreational), shellfish gathering and aquaculture are found in National Regulations, Canary Islands Fisheries Regulations and European regulations.

Artisanal fisheries in the Canary Islands are mainly managed by a complex mixture of input and output controls, which are mainly focused on: i) Limiting the fishing effort (input control); ii) Limiting total catch (output control): prohibition to catch some species of crustaceans, molluscs and fishes; and, iii) Establishing technical measures (Santamaría *et al.* 2013).

During the GEPETO project, various management measures have been discussed in the meetings and some management proposals for each Management Unit have been identified:

8.4.1 Management Unit “Traíñas (purse seiners)”

- It was mainly proposed to not confuse polyvalence activity with commercialization of bait and to commit on the established normative.

8.4.2 Management Unit “Other artisanal fleet”

The management proposals could be summarized as follows:

1. Effort

- Possibility to combine different artisanal gears during the same trip;
- Not to limit the number of fishing days nor the power of the engines for professional fishermen;
- To limit the number of licenses and fishing effort (number of days) for recreational fishing.

2. Technical measures

- Change in mesh size of the fish traps;

- Moray traps: To eliminate minimum depth. To request the measures of caught specimens. Implement a minimum size for the capture of morays;
- To vary (in regulations) the description of characteristics and uses of some gears;
- To vary (in regulations) some technical specifications of the vessels dedicated to minor gears.
 3. *Seasonal closures of certain areas for both professional and recreational fishing activity*
 4. *Catch*
 - To consider the other islands in the archipelago as areas reserved for traditional fishing;
 - To revise the minimum sizes for the capture of some species;
 - Recreational fishing: to control the sale of fish (poaching). To revise its regulations. To request its association, federation and statement of capture;
 - To obtain quota for the bluefin tuna. To request support to the administration.
 5. *Others*
 - To create Marine Protected Areas including some closed areas to any fishing activities.
 - More inspection and modification of marketing legislations in the captures coming from third countries;
 - Revision of the regulations of declaration of First Sale;
 - Permanence of the current legislation that regulates the beaconing of fishing gears;
 - Request for additional grants for biological stoppages;
 - Request for improvements in administrative management for the development of the professional activity.

8.5 Regional management bodies

The artisanal fishing activity in the Canary Islands is traditionally organized in *Cofradías* of fishermen, which represent their members and protect their interests. They are grouped in two federations: "*Federación Provincial de Las Palmas*" and "*Federación Provincial de Tenerife*". In the island of Tenerife there are 10 *Cofradías* distributed in the main fishing ports. These have a consultative role in the management of fisheries, applying regional decisions and making propositions about sensitive issues in their circumscription that are forwarded to a regional level.

The implementation of the Regional fisheries policy is carried out by the *Viceconsejería de Pesca del Gobierno de Canarias*; the *Ministerio de Medio Ambiente, y Medio Rural y Marino* on a National level and the European Administration on an European level. On the other hand, the *Cabildo* of Tenerife is an administrative entity with certain competences over fisheries, among others. At a larger scale, the Southern Western

Waters Regional Advisory Councils (SWW RAC), composed by a wide range of stakeholders (fishermen, NGOs), has currently a consultative role, so they do not manage fisheries.

8.6 Monitoring system

➤ General Considerations.

The conservation and management plan should include a system of control or monitoring based on the evaluation of indicators, increasingly developed and used as management tools of environmental issues (OECD 1991, OECD 1994; EEA 1999 a, b). Before selecting the indicators, it is necessary to clearly define the cause-effect relationships between the different components of the system, as well as to establish a conceptual framework from which the most appropriate indicators can be selected. Our proposal consists in using a DPSIR conceptual framework (acronym for *driving forces - pressure - state - impact - response*), which makes it easier to identify and analyse the indicators. Moreover, it simplifies the complexity of the environmental management and facilitates communication among the administrations, scientists and users in general, providing a tool for decision making. It is important that the selected indicators include information about the *Key elements*, as those key components of the ecosystem (for example, species or habitats that are protected or threatened, target species, etc.) that are likely to be affected by any of the DPSIR components (Ojeda-Martínez *et al.*, 2008, 2009). In the final selection it is necessary to take into account some requirements that a good indicator must fulfil (Meadows 1998; Ojeda-Martínez *et al.*, 2008).

Furthermore, in order to be effective, the monitoring plan has to comply with a series of guidelines in its overall design, such as the ones gathered by EMPAFISH Consortium (2008). They were originally designed for marine protected areas, but they are generalizable to other management actions that can be set in a fishery. Among other guidelines, the monitoring plan must: i) be comprehensive and holistic, integrating concerns related to biological and ecological variables with socio-economic and governability ones (Pomeroy *et al.* 2004, 2005); ii) begin as soon as possible, ideally before implementing management measures; iii) to be set up in relation to expected goals and objectives of management plan; iv) direct part of the monitoring to the exploited stocks; v) be continuous and undertaken in a periodic basis, always under the direct advise of competent scientific staff.

➤ Requirements of the monitoring plan for the artisanal fishery in Tenerife

Taking into account the above mentioned, it is necessary to meet a number of requirements in order to establish an effective monitoring plan:

- Availability of fishery statistics, which have to be complete and reliable. It is necessary to review the operation of information gathering processes in the points of first sale;
- Maintenance of an effective Network of Information and Sampling (NIS) , capable of collecting and reviewing the information and periodically sampling captures (mainly size structure);
- Collaboration of administrations in the transfer of data;
- Collaboration of the fisheries sector in the provision of information, in the sampling of the NIS and in possible experimental fishing;
- Monitoring the capture of key species (species that are increasing or decreasing in captures, vulnerable, of restricted distribution and of ecological/fishing interest) for their sampling, abundance estimates and size analysis;
- Selection of a sufficient number of representative fleet units (vessel type), for each zone (sides of the island and ports) and type of fishing, in order to carry out reliable and continuous sampling.

➤ Monitoring Plan: Indicators and their assessment.

Without prejudice to the final modifications that an expert panel can introduce before applying it, we propose the following plan in the framework of the conceptual DPSIR model (Table 5), taking into account the recommendations and criteria for the selection of indicators and design of the monitoring system seen before:

Table 5. Monitoring plan proposed for the evaluation of the fishery and the effectiveness of the management actions for the artisanal fishery of Tenerife. Adapted from Ojeda-Martínez et al. (2009), see definition of each indicator in there.

DPSIR	Type of indicator	Indicator	Periodicity
Driving forces	Fishing	Number of fishing boats; number of fishermen; power of fishing boats.	Yearly
		Number of fishing boats with a kind of gear.	Quarterly
	Fishing & Socioeconomic	Recreational boats; Number of licenses by each kind of recreational fishing.	Yearly
	Socioeconomic	Profit of the fishing sector.	Yearly
Pressures	Fishing	Boats fishing/day	Daily
		Biomass extracted (total and by species); CPUE (total and by species) by each gear.	Yearly
	Fishing & Socioeconomic	Number of recreational boats.	Yearly
State	Ecological & Fishing	Abundance and biomass for key species.	Yearly
		Size structure of key species.	Quarterly
	Ecological	Richness; Diversity; Community structure.	Yearly
	Socioeconomic	Economic value of each species.	Quarterly
Impacts	Ecological & Fishing	Species size variation of targeted species.	Quarterly
	Ecological	Changes in community structure, richness and diversity; Changes in abundance and biomass of key species.	Yearly
Responses	Fishing	Legislation changes.	Yearly
		Zoning (surface for each use).	Yearly
	Ecological & Fishing	Marine protected areas created.	Yearly
	Socioeconomic	Budget invested in fishery sector (total and actions for improvement, research, surveillance and educational programmes); licenses for sport fishing; Meeting between the stakeholders.	Yearly
		Surveillance hours.	Daily
	Denounces.	Monthly	

Additionally, we recommend an annual assessment of the evolution of the indicators, as well as the possibility of being able to enter or delete some of them if necessary, in order to evaluate the effectiveness of management measures.

