



REPORT

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A photograph of a small fishing boat on the water. The boat is white with a green hull and has the registration number 'TL 623289' on its side. Two people are visible on the boat, one in the foreground wearing a yellow jacket. The boat is moving through the water, creating a white wake. The background shows a coastline with trees and hills under a clear sky.

FISHERMEN ENGAGEMENT IN MEDITERRANEAN MARINE PROTECTED AREAS

A key element to the success of
artisanal fisheries management

EDITORS



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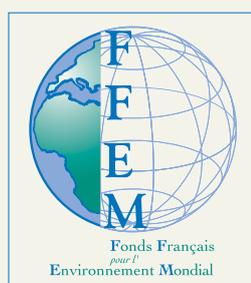
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FISHERMEN ENGAGEMENT IN MEDITERRANEAN MARINE PROTECTED AREAS

A KEY ELEMENT TO THE SUCCESS OF ARTISANAL FISHERIES MANAGEMENT

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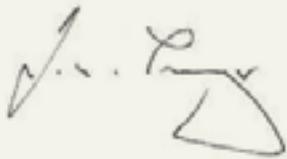
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FOREWORD



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Most Mediterranean fish stocks are currently overexploited: 82 % according to the European Commission and 79 % according to the General Fisheries Commission for the Mediterranean (2012). More directly than industrial fisheries, small scale, artisanal fisheries are considered to have broader positive effects on coastal communities and often less impact on the marine environment than their industrial counterparts. Artisanal fisheries provide critical income and protein to hundreds of million people and contribute to poverty alleviation and sustainable development in many coastal areas of the world. They operate in some of the biologically richest and most sensitive waters of the planet, where interactions with coastal and marine activities lead to complex interdependencies.

Artisanal fisheries in the Mediterranean Sea represent roughly 86 % of the approximately 42 000 fishing boats existing in the region. Although in decline and not properly accounted for either scientifically or politically, they are still highly socially, economically and ecologically relevant, even for EU countries. Artisanal fisheries provide around 100 000 direct jobs in the EU alone. In Europe, an operational definition of artisanal fisheries based on an overall length of vessels of up to 12 m has been proposed.

The objective of this publication is to show how coastal marine protected area (MPA) establishment and co-management involving fishermen from the very beginning in the Mediterranean have resulted in examples of successful coexistence between fishing and conservation interests such as in Torre Guaceto Marine Protected Area in Italy, Bonifacio Strait Nature Reserve, Scandola Nature Reserve, Port-Cros National Park and Parc marin de la Côte Bleue in France or Columbretes Fisheries Reserve in Spain. In those areas, conservation efforts have resulted in stabilized or even increasing fisheries yields, as confirmed by long-term scientific data series. These encouraging results now need to be demonstrated in a larger proportion of the hundreds of coastal MPAs established in the Mediterranean. This approach represents one of the solutions to move towards sustainable fisheries in the Mediterranean and in many other places.

But to achieve this, Mediterranean artisanal fishermen need enhanced recognition and engagement. An adequate legal framework that recognizes and legitimates the role, rights and responsibilities of artisanal fishers needs to be developed and implemented at a Mediterranean scale. Some positive developments for artisanal fisheries have taken place in this regard lately. Some measures for artisanal fisheries have been proposed in the latest reform of the EU's Common Fisheries Policy, such as the exemption from the transferable fishing concessions scheme, some financial measures aimed at helping local economies adapt to changes and, especially, the establishment of comanagement committees of marine resources whereby fishers can decide on the management of stocks on an equal basis as politicians and scientists. The General Fisheries Commission for the Mediterranean has also taken the first step towards integration of artisanal fisheries in the region by organising the 'First Regional Symposium on Sustainable Small-Scale Fisheries in the Mediterranean and Black Sea' in Malta in 2013. The establishment of a Mediterranean Platform of Artisanal Fishermen in 2012 is a good example of how artisanal fishers increasingly federate themselves so as to achieve an enhanced recognition of their needs and demands. However, more efforts will need to be done to reverse the decline of artisanal fisheries and make them fully sustainable.

WWF hopes that the present publication will contribute to this common effort by showing that MPAs can benefit artisanal fishermen in the long term and represent an important way forward for the future, alongside with other regional fisheries management tools.

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Port-Cros National Park - The "Champion" on its way to its fishing ground.

1. INTRODUCTION

1.1 ARTISANAL FISHING IN THE MEDITERRANEAN SEA

The term “artisanal fishing” is often equated with “small-scale fishing” (more frequently used by English speakers) even though some subtle differences between the two terms are sometimes pointed out. “Artisanal” indicates low levels of technology adopted during fishing operations without any reference to vessel size, while “small-scale” indicates small vessel size without any strict implication about the level of technology used. In the Mediterranean context, this difference is so highly nuanced - with a considerable proportion of small-scale vessels using low to moderate levels of technology - that we could refer to “small-scale artisanal fishing” (Griffiths *et al.* 2007). Throughout this document we will refer to “artisanal fishing” due to the common usage of this term in the Mediterranean context, especially considering that this report is chiefly addressed to Mediterranean stakeholders.

As a general rule, artisanal fishing is a difficult term to define because the criteria vary over space and time also often depending on the socio-cultural and historical context (Griffiths *et al.* 2007). The FAO glossary indicates that artisanal fisheries are: “traditional fisheries involving fishing households (as opposed to commercial companies), using relatively small amounts of capital and energy, relatively small fishing vessels (if any), making short fishing trips close to shore and mainly for local consumption. Artisanal fisheries can be subsistence or commercial fisheries, providing fishing products for local consumption or export” (FAO 2005).

Along the coasts of the Mediterranean Sea, fishing activities have been carried out for millennia using a number and a variety of gears that, through time, have become “traditional”, such as traps, fixed nets, etc. Artisanal fishing in the Mediterranean has evolved over time. Until a few decades ago, vessels operating artisanal fishing were mainly un-motorized. Recently, motorization (mainly in the form of outboard engines) has been increasingly adopted, but the use of this technological advancement (like many others) has not followed the same pace throughout the Mediterranean basin.

One relevant feature of artisanal fishing is the great diversity of gears and fishing techniques adopted all over the Mediterranean (generally called “métiers”; see details later), with a huge array of variations and/or distinctive features (e.g. octopus fishing using pots in North-African Mediterranean countries and in Spain, Ezzeddine-Najai 1992, González *et al.* 2011, a technique that has not changed substantially since Roman times).

Considering this high heterogeneity of conditions, it is difficult to provide a strict definition of what “artisanal fishing” actually is. However, for the sake of generalization in the Mediterranean context, some common features can be highlighted (also acknowledged by EU law). Artisanal fishing is usually operated by relatively small vessels (less than 12 meters total length, technically called “length out all”) typically fishing within the first three nautical miles (ca. 5.5 km) from the coast (Coppola 2006, Guyader *et al.* 2013) and within a limited radius of operation from their home harbor. Generally, artisanal fishing boats are equipped with a low-power engine and are operated by a single (usually the owner) or a few fishermen (frequently kindred). Artisanal fishing does not normally target a single species (as is the case with industrial or large-scale fishing targeting tuna or cod for example), but it is highly multi-specific (including a number of species of fish, mollusks and crustaceans, Farrugio *et al.* 1993).

Artisanal fishing uses a broad range of gears and techniques selected according to seasonal availability of target species (i.e. catchability) which reflects the differences in life-histories amongst target species (e.g. spawning and/or feeding migrations). Rotation of gears throughout the year is based on the fishermen's experience and knowledge of some aspects of the behavior, biology and ecology of target species (Battaglia *et al.* 2010).

The concept of "métier" (which denotes a combination of fishing gear, target species, area and season) is often used to characterize different artisanal fisheries (Mesnil and Shepherd 1990, Biseau 1998). The use of passive gears is a common feature of artisanal fishing with three gears (gillnets, trammel nets and longlines) accounting for approximately 85% of the artisanal gears used (Coppola 2006). Handlines, pots, dredges and other "personally developed" devices (Griffiths *et al.* 2007) play a secondary but by no means insignificant role. Beyond such a large variety of fishing gears, trammel nets are the most widely used gears throughout the Mediterranean, potentially assuring the catch of many commercially valuable and well-appreciated species (i.e. scorpion fishes, the striped red mullet, cuttlefish and the common spiny lobster, Battaglia *et al.* 2010, Matić-Skoko *et al.* 2011).

Artisanal fishing operations do not usually last longer than one day, and most of the time they just last a few hours, with some exceptions like fishing operations targeting the spiny lobster. Fishing operations do not generally take place every day (i.e. 150-220 days of fishing per year depending on the fishing area, Matić-Skoko *et al.* 2011, Guyader *et al.* 2013) due mainly to weather conditions and/or the time needed for gear/boat maintenance and fixing. In some areas where weather conditions are frequently extremely severe (such that the number of fishing days per year varies greatly from year to year but is generally low), this can be a factor affecting total catches, and thus fishermen revenues (e.g. in Cabo de Palos, Spain, Lorenzi 2013).

The artisanal fishing catch is mostly destined for local markets, i.e. fishermen sell the fish locally to residents, tourists, restaurants and fish shops. The catch can often be sold (legally or illegally) directly at landing and it does not generally go to industrial fish-processing plants.

Along the entire Mediterranean coast, artisanal fishing is an activity performed with a considerable number of vessels (about 80% of the 35,000 vessels composing the Mediterranean fishing fleet, Fishupdate.com) and fishermen (about 280,000, Griffiths *et al.* 2007).

Artisanal fishing in the Mediterranean has long played a fundamental role in both the economy and society (Farrugio *et al.* 1993) with considerable cultural and historical significance. For centuries, artisanal fishing has been an essential economic activity and one of the pillars of Mediterranean culture and related cultural diversity (Guidetti 2012). It has historically been a major food source, with employment and economic benefits for the inhabitants of Mediterranean coastal villages. Artisanal fishermen vessels are spread all over the Mediterranean but are generally grouped around small fishing communities based on small ports or docks (Féral 2001). These communities are composed of the families of artisanal fishermen who are often involved in multiple tasks in the fishery, from the production and repair of fishing gears to the handling and sale of the catches. This social aspect clearly represents a typical feature of artisanal fishing. Artisanal fishing is of great cultural value, due to the social and cultural characteristics, and knowledge and information passing from generation to generation (Gómez *et al.* 2006). In spite of its relatively low volume of catches and economic importance (i.e. compared to large-scale industrial fishery), artisanal fishing is socially important and an integral part of the Mediterranean coastal zone (Guyader *et al.* 2013). It strengthens people's affection for their territory (Guyader *et al.* 2013) and develops a harmonious relationship between coastal populations and the marine environment (Battaglia *et al.* 2010).

Reported catches from artisanal fishing are only 12% of the total biomass caught in the Mediterranean Sea (EU 2004). Artisanal fishing is often considered to have potentially less impact on marine resources than large-scale industrial fishing (Hawkins and Roberts 2004, Tudela 2004, but see Munoz *et al.* 2013 for a case study of artisanal fisheries possibly impacting reproduction of Mediterranean rockfishes). This widespread idea stems from the fact that artisanal fisheries discard little to no fish and do not substantially impact benthic communities (due to the adoption of passive gears). This makes a significant

difference compared to industrial trawlers using destructive fishing gear that destroys the bottom habitats on which exploited species depend, and discards 8–20 million tons of unwanted species each year on a global scale (Jacquet and Pauly 2008). In addition, artisanal fishing is generally considered a more environmentally-friendly fishing method due to lower fuel consumption by artisanal vessels than industrial fishing vessels (about one tenth, Guyader *et al.* 2013). This is due to the fact that artisanal vessels are smaller in size and usually operate with low-power engines, using passive gears and spending less time at sea.

However, it should be pointed out that artisanal fishing does have the potential to seriously impact fishing resources, when for example the fishing effort is considerably high (Tudela 2004, Munoz *et al.* 2013). This explains the growing recognition that the potential for artisanal fishing to be sustainable involves regulating the fishing effort, selecting appropriate characteristics of fishing gears and deriving more value from catches rather than increasing their size (Guidetti *et al.*, 2010b).

Large-scale industrial fishing is not generally a sustainable practice; it offers fewer social benefits than artisanal fishing (e.g. employing fewer people overall than small-scale fisheries) and it is more expensive and fuel-consuming (see Jacquet and Pauly 2008 for an analysis on the global scale). Data from Italy (source IREPA 2011) shows that artisanal fishing employs approx. 67% of the Italian fishing vessels and 48% of fishermen. The “number of fishermen employed per ton of catch” ratio is about five times higher for artisanal fishing than large-scale industrial fishing (i.e. 0.38 and 0.08 persons/ton of catch, respectively).

Although artisanal fishing is still important for some communities and is recognized as a potentially sustainable activity, this type of fishing is declining in many areas of the Mediterranean with a downward trend in the number of vessels and licenses, catches and net revenues (Guillou and Crespi 1999; Colloca *et al.* 2004, Gómez *et al.* 2006, Guyader *et al.* 2013, Lloret and Font 2013). In addition, populations of artisanal fishermen are progressively ageing: the age distribution is skewed towards older ages and young fishermen represent a fairly small fraction, often between 5 and 20% (Guidetti *et al.* 2010a, Matić-Skoko *et al.* 2011, Lloret and Font 2013). This indicates limited interest among younger generations in investing in a fishing profession. The search for more profitable employment opportunities in urban surroundings is perceived as the main reason for the lack of interest (Matić-Skoko *et al.* 2011). This is due to the fact that artisanal fishing is seen as a non-profitable activity: some fishermen are no longer able to make a profit from their business (due to stock depletion and/or increase in operating costs, and the ensuing low income generated) and need to develop other complementary professional activities (mainly in the primary and secondary sectors, agriculture, building, forestry and the service sector, Piante 2012, Guyader *et al.* 2013).

Although artisanal fishing has a relevant social and economic role in many Mediterranean countries, from a legal viewpoint it has long been relegated to a marginal role with a gap in policy that does not recognize its importance and particularity, often not making significant distinctions between this sector and large-scale industrial fishing in terms of regulations. This may have left artisanal fishing exposed to the “race for fish” (*sensu lato*), a competition to get shared fishing resources not only among artisanal fishermen, but also with other sectors such as large-scale fleets, recreational fishing, diving activities, tourism, aquaculture and other users of the coastal zone (Guyader *et al.* 2013).

The new Common Fisheries Policy (CFP) reform, that entered into force in January 1st, 2014, will introduce new measures for small-scale fisheries in European countries, recognizing the crucial role that artisanal fishing plays in the social and economic context of European coastal regions. In addition, particular attention is drawn to artisanal fishing by the General Fisheries Commission for the Mediterranean (GFCM), an FAO organization consisting of 23 Member countries along with the European Union aiming to promote the sustainable use of living marine resources.

From this perspective, financial measures beneficial to artisanal fisheries are likely to be defined in order to help local economies adapt to the ongoing changes.

1.2 MPAS AS A TOOL FOR FISHERIES MANAGEMENT

Fishing is commonly considered to be one of the greatest threats to many marine populations/stocks, marine biodiversity and ecosystem health (Worm *et al.* 2006). From the “simple” perspective of fishing, fish stocks, like any other (living) fishing resource, cannot be exploited beyond their capacity for replenishment, this being guaranteed by the periodic arrival of juveniles. If fishing is too intense, fish stocks may dramatically decline due to excessive removal of reproducers, which in the medium-long term negatively affects fishing revenues. From an ecosystem-wide perspective, most high-priced fishes on the markets are functionally important species (often top predators) within food webs (Friedlander and De Martini 2002). Their dramatic decline due to intense fishing was often found to cascade down altering populations of their prey and, indirectly, whole communities and ecosystems. These are quite common effects (on stocks and ecosystems) of both industrial and artisanal fisheries in many regions of the world, including the Mediterranean Sea (Sala *et al.*, 1998).

Although basic principles for effective management of natural populations, fishing stocks and whole ecosystems are generally known, management schemes applied in the real world to exploit fishing resources have seldom taken these recommendations into account. Links at ecosystem level must be correctly taken into account to properly preserve ecosystems and enhance fisheries.

In recent decades, a growing number of Marine Protected Areas (hereafter MPAs) *sensu lato* have been created worldwide with the aims of: 1) protecting natural populations of marine species and their habitats, together with related overall biodiversity, ecosystem functions and services; 2) enhancing fishing and especially supporting more sustainable fishing practices; 3) promoting local socio-economies and sustainable development; and 4) preserving historical and cultural values. Moreover MPAs are used for education and research, as well as for recreation and tourism purposes. MPAs can thus be described as multiple objective tools designed to accomplish conservation objectives and to promote sustainable development (considering social and economic aspects).

Definitions of and terminology related to MPAs (*sensu lato*) can vary quite significantly (sometimes different terms are just synonyms), and may differ from one country to another or may depend on the context (e.g. scientific, political). Among the various types of existing MPAs, “marine reserve” for instance is a term used mostly in the US to define areas where extractive activities are forbidden. Conversely, in the EU and the Mediterranean, the term MPA is much more common to define areas that often contain 1) sub-areas where some human activities are permitted but regulated (usually called “buffer zones”), and 2) one or more “no-take zones” where all extractive activity (and sometimes access) is forbidden. In some political documents, especially EU documents, the term “Fishing Reserves” is also used. Fishing Reserves are protected areas created for conservation purposes and for the sustainable use of fisheries resources. Fishing reserves are spatially delimited areas where the harvesting of marine resources is restricted, e.g. according to gear types (restricted fishing areas), or forbidden (no-take zones).

In this report, the term “MPA” will be used to generally define any marine area incorporating no-take zones into buffer zones, or including exclusively one or more no-take zones.

The Database of MPAs in the Mediterranean, MAPAMED, has so far recorded 677 MPAs (Mapamed.org 2013). Among these, 507 are Natura 2000 sites at sea, most of which have no management structure in place as yet and, more importantly, do not include any “no-take” areas. Among the 170 other MPAs, many have been zoned and encompass a “core zone” which is typically a “no-take” (sometimes “no-access”) area. Often called “reserve zones”, these latter zones are surrounded by other “buffer zones” characterized by different levels of restrictions, more lax than for the “core zone”. This solution allows conservation needs to be balanced with different users’ requirements (artisanal and recreational fishing, diving, navigation, etc.), which is extremely important in tourist regions like the Mediterranean Sea (see Font *et al.* 2013 for an analysis of recreational fishing in Mediterranean MPAs). On the other hand, some Mediterranean MPAs comprise “no-take zones”

On board sampling in the MPA of National Marine Park of Zakynthos



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only. Throughout the Mediterranean Sea, MPAs can have a number of different management structures: Gabrié *et al.* 2012 in their analysis on a subsample of Mediterranean MPAs found that the majority of MPAs have a decentralized management structure at a local or regional level (46%), whilst 36% are directly managed by national states. Some MPAs have a combined management (7.5%) or are managed by NGOs (Non-governmental organization, 5.5%).

Such a context in the Mediterranean also makes MPAs a potential tool for sustaining artisanal fishing and related human communities (e.g. Seytre and Francour 2008, 2009, Guidetti and Claudet 2010, Guidetti *et al.* 2010b), within an ecosystem-wide conservation perspective (Roberts *et al.* 2001, Gaines *et al.* 2011).

The concept of MPAs as exposed above is thus in line with modern views of fisheries management, shifting towards a more ecosystem-based approach, an argument that has been increasing among fisheries scientists (e.g. García and Cochrane 2005). Ecosystem-based fisheries management (EBFM) incorporates the concepts of stock interactions, stock-prey relationships and stock-habitat requirements into management (Christie *et al.* 2007). It essentially promotes management views aimed at limiting the impact(s) of fisheries on ecosystems (Zhou *et al.* 2010). EBFM was later expanded to include the human dimensions of fishing, and termed “ecosystem approach to fisheries (EAF)” (Garcia *et al.* 2003). EAF differs from EBFM by balancing societal economic needs with ecosystem health (Garcia *et al.* 2003; Christie *et al.* 2007). Unlike traditional management tools, MPAs can support EAF by protecting geographical areas to include target species, habitats and ecosystems, along with human dimensions (Lubchenco *et al.* 2003).

What in practice do MPAs do to be useful to sustaining artisanal fishing? Following the cessation of fishing activities within a given area, fishing mortality is immediately eliminated and targeted individuals can live longer. In addition, habitat quality generally ameliorates after an MPA is created and effective management/surveillance is set up. Protection measures positively affect the wealth, density and individual sizes of fish species, leading to a significant increase in spawning biomass over time. This family of effects is generally called direct “reserve effects”, which take place within the borders of well-enforced MPAs. A number of reviews and meta-analyses (e.g. Guidetti and Sala 2007, Claudet *et al.* 2008, Garcia-Charton *et al.* 2008), and papers (Bell 1983, Micheli *et al.* 2004, Di Franco *et al.* 2009, 2012, Seytre and Francour 2009, Sala *et al.* 2012) have reported direct ecological effects of MPAs in the Mediterranean Sea. Because fishing has historically targeted the higher trophic levels of marine food webs, many of the species that show the greatest increases within MPAs are upper-trophic level predators, with effects that propagate through food webs and influence the structure and dynamics of whole communities within MPAs. The most common indirect effect of MPAs is called “trophic cascade”, where the removal of human fishing leads to an increase in (previously) harvested predators and a decrease in their prey, and so on down to the base of the trophic web. As a result of these complex interactions, recovery of predator stocks within MPAs may indirectly influence entire communities driving them towards a pristine status (Sala *et al.* 1998). In general, marine benthic systems appear to be more susceptible than other systems to trophic cascades (Shurin *et al.*, 2002). In many temperate regions like the Mediterranean Sea, such changes have been seen in the form of shifts from macroalgal forests to coralline barrens (a sort of rocky desert). The re-establishment of lost predatory interactions within MPAs can help reverse or avoid those shifts (Sala *et al.* 1998; Guidetti 2006, Guidetti and Sala 2007).

Effects of MPAs and reserves are not limited to their boundaries. Once commercial species of fish increase within MPAs, especially within the no-take zones, fish biomasses can be exported outside the boundaries, via the so-called “spillover effect”. A portion of the biomass produced within the MPAs (or no-take zones) thus becomes available to local fishermen, with related benefits in socio-economic terms (Guidetti 2007, Harmelin-Vivien *et al.* 2008, La Mesa *et al.* 2011). Trophic effects of MPAs across boundaries have also been shown to affect fished sites, but studies on these aspects are too limited to provide any generalization (Guidetti 2007). Spillover is not the only benefit produced by MPAs beyond their boundaries. Increased production of eggs and larvae by reproducers under protection within MPAs can allow both the self-replenishment of MPAs, and

an export via current elsewhere, including towards sites open to fishing (an effect called “recruitment subsidy”, Gruss *et al.* 2011; see also García-Charton *et al.* 2008, Harmelin-Vivien *et al.* 2008, Di Franco *et al.* 2012). Settlement (when larvae metamorphose to early juveniles in coastal areas) and recruitment (when juveniles later join adult populations) can be powered by the availability and good conservation status of essential habitats (e.g. nursery areas, often represented by shallow waters) for juvenile fish (Harmelin-Vivien *et al.* 1995, Planes *et al.* 2000, Bussotti and Guidetti 2011, Cheminée *et al.* 2011, 2013).

To summarize, therefore, there are direct and indirect effects of MPAs within and outside the boundaries, which may have positive effects on local fisheries, especially artisanal fishing. The effects may appear obvious, provided that the rules and regulations of MPAs are properly enforced (Guidetti *et al.* 2008). The lack of enforcement is one of the most relevant issues concerning MPAs in the Mediterranean context (Fenberg *et al.* 2012).

Within the buffer zones of MPAs, artisanal fishing is usually allowed, in general according to national law, sometimes subject to more strict regulations than the national law. MPAs can, however, represent the scenarios in which experimental fishing management can be run within the framework of efforts to achieve sustainability.

In some Mediterranean MPAs (e.g. Torre Guaceto in Italy, Port-Cros in France) specific agreements with fishermen have allowed them to increase both the quantity and quality of fishing yields and related revenues. Such agreements can also secure their legitimacy and support for protection by the fishermen involved (Claudet and Guidetti 2010, Guidetti and Claudet 2010, Guidetti *et al.* 2010b).

Despite the potential positive benefits of MPAs for fisheries, MPAs can also pose problems on adjacent fisheries. One undesirable effect of no-take zones is the loss of fishing grounds available to fishermen, resulting in a displacement of the fishing effort. This effect is particularly important in certain contexts like small islands, where the overall available coastline is not particularly extensive and where fishermen do not have any other alternative than to concentrate along the stretches of coast outside the no-take zones. In this scenario, the same number of fishermen are forced to operate within smaller areas (i.e. the “squeeze” factor, Halpern *et al.* 2004) if the fishing effort remains the same. This process can lead to a high concentration of fishing effort in external areas flanking the MPA borders (as detected at Medes MPA, Goñi *et al.* 2006). Furthermore, this can result in extra costs for fishermen when they need to travel much further to fish (Hilborn *et al.* 2004 but see Kerwath *et al.* 2013). Nevertheless, studies carried out by Forcada *et al.* (2010) and Steizenmuller *et al.* (2008) in the Mediterranean have reported that proximity to an MPA is a decisive factor of the spatial distribution of fishing effort, which is often concentrated along the boundaries of MPAs or no-take zones (where fishermen expect or actually catch more fish). As a result, fish stocks outside the no-take zones (e.g. buffer zones) may run the risk of being severely overfished due to heightened fishing pressure (Hilborn *et al.* 2004, Di Franco *et al.* 2009).

In conclusion, MPAs and artisanal fishing are closely linked, and the potential of MPAs to enhance fisheries is relevant, particularly in the Mediterranean Sea where there are significant gaps in current legislation on the management of multiple-gear and multi-species artisanal fisheries at European Union (EU) and individual State level. While most Mediterranean MPAs were initially developed mainly to protect habitats and biodiversity (Francour *et al.* 2001), their actual use to sustain artisanal fisheries is quite recent, but more than promising. The increasing empirical evidence from various studies in this geographic area is showing positive ecological effects of MPAs and their potential to enhance artisanal fisheries (e.g. García-Charton *et al.* 2008, Claudet and Guidetti 2010, Fenberg *et al.* 2012).

1.3 CO-MANAGEMENT OF COMMON POOL RESOURCES: THE CASE OF ARTISANAL FISHERIES

During recent decades, a wide range of common pool resources (CPR, e.g. forests, water, fish stocks) have faced general depletion worldwide (Pauly *et al.* 2002, Ostrom 2009). From this evidence, the need to examine the circumstances under which CPRs can be successfully managed strongly emerged. CPRs are generally embedded in complex social-ecological systems (SEs, Ostrom 2009) that are made up of several subsystems (see Ostrom 2009 and references therein for a detailed discussion). In a complex SES, subsystems are fairly distinguishable but interact at the SES level, which then feeds back to affect the subsystems (Ostrom 2009).

Fisheries and fishing resources (i.e. fish stocks) are examples of SES and CPR, respectively. In the last decades, a clear downward trend in fishery catches has been seen globally (Pauly *et al.* 2002), against a continuous rise in demand for seafood, followed by a further increase in fishing effort and a consequent reduction of average catch per unit of effort (CPUE). Specific evidence of the declining trend is also available for the Mediterranean Sea (Leonart 2008). And this trend has not spared artisanal fisheries (Gómez *et al.* 2006). The growing fishing pressure has thus caused a severe exploitation of many stocks worldwide, highlighting the need for proper management of fishing resources. From this point of view, artisanal fishing represents an activity irrefutably difficult to manage, owing to its very nature (i.e. heterogeneity in resources targeted and gears adopted, its fragmentation, and small-scale and competitive nature) (MRAG 2002).

Until recently, within the context of artisanal fishing (but also for any SESs), it was largely assumed that stakeholders (e.g. fishermen) would never self-organize to maintain their resources long term, such that governmental bodies must impose management strategies. However, some central government policies have proven to be ineffective. Particularly, traditional “top-down” approaches based on centralized government intervention have proven largely inadequate in addressing a number of issues, such as managing local stocks to limit resource depletion and solving user-group conflicts (MRAG 2002, Arceo *et al.* 2013). On the other hand, there is more and more evidence that some resource users are stepping up their efforts to achieve sustainability (Ostrom 2009). In recent decades, there has been growing recognition that whenever fishermen are keenly involved in fisheries management, the management itself become more effective and legitimate (Sen and Nilsen 1996). From this perspective, in terms of CPR management, there has been a widespread shift in governance towards what is defined as “co-management” (Ostrom 2009, Cinner *et al.* 2012a), a bottom-up management approach as opposed to more conventional top-down approaches to management of natural resources (Berkes 2009). Co-management is an apparently simple notion that is very often misunderstood and confused with collaboration, implication, etc. The term co-management defines a partnership in which local stakeholders share power, responsibility and authority with governmental bodies (Berkes 2009) for the purposes of resources management (Evans *et al.* 2011, Cinner *et al.* 2012a). Based on this definition, co-management is considered different from community-based resource management (CBRM) because in this latter case government is not involved in the decision-making process concerning the management of local fisheries (Sen and Nilsen 1996). However, it must be emphasized that CBRM is largely uncommon in countries where governmental bodies effectively manage CPR (Jones *et al.* 2013), and from this perspective a number of authors have recently adopted CBRM and co-management (improperly) as synonyms (e.g. Ostrom 2009, Cinner *et al.* 2012a, Piante 2012).

Involving users in resource management is based on the idea of self-interest: users must have a stake in the conservation of resources in order to enhance their effort and commitment to preserve CPR. The theoretical basis of co-management is in the area of commons, and in particular Ostrom’s (1990) design principles for collective action. In general terms, the collection of resources from CPRs procures benefits for the individual stakeholders, while the costs and consequences are paid and shared at societal level. This unbalanced condition motivates users to maximize their yields. This process

Consultation meeting at
the Penisola del Sinis - Isola
Mal di Ventre MPA



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averts users from cooperating and can lead to overexploitation of the resource (Brandt *et al.* 2012), which may decline significantly or even collapse. Maximization of the current yield would be detrimental to future pay-offs, while more balanced resource extraction would increase the possibility of higher productivity and consequently higher revenues in the long term (Brandt *et al.* 2012). If future pay-offs are perceived as considerably high, the stakeholders (e.g. fishermen) are generally willing to relinquish a portion of current yields, to cooperate with the other stakeholders harvesting on the same resource and to invest in future productivity (Brandt *et al.* 2012). Such a change, nevertheless, is only possible when the management authority or the co-management approach proposed to fishermen is credible, and based on shared decision-making power and mutual trust among the players involved.

Co-management practice can be seen as a problem-solving process (Carlsson and Berkes 2005), and as a type of property rights regime in the continuum between from nearly total self-management to nearly total state management, in which there is a power-sharing arrangement between the governmental/management bodies and a community of stakeholders (Pomeroy and Berkes 1997).

Stakeholders in fisheries co-management vary depending on the case. They may be individuals or groups/organizations of people who are interested, involved or affected (positively or negatively) by marine and coastal resource use and management. According to Pomeroy and Rivera-Guieb (2006), “stakeholders may include groups affected by the management decisions, groups concerned about the management decisions, groups dependent upon the resources to be managed, groups with claims over the area or resources, groups with activities that impact on the area or resources and groups with, for example, special seasonal or geographic interests”.

In most cases, however, four main “actors” can be identified in a scenario involving co-management: resource users, government, other community members and the change agents.

The users of the resource (or primary stakeholders) are those that have an interest in managing the resource from day to day: persons living on the harvesting and use of marine and coastal fishing resources, individuals whose activities have an impact on these resources and, in turn, are affected by management actions. The users of fishing resources are fishermen. Fishermen’s relatives are also part of resource users, because in most cases, children and wives are directly involved in or depend on fishing activities.

The government is composed of entities at both the national and local level (state, region, city, town, district, village, Marine Protected Area) having legal authority over fisheries and coastal resources.

The other stakeholders involved in a fishing context are, for instance, wholesalers, boat owners, fish traders, fish processors, boat builders, etc. In a context of multiple-use MPAs (which represent a considerable proportion of all Mediterranean MPAs), recreational fishermen and diving operators can also be regarded as stakeholders.

The change agents usually belong to NGOs, development agencies, academic institutions and research institutions, acting as catalysts for change. They act as intermediaries between resource users and government, and help the community to be empowered and to manage the resources (Pomeroy and Rivera-Guieb 2006).

At present, co-management represents the only solution to sustain the majority of fisheries worldwide, particularly artisanal fisheries (Ostrom 2009, Gutiérrez *et al.* 2011, Cinner *et al.* 2012a, Cinner *et al.* 2012b). This process of decentralized management has become more and more common and is now recognized as a mainstream approach (Evans *et al.* 2011), especially in developing countries (see Arceo *et al.* 2013), with increased rights and responsibilities given to resource users (e.g. fishermen) through delegation of management authority. A number of cases of co-managed fisheries can be found worldwide (see Gutiérrez *et al.* 2011). Communities (of resource users and other stakeholders) are increasingly empowered with the responsibility of working with governmental bodies to take decisions about marine resources in a context of decentralized co-management (Cinner *et al.* 2012a).

Co-management should not be viewed as a single strategy for solving all fisheries management problems, but rather as a process of resource management, maturing, adjusting and adapting to changing conditions over time. A healthy co-management process will adapt over time in response to changes in the level of trust, credibility, legitimacy and success of the partners. Co-management involves aspects of democratization, social empowerment, power sharing and decentralization (Pomeroy and Rivera-Guieb 2006). The establishment of co-management can be complex, costly and very time- and effort-consuming. It may take several years to organize and initiate activities and interventions at community level. It also takes a long time for the partners to address concerns about legitimacy, trust, accountability and transparency (Pomeroy and Rivera-Guieb 2006). In the early stages, it is crucial to focus on building trust and engaging stakeholders (Walton *et al.* 2013). This phase is critical in order to initiate a process leading to co-management.

In the last two decades, a large body of literature was produced focusing on co-management experiences and on the benefits of co-management in fisheries. Recurrently recognized benefits of co-management include: increased sense of ownership leading to more responsible exploitation; improved management through use of knowledge of local socio-economic and ecological conditions; and greater compliance with regulations (Gutiérrez *et al.* 2011). Generally, co-management can help make management practices closely reflect local conditions and more legitimate in the eyes of stakeholders. This process helps to increase stakeholder motivation to comply with rules (Cinner *et al.* 2012a) and to constructively support protection/management initiatives (Claudet and Guidetti 2010). This aspect is crucial for artisanal fisheries where management, monitoring, control and enforcement of regulations under top-down centralized governments are extremely difficult, if not impossible, due to a number of factors including limited economic and human resources and a potential lack of stakeholder ownership and engagement.

Empirical findings highlighted that co-management arrangements succeed in sustaining resources and improving livelihoods of stakeholders who depend on them (Gelcich *et al.* 2008, Evans *et al.* 2011, Cinner *et al.* 2012a, but see McClanahan *et al.* 2009). However, despite the great attention paid to this topic, it should be noted that most available information comes from developing countries and that much less concerns the MPA context, especially in developed countries (but see Frangoudes and Alban 2004, Pascual-Fernandez and de la Cruz-Modino 2011).

Meeting of MPA managers and artisan fishermen in Italy (2012)



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Port-Cros National Park - The "Champion" on its way to its fishing ground.



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2. AIM OF THE STUDY

The general aim of this study is to assess the factors potentially contributing to improving management effectiveness of artisanal fishing in Mediterranean MPAs, with a special emphasis on the possible engagement of fishermen in local management schemes.

The specific aims of this study are:

- to provide an outline of the current situation of artisanal fishing (see chapter 1.1 for definition of artisanal fishing) in Mediterranean MPAs;
- to point out the potential variables influencing the success of artisanal fishing management (see chapter 3.1 for definition of management success adopted in the present study) in Mediterranean MPAs. Among the variables considered we included the “level of fishermen engagement in artisanal fishing management in each MPA” to test the hypothesis that involving users in resource management may have the potential to create benefits for fisheries management (see chapter 3.3).

This work includes 26 case studies from seven Mediterranean countries with the intention of providing both specific analyses of each single case, and generalities for the whole Mediterranean.

Here, we provide a descriptive analysis of the status of artisanal fishing management in the Mediterranean Sea (focusing on MPAs) and a series of recommendations that could help MPAs to implement a co-management building process of local artisanal fisheries.

3. MATERIAL AND METHODS

3.1 DEFINITION OF MANAGEMENT SUCCESS

To assess the potential success of any management strategy, the first step should be to define what “success” actually is (McCarthy and Possingham 2007). When the concept of “success” is defined in the literature, it commonly refers to vague notions of resource or institutional persistence (Berkes *et al.* 2006), with little reference to firm benchmarks or processes (Welch-Devine 2012). However, some authors made efforts to fill this gap by explicitly defining measurable ecological, social and economic outcomes contributing to the definition and quantification of “success” (see Evans *et al.* 2011, Gutiérrez *et al.* 2011), but these attempts are still quite rare and underdeveloped (see Welch-Devine 2012 for a detailed discussion on the definition of “success” in co-management practice).

In the present study, we centered our evaluation of “success” on the fact that artisanal fishing is a complex activity encompassing different themes: environmental (i.e. the extraction of fishing resources, potentially having an impact on marine ecosystems), economic (i.e. income for fishing communities), social (i.e. the link between Mediterranean coastal societies and the fishing activities), cultural and historical (i.e. cultural heritage related to traditional fishing). Due to this multifaceted nature, successful management practices of artisanal fishing should properly address all these aspects. We thus followed the definition given by Pomeroy *et al.* (1997) that identified “success” as the “well-being of the coastal ecosystem, including both the human and non-human elements”.

In this study, we targeted as an ideal management practice one that leads to, produces or maintains a) healthy fish assemblages (including most of the stocks targeted by fishing) within an MPA, b) benefits for fishermen (e.g. in terms of higher income) and c) overall acceptance of the management practice by fishermen. More specifically, we considered as an ideal successful condition (i.e. 100% success) the case of an MPA where: 1) the ecological effectiveness (from the absence of any positive effect to strong positive effects of the protection/management provided by the MPA on fish assemblages) and the increase in catches due to MPA implementation are proven by reliable and robust scientific evidence (preferably published in international peer-reviewed scientific journals), 2) fishermen compliance with rules and fishermen support for the overall management process were highlighted, 3) information about all the relevant variables (e.g. ecological, social and economic) was available and 4) a reliable specific study/monitoring of artisanal fishing management (preferably published in international peer-reviewed scientific journals) was done, and evidence is to some extent available.

It is evident that we deliberately chose the criteria in order to soundly include the concepts of information availability, quality, robustness and accessibility in the definition of successful management. This was done based on the following rationale: a) the importance of obtaining scientific information on multiple aspects in order to be able to implement a proper management plan, b) the idea that knowledge of past experiences is crucial for MPA managers and stakeholders in order to properly drive their management actions toward what was proven to be positive, and c) the fact that having the results of a study/monitoring published in international peer-reviewed journals makes them more reliable and credible than results published in reports, local journals, congress proceedings, etc. Publishing at international level in fact implies a formal selective evaluation by international and anonymous peer reviewers (with high rejection rates of manuscripts deriving from

studies that do not reach international standards of scientific quality). In addition, the fact that the information is available worldwide if it is published in international journals not only helps to improve management of the MPA where the study is conducted, but also of other MPAs worldwide. On the other hand, we are not inferring that research published in national journals or reports is valueless per se, but it is generally less accessible on an international scale (i.e. often published in non-vehicular languages, not found on the web through searches on widely used search engines) and its scientific reliability/value is not properly assessed through a formal peer-review process. We indeed included grey literature in our analyses, just ranking its “reliability weight” at a different and lower level compared to international peer-reviewed literature.

To achieve our goal, we followed the multidisciplinary framework of Ostrom (2009) as an appropriate basis for identifying relevant management attributes, their outcomes and to define an overall idea of success. A set of variables describing the interdisciplinary (ecological, socio-economic and informative) attributes and performance of artisanal fishing management in MPAs was defined. A “management success score” (from 0 to 100%) was developed by combining variables (see material and methods section for details).

3.2 SELECTION OF CASE STUDIES AND DATA COLLECTION

In the present work, the MPAs used as case studies were primarily selected using the criterion of geographical representativeness within the Mediterranean basin. For the sake of simplicity, we operationally divided the Mediterranean Sea into four different sub-regions: North-West Mediterranean, Adriatic Sea, Central-South Mediterranean and East Mediterranean (Fig. 1).



Figure 1: Green dots indicate the distribution of Mediterranean MPAs. Operative division of the Mediterranean Sea into four zones is shown: 1 (North-West Mediterranean), 2 (Adriatic Sea), 3 (Central-South Mediterranean), 4 (East Mediterranean). From Gabrié *et al.* 2012, modified.

We selected a number of MPAs roughly proportional to those established in each sub-region, chiefly using the MPA list reported in Gabrié *et al.* 2012.

In this study, we used multiple sources for gathering data:

- Questionnaires (Appendix 1) e-mailed to MPA managers and scientists, designed to obtain specific data from each MPA on management of artisanal fishing (e.g. fishermen allowed to fish in the MPA, gears allowed, regulations, fishermen involvement in the management process). This way, managers provided us with information that we would otherwise not have been able to obtain. Direct contact with MPA managers and scientists via email and/or phone has also been made to clarify responses to the questionnaires.
- Review of scientific literature obtained through a comprehensive search of various electronic library databases (including Web of Science, Google Scholar, Scopus, Aquatic Sciences and Fisheries Abstracts) using key words (different combinations of: fisher*, communit*, participatory, small scale, coastal, artisanal, stakeholder*, manag*, outcome*, benefit*, socio*, econom*, and income*) and the name of each MPA and then following up references therein. Additional searches were performed on Google.
- Review of available studies published on a national/local level, and of conference proceedings. As such studies are often unavailable on-line and unreported in scientific databases, we searched these sources in our personal archives or explicitly asked colleagues working in other scientific institutions, NGOs, MPAs, etc. throughout the Mediterranean.
- Review of grey literature; unpublished studies carried out by MPA management bodies and directly provided by the MPAs. This procedure also allowed us to account for other documents unavailable from more conventional sources.

The literature search was performed in May 2013. Papers and other documents published later were not considered in our analysis.

3.3 QUESTIONNAIRES

A total of 26 questionnaires, out of 30 sent, were answered by MPA managers/scientists who had been contacted during a first phase.

Thirty-two items were used in the questionnaire to collect information about artisanal fishing management within each MPA, together with the related ecological and socio-economic effectiveness. The questionnaire was developed with the help of Jean Boncoeur and Frederic Alban (University of Brest). The questionnaire was pre-tested and adjusted before being submitted to MPA managers and scientists.

3.4 SCIENTIFIC LITERATURE AND OTHER DOCUMENTS

Manuscripts in different languages (i.e. English, Spanish, French and Italian) were reviewed and processed. Manuscripts correspond to published papers (at international and national level), grey literature and any other material provided by the managers and scientists consulted.

3.5 DATA ANALYSIS

In order to analyze the data collected, we followed the same approach used in the study published in Nature by Gutiérrez *et al.* 2011, adapting it to our dataset and the Mediterranean context.

Using the Institutional Analysis and Design (IAD) framework (Ostrom 2007, 2009) as a theoretical basis, a set of variables was defined describing the interdisciplinary (ecological, technical, socio-economic and managerial) attributes and performance of (co-) managed artisanal fisheries, based on literature reviews (MRAG 2002, Gutiérrez *et al.* 2011). Discussions with project contributors and co-management stakeholders invited to a workshop held in Carovigno (Brindisi) in 2012 (see Piante 2012 for a report on the workshop) was essential to select the most appropriate set of variables. In the report, we will often use the term “variables”, which generally encompass explanatory variables (i.e. the factors possibly explaining the differences observed in management effectiveness) and response variables (what is measured to assess the management success). According to the available literature, whenever a distinction between the two categories of variables has to be made, “response variables” will be called “outcomes” and “explanatory variables” “attributes” (MRAG 2002).

Variables were generally grouped into three categories (economic, social and ecological), reflecting the major types of co-management impacts within critical dimensions of a fishery system (Evans *et al.* 2011).

We tentatively considered the largest number of variables in order to describe a range of different fishery management institutions and interventions (MRAG 2002). However, a number of variables had to be discarded due to the impossibility of obtaining sufficient/exhaustive data or to their low relative discriminating power among the MPAs considered (i.e. the same score and/or category was attributable to more than 95% of the MPAs considered).

The variables were described with multiple measurement scales (continuous, ordinal and nominal). Whenever possible, continuous measurement scales (e.g. surfaces in km²) were used to describe the variables. Often, however, this was not possible, particularly with respect to variables requiring a more qualitative assessment (e.g. level of engagement). In this case, ordinal scales were employed.

Regarding the “ecological effectiveness and its reliability/robustness” outcome (hereinafter “ecological effectiveness”), the following approach was adopted. A 2-point scale was adopted to assess the ecological effects of each MPA: absence of any positive effect of the MPA on fish assemblages (1 point); positive effect(s) of the MPA on fish assemblages (2 points). The reliability/robustness of this information was then weighted according to a 3-point scale: information communicated by an MPA manager or scientist through the questionnaire and not reported in any report or international publication (0.6 point); data and evidence coming from a report or national/local journal (0.8 point); data and evidence coming from an international peer-reviewed paper (1 point). The choice of scale for weighting information “reliability/robustness” was made so as not to overweight information from peer-reviewed papers compared to other information sources. We multiplied the coefficient of ecological effects (i.e. 1 or 2) by the coefficient of reliability/robustness (i.e. 0.6, 0.8 or 1) and successively, for the sake of simplicity and clarity (i.e. in order to express results in integers), we ranked the results on a 6-point scale, as follows: absence of any positive effect of the MPA on fish assemblage indicated by the MPA manager or scientist through the questionnaire and not reported in any report or international publication (rank=1); absence of any positive effect of the MPA on fish assemblages highlighted by results from a report (rank=2); absence of any positive effect of the MPA on fish assemblages highlighted by results from an international paper (rank=3); positive effect of the MPA on fish assemblage communicated by the MPA manager or scientist through the questionnaire and not reported in any report or international publication (rank=4); positive effect of the MPA on fish assemblages highlighted by results from a report (rank=5); positive effect of the MPA on fish assemblages highlighted by results from an international paper (rank=6).

The higher ordinal level (i.e. score) was represented by evidence of an MPA’s positive effect certified by a highly reliable/robust source (i.e. a peer-reviewed paper). Absence of or evidence of positive effects of MPAs were assessed as a result of the implementation of management (before-after analysis) or when comparisons were available between unprotected areas and MPAs (control-impact analysis).

The same rationale was applied for the “CPUE and its reliability” outcome (hereinaf-

ter “CPUE”, catch per unit of effort) that was used as a proxy of fishery benefits (higher catches or income). Information about fishermen revenues is largely missing (as previously evidenced by Badalamenti *et al.* 2000, Himes 2003 for the Mediterranean context) and we therefore used CPUE (or CUPA, catch per unit of area, depending on information available from each MPA), assuming the “fish price” to be constant between each MPA and its unprotected “control” area (or over time), and assuming that fishermen income will be related to the amount of fish caught. In this study, we also assumed the cost of fishing to be constant between each MPA and its unprotected “control” area (or over time). These assumptions thus make it possible to provide a simplified estimate of “fishing income”, as the latter is related not only to the amount of fish caught, but also to a number of other variables, such as operational fishing costs (such as fuel, personnel), the specific techniques used and the location of fishing areas. Revenues are also related to the composition of species (with some species being much more valuable than others) and fish size (with bigger fish being more valuable than small ones). However, generally, the most valuable species are the ones that are most targeted by fisheries and also the ones that benefit more (in terms of increased density and size) from MPA protection (Claudet *et al.* 2008, Guidetti *et al.* 2008, Guidetti *et al.* 2014). From this perspective, an equal-weight catch coming from an ecologically effective MPA (composed of more commercially valuable fish of larger size) could potentially be more valuable than a catch coming from an unprotected area. As a result, in this study the positive effect of an MPA on fishermen revenues could be underestimated, but the lack of detailed data (except for limited cases like Torre Guaceto MPA; Guidetti *et al.* 2010b) makes it impossible to provide more detailed analyses on fishermen revenues in MPAs on the Mediterranean scale.

Based on Gutiérrez *et al.* 2011, we defined as “add-on benefits” the direct and indirect potential conservation benefits resulting from fishermen environmental stewardship (see Gray and Hatchard 2007 for a detailed discussion on this concept). Specifically, we assessed add-on benefits by looking at 1) fishermen engagement in research/environmental programs developed in the local MPAs and 2) fishermen commitment to artisanal fishing management practices in the MPA. The latter point would be assessed by analyzing fishermen compliance with MPA rules and the number of offenses committed by fishermen authorized within the reference MPA for the local fishery, with a low/zero number of offenses indicating overall fishermen agreement. However, due to a lack of data, we used fishermen engagement in MPA surveillance as a proxy (i.e. participation in surveillance considered as a proxy of fishermen commitment to MPA management). To assess add-on benefits, we adopted a 3-point scale: low add-on conservation benefits when artisanal fishermen do not act as environmental wardens nor do they participate in environmental research projects (1 point); moderate add-on conservation benefits when artisanal fishermen act as environmental wardens or participate in environmental and/or research projects (2 points); high benefits when artisanal fishermen act both as environmental wardens and participate in environmental and/or research projects (3 points).

To assess the “info availability” outcome, we used a 7-point scale, from 0 to 6 depending on the number of relevant variables that were studied through (at least) an international paper (relative to each variable and MPA). Multiple papers assessing the same variable for the same MPA were thus considered as one. Following the rationale of Gutiérrez *et al.* 2011, we identified whenever possible the following relevant variables to be analyzed, in order to assess the management success: MPA’s ecological effectiveness on fish assemblages (mainly assessed using non-destructive sampling methods such as visual census); changes in CPUE; changes in fishermen revenues arising from catches; community empowerment; increase in social welfare; and add-on conservation benefits.

From the literature, it appears relevant to have information about these six variables to be able to assess the potential success of any (co)management practice for artisanal fishing. Unfortunately, information on a number of these variables is largely missing for Mediterranean MPAs (see results section) and we therefore used only three out of these six variables as “outcomes” (namely ecological effectiveness, CPUE and add-on conservation benefits), thanks to the possibility of collecting information through published papers, reports and/or questionnaires.

For the “Existence of any specific publication on artisanal fishing management” outcome,

we used a 3-point scale: absence of any specific publication on artisanal fishing management (0 points), publication(s) available as project reports, national/local journals or conference proceedings (1 point), publication(s) available in an international ISI journal (2 points). We considered to be a “specific publication”, an article/report expressly focusing on the issue of artisanal fishing management in an MPA, incorporating information on artisanal fishing CPUE within and outside the MPA (and/or showing a trend within the MPA over time). These papers provided information on the effect of management strategies (e.g. *numerus clausus*, gear restrictions, ban on spearfishing, etc.) on artisanal fishing CPUE within MPAs and/or more generally monitored trends of artisanal fishing. This information is crucial to implement and/or adapt any management plan aimed at maximizing management success.

Data was compiled for 21 variables for each of the 21 MPAs (out of 26 that responded to the questionnaire) where artisanal fishing was allowed within their boundaries (see results section), resulting in a data matrix of 441 cells. When information came from a literature source, the corresponding scored cells had one or more literature references. Because of the considerable number of variables and case studies, and the general scarcity of data, not all variables could be scored for each MPA. The resulting dataset was therefore “patchy”, with some missing values (~6% of the 441 cells composing the data matrix).

The MPA of Habibas (Algeria) was unfortunately excluded from the analysis due to the lack of information for most of the outcomes.

In order to compute a management success score, we used a standard principal components analysis (PCA), following the approach adopted by Pandolfi *et al.* (2003), on a multivariate matrix with the five outcomes.

We added two virtual MPAs to our dataset (a standard procedure), as representatives of 1) the worst condition (minimum management success) and 2) the optimal condition (maximum management success; see the aims of the study for a definition of “success”). Missing values within our dataset were well scattered among the variables and MPAs, and did not cause any problem for the analyses. To focus on patterns among MPAs rather than among variables, data was normalized. We used Euclidean distance as a resemblance measure.

A scree-plot of eigenvalues against PCA components (preparatory analysis) showed that only the first principal component (PC1) allows the variance of the data to be described (deep change in the slope between PC1 and PC2; Fig. 2). This first evidence allowed us to consider the PC1 as a synthetic and representative measure of management success.

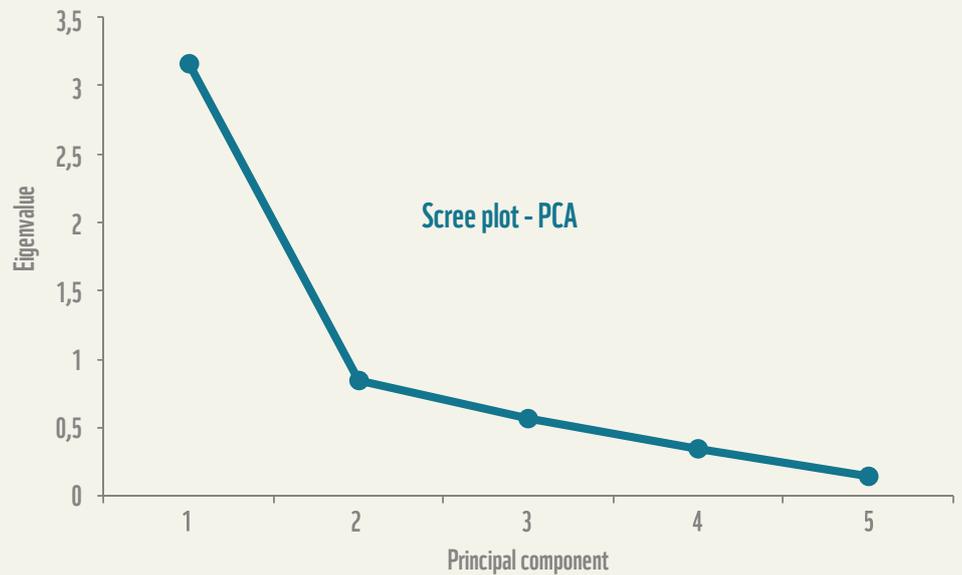


Figure 2: Scree-plot of PCA components and their eigenvalues.

We then plotted the percentage of management success as a function of the PC1 axis “normalized”, so that the worst co-management condition was equal to 0% of success and the best co-management condition corresponded to 100% of success. In this way, we obtained a synthetic measure (success score) encompassing a number of multidisciplinary variables used in this study.

This “success score” was used as the response variable in all subsequent statistical analyses.