8.7 Assessment and advisory system

For a canary fishing management, a Joint Management Committee composed by the stakeholders (professional, fishing administrations, scientists, NGOs) should be created. Ideally, the Committee should:

- Ensure that all parties are represented;
- Meet regularly (once a year);
- Establish a procedure for the decision-making process;
- Analyse, always under scientific supervision, the evolution of the indicators;
- Be able to implement changes to the own monitoring system (if needed) to adapt the management for the following years;
- Agree on and propose management measures and define the mechanisms to implement them.

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9 Anexo IV: Management unit definition template. Case Study: “Specific-targeted Octopus fleets in the Iberian Northwest”

9.1 Description of the management units proposed based on the three pillar

The Fishery for Octopus Fleets on the Iberian North West can be defined as “a Management Unit exploiting a common species within specific fishing grounds on a sustainable way.”

This Fleet is made of vessels that are registered on the “Minor Gears Modality” described on the *“Decree 15/11 of Tools and Gears of Galicia”*. This fleet specialises in the capture of octopus with vessels with a length of under 18m (59 Ft.) and a maximum power of 270 Horsepower of Vapour (HPA).

The main feature of this fleet is that, they are what we call Mixed Fleet, meaning by this: fleet that works with more than one Fishing Gear. This feature is regulated on the *“Order of the 26th of October 2004 regarding the Change of Gears of Galician Fleets”* and its later amendments. This law has the aim of *“determining Gears and Fishing Modalities on the exploitation licenses of fleet that change Fishing Gear”*.

This norm specifies that, all vessels can have a maximum of five different Gears on their fishing license. This basically means, that they have the chance of changing gear, allowing them to have several gears to use all throughout the year, and to catch different species.

It is also highlighted here, that this fleet cannot use two gears at the same time, and that they should register on a daily basis on the Fishing Activity’s Register Book.

Due to the fact of using Mixed Gears, we can define the activity of this fleet; as a group of vessels which main mono-specific target is octopus; using specific Octopus Traps (NASAS), who top up their activity with Secondary Fisheries, mainly Shell Fish Picking, Gill, and Hook.

The captured species are a Pool of Species or Fishing Resource with coastal distribution, normally limited to a specific area, which is normally close to the coastline, and this is because this species are normally found on those habitats, and are very distinctive of the Rias’ area and of areas that are at low sea levels.

The lifecycle of most of these resources takes place within the limits of the Management Unit.

The definition of unit on this case, is made based upon these three main pillars which have been suggested in the new unit proposal of Project GEPETO:

- Spatial Dimensions
- Fish Community
- Extracting Activity

This Fishery is quite heterogeneous, but we have to take several approaches into account on each of these three different levels.

In order to define the Management Unit, we should take into account an ecological approach in which we can see the distribution of the population of some of the species that are affected by factors such as: oceanographic and environmental conditions, time of the season, etc. This way we can distinguish two different areas, depending on the number of catches and the time of the year.

We can also take a more regional approach, based upon the different fishing areas, because there are a very wide variety of marine ecosystems, and this has a direct effect on the species caught in each area. Traditionally, there is a partition for catching the main species: octopus. Partition that is overseen by the yearly plan, resulting in 4 main different areas:

- South Region (From Miño to Vigo's Ria)
- Vigo and Pontevedra's Ria.
- Arousa's Ria
- North Region (Muros – Noia's Ria, Death Shore and the High Rias)

The last approach needs to take into account the extracting activity, where we can see two massive regions: North and South. In the North, they use lengthier vessels and have a higher number of fishermen working on board and they also go further away from their main ports on these areas. In the meantime, in the South Region, they can work inside the Rias, therefore vessels tend to be smaller and have less fishermen working on board.

These differences affect directly the technical management measures used to organise the extraction of resources, resulting directly on Exploitation Subunits.

The last approach is the most feasible because it is based on the fleet's activity and the main characteristic of this management unit is: the complimentary activity that the fleet carries out with secondary fisheries, which is different from the main activity and we can therefore also appreciate North-South differences.

9.1.1 Spatial Dimensions

The area, in which this activity is developed, the ICES VIIIc-IXa North Fishing Area, which is located within an Spanish area known as National Cantabric Waters and

Northwest. The area of this Management Unit is the exact same one, as the one on this Case Study. It's a platform on the Galician shore and it takes up to 1720 km of coastline, where we can find Capes, Gulfs, Beaches and "Rias". The "Rias" are very deep river valleys flooded by the sea with very particular ecosystems, with very high biological and productivity levels.

The activity of this fleet takes place within the first meters of the platform, due to its high productivity and biodiversity. In these ecosystems, it is easy to find a great number of species, with a very profitable commercial value, which are the main target of Galician Coastal Mixed Fleets.

Regarding the fleet's activity we can appreciate two sub regions; North and South, because there are geographical and oceanographic differences that influence this activity, the border between them is in the North of Arousa's Ria. (Corrubedo's Cape 42° 35' 00" N: 90° 06' 00" W)

9.1.2 Mixed Fleet

The Fleet comprised, is made of smaller scale artisan vessels used for inshore fishing, of a very polyvalent nature, due to having several gears and targeting different species. This type of fleet is known as "Minor Gears" and they usually operate on the National Cantabric Waters and the North West.

The main feature that describes the activity of Mixed Fleet is that this fleet exploits a wide array of resources, being able to work with different fishing gears, adapting them to the seasonal lifecycle variations of the species.

This fleet is made of a great number of small vessels that travel small distances, and stay near to their departure ports.

The targeted species, that each vessel or group of vessels of an area has, is determined by the number of the species in that area, at a particular time of the year, all this, resulting on an important spatial dependency.

The fleet is made out of 1327 Vessel (as on the 1st of May 2013), and they all have authorised Octopus Traps Gears (NASAS) on their licences. Only 676 managed to catch octopus on the 2012.

The number of vessel varies yearly, but it is approximately around 700 vessels.

Structure of the Fleet:

- Main Fishery: with **Nasas** (Specific Octopus Traps) Gears. Code FAO (FPO-...)
- Secondary Fisheries:
 - **Shellfish Picking** (Shellfish). Code FAO Gears (DRH-... & others)

- **Gill** (Gill). Code FAO Gears (GTR- ..., GNS-...)
- **Hooks** (Hooks). Code FAO Gears (LLS-...)

Throughout time, fleets that capture this species have had to adapt their structure so that they can optimise their resources, having to enforce technical and managerial measures.

9.1.3 Fishing Communities /Including Shell Fish

The Stock Scale

The Stock Scale is restricted to the spatial distribution of the species, generally located close to coastal borders. ICES XVIII and IX on the Northwest of the Iberian Peninsula.

The population of the targeted species of the fleets targeting Octopus on the Iberian Northwest” is limited by their own habitat, and has to comply with all current legislation regarding the exploitation of these species. The mixed nature of these fleets makes them capture the right species at the right time of the year, avoiding in this way the overexploitation of this particular resource. This is the type of fleet that captures this type of targeted species, on the area covered by the Management Unit.

The activity of this fleet has to be regulated as a whole, and not on an individual basis, as an isolated species, hoping not to cause any major changes on the exploitation of the resources.

Exploited Species

Our Targeted Species Group, are the existing resources on the Galician Rias Platform, to which small artisan inshore fishing vessels have access. These are shellfish and fish that exists in a great number on this areas, that top up the activity of the fleet that works with special octopus traps (Nasas), which are captured on a secondary basis, whenever these fleets are not exploiting their main catch, this activity is complimentary to their main activity.

The main targeted species is Common Octopus (*Octopus Vulgaris*), due to the number of catches and the width of its distribution. Amongst the other captured species (arranged by volume of catches) we can find: Shell fish, fishes that are widely distributed, demersal fish and some molluscs, bivalves and cephalopods (Table 6).