Regression trees were used to identify key features (i.e. explanatory variables) of management and to determine the way these variables would influence outcomes. Regression trees produce a hierarchical map of binary choices showing which attributes best partition the data according to the success score. Regression trees offer substantial advantages over other statistical methods when analyzing complex social-ecological datasets and in particular when modeling nonlinear data containing multiple interacting variables (see MRAG 2002, Gutiérrez *et al.* 2011).

4. RESULTS

4.1 CASE STUDIES

DISCLAIMER

This section of the report includes the case studies of all the MPAs considered and is intended as a disseminative tool specially targeting MPA managers, policymakers and fishermen. In this perspective, data and references (that follow the numeration for each MPA used in the section “Documents reviewed per each MPA”) therein were used with the explicit aim of providing straightforward and simple outputs. By doing so, we deliberately chose to favour simplicity over scientific rigor. Bibliographic references in each case study should be regarded as an indicator for readers interested in knowing the relevant scientific literature.

Radar graphs (only for MPAs where artisanal fishing is allowed) report the score for each of the outcomes considered as a percentage of the maximum score achievable (see “data analysis” section).

In some MPAs we added a “lessons learnt” section where comments and thoughts of managers or scientists are reported. All managers and scientists interviewed were asked to provide their comments about management, but arbitrarily we reported briefly only some of these comments basing on a “originality” criterion. From this perspective, MPAs where “lessons learnt” section is not present are to be intended as sharing the opinions reported for the other MPAs.

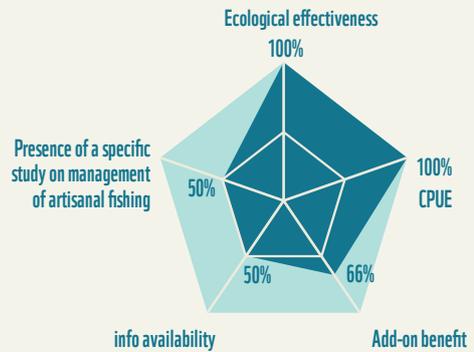


Figure 3: Green dots indicate the distribution of all Mediterranean MPAs. MPAs analyzed in the present study are represented by green dots partially filled with red. From Gabrié *et al.* 2012, modified.

CERBÈRE-BANYULS MARINE NATURE RESERVE (FRANCE)



ARTISANAL FISHING ALLOWED	YES	<input checked="" type="checkbox"/>	NO	<input type="checkbox"/>
MANAGEMENT PLAN FOR ARTISANAL FISHING	YES	<input checked="" type="checkbox"/>	NO	<input type="checkbox"/>
FISHERMEN ENGAGEMENT IN MANAGEMENT				



MPA PASSPORT

DATE OF CREATION:

1974 (1978 for Integral reserve (IR))

ESTABLISHMENT OF THE MANAGEMENT BODY:

1974

MANAGEMENT BODY:

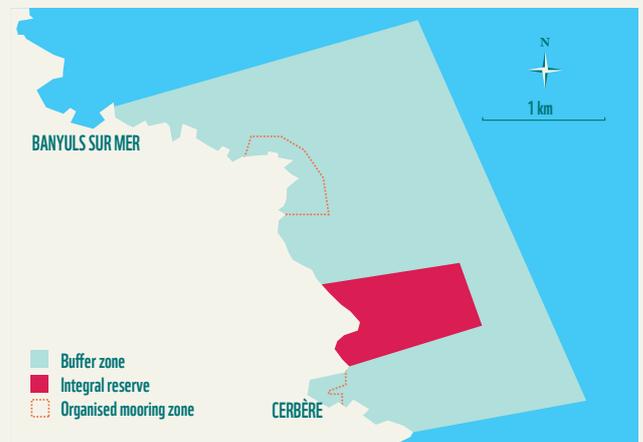
Cerbère-Banyuls Marine Nature Reserve

TOTAL AREA:

6.50 km²

ZONING:

5.85 km² buffer zone (BF) and 0.65 km² integral reserve (IR). Artisanal fishing is allowed in the BF. Recreational fishing is permitted only during the day and under specific regulation.



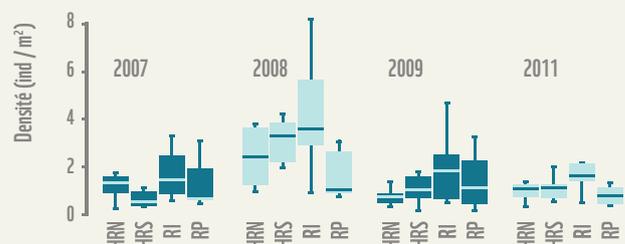
DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

- Reserve effect in term of fish biomass [5]
- Higher fish biomass within the IR.
- Biomass rapidly declining from IR outward.
- Evidence of fish spillover from IR outward [2,3,5].

Figure 1: Total density according to protection level (ORN : Outside Reserve North, ORS : Outside Reserve South, IR : Integral Reserve, BF : Buffer Zone) and year (2007,2008, 2009, 2011) at a 10-meter depth

Source: RNCB



ARTISANAL FISHING AT CERBÈRE-BANYULS RESERVE TODAY

Authorization required for fishing within the reserve. It is issued by the Departmental Directorate of Maritime Affairs after approval by a committee comprising the Reserve management body, *Prud'homie* and Maritime Affairs.

Number of vessels authorized to fish in the MPA: 15 boats maximum (local fishermen have priority).

Length of vessel: up to 8.5 m.

Authorized gears: 3 patches of fishing net 750 meters long or 1 or more fishing lines for a maximum of 500 hooks, deployed for 24 hrs. Nets shall be marked with flags bearing the number of the authorization. Three “bonitières” (fishing net to catch fishes belonging to the Scombridae family) fixed, each 250 meters long.

Traps prohibited.

CPUE (CATCH PER UNIT EFFORT) AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

- Highest CPUE: near the boundaries of IR (Fig.1).
- Decrease in CPUE as distance increases from the IR [3].
- Similar trends in fishermen income [3]

THE PROCESS OF FISHERMEN ENGAGEMENT

- 1974: establishment of the reserve. Consultative meetings took place before the reserve was established.
- 1978: The implementation of the IR was difficult.
- Today:
 - More frequent participation of fishermen in meetings.
 - No Fishing logbook to complete. Fishermen prefer that managers board fishing vessels.
 - No participation of fishermen in scientific monitoring.

LESSONS LEARNT

- Involve artisanal fishermen in the consultation process and in the establishment of the MPA if possible, or in the early management measures.
- Implement measures to manage commercial fisheries that integrate fishermen: sustainable fisheries, pescatourism (including training), return fishing data, possibility of collecting fishing data directly on board and / or at dock .
- Include fishermen in the annual reviews to make them feel included in the MPA management.
- Manage other activities permitted within the Reserve taking into account the long-standing activity of fishermen (e.g. traditional fishing area) such as in the case of managing dive sites which overlap with fishing sites.

Below: Two-banded sea breams.

Right: Artisanal fishing vessel in the Cerbère-Banyuls Marine Reserve.



BONIFACIO STRAIT NATURE RESERVE (FRANCE)



MPA PASSPORT

DATE OF CREATION:

1999, by decree of September 23rd 1999

ESTABLISHMENT OF THE MANAGEMENT BODY:

1982 (former Natural Reserve of the Lavezzi Islands)
Management body: Corsica Environment Office

TOTAL AREA:

794.6 km² incl. 782.94 km² of marine area

ZONING: 3 ZONES

- Open exploitation: artisanal fishing allowed, with limitation on gears (e.g. mesh size for trammel net), lobster fishing season.
- Enhanced protection zone (EPZ) (130 km²): Spearfishing forbidden, recreational fishing limited to hand-held gears, artisanal fisheries authorized under the same conditions as in the open exploitation areas.
- No-take zone (NTZ) (12 km²), all fisheries and scuba diving activities forbidden. Two fishing reserves (cantonnements de pêche) at Bonifacio (12.28 km²) and Porto-Vecchio (15.38 km²): all fisheries and scuba diving activities forbidden.

ARTISANAL FISHING
ALLOWED

YES



NO



MANAGEMENT PLAN
FOR ARTISANAL FISHING

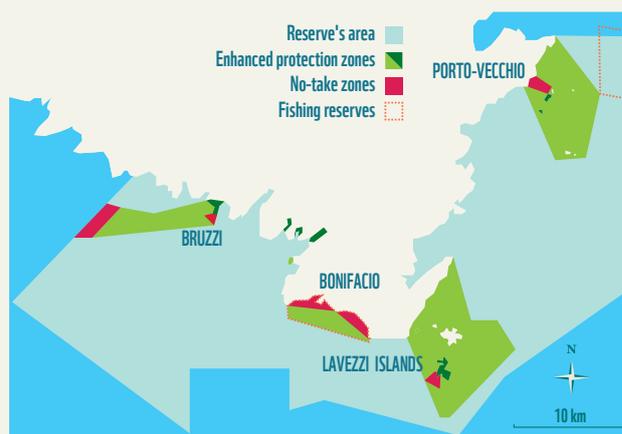
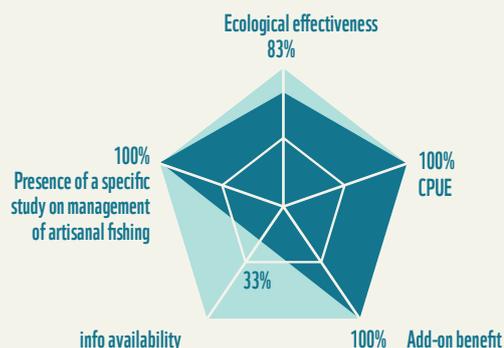
YES



NO



FISHERMEN ENGAGEMENT
IN MANAGEMENT



Capo Feno - International Marine Park of the Bonifacio Strait



© E. VOLITO, O.E.C.

DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

- **Lavezzi EPZ (25 years of protection):**
Reserve effect: Fish biomass three times higher in no-take zones than open exploitation zones: significant reserve effect in the RNBB in less than 5 years.
- **Open exploitation zones:** stability of low average biomass since 1995.
- **Lavezzi NTZ(1982):** stability of high average biomass since 1995.
- **Zones where spearfishing is forbidden since 1982:** average biomass 3.2 times higher than open exploitation zones.
- **Zones where spearfishing is forbidden since 1999:** average biomass 3.6 times higher than open exploitation zones.
- **Some areas (Bruzzi and Lavezzi Natural Reserve Zone (1992) and NTZ (1999)) closed to spearfishing for 10 and 20 years, then later closed to artisanal fisheries:** biomass indices increased by 1.8 times in ten years reflecting the effect of stopping this activity.
- **Effect of artisanal fishing on fish populations:** between 1992 and 2011, artisanal fisheries in the extreme south of the reserve appear to have been two times less significant than any other “fishing” effect.

Gorgonians and groupers - International Marine Park of the Bonifacio Strait



© E. VOLTO, O.E.C.

ARTISANAL FISHING AT BONIFACIO STRAIT NATURE RESERVE TODAY

- **Number of vessels authorized to fish:** between 30 and 35 fishermen fishing in the RNBB (figure may vary depending on the year).
- **Authorized gears:** trammel nets and secondarily longlines and traps.
- **Authorization:** Authorization of *prud'homie* is required to fish in the RNBB.
- No monitoring of artisanal catches data

CPUE (CATCH PER UNIT EFFORT) AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

CPUE for fishing nets: increasing trend between 1993 and 2012. Net increase between 1993 and 2005 now tending towards stability (Figures 1-3) [3,4].
The long-term series on CPUE highlight the reserve effect in fish nets (mesh size from 5 to 9, net deployed up to 24 hours) (Figures 1-3) [3,4].

Figure 1: Change in CPUE at the ZPR Lavezzi between 1993 and 2012. Modified from [3,4]



Figure 2: Comparison of CPUE mean values between different protection levels at RNBB. Modified from [3,4]

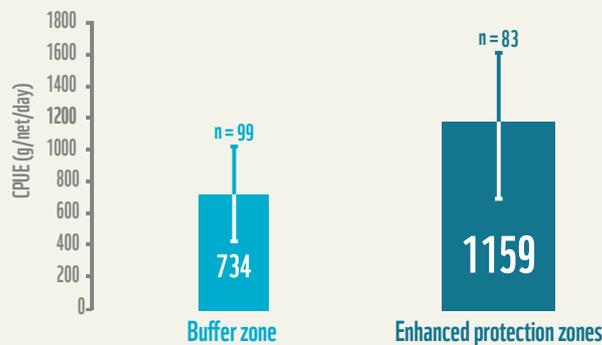
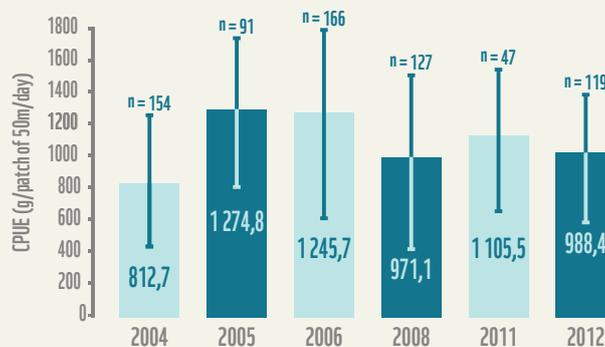


Figure 3: Change in CPUE for fishing nets to fish in g/patch of 50m/day at the RNBB between 2004 and 2012. Modified from [3,4]



THE PROCESS OF FISHERMEN ENGAGEMENT AT BONIFACIO STRAIT NATURE RESERVE

- 1982: Establishment of the Bonifacio *prud'homie* by fishermen
- 1992-1999: Fishermen largely contributed to the long process of reserve implementation. Currently, fishermen participate in frequent meetings of the RNBB Advisory Committee (representative of the Bonifacio *prud'homie*).
- Artisanal fisheries regulations were partially agreed jointly with artisanal fishermen.
- Fishermen are involved in the scientific monitoring of the RNBB (possibility of compensating fishermen participating in the monitoring).
- In 2004-2005, fishermen expressed the need to study fisheries that they considered to be in crisis (i.e. lobsters and sea urchins).
- Fishermen frequently inform managers (guards, scientists, MPA management) about surveillance difficulties. *Prud'homie* representatives are empowered to enforce prohibitions in fishing areas as well as the rules of the *prud'homie*.

LESSONS LEARNT

- The results of an MPA can influence fisheries management beyond the MPA boundaries. The collaboration of the RNBB and Bonifacio fishermen concerning lobster fishing is a good example of transfer of ecological engineering from RNBB to the rest of Corsica.
- Beyond the conservation of marine resources, results such as those obtained in the RNBB can be used in support of artisanal fisheries in relation to the European institutions. The specificity and sustainability of artisanal fishing should be recognized and taken into account by public fisheries policies at European and national levels, including the reform of the Common Fisheries Policy.

Fisheries - International Marine Park of the Bonifacio Strait



© O.E.C.

BRIJUNI NATIONAL PARK (CROATIA)



MPA PASSPORT

DATE OF CREATION:

1983

ESTABLISHMENT OF THE MANAGEMENT BODY:

1983

MANAGEMENT BODY:

“Brijuni National Park” Public Institution

Total area:

33.95 km² (26.52 km² marine part)

ZONING:

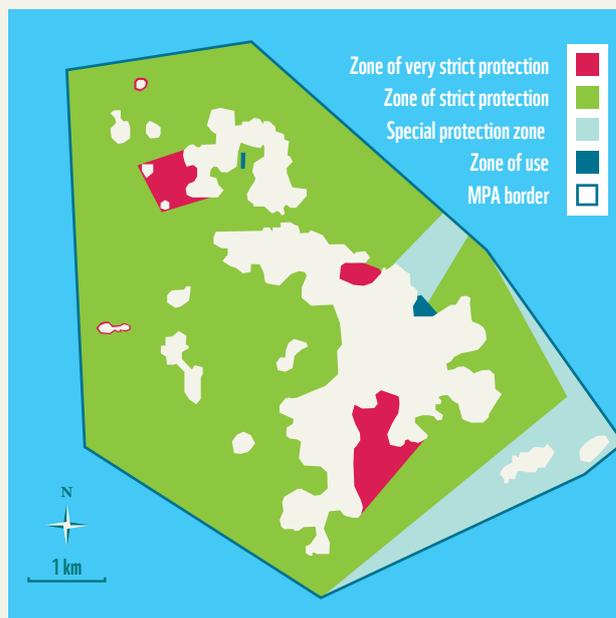
- 1a: Zone of very strict protection - in this zone, any kind of activity is strictly prohibited, except monitoring and scientific research.
- 1b: Zone of strict protection - no activities, except monitoring and research ; navigation is limited and regulated.
- 2a: Recreational fishing is allowed with the appropriate permit
- 3: Zone of use - no fishing activity allowed
- Zone where recreational fishing from the shore is allowed with the appropriate permit

ARTISANAL FISHING ALLOWED

YES



NO



Mediterranean Damselfish (*Chromis chromis*)



© ŽIGA ZDEŠAR

Common two-banded seabreams (*Diplodus vulgaris*)



© ANTON PREKALJ

DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

Scientific research carried out by the Institute of Oceanography and Fisheries of Split on the effectiveness of the Park in zones 1a, 1b, 1c and on four control areas located outside the National Park [1,2] highlights that:

- In 2008, the total species richness was 18% higher inside the National park area (zones 1a, 1b, 1c) than in the nearby unprotected area, while in 2013 it was 5% higher.
- Between 2008 and 2013 there has been a decreasing trend in total abundance of fish. Inside the National park area there has been a decrease of 34% in fish abundance and outside the National park area the decrease is 53%.
- However, in 2008 the total abundance of fish was 55% higher inside the National park area than in the nearby unprotected area, while in 2013 that figure was 166% higher.

The decrease in fish abundance could be due to illegal professional fishing activities.

THE PROCESS OF FISHERMEN ENGAGEMENT AT BRIJUNI MPA

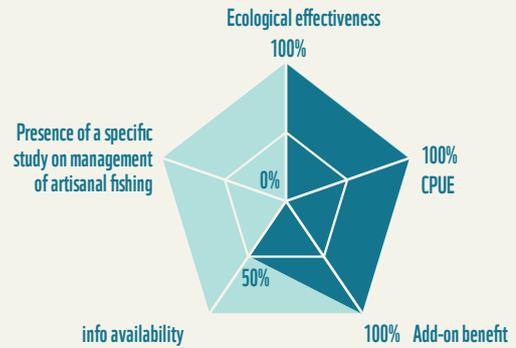
Artisanal fishermen are not engaged in the management of the MPA in which professional fishing is not allowed. Some illegal fishing is recognized.

Brijuni National Park



© RENCO KOSINOŽIĆ

CABO DE PALOS - ISLAS HORMIGAS MARINE RESERVE (SPAIN)



MPA PASSPORT

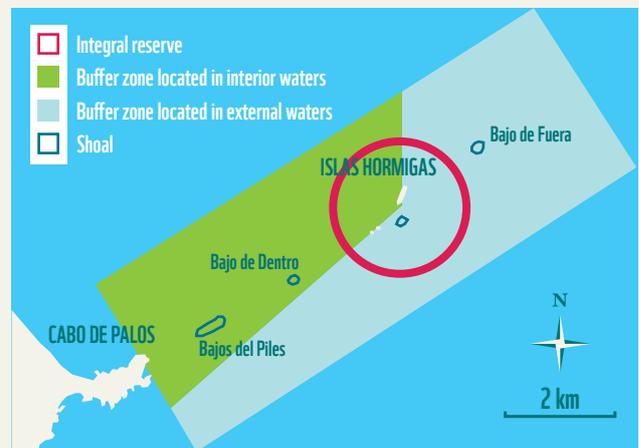
DATE OF CREATION:
1995

ESTABLISHMENT OF THE MANAGEMENT BODY:
1995 (Decree revised in 2011)

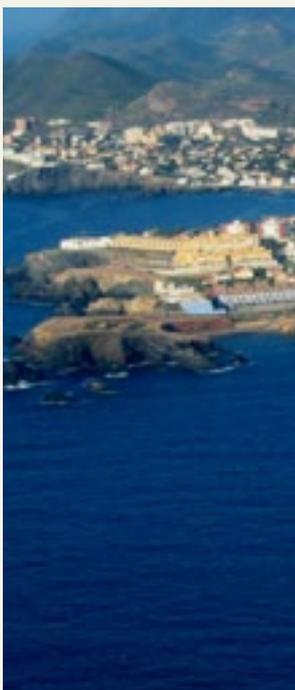
MANAGEMENT BODY:
Inshore waters: Murcia Region
Offshore waters: General Secretariat of Fisheries, Ministry of Agriculture, Food and Environment (MAGRAMA)

TOTAL AREA:
19.34 km²

ZONING:
2.7 km² of integral reserve
Spearfishing and recreational boat fishing are forbidden.



Aerial view of Cabo de Palos



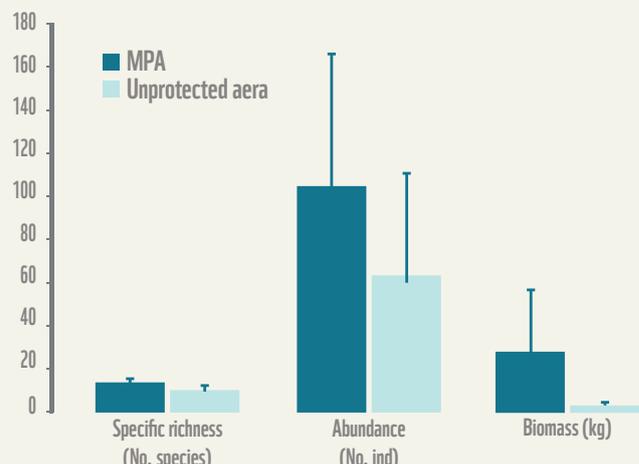
© O. ESPARZA ALAMINOS

DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

Specific richness, abundance and biomass of fish is significantly higher inside the reserve than in external unprotected areas [3].

Figure 1: Average specific richness, abundance and biomass (\pm SD) per transect for fish assemblages within and outside Cabo de Palos Reserve (from [3]). N.B. The unit of measurement is different for each variable (reported next to each variable)



ARTISANAL FISHING AT CABO DE PALOS RESERVE TODAY

Number of vessels authorized to fish: 15. Presence of a numerus clausus. Only artisanal fishermen whose vessels are documented are authorized to fish.

Gears allowed: traditional gears, bottom longlines and trammel nets allowed at depths greater than 12 m.

Patrolling: Performed by “guardapescas” (rangers) and two patrolling boats. Rangers have the power of auxiliary police and they can testify in the event of infringement. One of the fishermen is involved in patrolling and all fishermen can directly contact the rangers to report infringements.

CPUE (CATCH PER UNIT EFFORT) AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

Increase in catches (Fig. 2), CPUE (Fig. 3) and fishermen income [1].

Figure 2: Temporal trend of the total catch landed (tons) by the artisanal fleet of Cabo de Palos from auction records before and after the creation of the marine reserve in 1995.

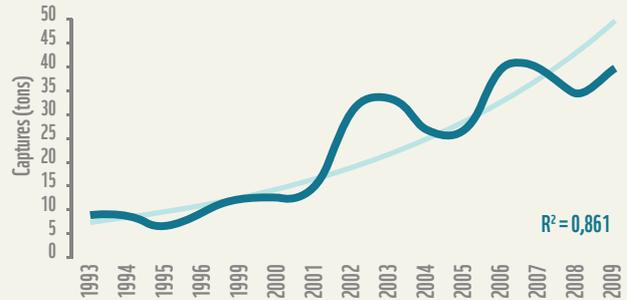
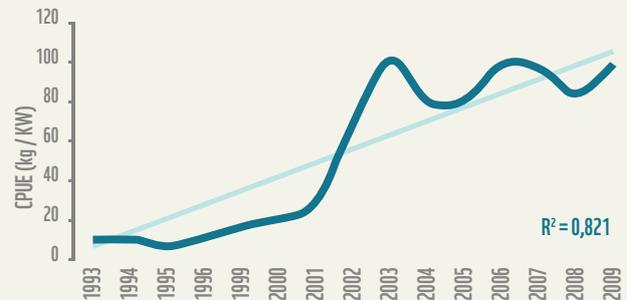


Figure 3: Temporal trend of CPUE (in kg / kW) of the artisanal fleet of Cabo de Palos, from auction records before and after the creation of the marine reserve in 1995.



Fisheries catch in Cabo de Palos

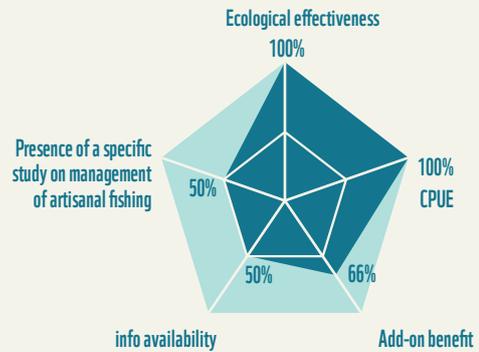


© O. ESPARZA ALAMINOS

THE PROCESS OF FISHERMEN ENGAGEMENT AT CABO DE PALOS RESERVE

- Fishermen are organized in cofradías (fishermen associations). They supported the reserve and were involved in its implementation through monitoring committees and technical meetings that they attended as relevant stakeholders.
- Fishermen are involved in decision-making and governance of the reserve.
- Fishermen were involved in the implementation of the regulations regarding fishing gears and fishing periods.
- Fishermen complete the CPUE form.
- Fishermen agree with the regulations concerning the no-take zone.

CABRERA ARCHIPELAGO MARITIME-TERRESTRIAL NATIONAL PARK (SPAIN)



MPA PASSPORT

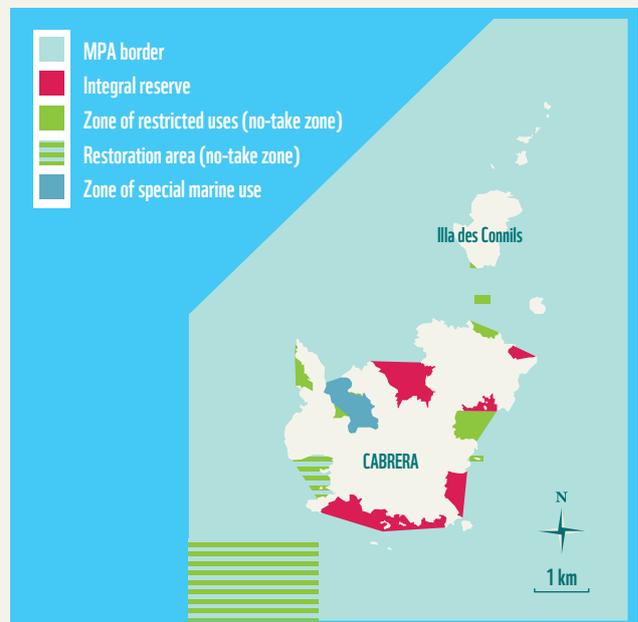
DATE OF CREATION:
1991

ESTABLISHMENT OF THE MANAGEMENT BODY:
1995

MANAGEMENT BODY:
Government of the Balearic Islands - Ministry of Agriculture, Food and Environment

TOTAL AREA:
100.87 km² incl. 87.72 km² marine part

ZONING:
Integral reserve (3.1%) and no-take zone (1.14%).
Recreational fishing is prohibited throughout the park.
Artisanal fishing is allowed in accordance with the regulations established.



Cabrera Bay



© CABRERA ARCHIPELAGO NATIONAL PARK

Experimental fishing



© CABRERA ARCHIPELAGO NATIONAL PARK

DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

A reserve effect was highlighted in terms of fish biomass [1]. Fish spillover and larval export were highlighted in the framework of TALACA et BIOMEX projects.

ARTISANAL FISHING AT CABRERA TODAY

Regulations: Fisheries Management Plan (Royal Decree 941/2001). The Plan defines who, when, where and how to fish in the MPA and what gear can be used. The plan applies the closed fishing zone concept: only fishermen located in the vicinity of the park and having a proven fishing activity in the Cabrera waters before the park's declaration are allowed to fish, with a weekly license. This is the most important feature of the management of fishing areas in Cabrera. Fishing regulations are more stringent in the waters of Cabrera than in the rest of the Balearics.

Number of vessels authorized to fish in the park: 48 may request a weekly permit; maximum 20 vessels allowed per day (8 per day with trammel nets deployed 3 hrs/day maximum at dawn and dusk, and using mesh 8 p/p.). Most often about 13 boats fish in the reserve at the same time.

Authorized gears: There are up to 18 different métiers allowed at Cabrera park. Most of the fishing activity (over 85 %) is done using bottom lines and gill and trammel nets. Trammel nets can total up to 3,250 meters maximum length ; lines can be arranged with a maximum of 500 hooks; gill nets for mullets can only be used from August 1st to November 31st.

Logbook: Fishermen use a fishing logbook in which they record data species by species, and they provide this information to the park on a regular basis.

Patrolling: fishing control is carried out by daily patrols on inflatable boats. Boats and/or fishing gear positions are recorded using a GPS. Environmental agents are agents of authority so they can fine offenders.

CPUE (CATCH PER UNIT EFFORT)

AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

A study on artisanal fisheries has shown that fishing effort, catches and revenues were higher near the integral zone of the park and decrease moving away from the boundaries of the reserve [2].

THE PROCESS OF FISHERMEN ENGAGEMENT AT CABRERA

- Fishermen are involved in MPA management. They actively participated in the preparation of the management plan and in particular the fishery management plan.
- They do not have any decision-making power apart from what we call personal commitments: some fisheries brotherhoods have decided to be more stringent with the gear regulations, and they reported a decrease in the catches of groupers in 2012.
- Fishermen are included with a representative in one of the park's governance bodies, the Patronato.
- Fishermen are involved mainly in studies on crustaceans (lobsters and slipper lobsters) caught by fishing boats.
- Fishermen do not take part in the surveillance and patrolling of the park.

Artisanal fisherman

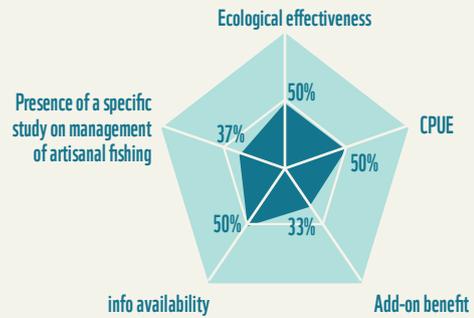


© CABRERA ARCHIPELAGO NATIONAL PARK

CAP CREUS NATURAL PARK (SPAIN)



ARTISANAL FISHING ALLOWED	YES	<input checked="" type="checkbox"/>	NO	<input type="checkbox"/>
MANAGEMENT PLAN FOR ARTISANAL FISHING	YES	<input type="checkbox"/>	NO	<input checked="" type="checkbox"/>
FISHERMEN ENGAGEMENT IN MANAGEMENT				



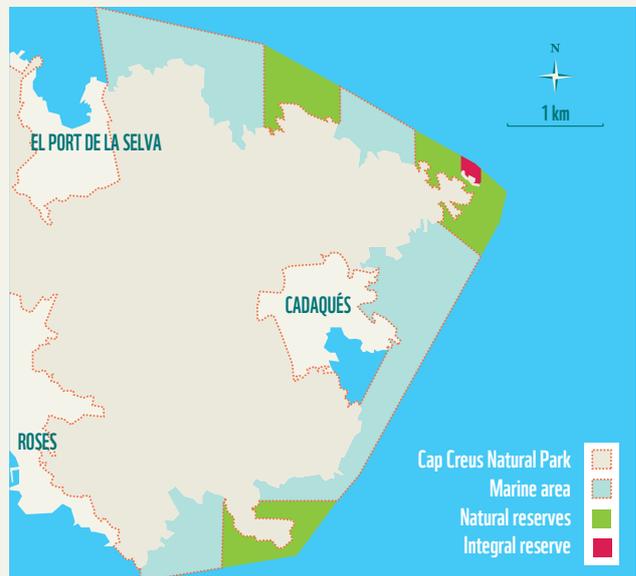
MPA PASSPORT

DATE OF CREATION:
1998

ESTABLISHMENT OF THE MANAGEMENT BODY:
1998

MANAGEMENT BODY:
Generalitat de Catalunya - Department of Agriculture, Fisheries and Food

TOTAL AREA:
130.22 km² incl. 30.87 km² marine part
Zoning: Integral reserve 0.21 km²



Measuring of *Sarda sarda*



© UNIVERSITY OF GIRONA - JOSEP LLORET

DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

No strong evidence of reserve effect. However, for some sedentary fish species it seems that there has been an increase in biomass [1,2].

ARTISANAL FISHING AT CAP CREUS TODAY

Authorized fishermen: Local fishermen and other from other towns. Nevertheless, there is only a small number of the latter group (the majority are residents in the MPA towns).

Authorized gears: At present, artisanal fishing regulations are not more restrictive within the MPA than in adjacent non-protected areas. Trawling and purse seining are not allowed anywhere in the park.

Artisanal fishing is allowed throughout Cap de Creus park with the exception of the integral reserve.

CPUE (CATCH PER UNIT EFFORT)

AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

No evidence of CPUE increase related to an effect of the park [1].

THE PROCESS OF FISHERMEN ENGAGEMENT AT CAP CREUS

- The confraria de pescadors (cofradias, fishermen associations) were involved a little in the consultation process during the MPA implementation stage.
- Fishermen do not have any decision-making power. They may only attend certain meetings where the confradias are represented among other stakeholders (Consell collaborador).

LESSONS LEARNT

- Address the socioeconomic issues that are forcing fishermen to quit their job;
- Protect and rebuild overexploited, vulnerable, sedentary species;
- Consider competition with recreational fishing;
- Avoid illegal trawling;
- Address the biological impacts of artisanal fishing on vulnerable species (particularly those with complex reproductive strategies) and also the ecological impacts (e.g. impact of trammel nets on coralligenous assemblages).

Artisanal fisherman from Roses fishing with a trammel net at Cap Creus



© JOSEP LLORET

CAP ROUX FISHING RESERVE (FRANCE)



MPA PASSPORT

DATE OF CREATION:
2003

MANAGEMENT BODY:
no formal management body

TOTAL AREA:
4.5 km²

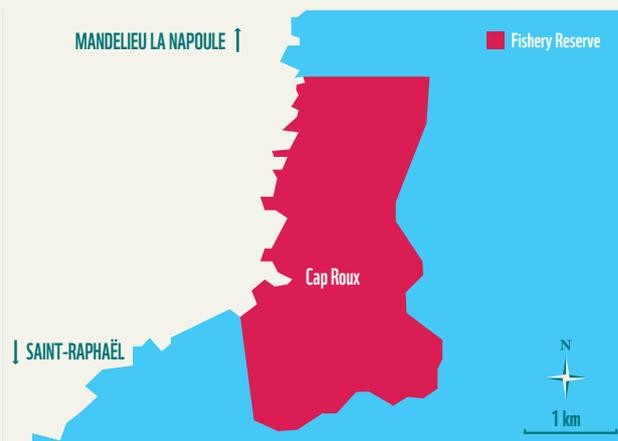
ZONING:
no fishing allowed in the whole reserve (professional, recreational, spearfishing).

ARTISANAL FISHING
ALLOWED

YES



NO



Fishing boat



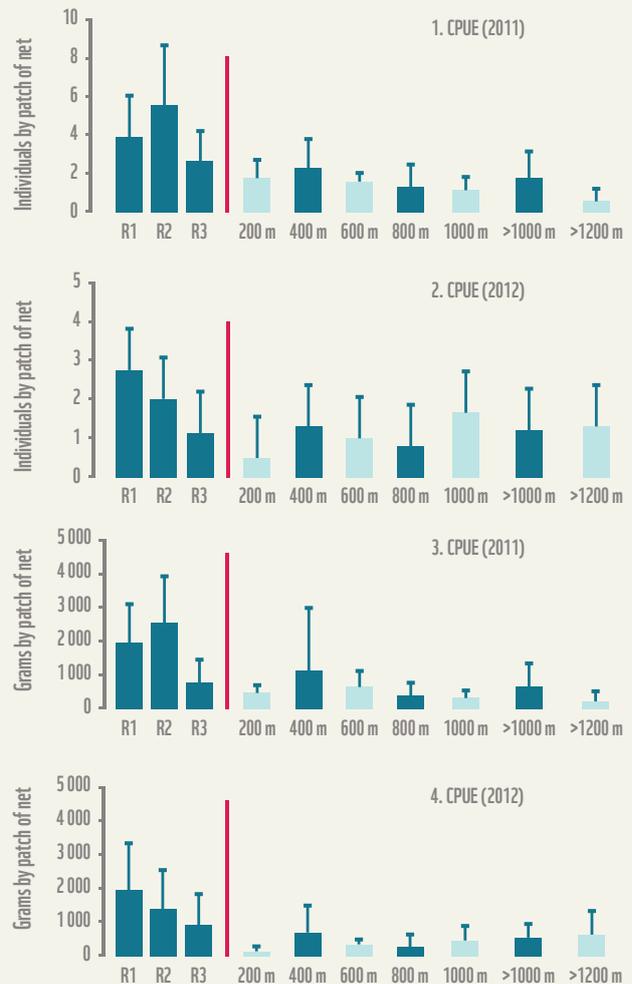
© LAURENT DEBAS

DOES THE MPA WORK ? ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

Experimental fishing:

- Both weight and size of target species (e.g. *Scorpaena scrofa*) are on average higher within the reserve than outside
- Rare species (e.g. *Sciaena umbra*, *Scyllarides latus*, *Palinurus elephas*) are only found inside the reserve [1]

Figure 1: Total CPUE (in 2011 and 2012 showed separately), in terms of abundance (1&2) and biomass (3&4), are higher inside the reserve than outside (the red line indicating the reserve boundary). From [1]



Artisanal fisherman close to Cap Roux



© LAURENT DEBAS

ARTISANAL FISHING AT CAP ROUX TODAY

The process of fishermen engagement

- Fishermen were responsible for the creation of the fishing reserve (“cantonement de pêche”).
- They have the power not to vote for its renewal.
- Since late 2012, they carry out regular patrolling of the site.
- They are involved in scientific monitoring of the reserve.

COLUMBRETES ISLANDS MARINE RESERVE (SPAIN)

ARTISANAL FISHING ALLOWED

YES



NO



MPA PASSPORT

DATE OF CREATION:

1990

ESTABLISHMENT OF THE MANAGEMENT BODY:

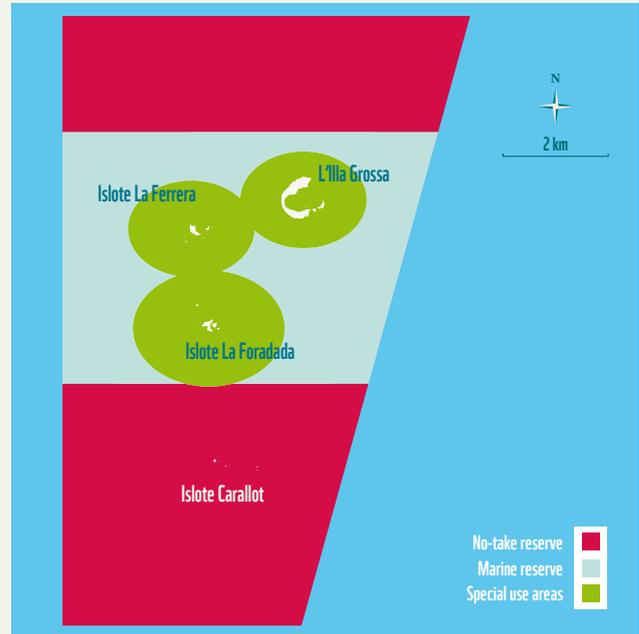
General Secretariat of Fisheries, Ministry of Agriculture, Food and Environment (MAGRAMA)

TOTAL AREA:

55 km²

ZONING:

A marine reserve, two no-take zones and three special use areas.



DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

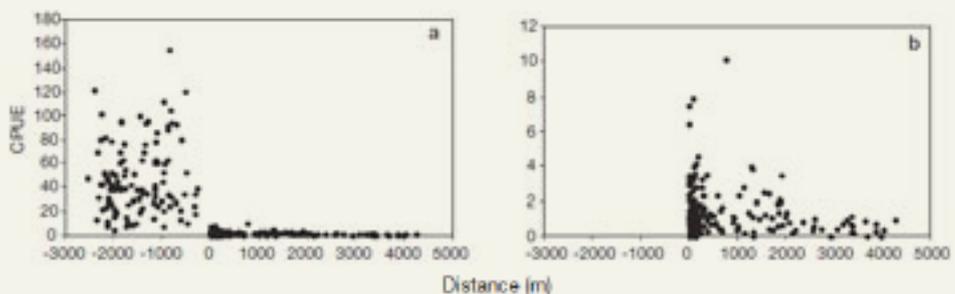
Lobsters

- Studies conducted in the reserve 7 to 9 years after its creation showed that abundance of *Palinurus elephas* within the reserve was 6 to 20 times higher than in comparable fished areas depending on the season [2].
- The spawning potential per unit area in the reserve was also 5 to 20 times greater than in Western Mediterranean exploited areas depending on their level of exploitation [3].
- After 9 to 12 years of no-take protection, there was a gradient of lobster density from the interior of the reserve up to a distance of about 4 km from its boundary, due to the spillover of lobsters from the reserve [4] (Fig. 1).

Commercial fish

- Studies conducted 8 to 16 years after fishing ceased in the reserve showed clear evidence of spillover of fish from the reserve to the adjacent fishery.

Figure 1: *Palinurus elephas*. CPUE (number of lobsters caught per 600 m of net per day) versus distance from fishing set to the reserve boundary. (a) Commercial and experimental data combined, (b) commercial fishery data on expanded y-axis scale



ARTISANAL FISHING AT COLUMBRETES ISLANDS MARINE RESERVE TODAY

Fisheries regulations:

Artisanal fishing is forbidden in the whole reserve

Professional fishing:

- Fishing forbidden within the no-take zones and special use areas ;
- Throughout the rest of the reserve, surface trolling is allowed exclusively targeting pelagic and highly migratory fishes
- Fishing authorization by registration of the vessel in the specific list of the reserve.

Recreational fishing:

- Forbidden within the no-take zones and special use areas ;
- Throughout the rest of the reserve, surface trolling is allowed exclusively targeting pelagic and highly migratory fishes
- In addition to the fishing license, vessels must obtain an access authorization.

CPUE (CATCH PER UNIT EFFORT)

AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

• Lobsters :

During an 8- to 17-year protection period, harvested spillover did offset the loss of yield resulting from the reduction of fishing grounds set aside in the reserve, producing a mean annual net benefit of 10% of the catch in weight [5].

• Commercial fish :

Studies conducted 8 to 16 years after fishing ceased in the reserve showed that commercial fish yields at the MPA border (up to 0.5 km from the boundary) increased continuously during the study period, despite being locally depleted due to fishing effort concentration (fishing the line) [6].

THE PROCESS OF FISHERMEN ENGAGEMENT

- An effective surveillance is necessary from the establishment of the reserve.
- Fishermen support the regulation of the reserve
- Fishing activities are monitored within and around the reserve by means of logbooks.

Spiny lobster - Columbretes



© D. K. KERSTING - SPANISH MARINE RESERVES SGP MAGRAMA

Aerial view - Columbretes



© S. REVENGA - SPANISH MARINE RESERVES SGP MAGRAMA

CÔTE BLEUE MARINE PARK (FRANCE)

ARTISANAL FISHING ALLOWED	YES	<input checked="" type="checkbox"/>	NO	<input type="checkbox"/>
MANAGEMENT PLAN FOR ARTISANAL FISHING	YES	<input checked="" type="checkbox"/>	NO	<input type="checkbox"/>
FISHERMEN ENGAGEMENT IN MANAGEMENT				



MPA PASSPORT

DATE OF CREATION:

1983

ESTABLISHMENT OF THE MANAGEMENT BODY:

1983

MANAGEMENT BODY:

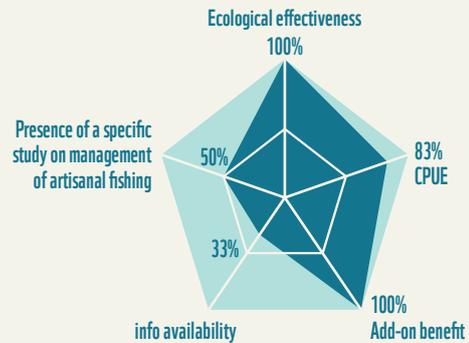
Côte Bleue Marine Park (PMCB)

TOTAL AREA:

98.73 km². PMCB is also included in a Natura 2000 site of 189.28 km²

ZONING:

2 fishing reserves (no-take zones) (Cap-Couronne: 2.1 km² and Carry-le-Rouet: 0.85 km²), where all fishing is forbidden, as well as dredging, anchoring and diving. In the rest of the park, all activities are authorized and subject to the general regulations at sea.



Aerial view of the Côte Bleue Marine Park



© FRÉDÉRIC BACHET

DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

- Evidence of reserve effect [2,3,4,7].
Figure 1 illustrates the increase in the weight and size of fish over time within the Cap Couronne fishing reserve. The average weight of fish has more than doubled in 12 years (x 2.4) [source PMCB].
- Higher fishing yields within fishing reserves.
Landed biomass and yields from experimental fishing in Cap Couronne reserve have multiplied by 5 since the reserve was established (Fig. 1 and 2).
- Fish spillover highlighted in the framework of the BIOMEX project [6,7].

Figure 1: Results from monitoring of fish assemblage carried out with experimental fishing at Cap-Couronne reserve.

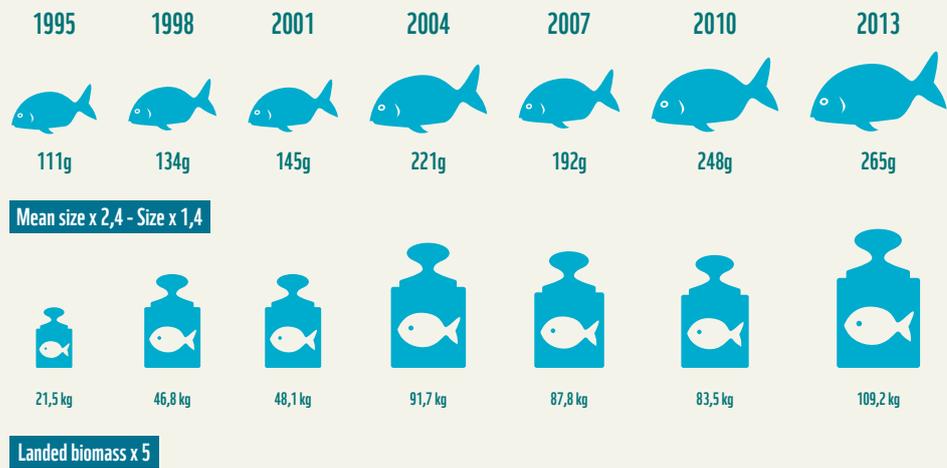
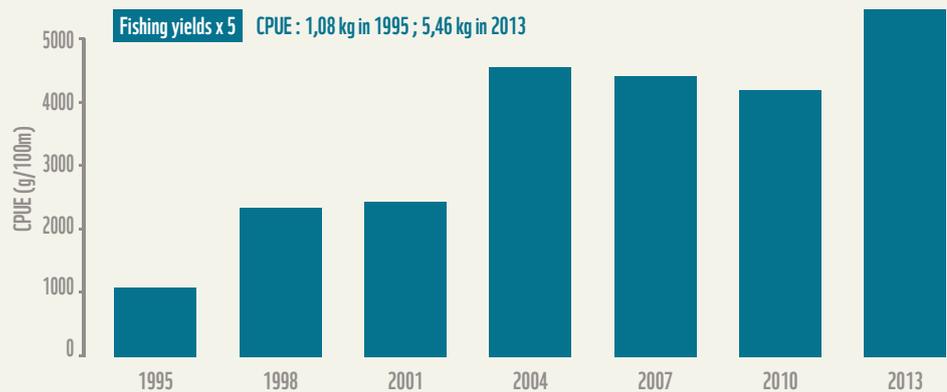


Figure 2: Change in experimental fishing yields in the Cap Couronne reserve between 1995 and 2013.



ARTISANAL FISHING AT CÔTE BLEUE MARINE RESERVE TODAY

Regulation of artisanal fishing in the Côte Bleue Marine Reserve

- Number of vessels allowed: no limits on the number of vessels authorized to fish in the reserve. Currently 62 fishermen, 35 active vessels (but 56 authorizations applied for) in 6 harbors, fishing in the reserve.
- All vessels are authorized to fish in the PMCB. Mainly fishermen from Prud'homies of Martigues and Marseille are authorized to fish in the reserve.
- Status of two fishing reserves (Carry-le-Rouet and Cap Couronne): all fishing is prohibited. Outside protected areas, the national regulations on MPAs apply (Act of 14 April 2006).
- Fishermen must complete a fishing logbook. The PMCB also has access to landing data.

Artisanal fishing management

- Since 1431 by prud'homies: they manage fishing and establish exploitation rules, including net deployment time, permitted mesh sizes, fishing sites, etc.
- 5,000 m³ artificial reef for production and protection installed, mainly outside the two protected areas.
- Implementation of Natura 2000 chart of good practice for sustainable fisheries (e.g. limitation on deployment time of lobster fishing nets).
- Regular monitoring of artisanal fishing activities, fishing effort around the two fishing reserves, and across the whole reserve. Experimental fishing is done every 3 years in the Cap Couronne reserve .

CPUE (CATCH PER UNIT EFFORT)

AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

Three “métiers” account for 78 % of catches: “hake”, “sea bream” and “sole” métiers. The study carried out over 2009-2010 shows that each boat catches about 5 tons of fish per year, which represents 29 kg per fishing operation and 40kg per fishing trip, with an average yield of 1.3 kg/100 m of net [1].

THE PROCESS OF FISHERMEN ENGAGEMENT AT CÔTE BLEUE MARINE PARK

- 1983: Establishment of Carry-le-Rouet fishing reserve.
- 1996: Artisanal fishermen at the origin of the establishment of Cap Couronne fishing reserve (which comes under the Prud'homie de Martigues).
- 1997: Change to the status as a public institution. Since the year 2000, establishment of a Joint Union which associates different professional fisheries organizations.
- The fishermen/managers partnership covers a wide range of aspects: participation in the Marine Park governance, planning of scientific studies, and proposals for regulations on the basis of labor arbitration regulations. Fishermen are involved in decision-making related to the Park and its governance.
- Fishing regulations set up and implemented in consultation with fishermen (rules set by the European Union, Common Fisheries Policy, December 2006).
- Artisanal fishermen involved in the scientific monitoring of PMCB.
- Fishermen involved in PMCB patrolling.

LESSONS LEARNT

Effective collaboration with fishermen, regular presence of Park officers in the field, and concrete involvement of fishermen in management and monitoring (e.g. experimental fishing) are important to ensure proper artisanal fishing management within the park. Several studies have highlighted tangible results and a positive perception of the fishermen/managers partnership by fishermen.

Fisherman sewing nets in the Côte Bleue Marine Park



© ÉRIC CHARBONNEL

GÖKÇEADA MARINE PARK (TURKEY)

ARTISANAL FISHING ALLOWED

YES



NO



MPA PASSPORT

DATE OF CREATION:

1999

NO MANAGEMENT YET.

MANAGEMENT BODY:

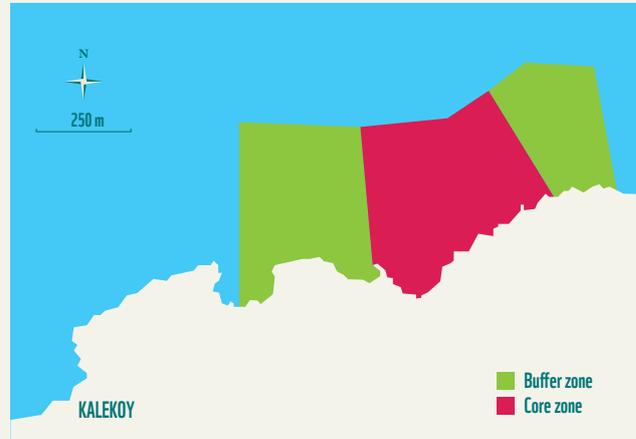
Turkish Foundation for Marine Research (TUDAV)

TOTAL AREA:

Approx. 4.9 km²

ZONING:

Core zone surrounded by two buffer zones. All fishing activities are forbidden.



View over the Gökçeada MPA



© BÜLENT TOPALOĞLU/TUDAV

DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

TUDAV personal communication:

- Slight increase in fish biomass within the park.
- Decrease in fish biomass in the unprotected areas outside the park.
- Presence of rare species (rays, groupers, etc.) within the MPA
- Populations of some target species (particularly lobster, dentex, grouper and octopus) now in better condition, due to the effect of export from the MPA.

ARTISANAL FISHING AT GÖKCEADA MARINE PARK TODAY

The process of artisanal fishermen engagement:

- Fishermen informed about the establishment of the Marine Park.
- Fishermen comply with the fishing ban.
- However occurrence of poaching: spearfishing and illegal fishing with bottom longlines.

CPUE (CATCH PER UNIT EFFORT)

AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

TUDAV personal communication:

- No data available on CPUE outside the reserve
- No significant impact on fishermen revenues related to Park establishment.

Fishing swordfish with a harpoon



© ÖNÜL GÖNÜLAL

HABIBAS ISLAND NATURAL MARINE RESERVE (ALGERIA)



MPA PASSPORT

DATE OF CREATION:

2003

Management started in 2013

MANAGEMENT BODY:

National Commission for the Coast (CNL)

TOTAL AREA:

218.9 km² (whose 21.82 km² of the central zone, see map)

ZONING:

a no-take zone of 21.66 km² (all fishing banned), a buffer zone of 0.16 km² corresponding to 3 mooring areas, and a transition zone of 197.11 km² where fishing is allowed.