Table 6. Exploited species

English Name	Spanish Name	Scientific name	ALPH A	Mode	Used Gears	FAO code	Stock Assessment	Know Stock Distribution
Octopus	<i>Pulpo</i>	<i>Octopus vulgaris</i>	OCC	Traps	Octopus Traps	FPO-o8.2.o	No (NO TAC)	No
Barnacle	<i>Percebe</i>	<i>Pollicipes pollicipes</i>	PCB	Shellfish	Scraper	-----		
Spider Crab	<i>Centolla</i>	<i>Maja brachydactyla</i>	SCR	Gill	Trammel	GTR-07.5.o		

European Conger	<i>Congrio</i>	<i>Conger conger</i>	COE	Hook	Long line	LLS-09.3.0	No (NO TAC)	No
Sea Bass	<i>Lubina</i>	<i>Dicentrarchus labrax</i>	BSS	Hook	Long line	LLS-09.3.0	No (NO TAC)	No
Common Sole	<i>Lenguado</i>	<i>Solea vulgaris</i>	SUN	Gill	Miños	GTR-07.5.0	No (TAC)	No
Pout	<i>Faneca</i>	<i>Trisopterus luscus</i>	BIB	Hook	Long line	LLS-09.3.0	No (NO TAC)	No
Hake	<i>Merluza</i>	<i>Merluccius merluccius</i>	HKE	Gill	Beta	GNS-07.1.0	Yes (TAC)	Yes
Pullet Carpet Shell	<i>Almeja Babosa</i>	<i>Venerupis pullastra</i>	CTS	Shellfish	Hook or <i>Raño</i>	DRH-04.2.0		
Common Cuttlefish	<i>Sepia</i>	<i>Sepia officinalis</i>	CTC	Gill	Trammel	GTR-07.5.0	No (NO TAC)	No

*There are still some species of which we still do not know their distribution and the evaluation of stock should be studied on the near future, on a Specific Management Unit level, in order to be taken into account later on with managerial purposes.

Habitat of These Species

The exploited species are strongly connected to their habitat, and lots of them are bottom dwellers (benthonic), sessile, demersal or simply live within a very limited territory within their natural habitat. Its number and population depend on the very particular ecosystem of the Iberian Northwest Atlantic Coast.

The special scale of this Management Unit is given by the existence of coastal ecosystems that limit the distribution of most of the species and define its borders.

9.2 Management objectives

Main Objective: Ensuring the sustainability and profitability of the activity of mixed fleet specialised on the capture of octopus by the means of a management plan.

The specific aims of the Management Plan are maintaining the mixed nature of this fleet by using the right management tools on several levels:

- Environmental: Assuring the sustainability of the resources and environment issues
- Social: Securing employment
- Economical: Ensuring the Value of Catches.

9.3 Management tools

The management tool needed here, has to include all of the approaches mentioned on the Management Unit Definition, in order to comply with all current legislation on the activity of this fleet, going from Specific Exploitation Plans or Gear Legislation, onto management plans. This approach can be the most suitable, in order to improve the current management plan of the activity of "Specific-targeted Octopus fleets in the Iberian Northwest"

We should take into account, that we are talking about a Management Unit which activity is affected by North-South differences, in the case of the fleet on the area of this study; the fact is that secondary fisheries also have a very important role, as well as the main fisheries.

Management Proposal:

Amongst the tools and measures that can improve the management of this fleet's activity, there are a number of technical measures that can be used to regulate the different gears and to organise the number of catches of the targeted species.

Nowadays, there are regulations on the activity of the different Fisheries in which these type of fleet operates, with legislation on Gears Use (measures, seasons, quotas) and there is existing legislation on the species, both regarding its capture, using no means of effort, as to its size and the times of the year when its capture is allowed.

All this, is thoroughly developed by specific normative on the Use of Gears and throughout the use of specific fishing and shell fish exploitation plans, but we need to improve the existing plans through a new specific management plan for this fleet, in which we can include all these measures, and at the same time, adapt them to resource seasonality in order to optimize the marketing targets of the species, that are directly related to the number of catches of the exploited resource. This way, we could manage fishing attending to resource conservational criteria, the fishing activity itself and to the socioeconomic interests of this type of Fishery.

Finally, combining all of these Secondary Fisheries Management Measures, so that we can organize the main fishery's activity and to compliment it with a Common Management Proposal for this type of fleet.

9.4 Regional management bodies

Nowadays, the current regulation of the activity of "Specific-targeted Octopus fleets in the Iberian Northwest" and so the management of this type of Fishery, is regulated by norms that come from all sorts; European Administrations, National, Regional and even Local Development Plans. All this, toughens the job of a fleet that has to comply with different normative on catches, for the different species, on many different administrative levels, and even having to follow different criteria, without having a global vision of the whole of the fleet's activity.

Octopus and Spider Crab have their own Yearly Exploitation Plans that set the existing legislation on quotas for this species in Galicia.

Some species like Hake have to comply with European legislation, through TAC's and there is a national plan for that, defining the competences of these TAC, among the fleet segments or modalities; we can find what we call "Minor Gears" to which we have assigned a percentage. At the same time this quota is redistributed every three months to comply with the yearly plan.

Shell Fish exploitation is regulated by Local Yearly Exploitation Plans, local, Fishermen's Guilds are in charge of gathering and handing in this information, in this case; goose barnacles or bivalve molluscs.

On top of the captured species there are a lot of species, that do not have any specific regulation yet, but they comply with the legislation on the gear with which these are captured.

Making it really difficult to employ any management measures, due to the fact that this activity is treated individually or isolated, without taking into account the activity that a vessel of this fleet will carry out on a whole year.

This situation is due to the mixed nature of the activity of this type of fleet that arises from the ability to use different fishing gears.

In certain seasons of the year, we can have a situation that results on the inactivity of the fleet due to a biological halts, with local measures to organise the workflow or we can run out of quotas on a trimester for a certain species. This is the result of a lack of coordination and a lack of complementarity of the current management measures in place.

New Regional Level Proposal:

The Management Plan should have a Monitoring Committee or a Management Direction. Due to the fact that we already have a Monitoring Committee for the current Octopus Yearly Plan, we could reinforce this institution, in a way in which it would be the competence of this institution itself the one that does the follow up of the plan. In this management plan, all parties involved on the fishing activity, should be represented and amongst its competences they should have the assessment of the development of management measures and they should be able of making proposals to adequate the plan to the new situations that the alteration on stock, value of products or new legislation on the activity could have on this fleets.

9.5 Monitoring system

In order to set an effective monitoring system that defines exactly, what data is necessary to do an effective follow up of the activity of this fleet, and therefore choose several indicators that help us study the evolution of this activity.

The main indicator is the maintenance of employment and the sustainable exploitation of the targeted species looking towards the natural equilibrium of theses on our ecosystem, but we can also define some, environmental, social and economical indicators.

- *Environmental Indicator:* Targeted Population's Biomass and use of alternate gears
- *Social Indicator:* Profitable specialised employment rates.
- *Economical Indicator:* Final Value of fishing products.
- *Dependency Indicator:* Between the main fishery and secondary fisheries.

There are thousands of data available for a follow up. This information is generally available on regional administrations. All parties should agree upon the most suitable indicators in order to assess the development of the management Plan.

We should be designing a monitoring system that will display the information to create “ a database of the fleet’s activity” that accurately shows the catches and the socio-economical activity. We are in front of an analytical and statistical database that we can use as a management tool.

The data is available but needs to be organised, so that we can use them as indicators (Table 7. Proposed indicators):

Table 7. Proposed indicators

Information Needed	Procedures
Number of catches	System to Follow Up the Fleet’s Captures
Employment	Register of Vessels, Income analysis.
Value of Captures	Follow-Up of the Value of Fishing Products.

The Fishing Sector can add data of the activity with their own monitoring system, using a similar system to the one developed for the Case Study of the GAP-2 Project in Arousa’s Ria. This monitoring system, will let us know better about the activity of mixed fleets with real capture data, not only sales numbers but also about the fishing areas or the gears used for fishing.

9.6 Assessment and advisory system

In order to assess the progress on the management of this Management Unit, the plan should oversee the creation of both, a specific control tool, and a result assessment tool.