ARTISANAL FISHING
ALLOWED

YES



NO



MANAGEMENT PLAN
FOR ARTISANAL FISHING

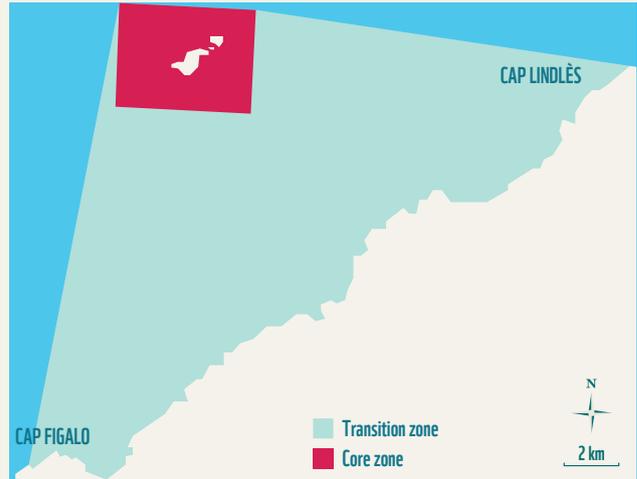
YES



NO

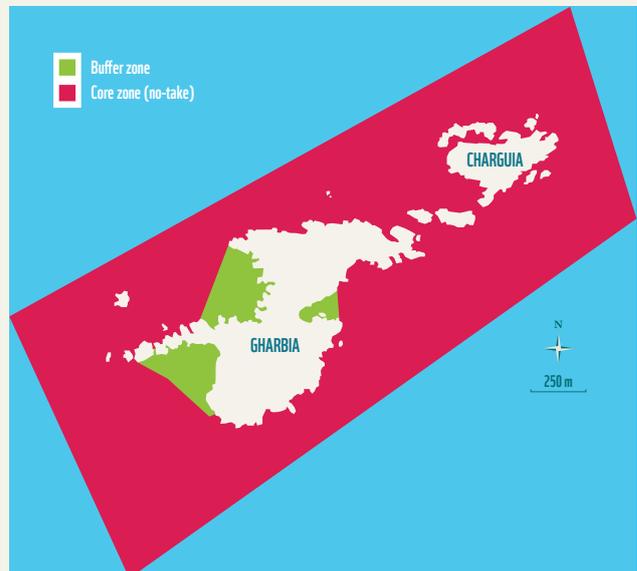


FISHERMEN ENGAGEMENT
IN MANAGEMENT



Port of Habibas

© TARIK MOKHTARI



ARTISANAL FISHING AT HABIBAS ISLAND RESERVE TODAY

Artisanal fishing regulations in Habibas Island Reserve

Authorized fleet: no restriction based on the harbour of origin

Artisanal fishing management

- Management plan in preparation.
- Consultation process engaged at all levels and for all actors, including meetings with artisanal fishermen in order to gather their views for the management plan in preparation and for a specific regulation on artisanal and recreational fishing.

The process of fishermen engagement at Habibas Islands Reserve

Artisanal fishermen were consulted at meetings and participatory workshops, through the “Fishing Chamber” of Wilaya. Opinions were issued, but they do not have the formal power to influence the decision.

Table 1: Vessels and gears authorized to fish within the reserve, per harbor

	BOUZEDJAR HARBOUR		BENI SAF HARBOUR	
	< 4.8 m	4.8 - 7 m	< 4.8 m	4.8 - 7 m
VESSEL LENGTH	< 4.8 m	4.8 - 7 m	< 4.8 m	4.8 - 7 m
NUMBER OF VESSELS	14	8	13	6
FISHING GEARS	Gillnets and trammelnet		Gillnets, longline, seine, trammelnet	Gillnet

THE PROCESS OF FISHERMEN ENGAGEMENT

- Long time to achieve fishermen awareness of the positive effects of the reserve and the restrictions associated with them. Fishermen are more inclined to consider short-term effects and possible benefits. Without compensation measures (not necessarily financial), there is very little chance of securing fishermen involvement.
- Building the management capacity of MPA staff, particularly of members spending time in the field (e.g. eco-guard) for surveillance and patrolling is a key factor.

Fishing near Oran



© KARIM KERDAGH

KAS-KEKOVA MARINE RESERVE (TURKEY)



ARTISANAL FISHING
ALLOWED

YES



NO



MANAGEMENT PLAN
FOR ARTISANAL FISHING

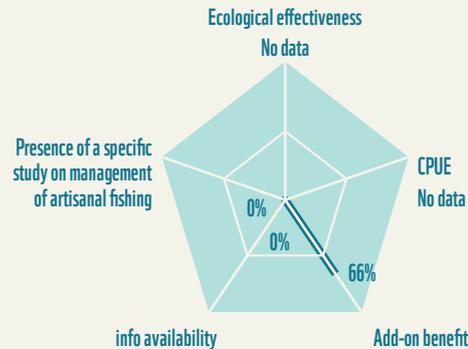
YES



NO



FISHERMEN ENGAGEMENT
IN MANAGEMENT



MPA PASSPORT

DATE OF CREATION:

1990 (extended to Kas in 2006)

MANAGEMENT BODY:

General Directorate of Natural Assets Protection (GD-NAP)

TOTAL AREA:

258.30 km² (Marine part: 165.91 km²)

ZONING:

25 km² of integral reserve (no-take zones were imposed by the fisheries legislation ; in 2012, zones where diving is forbidden were established on a voluntary basis.

DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

Fish market



© WWF TURKEY

Absence of scientific data about this issue. Scarce information from a pilot study indicates that:

- Decline in grouper population from 2002 to 2011.
- *Epinephelus caninus*: extinction threshold reached in 2011 (2 individuals).
- The same observation applies to the different populations of Sparidae species.
- Illegal fishing prevents populations from properly recovering within the MPA.

ARTISANAL FISHING AT KAS-KEKOVA MPA TODAY

Artisanal fishing regulations at Kas-Kekova MPA

Number of vessels authorized to fish: about twenty boats of 7-8 m length

Gears authorized: longline, shallow fishing nets (fifteen boats allowed), deep fishing nets (5-6 boats allowed).

Where in the MPA: zones 2 and 6, and out of zones 1-10.

Monitoring: species caught, and mesh size.

Other activities: Fishermen perform pescatourism within the MPA.

Table 1: Number of individuals of target species observed within Kas-Kekova MPA (WWF, 2011)

Year	Nb of dive	<i>E. marginatus</i>		<i>E. costae</i>		<i>E. aeneus</i>		<i>E. caninus</i>		<i>E. halfensis</i>		<i>M. rubra</i>		<i>P. pagrus</i>	
		n	of	n	of	n	of	n	of	n	of	n	of	n	of
2002	136	959	7.05	169	1.24	16	0.12	16	0.12	1	0.01	63	0.46	100	0.74
2006	130	319	2.45	313	2.41	6	0.05	1	0.05	2	0.02	92	0.71	6	0.05
2009	129	194	1.5	279	2.16	20	0.16	4	0.16	0	0	27	0.21	11	0.09
2010	188	171	0.91	328	1.74	29	0.15	3	0.15	0	0	40	0.21	2	0.01
2011	69	76	1.11	126	1.84	6	0.09	2	0.09	0	0	9	0.13	11	0.16

n: number of individuals recorded. of: observed number of individuals per dive

Year	Nb of dive	<i>Dentex dentex</i>		<i>D. vulgaris</i>		<i>D. sorgus</i>		<i>D.puntazzo</i>		<i>S.cantharus</i>		<i>L.mormyrus</i>		<i>S. salpa</i>	
		n	of	n	of	n	of	n	of	n	of	n	of	n	of
2002	136	91	0.67	1970	14.49	1521	11.18	209	1.98	17	0.13	111	0.81	1157	8.50
2009	129	24	0.19	3596	27.88	1396	10.82	162	1.26	257	1.99	10	0.08	1262	9.78
2010	188	128	0.68	3379	17.97	1307	6.95	119	0.63	12	0.06	28	0.15	390	2.07
2011	69	49	0.71	2055	29.78	895	12.97	37	0.54	11	0.16	0	0	72	1.04

n: number of individuals recorded, of: observed number of individuals per dive

THE PROCESS OF FISHERMEN ENGAGEMENT AT KAS-KEKOVA MPA

- Kas fishermen are organized in a cooperatives.
- They were involved in the development of the management plan of the MPA within the framework of a project led by WWF.
- Fishermen participated in a decision-making process related to the design of the new zoning plan of the MPA. The main conflict was between the local artisanal fishermen and divers. After two years of participatory discussions and negotiations, fishermen and divers identified no-diving areas (where fishermen can fish) and no-fishing areas (where tourists can dive).
- However, the circular about fishing in 2012 imposed more prohibitions on them than expected in the proposed management plan, and more areas were closed to fishing about which they do not agree.
- The fishermen were not involved in the draft of regulations because these decisions are made at ministerial level.
- Fishermen are involved in MPA surveillance on a voluntary basis. They mostly report fishing with dynamite to the Coast Guards, but this is not a formal procedure.
- Fishermen are temporarily employed in other types of professional activities: diving, excursion boats. But for the moment, they are not offered any aid to compensate for the loss of revenue related to the establishment of a no-fishing area.

Fishermen in Kas-Kekova



© MARINA GOMEI - WWF TURKEY

KORNATI NATIONAL PARK (CROATIA)



MPA PASSPORT

FORMAL IMPLEMENTATION:
1980

MANAGEMENT STARTED:
1982

MANAGEMENT BODY:
"Kornati National Park" Public Institution

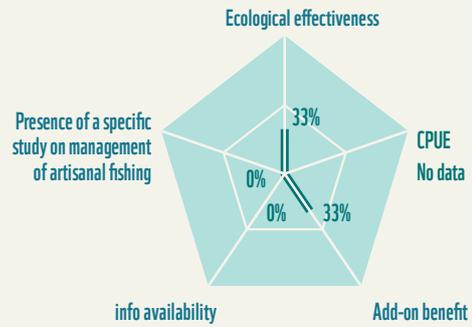
TOTAL AREA:
216.78 km² (167.11 km² of marine area)

ZONING:
4 strictly protected areas (11.35 km² representing 8.60% of both the marine and terrestrial area). Fishing is not allowed in the anchoring zones (16 bays) and diving locations (9). The subzone of Tradition and Culture (as part of Zone II: Directed Protection Zone) includes a "fishing area" of 3,389.15 ha (15.63% of total area or 20.28% of marine area)

ARTISANAL FISHING ALLOWED YES NO

MANAGEMENT PLAN FOR ARTISANAL FISHING YES NO

FISHERMEN ENGAGEMENT IN MANAGEMENT 0 1 2 3 4



Aerial view of Kornati Archipelago



DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

No significant evidence of reserve effect [1,2].

ARTISANAL FISHING AT KORNATI MPA TODAY

Authorized fishermen: Residents in the MPA area and land-owners of the area registered as “family farmers” (sheep farms, olive trees).

Around 25 residents and 352 registered owners could potentially fish in the MPA but not all are interested in having a fishing license.

License: Fishermen need a license to fish inside the Kornati MPA. Since 2011 one license is issued for one “farming house” - for the owner of the farm and its members which is approximately three persons per license. Before 2011, each land owner had the right to have one license (for one boat) for himself only. The license is issued for the calendar year. (2011: 151 licenses).

There is **no maximum number of licenses** set a priori.

Gear authorized: When fishing with gillnet it is forbidden to use frightening gear and equipment, artificial illumination and baits.

No matter what type of fishing gear or method is used, it is mandatory to return the catch to the sea for:

- all European Spiny Lobsters (*Palinurus elephas*), European Lobster (*Hommarus gammarus*) and Large European Spider Crab (*Maja squinado*) whose size is less than the prescribed minimum size recommended, which cannot be caught, collected or placed on the market ;
- females of European Spiny Lobsters and European lobsters with external eggs ;
- females of Large European Spider Crab with tinted external eggs.

Size and weight limitations: minimum sizes and periods during which fishing is prohibited exist for several fish and crustacean species. Permitted daily catch is limited to 5 kg only for crustaceans, such as *H. gammarus*, *P. elephas* and *M. squinado*.

Surveillance: The Surveillance Department controls mostly areas where fishing is not allowed. It is hard to control gears (length of nets, mesh size) while gear is submerged. The Department for Nature Protection Inspection (Ministry of Environment and Nature Protection) controls catches and gear periodically as well as the Marine Police.

Artisanal fishermen in Kornati

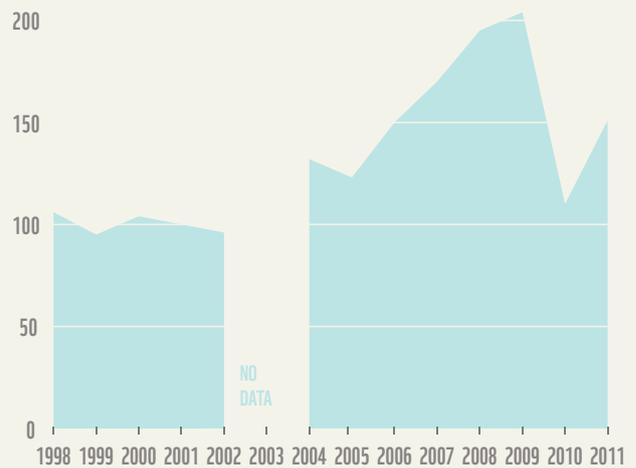


© KORNATI NATIONAL PARK

Table 1: Fishing rules in Kornati MPA

TYPE OF GEARS	CHARACTERISTICS	DATE OF USE
Single gillnets (TL = 150 m)	Gillnets for smelt (<i>Atherina hepsetus</i>) (mesh size = 10-12 mm ; height < 400 meshes)	Forbidden from February 1 st to April 30 th
		Forbidden from May 1 st to September 30 th
	Gillnet for various fish "prostica" (mesh size from 32 to 40 mm ; height < 200 meshes)	
Trammel nets for various fish species ("popone")	Up to 100 m TL; mesh size for the middle layer may be from 40 to 50 mm. Mesh size of two outer netting layers may be from 150 to 350 mm. Max. height = 5.5 meshes of the outer and 42 of the middle layer	Forbidden from May 15 th to September 10 th
Fish traps	Up to 3 ; mesh size min. 40 mm	
Trap for lobsters	Max. one; mesh size min 40 mm	Forbidden from September 10 th to May 15 th
Forbidden from September 10 th to May 15 th	Max. 2, with hooks on each line without use of artificial light	
Demersal long line fishing	Up to 100 hooks	
Harpoon	Without use of artificial light	

Figure 1: Trend of the number of licenses given each year for fishing inside Kornati MPA.



CPUE (CATCH PER UNIT EFFORT) AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

No information concerning CPUE.

PROCESS OF FISHERMEN ENGAGEMENT IN KORNATI MPA

- Fishermen were involved in the development of a Management plan through participation in a thematic workshop. They were also invited to give their comments and recommendations during the process of developing an Ordinance on Internal Order (2010) in which some major changes about fishing activities were made. But they had no decision-making power and neither was a specific participatory body created.
- Many of the fishermen are members of the NGO “Kurnatari” which is an association of land owners of Kornati Archipelago. But there is no continuous communication with this NGO.
- The key element for successful fisheries management in Kornati NP is the strong involvement of local fishermen in surveillance activities.



MEDES ISLANDS MARINE RESERVE (SPAIN)



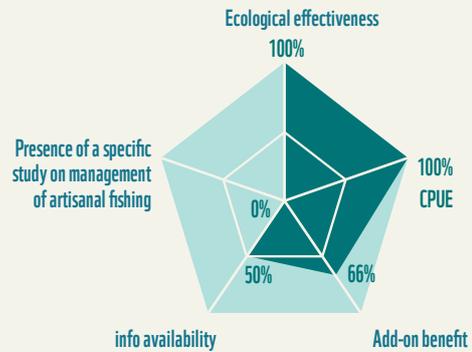
ARTISANAL FISHING
ALLOWED

YES NO

MANAGEMENT PLAN
FOR ARTISANAL FISHING

YES NO

FISHERMEN ENGAGEMENT
IN MANAGEMENT



MPA PASSPORT

DATE OF CREATION:

1983 (1990 for the buffer zone). The Islands belong to the Natural Parks of Montgri, Medes Islands and Baix Ter.

MANAGEMENT BODY:

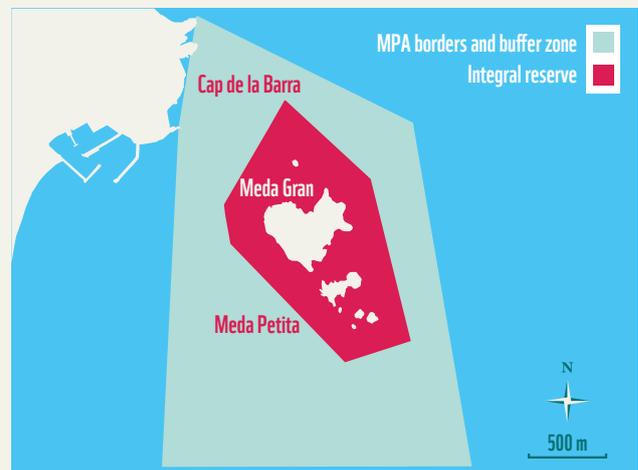
Catalonian Government - Department of Agriculture, Livestock, Fisheries, Food and Natural Environment

TOTAL AREA:

6.03 km² (incl. 5.11 km² of marine area)

ZONING:

A buffer zone (4.20 km²) where artisanal fishing is allowed, and an integral reserve (0.91 km²).



Artisanal fishermen in Medes Islands



© MIGUEL SECANELL

Fishing boat at sunset



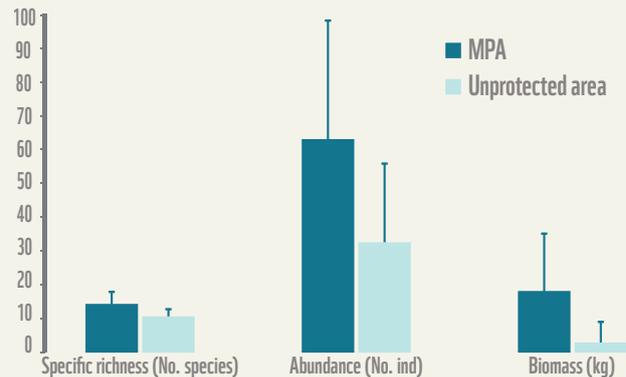
© MIGUEL SECANELL

DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

Several studies have highlighted a significant reserve effect [2,6]. Species richness, abundance and biomass area significantly higher inside the MPA than outside (Fig.1) [2].

Figure 1: Average specific richness, abundance and biomass (\pm SD) per transect for fish assemblages within and outside Medes Islands Marine Reserve. Data from [2]. N.B. The unit of measurement is different for each variable (indicated next to each variable)



ARTISANAL FISHING AT MEDES ISLANDS TODAY

Authorized fishermen: only local fishermen (from the Fishermen's association of Estartit).

Number of authorized vessels: 14 (average length of 6.5 m and an average power of 31.4 HP). Only 7 of the 14 boats regularly fish within the MPA.

Authorized gears: long line and trammel net only.

Surveillance: performed by the MPA staff, with some occasional reinforcements by forest rangers (rural guards) and the marine rangers of the Guardia Civil del Mar.

CPUE (CATCH PER UNIT EFFORT)

AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

Total CPUE and CPUE and size of common pandora (*Pagellus erythrinus*) have increased close to the integral reserve because of the direct and indirect reserve effects. CPUE and size of surmullet (*Mullus surmuletus*) have slightly increased close to the integral reserve [7].

THE PROCESS OF FISHERMEN ENGAGEMENT AT MEDES ISLAND RESERVE

- Fishermen are organized into guilds (Cofradias). They were involved in the process of MPA implementation but they were not very confident at the start.
- Fishing regulations (e.g. weight, species, etc.) are implemented in agreement with local fishermen. Fishermen are part of the supervisory board of the MPA.
- The fishermen were involved in scientific research programs, such as the BIOMEX project.

MIRAMARE MPA (ITALY)



MPA PASSPORT

DATE OF CREATION:
1986

MANAGEMENT STARTED IN:
1986

MANAGEMENT BODY:
WWF Italy

TOTAL AREA:
1.2 km²

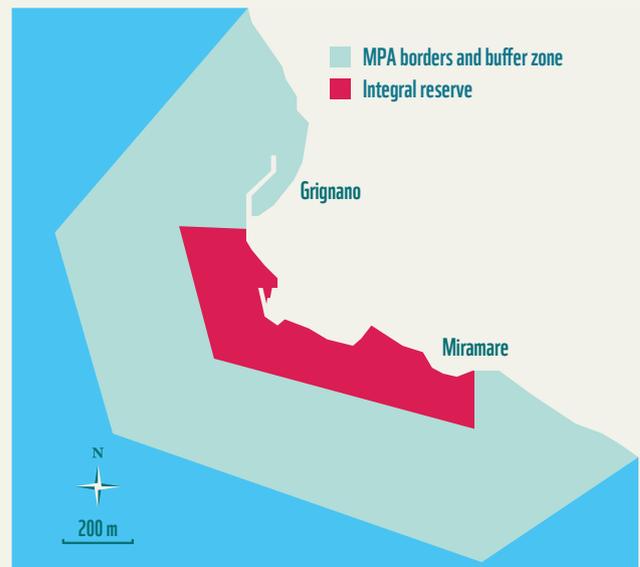
ZONING:
A zone (integral reserve, 0.3 km²), B (general reserve)
Recreational fishing: only shore fishing allowed

ARTISANAL FISHING
ALLOWED

YES



NO



Aerial view of the Miramare MPA



© NOE/ARCHIVIO WWF-AMP MIRAMARE

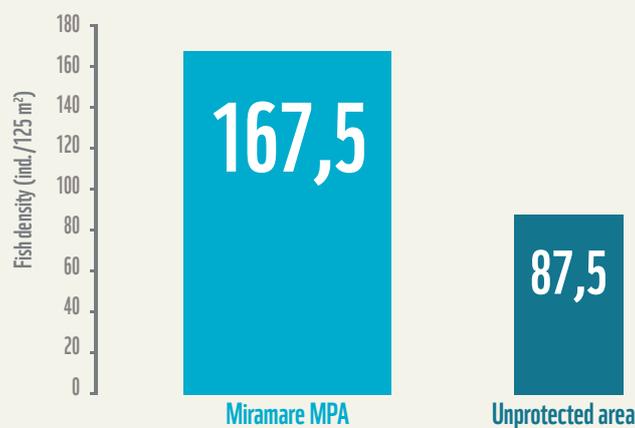
DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

Published studies highlight a clear reserve effect with higher density recorded within the MPA (Fig. 1).

Total density, and density of medium- and large-sized individuals of three target fish (*Diplodus sargus sargus*, *Diplodus vulgaris* and *Sparus aurata*) were higher within the MPA than in the external unprotected areas.

Figure 1: Fish density outside and inside Miramare MPA (data from [1] and [2])



ARTISANAL FISHING AT MIRAMARE TODAY

Artisanal fishing is not allowed within Miramare MPA boundaries.

The main goal of Miramare MPA is the protection and conservation of species. Long-term (20 years) dialogue between managers and fishermen has been carried out in order to raise fishermen's awareness and try to prevent poaching within the MPA.

Brown meagers in the Miramare MPA



© SAUL CIRIACO/ARCHIVIO WWF-AMP MIRAMARE

PLEMMIRIO MPA (ITALY)



MPA PASSPORT

DATE OF CREATION:
2004

MANAGEMENT STARTED IN:
2005

MANAGEMENT BODY:
Consortium municipality of Siracuse, Province of Siracuse.

TOTAL AREA:
24.29 km²

ZONING:
A zone (integral reserve, 0.8 km²), B (general reserve), C (partial reserve)

RECREATIONAL FISHING:
allowed with restrictions

ARTISANAL FISHING ALLOWED	YES	<input checked="" type="checkbox"/>	NO	<input type="checkbox"/>
MANAGEMENT PLAN FOR ARTISANAL FISHING	YES	<input type="checkbox"/>	NO	<input checked="" type="checkbox"/>
FISHERMEN ENGAGEMENT IN MANAGEMENT				

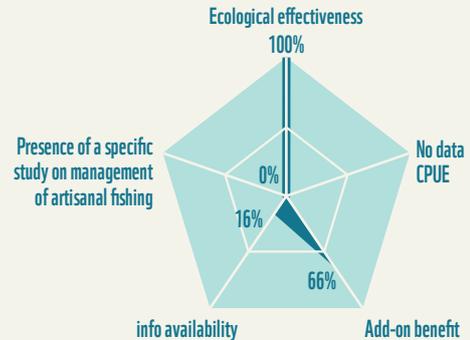
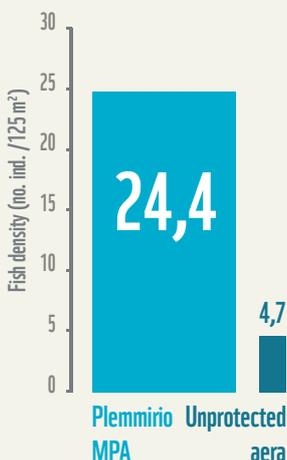


Figure 1: High-commercial value fish density outside and inside Miramare MPA (data from [1])



DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

Scientific data indicates that in Plemmirio MPA small size fish and species of low-medium commercial value do not show any significant differences in terms of abundance compared to unprotected external areas. High commercial value species show abundances significantly higher inside the MPA (Fig. 1) [1].

ARTISANAL FISHING AT PLEMMIRIO TODAY

- Fleet allowed to fish in the MPA (2013):** only local fishermen. 28 vessels authorized
- Gear allowed:** trammel nets maximum 1,000 m long, longline max. 200 hooks
- Mesh size:** 40 mm
- Frequency:** no imposed limitation
- Where in the MPA:** in zone B and zone C

CPUE (CATCH PER UNIT EFFORT) AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

Scientific information is not available concerning the potential effect of the MPA in increasing CPUE compared to unprotected areas. A scientific program is in progress.

THE PROCESS OF FISHERMEN ENGAGEMENT AT PLEMMIRIO MPA

At Plemmirio MPA, the process of fishermen engagement started in recent years by involving fishermen in two research programs. These programs have improved cohesion among fishermen and MPA management bodies. The development of initiatives aimed at increasing fishermen revenues through improved exploitation of fishing resources is a key aspect.

Fishing nets in Santa Lucia



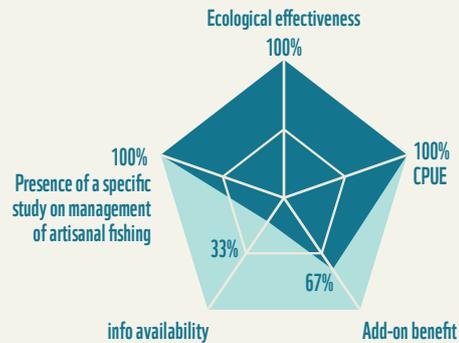
Plemmirio MPA



PORT-CROS NATIONAL PARK (FRANCE)



ARTISANAL FISHING ALLOWED	YES	<input checked="" type="checkbox"/>	NO	<input type="checkbox"/>	
MANAGEMENT PLAN FOR ARTISANAL FISHING	YES	<input checked="" type="checkbox"/>	NO	<input type="checkbox"/>	
FISHERMEN ENGAGEMENT IN MANAGEMENT	0	1	2	3 <input checked="" type="checkbox"/>	4



MPA PASSPORT

DATE OF CREATION:
1963

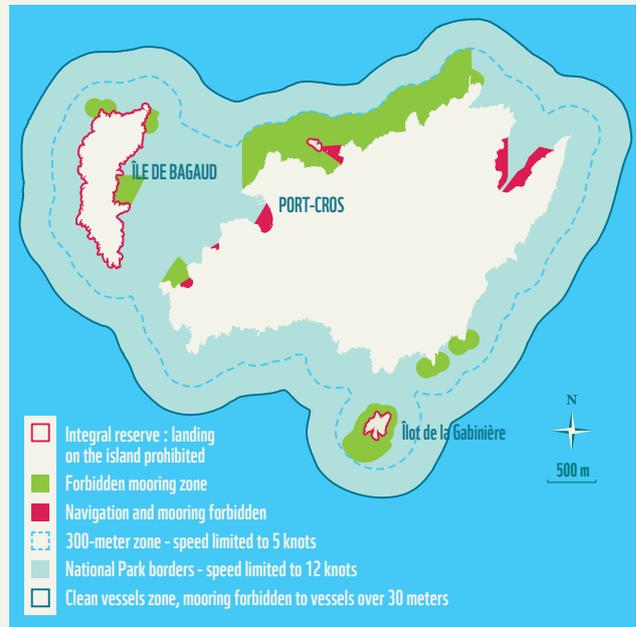
FISHERIES MANAGEMENT STARTED IN:
1999 (Professional fishing charter)

MANAGEMENT BODY:
Port-Cros National Park (PNPC)

TOTAL AREA:
19.88 km² (Port-Cros Island, Bagaud Island and Rascas and Gabinière islets) incl. 12.88 km² of marine area

ZONING:
Integral reserve (IR) (Pointe du Rascas on Port-Cros Island): all activities are forbidden. The rest of the MPA is subject to regulation:

- Mooring is regulated and prohibited in certain areas
- Scuba diving is forbidden, but permission may be granted, subject to signing a charter.
- recreational fishing is prohibited in the whole MPA except for trolling in the north of the island.
- Artisanal fishing is allowed
- Collection of sea urchins is prohibited in the whole MPA.



Fisherman who signed the Fishing Charter

© ISABELLE MASINSKI

DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

- Increase in the density of two-banded sea bream, white sea bream, sharpnose sea bream, red porgy and comber (Fig.1.) [8]
- Populations of top predators have increased (e.g. dusky grouper, common dentex, barracudas). 727 groupers identified in 2011 with an increase of 162 individuals in three years (Fig.2.) [12]
- Increase in populations of vulnerable species (dusky grouper, brown meagre). [12]
- Low impact of artisanal fishing on these species. Species rarely caught with fishing nets despite their relatively high abundance.
- Reserve effect and spillover highlighted.

Figure 1: Density of target species in 1990 and 2007 at PNPC. From [8]

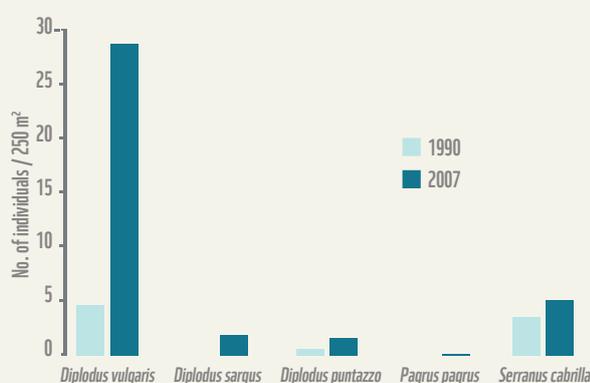
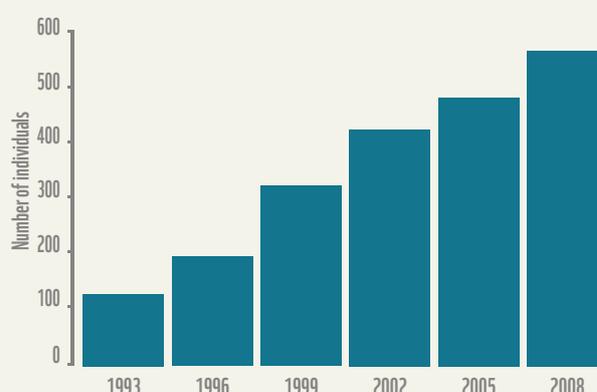


Figure 2: Temporal trend of number of individuals of dusky grouper from 1993 to 2008 at PNPC. From [12]



Fishing catches



© CHRISTEL GÉRARDIN

ARTISANAL FISHING AT PORT-CROS NATIONAL PARK TODAY

- It has been allowed since the creation of the park, except for some forms (trawling) that are prohibited. Professional activities are subject to the signing of a charter between each professional fisherman and the National Park. An order of the Prefect of the Region (No. 2013354-0001 of 20 December 2013) makes it mandatory.
- Regulations: vessel size (10 m maximum, up to 3 people on board), the size of nets and mesh (2,000 m length of nets per boat maximum; minimum mesh size allowed 7, i.e. 83.2 mm; mesh size 6 at more than 30 m depth), the number of fish baskets (6 per boat maximum), the number of longline hooks (maximum 500 per boat), the number of longliners (no more than two to be fishing simultaneously in the National Park), the deployment time (24 hours maximum between the surface and 30 m depth, 48 hours maximum beyond 30 m), and the no-fishing zones (see map). In addition, fishermen agree not to set out their nets more than two days in the same place, to inform park managers about their fishing activities, to complete a logbook and to submit it to the Park.
- Professional fishermen who sign the Charter will receive the “Partner of the National Park of Port-Cros” logo as stickers to be affixed onto their boat or as a partnership flag. The annual award of the logo is subject to signing and enforcement of the Charter.



Table 1: Evolution of the minimal fishermen population fishing in the Park between 1990 and 1997 (from Francour *et al.*, 1999), from 2000 to 2010 (Cadiou *et al.*, 2008, 2009, 2010 and current work). n. d.: non-defined.

Bumber of fishermen		
	Period	↓
1990	june-sept.	15
1992	april-dec.	18
1996	n.d.	9
1997	n.d.	9
2000	fev.-nov.	13
2001	dec.00-nov.01	9
2002	fev.-nov.	10
2003	march-dec.	9
2004	dec.03-nov.04	10
2005	jan.-nov.	13
2006	jan.-nov.	14
2007	jan.-nov.	16
2008	jan.-nov.	17
2009	jan.-oct.	13
2010	fev.-sept.	11
2011	fev.-oct.	13
2012	jan.-nov.	8

Scientific monitoring has been put in place to assess the artisanal fishing effort to better understand the patterns and rhythms of fishing activities, the “métiers” carried out and catches made around Port-Cros.

In the framework of the Fishing Charter, fishermen fill in a fishing logbook every time they go fishing at Port-Cros. Since 2003, scientist have been embarking on board fishing vessels in order to improve knowledge of artisanal fishing (in terms of activities, spatial and temporal patterns, gears adopted, etc.), to improve data coming from fishing logbooks and to collect data on catches.

Meanwhile, park officers during their patrolling carry out a count of the fishing gears deployed around the island of Port-Cros.

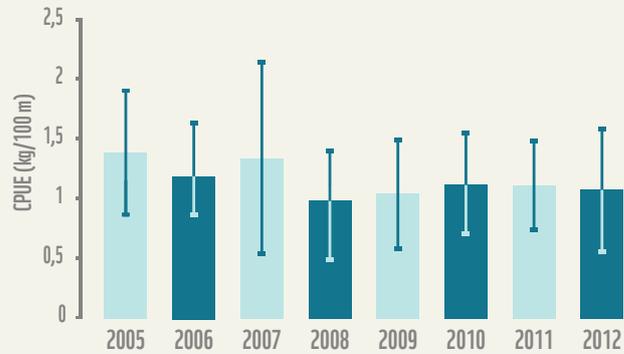
Crossing information from logbooks and counts allows for a better estimate of fishing effort throughout the year. At the end of 2012, twelve years of sampling had been conducted.

CPUE (CATCH PER UNIT EFFORT) AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

Annual fishing yields from 2005 to 2012 are comprised between 0.95 and 1.37 kg/100 m of net (Figure 3). Yields are higher at the beginning of the period: the results of years 2005 and 2007 are significantly higher than the 2008-2012 period, except 2006 which is not different from 2007, 2008 and 2009.

The year 2008 was marked by an overall reduction in yields. Since 2008, annual yields have been stable. The yield in 2012 reached 1.08kg/100 m net [1].

Figure 3: Mean annual yields of fishing nets (kg/100 m of net) in Port-Cros National Park of fishermen who completed their logbooks.



THE PROCESS OF FISHERMEN ENGAGEMENT AT PORT-CROS NATIONAL PARK

- 1963: Creation of PCNP. No consultation with professional fishermen.
- 1999: Introduction of a professional fishing charter in consultation with professional fishermen. The charter is reviewed annually by commercial fishermen and managers jointly.
- Since 1999: A representative of professional fishermen has been on the Management Board and the Economic and Social Council
- Since 1999: Fishermen involved in scientific monitoring through logbooks and embarkations.
- Since 2006 at Porquerolles, existence of concerted action through the Natura 2000 Steering Committee involving different stakeholders (including artisanal fishermen) for management of space and resources.

LESSONS LEARNT

- Needs: regular surveillance of the park, monitoring of fishing effort by park rangers, limitation in some areas (i.e. diving sites).
- Dialogue and participatory development of regulations with fishermen
- Importance of professional fishing charter as a tool for managing artisanal fisheries in agreement with artisanal fishermen.

Artisanal fishing boats in the Port of Niel



© CHRISTEL GÉRARDIN

PORTOFINO MPA (ITALY)



ARTISANAL FISHING ALLOWED	YES	<input checked="" type="checkbox"/>	NO	<input type="checkbox"/>
MANAGEMENT PLAN FOR ARTISANAL FISHING	YES	<input checked="" type="checkbox"/>	NO	<input type="checkbox"/>
FISHERMEN ENGAGEMENT IN MANAGEMENT	<div style="display: flex; justify-content: space-around; align-items: center;"> 0 1 2 3 4 </div>			

MPA PASSPORT

DATE OF CREATION:
1999

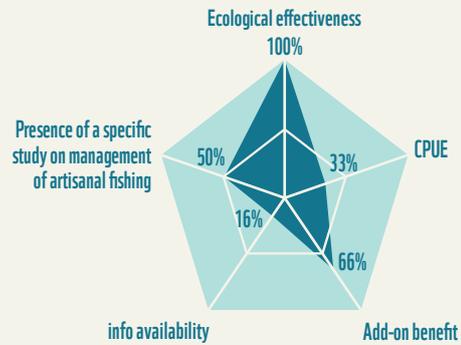
MANAGEMENT STARTED IN:
1999

MANAGEMENT BODY:
Consortium of municipalities of Camogli, Portofino, S.Margherita Ligure, province of Genova, and University of Genova.

TOTAL AREA:
3.46 km²

ZONING:
A zone (integral reserve, 0.19 km²), B (general reserve), C (partial reserve)

RECREATIONAL FISHING:
allowed with restrictions, duly authorized by the MPA management body

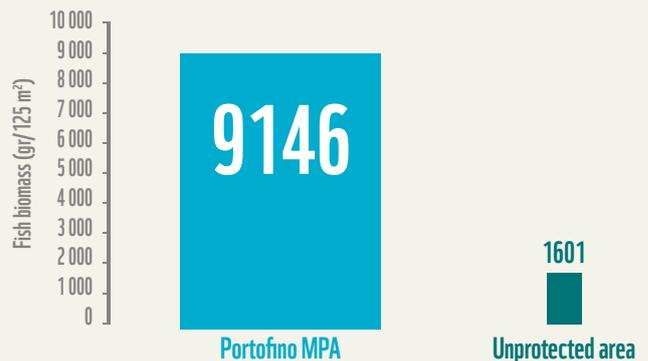


DOES THE MPA WORK? ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

Scientific data indicates that Portofino MPA shows a reserve effect with higher fish biomass inside (in zone A) compared to unprotected areas outside the MPA's borders (Fig. 1).

Data from a national project suggests spillover [4].

Figure 1: Fish biomass outside and inside Portofino MPA (data from [1])



ARTISANAL FISHING AT PORTOFINO TODAY

Fleet allowed to fish in the MPA (2013): only local fishermen. 35 vessels allowed
Gear allowed: trammel net, gillnet, longline (max 200 hooks), seine boat for transparent goby (*Aphia minuta*) fishing
Mesh size: as defined by national law
Frequency: no imposed limitation
Where in the MPA: in zone B and zone C

Other traditional fishing gears (e.g. *tonnarella* and *mugginara*) are allowed during specific periods and are restricted to a single site within the MPA.

CPUE (CATCH PER UNIT EFFORT) AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

Data from the report of a national project carried out in 2004-2005 suggests that catches in zone B are not higher than in external areas. Different evidence arose focusing on a single subset of target species (i.e. *Dentex dentex*, *Diplodus sargus*, *D. vulgaris*, *Mullus surmuletus*, *Pagellus erythrinus*, *Sparus aurata*, *Sciaena umbra*, *Phycis phycis*, *Scorpaena scrofa* and *S. porcus*) with higher catches within the MPA than outside. Since 2012 the MPA has started a new monitoring activity in order to verify whether the average CPUE value is changing over time.

Figure 2: Average CPUE of target species in the B zone of Portofino MPA versus outside (data from [4])



Artisanal fishing in Portofino

© VALENTINA CAPPANERA



Aerial picture of Portofino

© MARIO MALATESTA



THE PROCESS OF FISHERMEN ENGAGEMENT AT PORTOFINO MPA

At Portofino MPA fishermen are invited to meetings organized by the management body of the MPA when decisions concerning modification of the management plan are to be made.

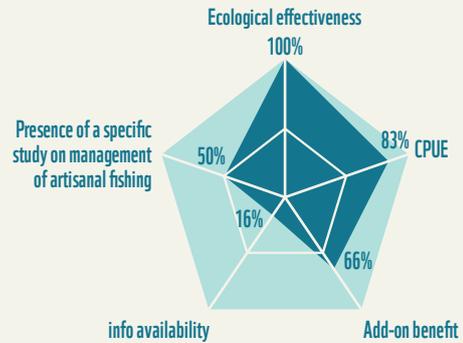
The MPA is carrying out some actions aimed at improving trust between fishermen and the MPA itself.

Since 2009 the MPA has been evaluating traditional fishery and local cultural heritage specially focusing on the “Tonnarella” of Camogli. The Manager would like to develop a training course to create new human resources for small-scale fishing.

SCANDOLA NATURE RESERVE (FRANCE)



ARTISANAL FISHING ALLOWED	YES	<input checked="" type="checkbox"/>	NO	<input type="checkbox"/>
MANAGEMENT PLAN FOR ARTISANAL FISHING	YES	<input checked="" type="checkbox"/>	NO	<input type="checkbox"/>
FISHERMEN ENGAGEMENT IN MANAGEMENT	<div style="display: flex; justify-content: space-around; align-items: center;"> 0 1 2 3 4 </div>			



MPA PASSPORT

DATE OF CREATION:
1975

MANAGEMENT BODY:
Regional Nature Park of Corsica (PNRC)

TOTAL AREA:
15.69 km², marine part 10 km²

ZONING:
Two zones: an integral reserve (IR) of 0.8 km² and a buffer zone or non-integral reserve (NIR) extending over 9.2 km² where all activities are regulated. Professional fishing is permitted as part of an exemption system that allows local fishermen to carry out their activity under strict rules. Recreational fishing is prohibited.



Fishermen in Scandola



© P. FRANCOUR

DOES THE MPA WORK ?

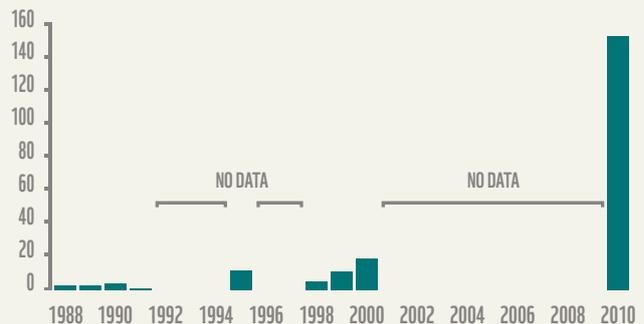
ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

- FAST indices (i.e. measure of the status of fish assemblage) higher within the IR in 2010. Better ecological status of fish assemblages within the RI compared to the outside unprotected areas (Tab. 1) [2]
- Between 1999-2001 and in 2010: increase in the population of groupers (*Epinephelus spp.*). [Fig. 1, P. Francour unpublished data]
- Simplification of fish assemblage within the IR, with a reduced number of species and a marked dominance by a single species, the dusky grouper *Epinephelus marginatus*.
- Northern part of the reserve, deterioration of the fish assemblage, probably related to an intensification of the commercial fishing effort.

Table 1: Comparison between years of the ecological value of fish assemblages from different areas sampled within and close (outside) to the Scandola Nature Reserve. 1: assemblages with very good status, 5: assemblages with very poor ecological status. An indication reflects a deterioration in the assemblage. From [2]

	Ecological value		COMMENTS
Integral reserve	1999	1	Between 1999 and 2001, the fish assemblages of the integral reserve were considered to have a very good ecological status. En 2010, an evolution was observed: the ecological status was still good but less that in 1999-2001.
	2000	1	
	2001	1	
	2010	1-2	
Northern reserve	2000	2	In 2000, like in 2001, the ecological status of the fish assemblages was considered as good. The ecological value is similar in 2010, even if the scored values are lower.
	2001	2	
	2010	2	
Outside	2000	3	The ecological status of the fish assemblages was average in 2000 and showed a slight degradation in 2010.
	2010	3	
Intermediary	2000	3	The ecological status of the fish assemblages was average in 2000 and remained at the same level in 2010.
	2010	3	

Figure 1: Temporal trend of dusky grouper abundance at the islet of Palazzu, from 1988 to 2010.



ARTISANAL FISHING AT SCANDOLA RESERVE TODAY

Number of vessels authorized to fish: 7 permanent exemption permits, 9 temporary permits. Permit valid for one year.

Authorized gears: net, longline and trap. Ban on simultaneous use of nets and longlines. 40 net patches allowed per boat. Deployment time: two nights.

Where in the reserve: in the buffer zone, duly authorized.

Who: 10 local fishermen (from towns close to the reserve) who fish permanently within the buffer zone. A dozen other fishermen carry out their activity on a temporary basis in the buffer zone.

Other activities: One fisherman carries out pescatourism.

CPUE (CATCH PER UNIT EFFORT) AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

Scientific monitoring conducted between 2001 and 2012 shows that fish yields undergo marked seasonal variations and ranges between 2 and 3 kg of fish per 100 m of net [3]. (Tab.2)

Fishing yields tend to increase for the net with average mesh nets 6-8, but not for nets with larger mesh size or for lobster nets.

During the same period, the fishing effort increased: the number of gears increased and techniques were perfected (boat equipped with winches, use of monofilament nets).

table 2: Average total CPUE in biomass (standard deviation). In grey data refer to spring. From [3].

SEASON	NB OF NETS	YIELDS/ 100M OF NET (KG) TOTAL BIOMASS	YIELDS / 100M OF TRAMMEL NET (KG)FISH BIOMASS
April 2001	34	2.96 (3.98)	2.55 (4.19)
July 2001	30	2.34 (1.99)	2.01 (1.91)
July 2002	57	1.85 (2.08)	1.21 (2.67)
September 2002	26	0.95 (0.66)	0.92 (0.54)
May 2006	68	3.29 (2.90)	2.98 (2.83)
September 2006	55	2.27 (1.66)	2.07 (1.68)
October 2007	31	1.99 (2.03)	2.05 (2.02)
Juin 2011	71	2.29 (3.16)	1.75 (2.68)
Mai 2012	68	3.84 (4.74)	2.89 (1.39)

This evidence can be due to four main reasons: the effective surveillance of the reserve, the presence of pristine habitats, fishing pressure not too high and fishermen who have carried out sustainable fishing (Le Direach pers. comm.).

THE PROCESS OF FISHERMEN ENGAGEMENT AT SCANDOLA RESERVE

- Fishermen were consulted and issued a favorable opinion. Consultation and information yielded a consensus for the establishment of the MPA. Fishermen agree to the RI, but the presence of reserve rangers must be permanent and persuasive
- Artisanal fishermen are involved in decision-making about their profession, in the management of fisheries resources and they are informed about the MPA governance.
- Fishing regulations are decided and implemented in consultation with fishermen.
- Fishermen are directly informed about the progress of legal and scientific activities through in situ information meetings.
- Fishermen are involved in scientific monitoring of the reserve.
- Fishermen are involved in reserve surveillance. Reserve rangers verify the indications and information provided by fishermen.

Aerial view of Scandola



© J. DOMINICI

MPA PENISOLA DEL SINIS - ISOLA DI MAL DI VENTRE (ITALIE)



MPA PASSPORT

DATE OF CREATION:

1997

MANAGEMENT STARTED IN:

1998

MANAGEMENT BODY:

Municipality of Cabras

TOTAL AREA:

267 km²

ZONING:

A zone (integral reserve, 5.29 km²), B (general reserve), C (partial reserve)

RECREATIONAL FISHING:

only angling allowed for residents and/or duly authorized by the MPA management body.

ARTISANAL FISHING ALLOWED

YES



NO



MANAGEMENT PLAN FOR ARTISANAL FISHING

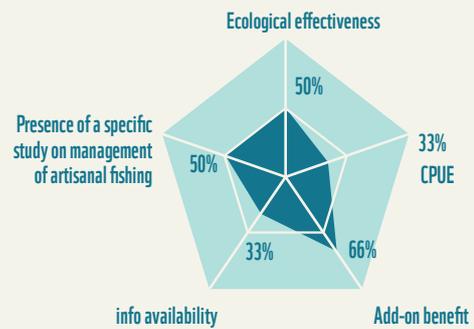
YES



NO



FISHERMEN ENGAGEMENT IN MANAGEMENT



Fishing boat



© GIOVANNI BEARZI

DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

Scientific data indicates that Penisola del Sinis - Isola di Mal di Ventre MPA does not show any evident reserve effect probably due to the low enforcement level [1].

ARTISANAL FISHING AT PENISOLA DEL SINIS - ISOLA DI MAL DI VENTRE TODAY

Fleet allowed to fish in the MPA (2013): no imposed limitation. 100 vessels allowed to fish within the MPA (local fishermen).

Gear allowed: Trammel nets, longlines, gillnets, combined gillnets-trammel nets, pots (quantity now established by regional law/decreet).

Mesh size: as defined by national law.

Frequency: no imposed limitation.

Where in the MPA: in zone B and zone C.

CPUE (CATCH PER UNIT EFFORT) AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

Preliminary data indicate that CPUE within the MPA is relatively low (8.7 kg/1000m of trammel net per day) compared to catches recorded in other Italian areas [2]

THE PROCESS OF FISHERMEN ENGAGEMENT AT PENISOLA DEL SINIS - ISOLA DI MAL DI VENTRE

At Penisola del Sinis - Isola di Mal di Ventre fishermen are regularly involved in meetings and participate in consultative processes (e.g. definition of regulations). Providing the MPA with a real surveillance system that enforces regulations is important to legitimate the MPA in the eyes of the fishermen.

Fishing catches



© PENISOLA DEL SINIS MPA



© PENISOLA DEL SINIS MPA

TABARCA ISLAND MARINE RESERVE (SPAIN)



MPA PASSPORT

DATE OF CREATION:
1986

MANAGEMENT BODY:
Inshore waters: Consejería de Agricultura y Medio Ambiente de la Comunidad Valenciana

OFFSHORE WATERS:
General Secretariat of Fisheries, Ministry of Agriculture, Food and Environment (MAGRAMA)

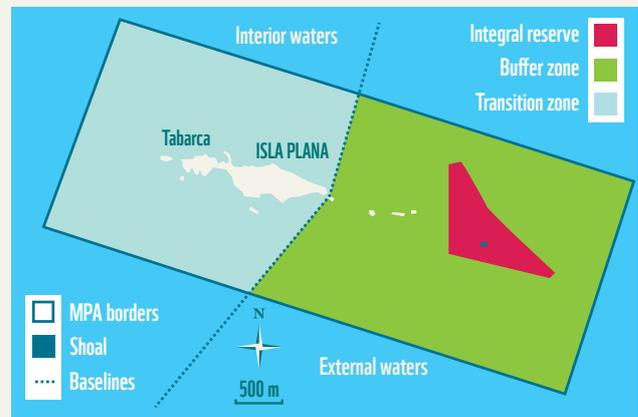
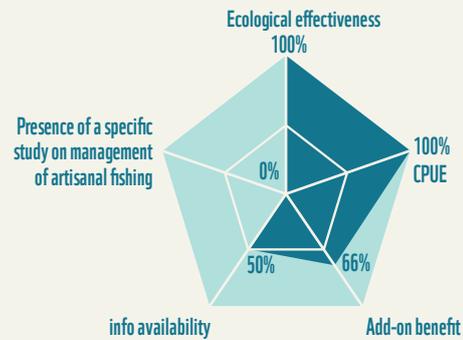
TOTAL AREA:
14 km²

ZONING:
3 levels of protection: an integral reserve (0.78 km²) where all activities are forbidden except for scientific research; a buffer zone where fishing with selective gears is allowed (trolling, pelagic fish traps); a transition zone where fishing with selective gears and also water-based activities (bathing, diving and anchoring) are allowed.

ARTISANAL FISHING ALLOWED YES NO

MANAGEMENT PLAN FOR ARTISANAL FISHING YES NO

FISHERMEN ENGAGEMENT IN MANAGEMENT 0 1 2 3 4



Fishermen in the reserve



©SPANISH MARINE RESERVES SGP MAGRAMA

Groupers



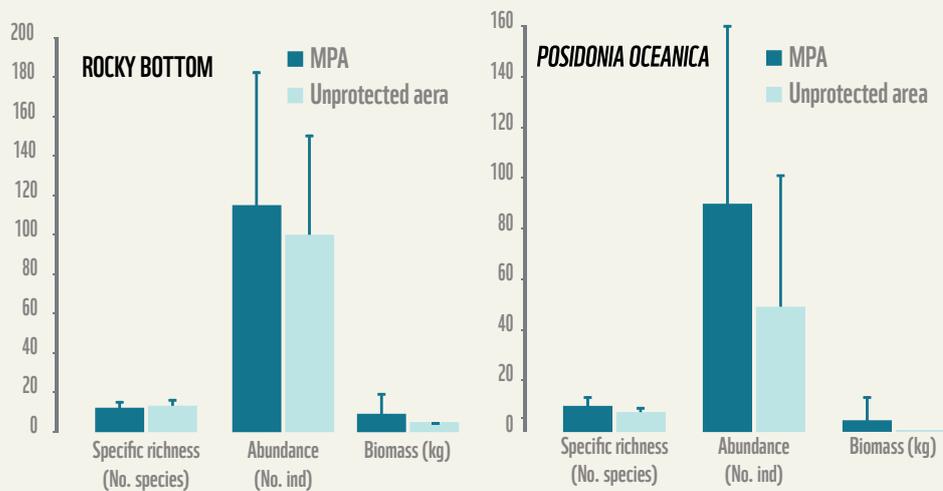
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DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

- On rocky bottoms, average species richness, fish abundance and biomass recorded within the reserve are not significantly different from the levels recorded in external areas (Fig. 1). A significant reserve effect has been highlighted on *Posidonia oceanica* meadows (Fig. 2) [4].
- This finding can be due to the fact that rocky bottoms are rare and isolated among *Posidonia oceanica* meadows, fishing pressure being higher on seagrass meadows.
- Fish spillover is highlighted [3].

Figure 1: Average specific richness, abundance and biomass (\pm SD) per transect for fish assemblages within and outside Tabarca reserve (top: rocky bottom, bottom: *Posidonia oceanica* meadow). Data from [4]. The unit of measurement is different for each variable (indicated next to each variable).



ARTISANAL FISHING AT TABARCA RESERVE TODAY

Number of vessels authorized: all local professional fishermen whose vessels are registered. No limits on the number of fishermen allowed to fish in the MPA.

Authorized gears: moruna net, trolling, trammel net (specifically in the Barra Norte zone), fishing with bait (with the exception of longlines).

Authorized fishermen: local fishermen.