On top of doing a new definition of the management direction of the plan or a “Monitoring Committee”, we should implement follow-up measures that warranty all parties.

Firstly, we should build a “database of the activity of this fleet” establishing the contents of this data with the consensus of all parties involved on the activity.

Secondly, we need to agree upon a series of follow up indicators and assess their results, so that we can act upon them by taking the right managerial decisions.

Least but not last, we need to organise the workload and the follow up of the monitoring of the plan.

Lastly, the “Monitoring Committee” should:

- Ensure all parties are represented
- Establish a procedure for decision making
- Analyse indicators and implement changes to adequate management next year
- Make an analytical assessment of the main resource
- Propose management measures and define mechanisms to put them into place.
- Make sure all agreements are met and establish a monitoring system.

10 Anexo V: Management unit definition template

Case Study: “Iberian mixed fisheries”

10.1 Description of the management units proposed based on the three pillars

The Atlantic Iberian shelf is particularly narrow and the spatial dimension of fisheries, which can be applied successfully in more extensive continental shelves (*i.e.* Bay of Biscay), here only differentiates clearly the littoral fisheries because they are the only operating in internal waters (mostly in the Galician estuaries: “rias”). These fisheries are directed to sedentary or low-mobility resources (bivalves, crustaceans or cephalopods) whose management is transferred from the central Government to regional administrations.

Nevertheless, as territorial waters (12 nm) often cover most of the continental shelf, is not easy to distinguish between coastal, continental-shelf or continental-slope fisheries, because besides the common areas, the duration of trips does not usually exceed 24 hours. However, the fisheries developed beyond littoral waters also share a large number of target species. This feature limits the success of the current EU management measures, mainly based on single-stock TACs. It is known that the management of this kind of fisheries greatly improves by applying an integrated approach as if it were a single multi-fisheries multi-stocks management unit: **Iberian mixed-fisheries MU**.

10.1.1 Spatial dimension

Oceanographically, the Atlantic Iberian waters (ICES Divisions VIIIc and IXa) include three areas with different characteristics: Gulf of Cadiz with Mediterranean influence, Atlantic front with high upwelling process, and Cantabrian Sea (south area of Bay of Biscay) with transition between subtropical and subpolar areas. Politically, the Atlantic Iberian waters are compounded of the Spanish and Portuguese national waters.

However, from an ecological point of view, the narrowness of the Iberian continental shelf provides a **common spatial dimension** where different fleets share a variety of fishing resources.

10.1.2 Fleets included

The vessels allowed operating in Atlantic Iberian waters belong to the national fleets of the two coastal countries in the area: Spain and Portugal. Therefore, the vessels

fishing Iberian stocks have to apply for a fishing licence to operate in the respective National waters. Both countries classify their national vessels in fleet categories depending of the gear type (trawl, purse seine, gillnet or longline), but both countries leave an independent group for the small-scale fleet.

Except for littoral fleet directed specifically to shellfish, the remaining fleets operate on a narrow continental shelf where they exploit a variety of fishing resources by using different type of gears (trawl, gillnet, long lines...), forming a common demersal mixed-fisheries fleet. Although recent changes in fishing strategies and gears design have led some traditional demersal fleets to also exploit pelagic species, is not simple the combined management of demersal and pelagic stocks. On the one hand, most of the landings of pelagic stocks are made by fleets (purse seine, hand lines...) without any effect on demersal stocks. On the other hand, the populations of large pelagic species usually inhabit wide oceanic areas, so their life cycle is developed beyond the geographical limits of the case study.

Therefore, focusing exclusively on the demersal stocks, the potential Iberian mixed-fisheries MU would be composed of **12 métiers**. The métier, homogeneous groups of trips (regarding gear, objective species, area and season) is a scientific improvement for analytical purposes, as it allows for proper distribution of effort and catch between vessels and fisheries. However for the purposes of management and regulation, these métiers can be re-aggregated in the traditional fishing categories or gear types:

Table 8. Métiers defined in the Iberian waters case study

Gear category	DCF Metier (Acronym)	DCF Definition
NETS	GNS_DEF_>=100_0_0	Set gillnet targeting demersal fish with mesh sizes larger than 100 mm
	GNS_DEF_60-79_0_0	Set gillnet targeting demersal fish with mesh sizes within the range 60-79 mm
	GNS_DEF_80-99_0_0	Set gillnet targeting demersal fish with mesh sizes within the range 80-99 mm
	GTR_DEF_60-79_0_0	Trammel net targeting demersal fish with mesh sizes within the range 60-79 mm
HOOKS and LONGLINES	LHM_DEF_0_0_0	Hand line targeting demersal fish
	LLS_DEF_0_0_0	Set longline targeting demersal fish
SMALL SCALE (artisanal)	MIX_polyvalent	No DCF métier: Only the fraction of the Portuguese polyvalent fleet with catches from stocks included in the following section was considered
TRAWL	OTB_CRU_>=55_0_0	Bottom otter trawl targeting crustaceans using mesh sizes larger than 55 mm
	OTB_DEF_>=55_0_0	Bottom otter trawl targeting demersal fish using mesh sizes larger than 55 mm
	OTB_MCD_>=55_0_0	Bottom otter trawl targeting mixed crustaceans and demersal fish using mesh sizes larger than 55 mm
	OTB_MPD_>=55_0_0	Bottom otter trawl targeting mixed pelagic and demersal fish using mesh sizes larger than 55 mm
	PTB_MPD_>=55_0_0	Bottom pair trawl targeting mixed pelagic and demersal fish using mesh sizes larger than 55 mm

10.1.3 Fish communities included

As in the rest of European fishing grounds, the stock is the current biological MU used to manage the fishing resources in Iberian waters, so that the spatial distribution of the stock is a key aspect to determining fishing management measures on a particular area. The distribution of the main Iberian demersal stocks is coincident with the extension of the study area (ICES divisions VIIIc and IXa); however most of pelagic stocks cover more wide areas. Therefore, if we focus only on those “transversal” stocks, *i.e.* those stocks appearing in the catches of the different métiers listed in the previous section, and whose life cycle is fully developed in the case study area, there are up to **10 stocks** which are potential candidates in a mixed-fisheries management analysis in Iberian waters:

Table 9. Exploited species by the Iberian waters fleet

Code	Common name	Scientific name	Stock	Nº	Analytical assessment
ANK	Black anglerfish	<i>Lophius budegassa</i>	VIIIc-IXa	1	ASPIC
HKE	Hake	<i>Merluccius merluccius</i>	VIIIc-IXa	2	GADGET
LDB	Four-spot megrim	<i>Lepidorhombus boscii</i>	VIIIc-IXa	3	XSA
MEG	Megrim	<i>L. whiffiagonis</i>	VIIIc-IXa	4	XSA
MON	White anglerfish	<i>Lophius piscatorius</i>	VIIIc-IXa	5	SS3
NEP	Norwayn lobster	<i>Nephrops norvegicus</i>	FU25	6	No analytical
			FU2627	7	No analytical
			FU2829	8	No analytical
			FU30	9	No analytical
			FU31	10	No analytical

10.2 Management objectives

The EU fishing rules of the current Common Fishery Policy (CFP) are of three types: catch limits, fishing effort limitations, and technical measures. Regarding the catch limits, they are decided by the Council of Fisheries Ministers and set by applying Total Allowable Catches (TACs) by stock. However, the final decision is based on the Commission’s proposal, which is based in turn on the ICES (International Council for the Exploration of the Sea) scientific advice. The context for the ICES advice in fishing management is set by several international agreements and policies, among which are those related with the maximum sustainable yield (MSY) approach.

The United Nations Convention on the Law of the Sea (UN, 1982) notes that the allowable catch must be based on scientific information and designed to maintain species to levels supporting a maximum sustainable yield. This policy was reaffirmed by the Johannesburg Declaration of the World Summit on Sustainable Development (UN, 2002) by setting a deadline for achieving this goal not exceeding 2015. Maximum Sustainable Yield (MSY) is a broad conceptual objective aimed at achieving the

highest possible yield over the long term, which involves both sustainability of stocks and coexistence of métiers.

The management objectives of a potential Iberian mixed-fisheries MU fits with the **current Maximum Sustainable Yield (MSY) approach**.

10.3 Management tools

The MSY concept can be applied to an entire ecosystem, an entire fish community, or a single fish stock. However, to support the European stock by stock management system, implementation of the MSY concept by ICES is currently applied to individual fish stocks. This does not obviate the need to modify stock-specific advice to take account of technical interactions and biological interactions.

Technical interactions result from the non-selective nature of many fishing operations. For a mixed-species fishery, it may not be possible to achieve the single-stock MSYs (translated into TACs) of all the stocks simultaneously. ICES has developed mixed-fisheries models that incorporate the technical interactions between fleet units and stocks, and provide different trade-offs taking into account Fmsy for each stock in the fishery. Therefore, the current management system, based on single-stock TACs, can easily evolve into a mixed-fisheries management system based on **multi-TAC management tools**.

At the same time, the base of the current management plan in the area for “the recovery of the Southern hake and *Nephrops* stocks in the Cantabrian Sea and Western Iberian peninsula” (EC, 2005) could be extended to other stocks. Thereby, with the establishment of a **mixed-fisheries management plan** the effort control regime might be more realistic.

10.4 Regional management bodies

The Regional Fisheries Management Organization (RFMO) for North-east Atlantic (North East Atlantic Fisheries Commission: NEAFC) only makes recommendations concerning fisheries conducted beyond the areas under jurisdiction of Contracting Parties. Therefore, fisheries management measures in Iberian waters are set directly by the European Commission following the scientist advice of ICES. Since 2004, the Regional Advisory Councils (RACs) give a wide range of stakeholders a real opportunity to influence policy development on an ongoing basis; however they do not manage fisheries.

Although the management of a potential Iberian mixed-fisheries MU fits with the current decision-making system, it may be important to support the creation of a **bilateral regional management body between Spain and Portugal.**

10.5 Monitoring system

Monitoring a fishery system rests on the quality of the data collection programme. The current EU Data Collection Framework (DCF) for the Common Fisheries Policy (CFP) (EC, 2008) established a new sampling stratum which is vital for the analysis and management of mixed fisheries: the “metier”. A metier is a group of fishing operations targeting a similar (assemblage of) species, using similar gear, during the same period of the year and/or within the same area and which are characterised by a similar exploitation pattern (EC, 2010). Besides, DCF established a concurrent sampling system where all species in the catch must be sampled. This provides the data needed to parameterize the technical interactions between stocks and metiers.

The monitoring of a potential Iberian mixed-fisheries MU fits with the **current DCF sampling design.**

10.6 Assessment and advisory system

Traditionally, ICES bases its scientific advice on single-stock assessments, which are used to obtain catch options and prognosis. Particularly, the TAC advice is based on single-stock short-term predictions.

Nowadays, ICES has developed new methodologies in order to integrate more than one stocks in short-term forecasts. The Fcube mixed-fisheries forecast method (Ulrich *et. al.*, 2011) allows analyzing several stocks simultaneously using the results from their respective single-stock assessments, providing as a result an integrated multi-TAC. This method, or similar, can be an operative tool to analyze the Iberian mixed-fisheries MU and provide **mixed-fisheries forecasts.**

10.7 References

EC. 2005. Council Regulation (EC) No 2166/2005 of 20 December 2005 establishing measures for the recovery of the Southern hake and Norway lobster stocks in the Cantabrian Sea and Western Iberian peninsula and amending Regulation (EC) No 850/98 for the conservation of fishery resources through technical measures for the protection of juveniles of marine organisms. OJ L 345, 28.12.2005, p. 5.

- EC. 2008. Council Regulation (EC) No 199/2008 of 25 February 2008 concerning the establishment of a Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy. OJ L 60, 5.3.2008, p. 1.
- EC. 2010. Commission Decision of 18 December 2009 adopting a multiannual Community programme for the collection, management and use of data in the fisheries sector for the period 2011-2013 (2010/93/EU). OJ L 41, 16.2.2010, p. 8.
- Ulrich, C., Reeves, S. A., Vermard, Y., Holmes, S. J., and Vanhee, W. 2011. Reconciling single-species TACs in the North Sea demersal fisheries using the Fcube mixed-fisheries advice framework. – *ICES Journal of Marine Science*, 68: 1535–1547.
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11 Anexo VI: Management unit definition template. Case Study: “Bay of Biscay”

11.1 Description of the management units proposed based on the three pillar.

Various meetings have been held on the management unit for Bay of Biscay (experts, French fishery organizations). Activities are went through discussions on defining management units from a scientific perspectives towards an operational one. The discussions focused on various reflections like: the concept of management unit, the territorial approach, the consistency/feasibility with existing/operational management tools, the need of spatialization of some management tools, and the methodology for a definition of management units in Bay of Biscay.

The conclusions of the working group highlighted that there is an infinite number of management units according to the questions. The territorial approach is a prospective approach and some issues still need to be brought to knowledge (especially about functional areas) to deploy a management at these scales. It was also pointed out the difficulty of delimiting territorial management units and to control the access of vessels to various territorial units.

The fishery organizations advocates a more operational approach with the fleet as MU, to get clear elements to answer to the major objectives of the new Common Fisheries Policy (MSY, discard). This approach was adopted for the preparation of the Bay of Biscay multispecific management plan.

This approach is nevertheless compatible with a territorial approach according to management issues. As such, a spatial management approach is being tested on the "Grande Vasière" (soy muddy bottom area within Bay of Biscay), to improve fishing activities and impacts on environment. The approach is being undertaken through a consultation platform involving fishing organizations, scientists, French administration and NGO.

11.1.1 Spatial dimension

IFREMER defines the FISHERY as a entity defined for the **management** of fishing capacity in a **specific geographic area where various métiers operate** for the catches of species that occupy habitats with similar characteristics. This approach is multi-fleets, multi-métiers and multispecific, and his objective is a territorial consistency of management measures.

The current management system includes two types of measures : conservation measures and access regulations. These measures apply to species, gears, fleets, on a specific areas. The fishery approach is complementary, and management units can be

defined according to operational criteria: « physionomy » and geomorphology of fishing area, ecosystem, target species, regulatory environment & governance, specific management areas and the reality of spatial activity of fishermen.

From the definition of fisheries and criteria, several coherent units can be identified from coast to slope (Figure 7).

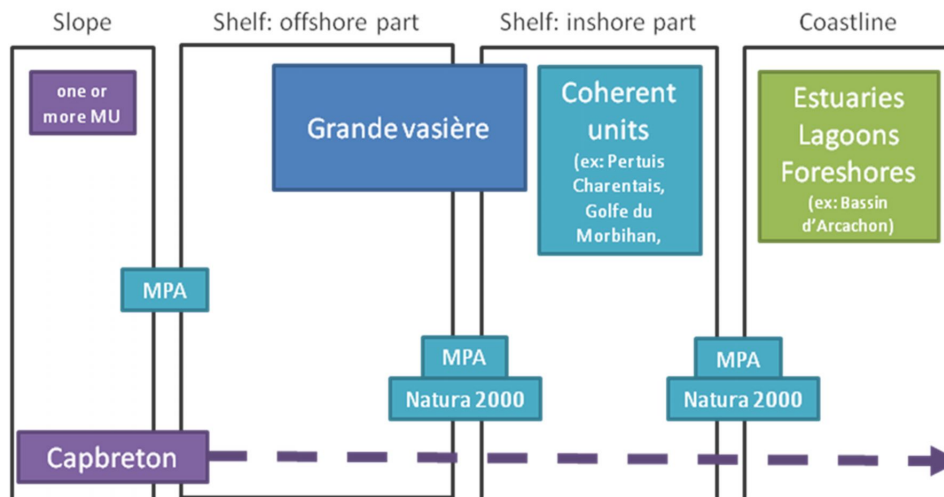


Figure 7. Coherent units for the Bay of Biscay

Then, the distributions of retained catches for the main nineteen species of Bay of Biscay helped refine the definition of management units (Figure 8), and allowed to distinguish eight major areas for Bay of Biscay (Figure 9).