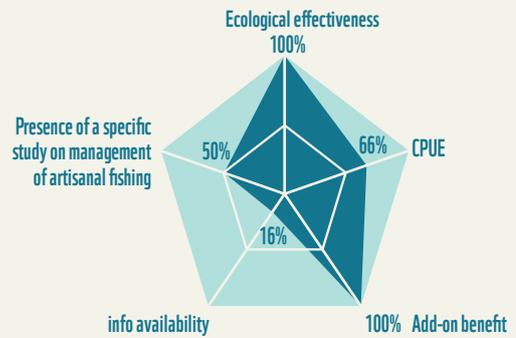
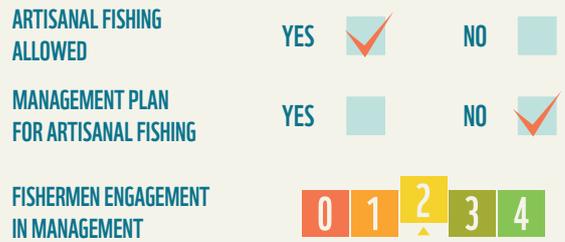
Where in the reserve: 95 % of the Tabarca Reserve.

Surveillance: provided by rangers and two fishing boats. These guards have the power of auxiliary police and special authority to report illegal actions.

THE PROCESS OF FISHERMEN ENGAGEMENT AT TABARCA RESERVE

- Fishermen organized in associations (“cofradias”).
- Fishermen involved in the implementation of the reserve through control committees and technical meetings.
- Fishermen involved in decision-making and governance.
- An effective surveillance since the beginning are important to ensure proper fishing management in the reserve.

TAVOLARA-PUNTA CODA CAVALLO MPA (ITALY)



MPA PASSPORT

DATE OF CREATION:
1997

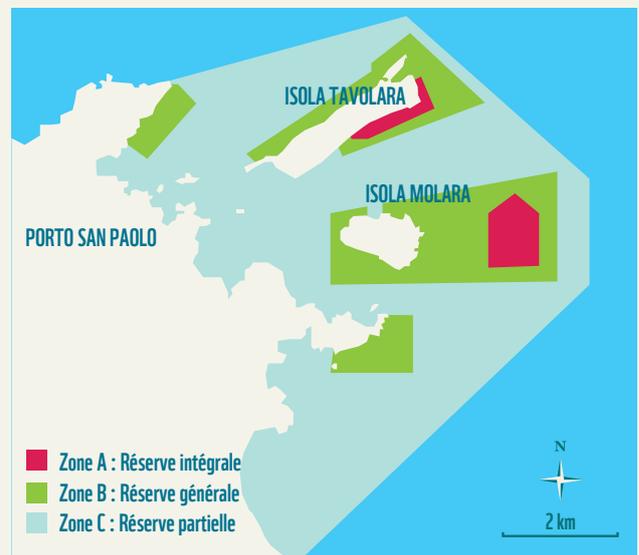
MANAGEMENT STARTED IN:
2003

MANAGEMENT BODY:
Consortium of municipalities of Olbia, Loiri - Porto San Paolo and San Teodoro

TOTAL AREA:
153.57 km²

ZONING:
A zone (integral reserve, 5.29 km²), B (general reserve), C (partial reserve)

RECREATIONAL FISHING:
allowed with some limitations more restrictive than national laws



Molarotto site



© ANDROMED

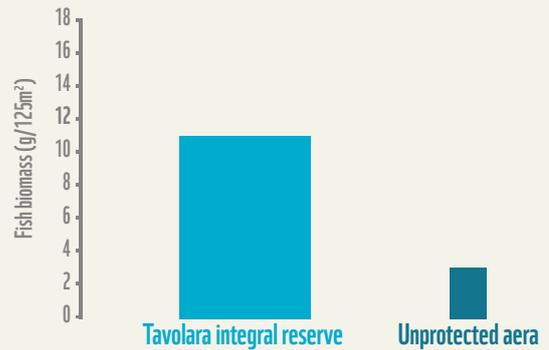
DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

Scientific data indicates that Tavolara-Punta Coda Cavallo MPA shows clear reserve effects:

- higher fish biomass inside (in zone A) compared to unprotected sites outside the MPA's borders (Fig. 1, data from [1]) ;
- especially high biomass of target species (e.g. the dusky grouper *Epinephelus marginatus* and the white sea bream *Diplodus sargus*) has been recorded in protected rocky banks [4].

Figure 1: Fish biomass (average) evaluated using underwater nondestructive visual census



ARTISANAL FISHING AT TAVOLARA-CAPO CODA CAVALLO TODAY

Fleet allowed to fish in the MPA (2013): no imposed limitation. 15 vessels usually fishing within the MPA

Gear allowed: selective gears that do not damage the bottom, no further specifications

Mesh size: as defined by national law

Frequency: no imposed limitation

Where in the MPA: in zone B and zone C

A management plan for artisanal fishing has been submitted to the Ministry in charge and is awaiting approval.

Artisanal fisherman



© G. CANU

CPUE (CATCH PER UNIT EFFORT) AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

Data from the report of a national project highlighted an average CPUE of 18 kg/1,000 m trammel net within the MPA [2]. Little data is available about CPUE in external unprotected areas.

THE PROCESS OF FISHERMEN ENGAGEMENT

At Tavolara - Punta Coda Cavallo, the process of fishermen engagement started in recent years by involving fishermen in environmental education programs carried out in schools where fishermen had the possibility of sharing their experience and knowledge with students. These programs enhance cohesion between fishermen and the MPA management body.

TORRE DEL CERRANO MPA (ITALY)



MPA PASSPORT

DATE OF CREATION:
2009

MANAGEMENT STARTED IN:
2010

MANAGEMENT BODY:
Consortium including municipalities of Pineto and Silvi, province of Teramo and Abruzzo Region

TOTAL AREA:
34.31 km²

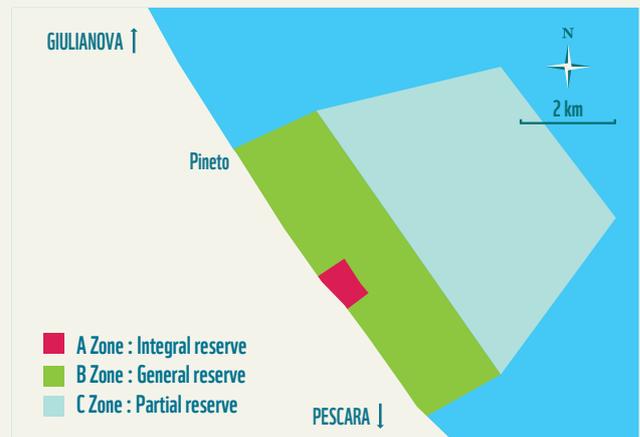
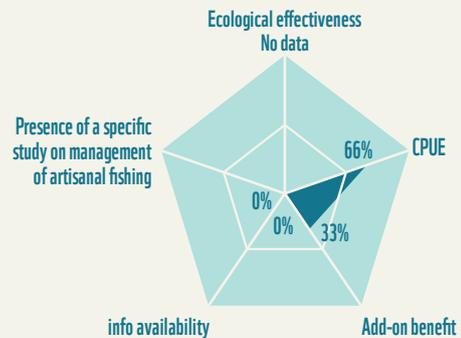
ZONING:
B (general reserve), C (partial reserve), D zone (protection zone)

RECREATIONAL FISHING:
Allowed for residents in zone C, for everyone in zone D.

ARTISANAL FISHING ALLOWED YES NO

MANAGEMENT PLAN FOR ARTISANAL FISHING YES NO

FISHERMEN ENGAGEMENT IN MANAGEMENT 0 1 2 3 4



DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

No published information is currently available on the MPA's ecological effectiveness.

ARTISANAL FISHING AT TORRE DEL CERRANO TODAY

Fleet allowed to fish in the MPA (set in 2010): no imposed limitation. 31 vessels allowed to fish within the MPA (local fishermen)

Gear allowed: as defined by national law

Mesh size: as defined by national law

Frequency: no imposed limitation

Where in the MPA: in zone B, C and D (limited in zone B)

CPUE (CATCH PER UNIT EFFORT) AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

No published information is currently available on the MPA's ecological effectiveness. Fishermen informally reported a substantial increase in CPUE within the MPA after its implementation and following the ban of “turbosoffianti” (i.e. boats using suction dredges in sandy/muddy bottoms to collect clams).

THE PROCESS OF FISHERMEN ENGAGEMENT AT TORRE DEL CERRANO

At Torre del Cerrano fishermen have begun to be engaged through research and educational programs.

Torre del Cerrano



© FABIO VALLAROLA

Fishing vessel



© FABIO VALLAROLA

TORRE GUACETO MPA (ITALY)



MPA PASSPORT

DATE OF CREATION:

1991

MANAGEMENT STARTED IN:

2000

MANAGEMENT BODY:

Consortium WWF, municipalities of Brindisi and Carovigno

TOTAL AREA:

22.27 km²

ZONING:

A zone (integral reserve, 1.79 km²), B (general reserve), C (partial reserve)

RECREATIONAL FISHING:

only shore fishing allowed, duly authorized by the MPA management body

ARTISANAL FISHING ALLOWED

YES



NO



MANAGEMENT PLAN FOR ARTISANAL FISHING

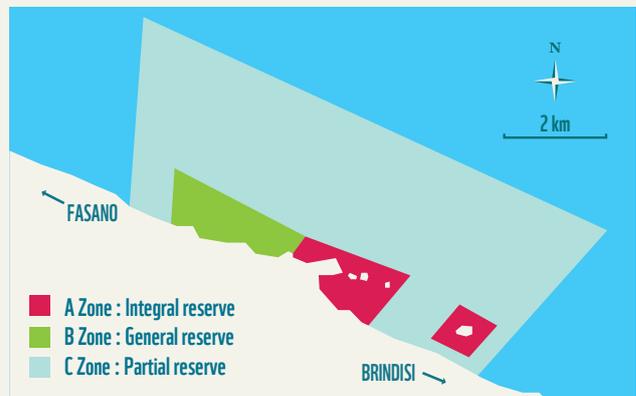
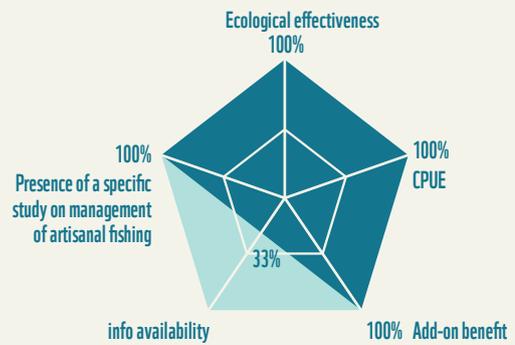
YES



NO



FISHERMEN ENGAGEMENT IN MANAGEMENT



Fishing catches



© CATHERINE PLANTE

DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

Figure 1: Fish biomass (average) evaluated using underwater non-destructive visual census



Scientific data [1-3, 6 and unpublished data by Guidetti *et al.*] indicates that Torre Guaceto MPA shows clear reserve effects: higher fish biomass inside (especially in zone A) compared to unprotected sites outside the MPA's borders ; spillover of adult fish biomass towards fished grounds ; for some fish (e.g. sea breams), egg/larvae production is 15 times higher within the MPA than outside, which fuels both the replenishment of the MPA and export over long distances to possibly benefit local fisheries.

ARTISANAL FISHING AT TORRE GUACETO TODAY

Fleet allowed to fish in the MPA (2013): 8 vessels

Gear allowed: trammel nets maximum 1,000 m long

Mesh size: minimum 3.0 cm (side, knot to knot)

Frequency: once per week

Where in the MPA: only in zone C

Artisanal fishermen in Torre Guaceto



© DARIO FIORENTINO

CPUE (CATCH PER UNIT EFFORT) AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

Figure 2: Temporal trends in average CPUE in the C zone of the MPA vs. outside



CPUE has been systematically and scientifically monitored to compare temporal trends of catches inside zone C and outside the MPA borders (data outside not available for the 2009-2010 period) [4,5].

After opening the MPA (only zone C) to fishing, total CPUE inside the MPA was on average 60 kg/km of net/day. Then CPUE stabilized around values 2-3 times higher inside the C zone than outside.

THE PROCESS OF FISHERMEN ENGAGEMENT AT TORRE GUACETO

Torre Guaceto was a traditional fishing site for local fishermen. The creation of the MPA did not pose any problem initially, in the absence of any restriction. In 2000, the management body was established and the MPA managed. In the absence of data, fishing was forbidden in the entire MPA, which caused vehement reactions from fishermen against the MPA and the authorities responsible for patrolling the area, with fishermen who felt they were the moral owners of the MPA territory.

In 2005 fishermen were invited to start an experimental fishing activity in selected areas of zone C, under the supervision of a scientific body. A considerable portion of the MPA (18.85 km²) was thus re-opened to artisanal fishing and data on catches was collected in collaboration (between the MPA staff, scientists and fishermen): this phase (1-2 years) helped improve personal relationships and reciprocal trust. A protocol to regulate fishing activities (to avoid overfishing, fishing juveniles and keystone species) was negotiated with the fishermen, who had the power to propose solutions according to their needs and customs.

The fishermen engagement in management radically changed the initial situation: illegal fishing reports were 300 in 2001-2003, less than 20 in 2006 and 1-2 per year in 2010-2012. In 2008, formal rules of conduct (including more restrictive rules) were accepted by the fishermen, on a voluntary basis, in agreement with the MPA and the scientific body. These rules were finally included in the regulations subsequently accepted by the Italian Ministry responsible for MPAs.

In recent years (2010-2013), the MPA, in collaboration with a scientific body and the “Slow-Food” association, has supported projects to sustainably exploit commercially low-value species (e.g. mugilid fish). Recently, a new cooperative was created, which specifically refers to the MPA of Torre Guaceto. This is a notable step forward in the process of

integration between the MPA and fishermen, proving that, even though mature co-management is still far off, fishermen now feel a part of the management, cooperating on the surveillance of the area and having improved their income. The resulting increase in fishermen income represented a crucial step in the whole process.

The small port of Specchiolla (close to Torre Guaceto)



© CATHERINE PIANTE

TREMITI ISLANDS MPA (ITALY)

ARTISANAL FISHING ALLOWED

YES



NO



MANAGEMENT PLAN FOR ARTISANAL FISHING

YES



NO



FISHERMEN ENGAGEMENT IN MANAGEMENT



MPA PASSPORT

DATE OF CREATION:

1989

MANAGEMENT STARTED IN:

1995

MANAGEMENT BODY:

National Park of Gargano

TOTAL AREA:

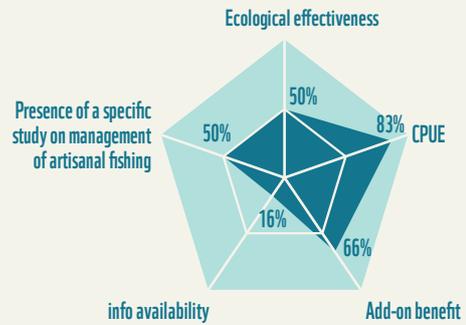
14.66 km²

ZONING:

A zone (integral reserve, 1.80 km²), B (general reserve), C (partial reserve)

Recreational fishing:

only in zone C, duly authorized by the MPA management body



Panoramic view of Tremiti Islands MPA



DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

Published information highlighted a lack of difference in both fish density and biomass between zones of different protection levels [1]. This evidence can suggest a lack of reserve effect.

ARTISANAL FISHING AT TREMITI ISLANDS TODAY

Fleet allowed to fish in the MPA (2013): no imposed limitation. 14 vessels potentially allowed to fish within the MPA (local fishermen)

Gear allowed: Trammel nets, longlines, gillnets, pots

Mesh size: as defined by national law

Frequency: no imposed limitation

Where in the MPA: in zone C

CPUE (CATCH PER UNIT EFFORT)

AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

Based on fishermen interviews, CPUE was estimated to be approximately 12 kg/km of trammel net per day, a value relatively high compared to CPUEs from other Italian areas [2]. However, no historical data nor formal comparison with unprotected areas are available.

THE PROCESS OF FISHERMEN ENGAGEMENT AT TREMITI

At Tremiti Islands, fishermen have started to be engaged in recent years through meetings and involvement in research programs. Fishermen initially showed some reluctance to cooperate but they have progressively started to slowly increase their trust in the MPA management and scientists. Effective patrolling of the MPA is key in order to legitimate the management process in the eyes of fishermen.



© CENTRE DE PLONGÉE DE TREMITI

NATIONAL MARINE PARK OF ZAKYNTHOS (GREECE)



MPA PASSPORT

FORMAL IMPLEMENTATION:

1999

MANAGEMENT STARTED IN:

2000

MANAGEMENT BODY:

Management Agency of NMPZ

TOTAL SURFACE AREA:

104.33 km² (89.2 km² of marine area)

ZONING:

- Laganas Bay - Area Ia - trawlers, purse seiners, recreational and spear fishing are banned throughout the year within the MPA limits. Zone A (8.98 % of the MPA): no boating activity, no-take area for 6 months/year (May to October), Zone B: (40.30 % of the MPA) boating speed limit, no anchoring permitted, Zone C (8.30 % of the MPA) : boating speed limit, anchoring permitted.
- Strofades Islands - trawlers, purse seiners, recreational and spear fishing are banned throughout the year.

ARTISANAL FISHING ALLOWED

YES



NO



MANAGEMENT PLAN FOR ARTISANAL FISHING

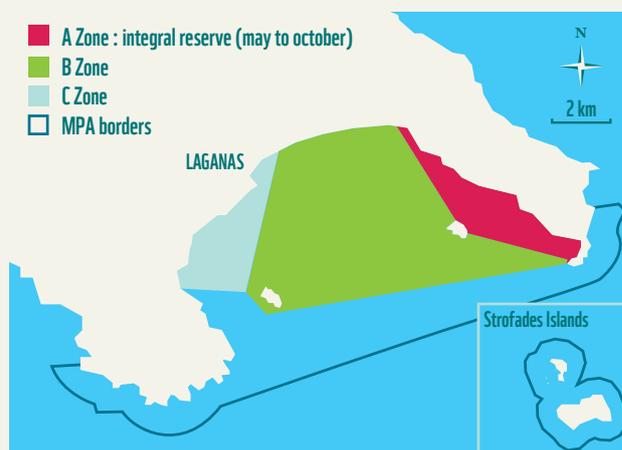
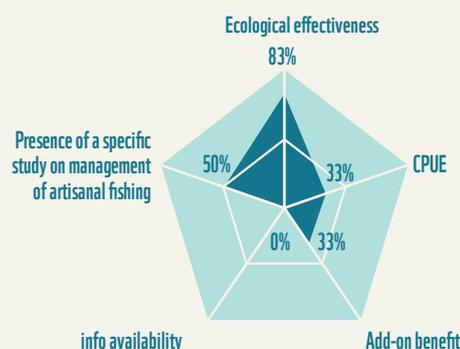
YES



NO



FISHERMEN ENGAGEMENT IN MANAGEMENT



Saint Peter's fish (*Zeus faber*) caught in trammel nets



© C. DIMITRIADIS

Fish catch in the MPA of NMPZ



© I. FOURNARI-KONSTANTINIDOU

DOES THE MPA WORK ?

ECOLOGICAL EFFECTS FOLLOWING PROTECTION AND MANAGEMENT

The results of a visual census carried out recently (2013) indicate that although there seems to be a pattern of increased abundance and biomass of fish in the more protected areas, the overall low abundance and biomass values as well as apex predators and carnivorous fish, point to the fact that current measures may not provide sufficient protection to produce a more evident reserve effect.

ARTISANAL FISHING AT NMPZ TODAY

Fleet allowed to fish in the MPA: all artisanal fishermen with no restrictions (about 50 fishing vessels regularly fishing)

Mean length of fishing boats: about 6.83 m.

Gear allowed: static trammel nets and long-lines (98 %).

Where: Strofades Islands

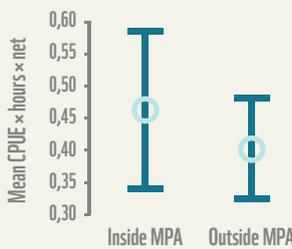
Surveillance: done by the agency managing the MPA and not by fishermen. Fishing regulation enforcement (fishing gears, catches, etc.) is mainly performed by the port police

in order to detect illegal practices. Surveillance of fishing is mainly carried by the park rangers of NMPZ patrolling the sea (usually park rangers and coast guard together). Fisheries surveillance is also carried by land guards, mainly regarding the ban on entry into zone A and control of illegal activities.

ARTISANAL FISHING MANAGEMENT

So far, no direct and standardized management of fisheries exists. During the last ten years, priority has been given to law enforcement (prohibition of recreational fishing and trawling) and thus, the first steps have been taken to ensure the future viability of artisanal fisheries. With regard to consultation, the main focus was the application of maritime legislation as well as contact with local fishermen. Since 2012, the MPA has focused on monitoring fishing activities and on improving the relationship between the MPA and the artisanal fishermen which is currently facing significant problems. The MPA management body mainly communicates with fishermen through the president of the local fisheries committee. However, the MPA has recently started holding personal interviews and meetings with each fisherman. Monitoring of artisanal fisheries began in 2012 and management measures have only been proposed recently.

Figure 1: Mean total CPUE inside and outside MPA (from [1])



CPUE (CATCH PER UNIT EFFORT) AS AN INDEX OF PRODUCTIVITY AND SUSTAINABILITY

In a study carried out in 2013, CPUE values were higher for some species within the MPA borders (e.g. *Diplodus sargus*, *Scyllarides latus*, *Sciaena umbra*, *Epinephelus spp* and *Labrus spp*), while for other species CPUE was higher outside the limits of the MPA (e.g. *Scorpaena scrofa*, *Phycis phycis* and *Sepia officinalis*). On the whole, no significant difference in total CPUE was recorded between the MPA and external unprotected areas (Fig. 1) [1].

FISHERMEN PARTICIPATION IN THE MANAGEMENT OF ZAKYNTHOS MPA

For now, the fishermen are not involved in the management of the MPA. But from 2013, fishermen will be involved and participate for the first time in decisions and matters concerning governance. The Special Committee “Monitoring and Management of marine resources” was recently established, including a representative of artisanal fishermen. However, fisheries management has been delayed in the MPA for many years as other urgent priorities were put forward. Therefore, efforts and results of the aforementioned Committee are in their initial phase.

Some fishermen were involved in sampling conducted as part of the MedPan North project. It should be noted that fishermen willingness to participating in the research varied. Fishermen do not understand the benefits associated with the sustainable management of the MPA and hence further efforts by the management agency should be made in this direction.

Fishermen do not fully support the MPA, but they comply with the current regulations. However, they are not willing to comply with further restrictions and regulations.

Table 1: Summary of the Marine Protected Areas (listed in alphabetical order) analyzed in the present study. NA indicates that: 1) no specific management plans for artisanal fishing are implemented in the MPA and 2) level of fishermen engagement is not assessed, because artisanal fishing is not allowed within the MPA boundaries.

MPA name	Country	Mediterraena sub-region (see Fig. 1)	MPA size in Km ²	MPA implementation year	Artisanal fishing allowed in MPA	Presence of a specific management plan for artisanal fishing	Fishermen engagement level
BANYULS	France	1	6.5	1974	yes	yes	3
BONIFACIO	France	1	782.9	1999	yes	yes	3
BRIJUNI	Croatia	2	26.5	1983	no	NA	NA
CABO DE PALOS	Spain	1	19.3	1995	yes	yes	3
CABRERA	Spain	1	87.7	1991	yes	yes	3
CAP DE CREUS	Spain	1	30.9	1998	yes	no	2
CAP ROUX	France	1	4.5	2003	no	NA	NA
COLUMBRETES	Spain	1	55	1990	no	NA	NA
CÔTE BLEUE	France	1	98.7	1983	yes	yes	3
GOKCEADA	Turkey	4	4.9	1999	no	NA	NA
HABIBAS	Algeria	3	218.9	2003	yes	no	2
KAS-KEKOVA	Turkey	4	165.9	1990	yes	no	2
KORNATI	Croatia	2	167.1	1980	yes	yes	2
MEDES	Spain	1	5.11	1983	yes	yes	3
MIRAMARE	Italy	2	1.2	1986	no	NA	NA
PENISOLA DEL SINIS	Italy	1	267	1997	yes	no	3
PLEMMIRIO	Italy	3	24.3	2004	yes	no	1
PORT-CROS	France	1	12.9	1963	yes	yes	3
PORTOFINO	Italy	1	3.5	1998	yes	yes	2
SCANDOLA	France	1	10	1975	yes	yes	3
TABARCA	Spain	1	14	1986	yes	yes	2
TAVOLARA	Italy	1	153.6	1997	yes	no	2
TORRE DEL CERRANO	Italy	2	34.3	2009	yes	no	1
TORRE GUACETO	Italy	2	22.2	1991	yes	yes	3
TREMITI	Italy	2	14.7	1989	yes	no	2
ZAKYNTHOS	Greece	3	89.2	1999	yes	no	1

4.2 GENERAL FEATURES OF MPAS ANALYZED

A total of 26 reference persons from the consulted MPAs replied to the questionnaire. Out of the 26 MPAs taken into account, eight are located in Italy, six in Spain and six in France, two in Turkey, two in Croatia, one in Greece and one in Algeria (Fig. 4).

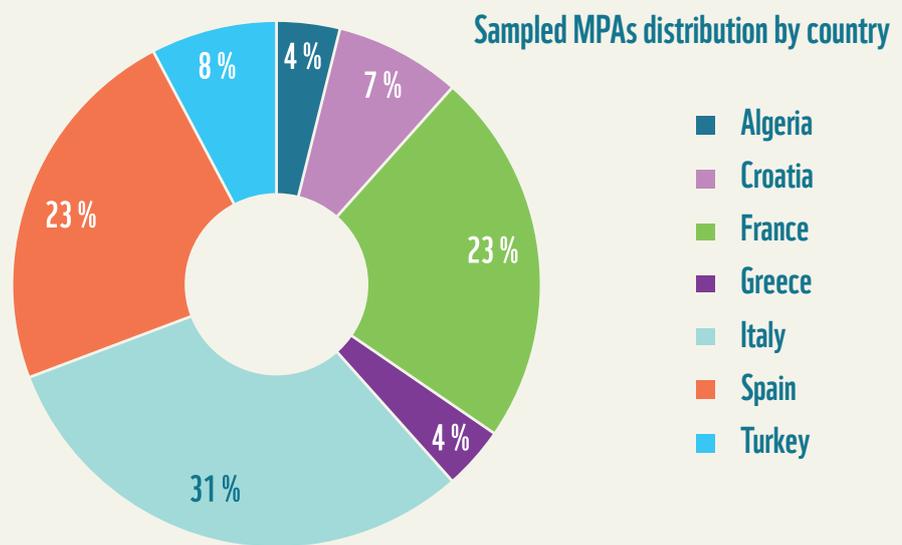


Figure 4: Percentage of distribution by country of the MPAs investigated.

The oldest MPA included in the study is Port-Cros (France), while the most recent is Torre del Cerrano (Italy) (Fig. 5).