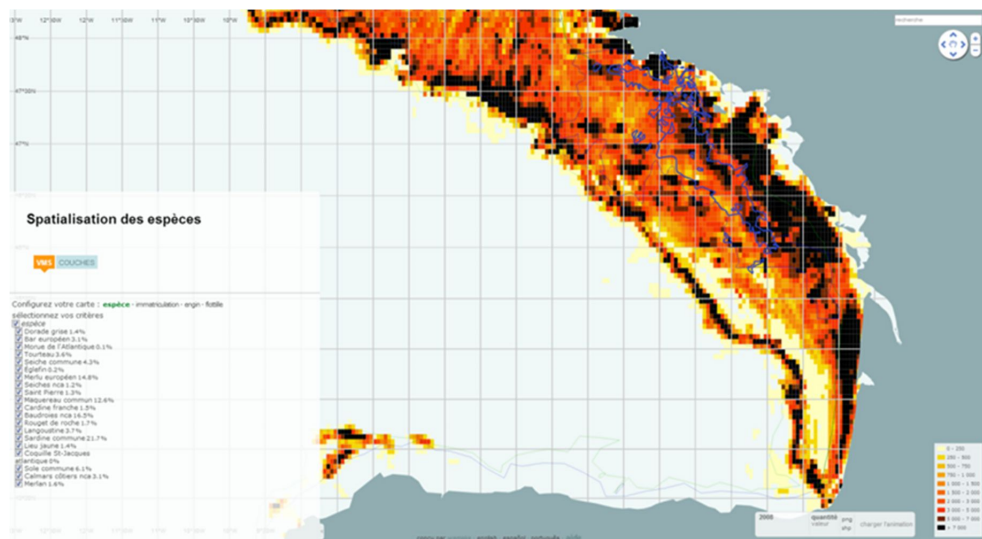


Figure 8. Distribution of retained catches for the main nineteen species for the French geolocalized vessels (2008)

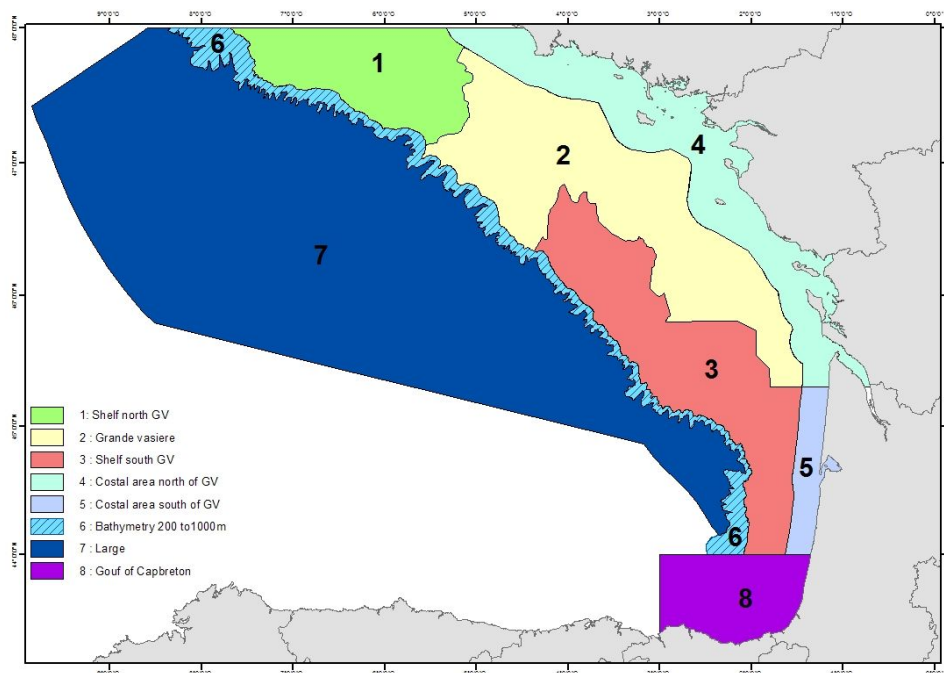


Figure 9. Possible scenario of management units for Bay of Biscay

This scenario was discussed during the meetings with stakeholders about management units in the Bay of Biscay case study. Given the above conclusions of the meetings, this scenario has been dropped in favour of a fleet approach.

11.1.2 Fleets included

The fleets of Bay of Biscay exploit a variety of fishing resources by using different type of gears (trawls, gillnets, long lines...), forming a common mixed-fisheries fleet. In the GEPETO project, it was proposed to make a complete description of the fleet which operate in the Bay of Biscay with a description of their activities, their spatio-temporal distribution, the stakes on each fleet and the possible interactions. This work will be carried out by Pêcheurs de Bretagne and completed by various French fishery organizations (work in progress).

The Table 10 gives a list of French fleets operating in Bay of Biscay. This table provides a partition of the active fishing vessels, taking into account the main combinations of métiers practiced in the year. The fishing vessels are divided into fleets as well, that is to say, groups of vessels adopting similar strategies (same métiers or combination of métiers) during the year. This fleet is defined by vessel on the basis of its annual activity and of all frequented fishing areas. A vessel can practice several métiers during the year, but will be affected only to one fleet.

Table 10. List of fleets and cumulative key figures by fleet (source: CFFR and activity calendars)

Flottille	Nombre de navires	Puissance totale (kW)	Jauge totale (U.M.S.)	Nombre de marins
Chalutiers exclusifs	322	97 708	28 496	1277
Tamiseurs	273	18 344	904	316
Fileyeurs	254	47 195	10 909	920
Chalutiers non exclusifs	222	24 420	2 523	416
Fileyeurs Caseyeurs	132	12 277	761	216
Métiers de l'hameçon	122	13 443	1 458	214
Fileyeurs Métiers de l'hameçon	97	11 890	1 080	199
Dragueurs	96	10 376	869	200
Divers métiers côtiers	76	3 935	149	101
Caseyeurs	61	7 761	1 480	156
Caseyeurs Métiers de l'hameçon	60	5 278	314	89
Senneurs	39	10 705	2 708	218
Total	1 754	263 332	51 652	4 321

11.1.3 Fish/shellfish communities included

As in the rest of European fishing grounds, the stock is the current biological MU used to manage the fishing resources in Bay of Biscay, so that the spatial distribution of the stock is a key aspect to determining fishing management measures on a particular area.

The distribution of the main Bay of Biscay stocks is coincident with the study area (ICES divisions VIIIab) or the extension of the study area (ICES divisions VIIIabde). Other stocks cover more wide areas, especially with ICES area VII. In this way, there are **at least 12 stocks which are potential candidates in a mixed-fisheries management analysis in Bay of Biscay** (Table 11):

Table 11. List of species targeted for mixed-fisheries MP of Bay of Biscay

Species	Stock
Sole	VIIIabd
<i>Nephrops</i>	VIIIabd
Hake	IV, VI, VII + VIIIabd
Monkfish	VII + VIIIabd
Pollack	VIII
Whiting	VIII
Megrims	VII + VIIIabd
Blue whiting	
Horse mackerel	
Mackerel	
Seabass (no TAC)	VIII
Red mullet (no TAC)	VI, VII, VIII, IX

11.2 Management objectives

The EU fishing rules of the current Common Fishery Policy (CFP) are of three types: catch limits, fishing effort limitations, and technical measures. Regarding the catch limits, they are decided by the Council of Fisheries Ministers and set by applying Total Allowable Catches (TACs) by stock. However, the final decision is based on the Commission's proposal, which is based in turn on the ICES (International Council for the Exploration of the Sea) scientific advice. The context for the ICES advice in fishing management is set by several international agreements and policies, among which are those related with the maximum sustainable yield (MSY) approach.

The United Nations Convention on the Law of the Sea (UN, 1982) notes that the allowable catch must be based on scientific information and designed to maintain species to levels supporting a maximum sustainable yield. This policy was reaffirmed by the Johannesburg Declaration of the World Summit on Sustainable Development (UN, 2002) by setting a deadline for achieving this goal not exceeding 2015. Maximum Sustainable Yield (MSY) is a broad conceptual objective aimed at achieving the highest possible yield over the long term, which involves both sustainability of stocks and coexistence of métiers.

The management objectives of Bay of Biscay is to propose a mixed-fisheries management plan allowing **to reach policy objectives of Maximum Sustainable Yield and discards reduction while maintaining as much as possible profitability and employment** (i.e mitigating economic impacts). Scenarios on reaching MSY through different options (exploitation pattern, reduction in number of days at sea, reduction in number of boats) will be thoroughly discussed with the fishing sector. The fishing sector is interested in the management plan because it should bring greater visibility through greater predictability of landings enabling maintaining the activity (socio-economic objectives). The objective is to deliver first scenarios at the end of the project.

11.3 Management tools

The MSY concept can be applied to an entire ecosystem, an entire fish community, or a single fish stock. However, to support the European stock by stock management system, implementation of the MSY concept by ICES is currently applied to individual fish stocks. This does not obviate the need to modify stock-specific advice to take account of technical interactions and biological interactions.

Technical interactions results from the non-selective nature of many fishing operations. For a mixed-species fishery, it may not be possible to achieve the single-stock MSYs (translated into TACs) of all the stocks simultaneously. ICES has developed mixed-fisheries models that incorporate the technical interactions between fleet units and stocks, and provide different trade-offs taking into account Fmsy for each stock in the fishery. Therefore, the current management system, based on single-stock TACs, can easily evolve into a mixed-fisheries management system based on **multi-TAC management tools**.

11.4 Regional management bodies

The Regional Fisheries Management Organization (RFMO) for North-east Atlantic (North East Atlantic Fisheries Commission: NEAFC) only makes recommendations concerning fisheries conducted beyond the areas under jurisdiction of Contracting Parties. Therefore, fisheries management measures in Bay of Biscay are set directly by the European Commission following the scientist advice of ICES. Since 2004, the Regional Advisory Councils (RACs) give a wide range of stakeholders a real opportunity to influence policy development on an ongoing basis; however they do not manage fisheries.

The management of a potential Bay of Biscay mixed-fisheries MU fits with the **current decision-making system**.

11.5 Monitoring system

Monitoring a fishery system rests on the quality of the data collection programme. The current EU Data Collection Framework (DCF) for the Common Fisheries Policy (CFP) (EC, 2008) established a new sampling stratum which is vital for the analysis and management of mixed fisheries: the “métier”. A métier is a group of fishing operations targeting a similar (assemblage of) species, using similar gear, during the same period of the year and/or within the same area and which are characterized by a similar exploitation pattern (EC, 2010). Besides, DCF established a concurrent sampling system where all species in the catch must be sampled. This provides the data needed to parameterize the technical interactions between stocks and métiers.

The monitoring of a potential Bay of Biscay mixed-fisheries MU fits with the **current DCF sampling design**.

11.6 Assessment and advisory system

Traditionally, ICES bases its scientific advice on single-stock assessments, which are used to obtain catch options and prognosis. Particularly, the TAC advice is based on single-stock short-term predictions.

Nowadays, ICES has developed new methodologies in order to integrate more than one stocks in short-term forecasts. The Fcube mixed-fisheries forecast method (Ulrich *et. al.*, 2011) allows analyzing several stocks simultaneously using the results from their respective single-stock assessments, providing as a result an integrated multi-TAC. The IAM bio-economic model could also be used to answer these questions. These methods, or similar, can be operative tools to analyze the Bay of Biscay mixed-fisheries MU and provide **mixed-fisheries forecasts**.

11.7 References

- EC. 2008. Council Regulation (EC) No 199/2008 of 25 February 2008 concerning the establishment of a Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy. OJ L 60, 5.3.2008, p. 1.
- EC. 2010. Commission Decision of 18 December 2009 adopting a multiannual Community programme for the collection, management and use of data in the fisheries sector for the period 2011-2013 (2010/93/EU). OJ L 41, 16.2.2010, p. 8.
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12 Anexo VII: Management unit definition template.

Case Study: “Celtic Sea”

12.1 Description of the management units proposed based on the three pillar.

The Celtic Sea is an extensive area of shallow continental shelf bounded by Ireland to the north and England and Wales to the south. Various different geographic delineations and naming conventions have been proposed throughout history leading to some confusion about the definition of the area. In addition the Irish Sea, West of Scotland, West of Ireland and Celtic Sea are collectively known as the Celtic Seas.

There are a number of large bays and harbours along the Irish and UK coastline. Several large river systems input into the area including the Severn, the Lee, the Blackwater and the Nore, Suir and Barrow. There is a natural boundary in the form of an oceanographic front running from the south eastern corner of Ireland to the south western tip of Wales.

12.1.1 Spatial dimension

For pragmatic geopolitical reasons the NWWRAC limited the defined geographic extent of the long term management plan to VIIfg. Many fisheries and species/stock distributions extend in to other adjacent areas. VIIfg is characterised by a generally shallow sea area <100m with one large deeper area, the Celtic Sea deep or ‘Smalls’ and several banks surrounded by deeper channels. Geologically there seabed habitat is quite diverse. To the west and south there is a gradual deepening of water towards the shelf break which is in VIIj. To the south and south east is the western channel where both the habitat is depth is similar.

The complex habitat results in very distinctive communities, which are exploited by different fishing gears and métiers with varying degrees of overlap and interaction. For example in the Irish fleet, it has been possible to identify the dominant species at a fine spatial scale (Geritsen *et al*, 2012). This clearly shows the spatial diversity across the area as well as providing the ability of spatially identifies distinct fishing grounds based on the dominant species in the retained catch. Spatial stratification of habitat based on species assemblages on discard trips has been used by CEFAS to develop a new ecosystem survey for the area (Kupschus, pers. Comm.).

12.1.2 Fleets included

The activities of fishing fleets in the area can and have been stratified in several different ways; DCF stratification, STECF-Effort group stratification, gear, mesh and catch composition based stratification, statistical definition of métiers (e.g. Davie & Lordan, 2011). Here for simplicity we describe the main fleets based on the STECF-effort segmentation.

Fishing effort in VIIfg is dominated by Ireland and France. The main demersal gears used are otter trawls (TR₁ and TR₂) with approximately 8 million KW days annually. The TR₂ gear has cod end mesh <100mm and is mainly targeting *Nephrops*. The TR₁ gear with >100m is used to target mixed roundfish (cod, haddock and whiting) and/or benthic species (monkfish, megrim, hake). The UK and Belgium dominate the beam trawl fisheries in VIIfg (BT) which show a declining trend in effort since 2003. Beam trawls are used to target sole, plaice, monkfish and megrim. There are lesser amounts of effort using various forms of gill nets and longlines in VIIfg.

There are other important shellfish fisheries (pot and dredge) and pelagic fisheries (mainly pelagic trawl) fishery operating in VIIfg. While these fisheries are not the main focus of the management plan they do interact with demersal fisheries in the area.

12.1.3 Fish/shellfish communities included

Demersal fisheries in the Celtic Sea catch a wide variety of fish and shellfish species. For example demersal trawl surveys in this area catch >100 fish species annually (Marine Institute, 2012). Notwithstanding the diversity in demersal species community the top 20 species account for ~ 95% of landings ICES carries out assessments and provides some form of management advice for 10 of the most important demersal species/groups which account for ~ 78% of the total demersal landings biomass from VIIfg (Figure 10).

Landings from the eastern part of the Celtic Sea tend to be more mixed and dominated by mixed-gadoids. There are distinct areas where targeted *Nephrops* and flatfish operate. The western parts of the Celtic Sea tend to be dominated by hake, monkfish and megrim. There are also a number of important species which are not subject to TAC constraints and are not currently subject to analytical stock assessments.

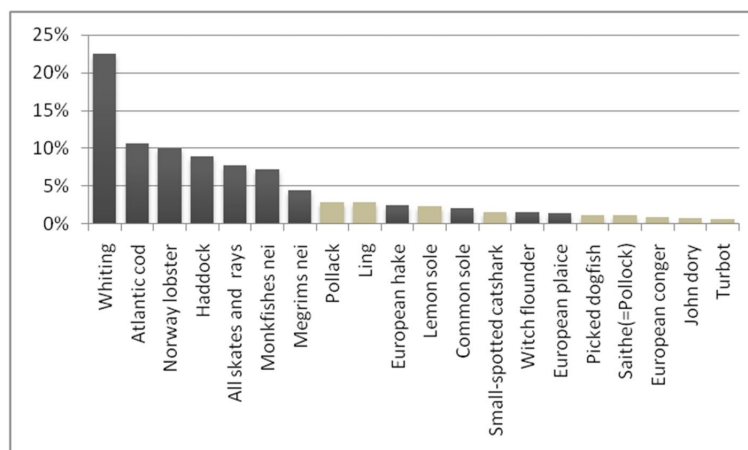


Figure 10. Percentage of total demersal landing by weight for the top 20 species from VIIfg. Stocks for which ICES provided management advice are shown in dark grey

12.2 Management objectives

In common with the majority of EU demersal fisheries, those in the Celtic sea can be characterised as being biologically and technically diverse with discarding of juvenile and over quota species problematic for many demersal species. In such fisheries, it is not entirely possible to control which species and how much of each is caught. In fact the economics will drive fishers to make best use of all TACs available to them. Under the current management approach, where single species TAC's are largely set without due consideration of these technical interactions, the TACs for some stocks are exceeded in trying to maximise the TACs of other stocks. Unless tactical and technical adaptations are introduced, it may not be possible to attain single-stock MSY levels and maximise potential yield simultaneously. Additionally, improvements in selection pattern for many of the key species could result in short and medium terms gains as higher section patterns are consistent with increases in Fmsy targets and therefore yield (STECF, 2012) it is therefore important that the effects of changes in exploitation pattern are also considered in the context of setting fishing opportunities.

Between 2010 and 2011 the NWWRAC developed and approved a framework and objectives for a mixed demersal fisheries management plan in the Celtic Sea (ICES Divisions VIIIfg). Figure 11 gives a schematic overview of the structure of this management plan. The plan itself was initially based on the Gulf of Alaska mixed fishery plan and it evolved through various consultations and deliberations at NWWRAC CS focus group meetings. The general aim of this plan is to address the high level CFP objectives by applying management measures at an appropriate region scale. The plan should be very much bottom up such that management objectives, tools, costs and trade offs are developed and applied in a transparent and considered way in consultation with key stakeholders. International experience has shown that this type of management paradigm has performed better (Hilborn, 2007).

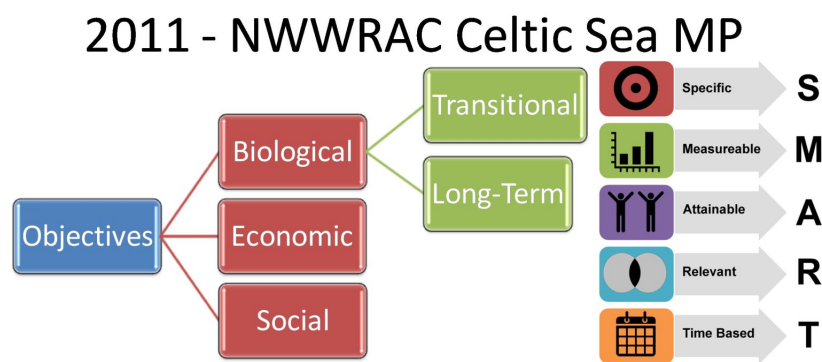


Figure 11. Schematic overview outlining the structure of the NWWRAC CSLTMP

12.3 Management tools

Fisheries in the Celtic Sea are mainly managed by a complex mixture of input and output controls including:

1. TACs (Council Regulation EC No 39/2013)
2. Disparate national quota management arrangements (e.g. <http://www.agriculture.gov.ie/fisheries/fisheriesmanagementnotices/fisheriesmanagementnotices2013/>)
3. Mesh regulations and minimum landings sizes MLS (e.g. Council Regulations 850/98)
4. National management measures, licensing and market control regimes (e.g. <http://www.agriculture.gov.ie/fisheries/seafisheriesadministration/fishingboatlicensing/>)
5. Effort & capacity ceilings (Council Regulation EC No 1415/2004)
6. Spatio-temporal closure 'Trevoes box' (Council Regulations 27/2005, 51/2006, and 41/2007, 40/2008, and 43/2009).
7. Mesh regulations associated with the hake recovery plan
8. BSA – Irish Box (Figure 6.3 and Council Regulation No. 1954/2003)
9. Natura 2000 special areas of conservation (Figure 6.5)
10. Discard reduction TCMs (EC Regulation 737/2012)
11. There are also developing proposals by the UK to introduce further Marine Conservation Zones or MSZ in the Celtic Sea.

Despite all of the above there is a perception by fishermen and managers alike that these are not working appropriately. During GEPETO meetings various other management measures have been discussed and proposed including effort control (without quotas), Real Time Incentives RTIs (Kraak, et al. 2012), mesh size and TCM changes and additional closed areas.

The NWWRAC management plan has stipulated at its core “catch based management” with discard reductions envisaged and a results based management system rather than prescriptive regulations.

12.4 Regional management bodies

All fisheries in this area are within the remit of the CFP. DGMARE is the European Commission section with responsibility for implementing the CFP. A new Common Fisheries Policy (CFP) has been agreed by Council and Parliament and is effective from 1 January 2014. The new CFP seeks to bring fish stocks back to sustainable levels, put an end to wasteful fishing practices, and create new opportunities for jobs and growth in coastal areas. To achieve this it focuses on banning discards, empowering the sector and decentralising decision making, prioritising aquaculture, supporting small scale fisheries, improving the scientific knowledge on the state of stocks, and taking responsibility in foreign waters through the EU's international agreements.

Since the reform of the CFP the managing authorities in several Member States of the EU i.e. Ireland, France, Spain, UK, Belgium and the Netherlands have been meeting monthly to develop regionalised management plans including in the area covered by this NWWRAC CSLTMP.

12.5 Monitoring system

The main stocks in this area are covered under the Data Collection Framework which implements a data collection regime to support the CFP ([EC 2008](#)). Various control regulations also apply to monitor landings, catches and effort and set out reporting requirements at a vessel and national level ([EC 2010](#)).

12.6 Assessment and advisory system

Most stocks and fisheries are assessed and advised on by [ICES](#) and STECF. The ICES expert groups and the main stocks assessed are listed below.

Table 12. ICES working groups relevant for this case study

ICES EG	Stock Names & Codes
WGCSE	Celtic Sea cod (cod-VIIek), Celtic Sea Haddock (had-VIIb-k), SW Ireland Nephrops (nep-19), Labadie Nephrops (nep-20-21), Smalls Nephrops (nep-22), Celtic Sea Plaice (ple-celt), Celtic Sea Sole (sol-celt), Celtic Sea whiting (whg-VIIb-k) Pollock in VII (pol-VII)
WGBIE (WGHMM)	Anglerfish (<i>L. budegassa</i>) in the Celtic Sea and Bay of Biscay (anb-78ab), Anglerfish (<i>L. piscatorius</i>) in the Celtic Sea and Bay of Biscay (anp-78ab), Megrin in the Celtic Sea and Bay of Biscay (mgw-78)
WGEF	Rays and skates in the Celtic Sea ecoregion

Single species stock assessments and short-term forecast are carried out for most stocks. The ICES data limited approach is also applied for some stocks to produce landings or catch advice. Effort data at national and gear level are aggregated by [STECF](#) for the VIIIfg area annually.

The [NWWRAC](#) is stakeholder-led Advisory Councils that provide the Commission and EU countries with recommendations on fisheries management matters.

12.7 References

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