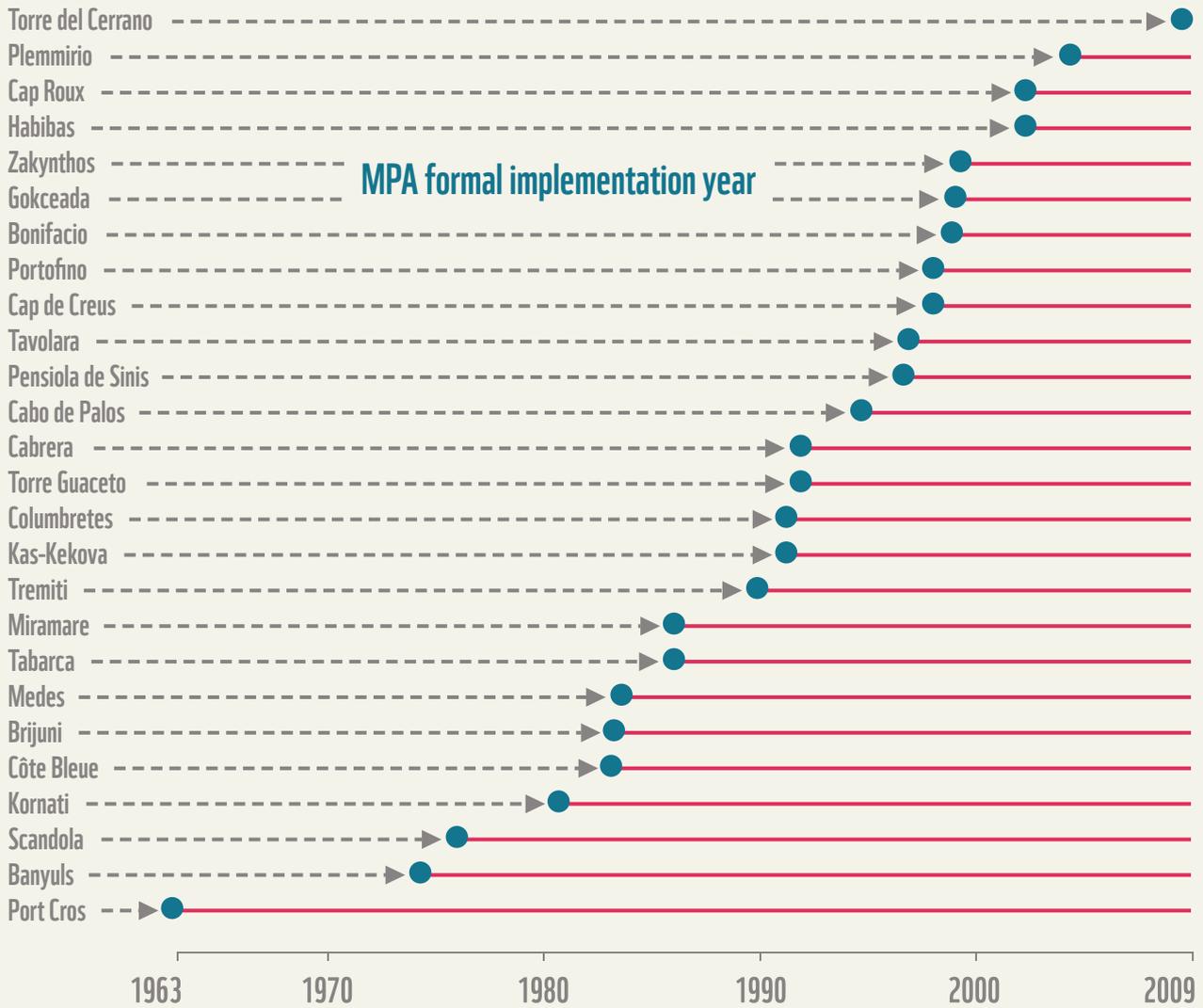


Figure 5: MPA implementation year. Blue dots indicate the implementation year for each MPA. Solid red lines indicate the time span after implementation. The dotted grey arrows connect MPA names to their corresponding dot in the graph. Time-span is comprised between the implementation year of the oldest and the most recent MPAs considered in the present study.

Average size of the MPAs included in this study (considering all the zones at different protection levels) is 89.2 ± 30.9 km² (mean \pm s.e.), with Bonifacio (France) representing the largest and Miramare (Italy) the smallest (Fig. 6). This data refers to 2012, and some changes in the MPA design (chiefly in terms of increased MPA size) have occurred in some cases (i.e. Port-Cros, Banyuls).

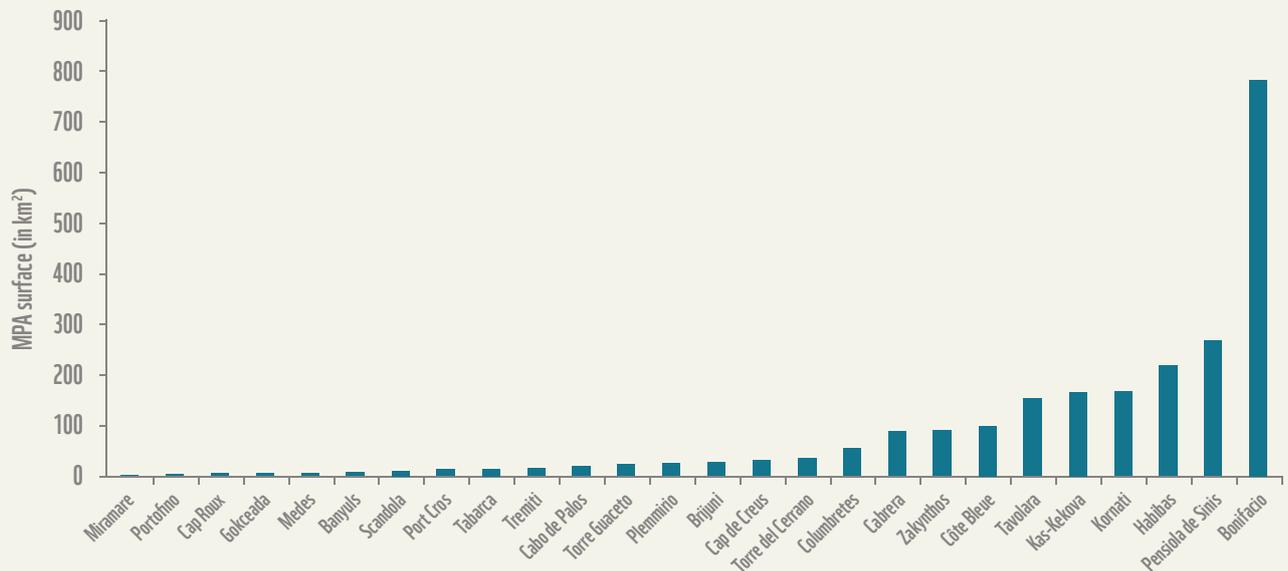


Figure 6: Total area (in km²) of the sampled MPAs. MPAs are listed in order from the smallest to the largest.

From a formal point of view, Torre del Cerrano (Italy) is the only MPA without a no-take zone, while at Cap Roux (France) and Gökçeada (Turkey) the entire MPA is a no-take zone (Fig. 7).

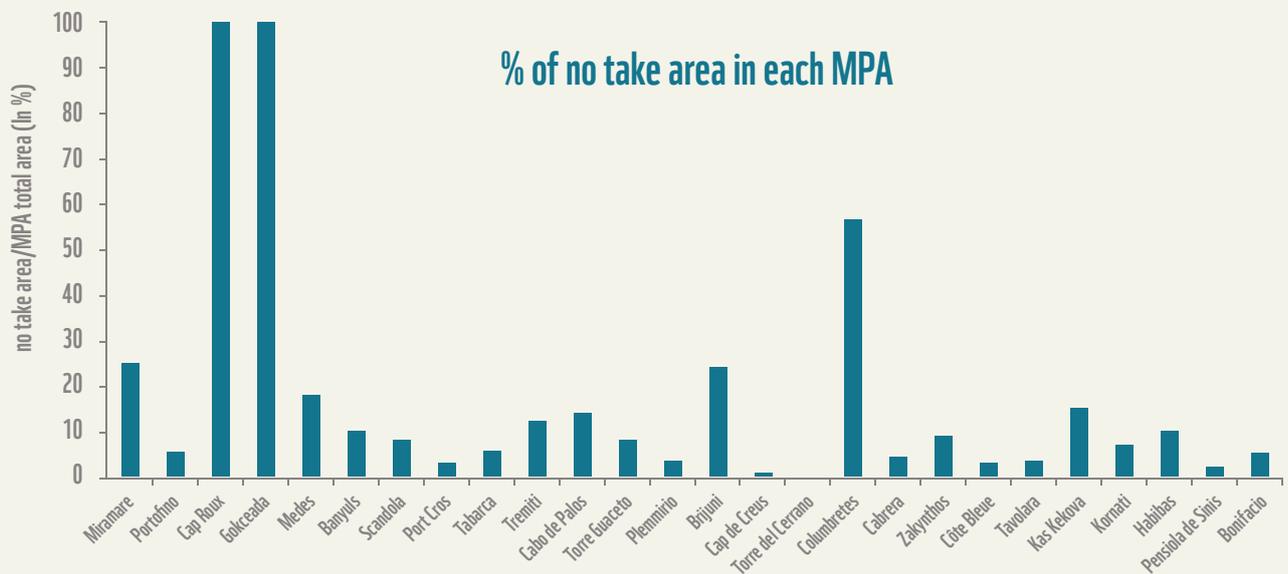


Figure 7: Percentage of no-take area/MPA total surface area. MPAs are listed in the same order as in the previous figure.

On average, $17.3 \pm 5.2\%$ (mean \pm s.e.) of the total coverage of each MPA is represented by no-take zone.

Focusing on the total coverage of the no-take zones (in km²), the largest is included in Bonifacio (France) followed by Columbretes (Spain) (Fig. 8). On average, in each MPA, 6.9 ± 2.0 Km² are represented by no-take zones.

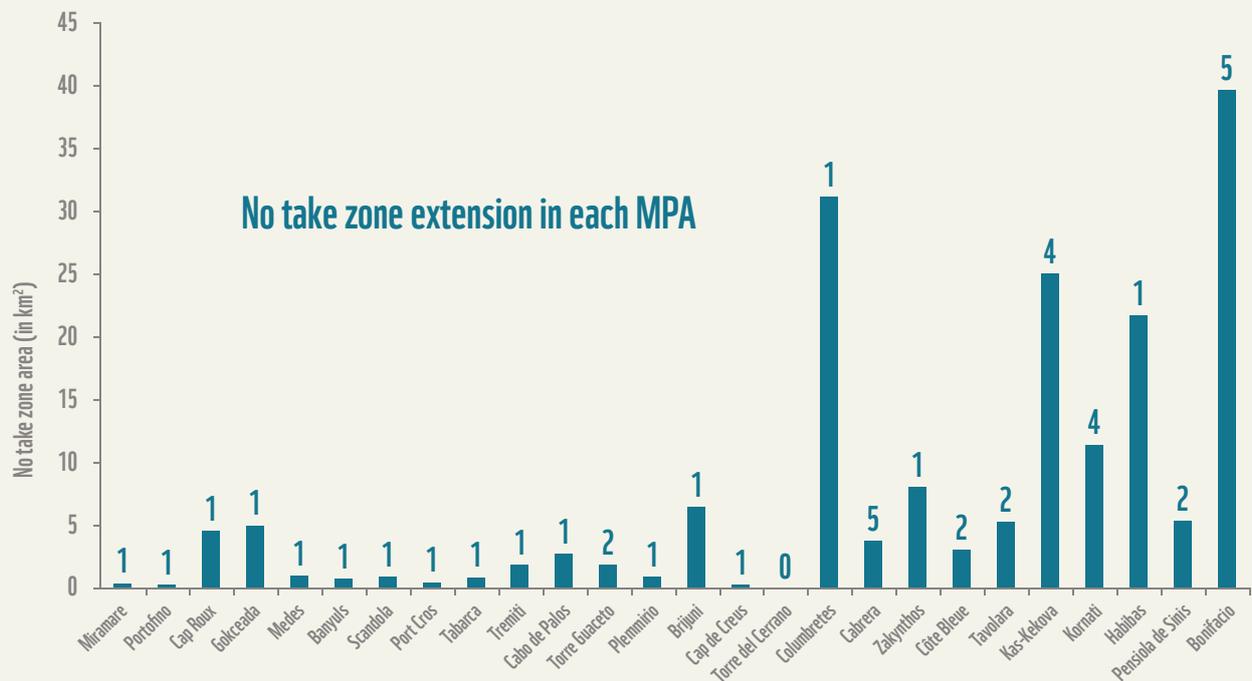


Figure 8: Surface area of the no-take zone (in km²) in the sampled MPAs. When more than one no-take zone is present in an MPA, the overall surface area was considered. MPAs are listed in the same order as in the previous figure. The numbers over the bars indicate the number of no-take zones in each MPA.

This data shows that most Mediterranean MPAs are multi-use MPAs, where only a small portion of the MPA is integrally protected. Fishing (both professional and recreational), boating, surfing, diving, and other recreational activities are often and almost everywhere allowed outside the no-take zones, under specific regulations.

4.3 ARTISANAL FISHING IN MPAS – STATE OF THE ART

4.3.1 MANAGEMENT PLAN OF ARTISANAL FISHING IN THE SAMPLED MPAS

Artisanal fishing is not permitted at all in five out of the 26 MPAs analysed: Miramare (Italy), Columbretes (Spain), Cap Roux (France), Brijuni (Croatia) and Gökçeada (Turkey).

Of the 21 MPAs in which artisanal fishing is permitted (hereinafter defined as “fishing MPAs”, F-MPAs), 12 have a management plan regulating artisanal fishing, while the remaining 9 (43% of the MPAs allowing artisanal fishing) do not currently have any management plan containing elements pertinent to artisanal fisheries (Table 1). Out of these nine MPAs, three declared that a management plan is currently under construction or has already been submitted for approval to competent administrative authorities.

In 14 MPAs (66% of the MPAs that allow artisanal fishing) a more restrictive regulation (in terms of allowed gears and their technical features) than the respective national/regional law is enforced: Kornati, Cabo de Palos, Torre Guaceto, Cabrera, Tabarca, Medes, Banyuls, Bonifacio, Côte Bleue, Port-Cros, Zakynthos, Portofino, Plemmirio and

Tremiti. More specifically, these regulations within MPAs concern, for example, spear-fishing (allowed or not), fishing frequency, length and mesh size of fixed nets, number of hooks of fishing lines, etc.

In 11 MPAs (52% of the F-MPAs) artisanal fishermen need a specific authorization issued by the MPA management bodies to duly carry out fishing operations: Kornati, Cabo de Palos, Torre Guaceto, Cabrera, Medes, Tabarca, Banyuls, Port-Cros, Scandola, Plemmirio and Tremiti. Only three MPAs have a “*numerus clausus*” (i.e. a maximum number of authorizations set a priori): Cabrera (Spain, maximum 20 vessels per day), Cabo de Palos (Spain, maximum 15 vessels per year, with no limitations on the number of fishing days per year) and Banyuls (France, maximum 15 vessels per year, with no limitations on the number of fishing days per year) (Fig. 9).

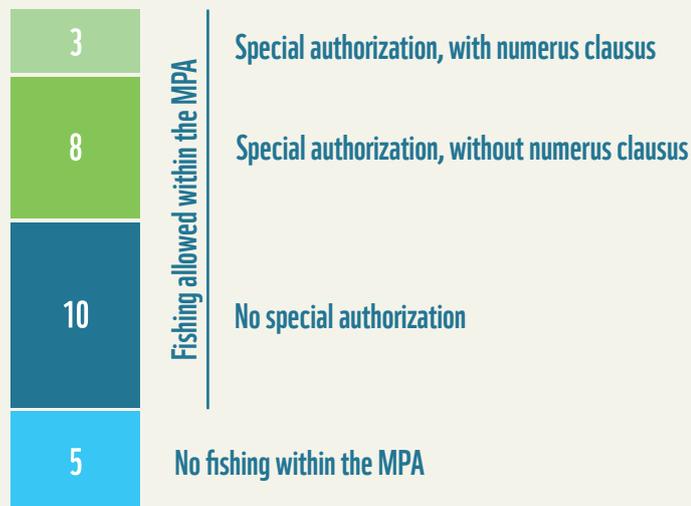


Figure 9: Number of MPAs per each of the four different categories of artisanal fishing management identified.

4.3.2 WHO IS ALLOWED TO OPERATE ARTISANAL FISHING IN MPAS

The MPAs examined allow artisanal fishing to 1) fishermen residing within the MPA territory, 2) fishermen residing within the MPA and surrounding territories or 3) all fishermen without any restriction concerning their residence and/or port of registration (Fig. 10).

The most common category of regulation was the artisanal fishing permission to fishermen residing within the MPA and surrounding territories (in approximately 43% of the MPAs: Torre Guaceto, Cap de Creus, Medes, Tabarca, Bonifacio, Côte Bleue, Port-Cros, Penisola del Sinis and Plemmirio).

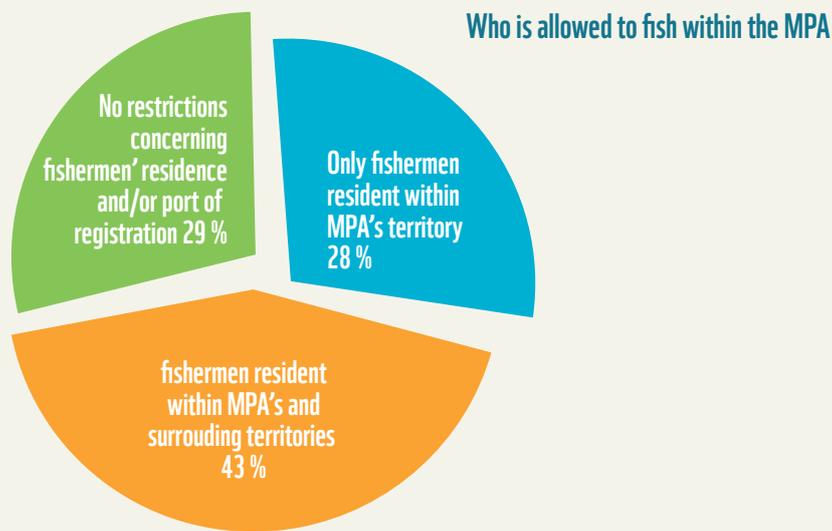


Figure 10: Percentage of access to fishing in MPAs. Restriction categories are indicated.

4.3.3 FISHERMEN ENGAGEMENT

We classified the level of engagement of artisanal fishermen in artisanal fishing management in MPAs on a 5-point scale, from 0 to 4: no contact between fishermen and the MPA management body (0 points); some early stage interaction between fishermen and the MPA management body, for example early informal contacts and discussion (1 point); interaction between fishermen and the MPA management body through meetings during which fishermen are essentially listeners and communication is mainly unidirectional from the MPA management body toward fishermen (2 points); more “developed” interactions between fishermen and the MPA management body through meetings where fishermen act as advisors and communication is bidirectional (both fishermen and the MPA management body are able to express their own views and ideas; 3 points); highly developed interactions between fishermen and the MPA management body possibly leading to co-management, where the two parties share decision-making power on management (4 points).

No examples of level 0 or 4 were found in the MPAs analyzed in this study. The most common cases were levels 2 and 3: Torre Guaceto, Kornati, Cabo de Palos, Cabrera, Cap de Creus, Medes, Tabarca, Banyuls, Bonifacio, Côte Bleue, Port-Cros, Scandola, Tremiti, Kas-Kekova, Habibas, Penisola del Sinis, Tavolara and Portofino (Fig. 11).

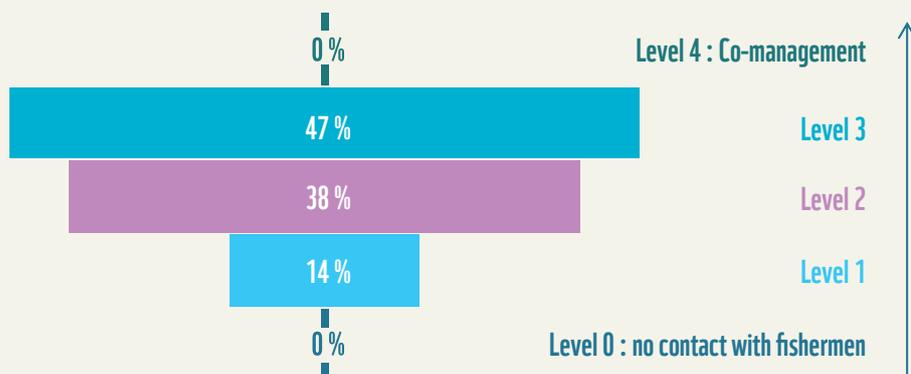


Figure 11: Percentage of fishermen engagement level in MPAs.

4.3.4 ARTISANAL FLEETS

As far as F-MPAs are concerned, in three cases we were unable to quantify the number of vessels allowed to fish within the MPAs because of a complete lack of existing information on local fisheries (Habibas MPA) or because only data at regional level was available, without the possibility of knowing how many were active in or around the MPAs (Cap de Creus and Tabarca MPAs).

On average, 32 ± 6 (mean \pm s.e.) vessels are allowed to fish within each MPA, with the minimum number of vessels recorded for Torre Guaceto ($n=8$) and the maximum for Penisola del Sinis-Isola di Mal Di Ventre ($n=100$) (Fig. 12).

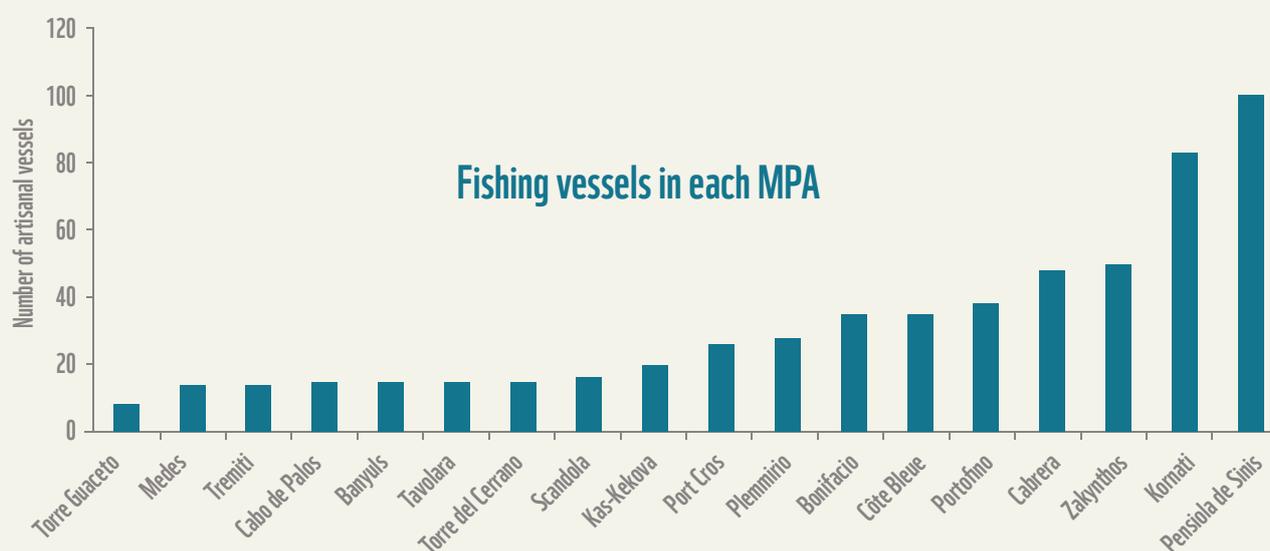


Figure 12: Number of artisanal vessels allowed to fish within each MPA. Habibas, Cap de Creus and Tabarca MPAs were excluded from this graph because data about the number of fishing vessels is missing or substantially incomplete.

One point deserving major attention is the fact that it is difficult to find out, whatever the number of authorizations formally issued, how many active fishermen and boats actually operate in a given MPA.

The number of artisanal vessels authorized per km² of MPA (i.e. excluding no-take areas) is, on average, 1.6 ± 0.6 (mean \pm s.e.) vessels, with the lowest ratio recorded for Bonifacio and the highest for Portofino (Fig. 13).

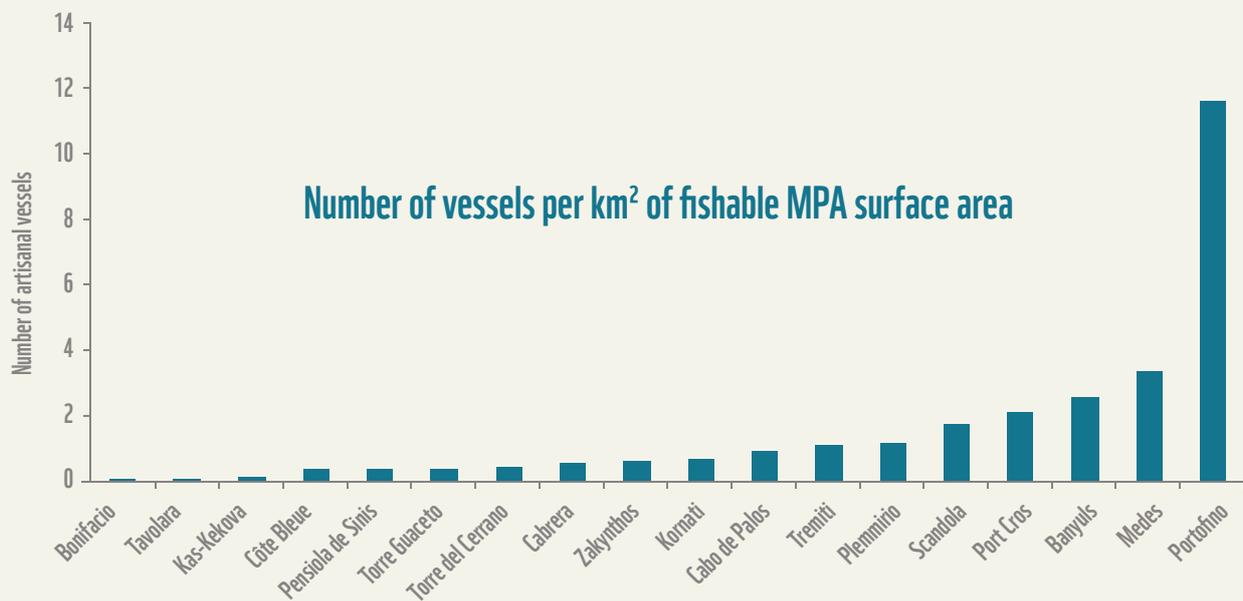


Figure 13: Number of authorized vessels/fishable surface area (in km²) in each MPA included in this study where artisanal fishing is allowed. Habibas, Cap de Creus and Tabarca were excluded from this graph because data about the number of fishing vessels is missing or substantially incomplete.

It should be stressed that this estimation cannot be interpreted as a measure of fishing effort within each MPA. To have a broader picture, in fact, we merely considered all the vessels without any distinction of length, fishing techniques, number of fishing operations per month, etc. Due to the lack of precise information, it is practically impossible to estimate the fishing effort per each MPA.

A few exceptions are represented by the MPAs where 1) fishermen are required to apply for authorization every time they carry out fishing operations and they specify fishing gears and fishing time (e.g. Torre Guaceto), 2) a specific study on fishing effort has been carried out (e.g. Medes, Cabo de Palos, Tabarca, Cabrera, Banyuls, see Goñi *et al.* 2008).

Artisanal fisherman at Penisola del Sinis



© AMP PENISOLA DEL SINIS

4.3.5 ARTISANAL FISHING GEARS ALLOWED IN MPAs INCLUDED IN THE STUDY

From both the questionnaires and the literature analysis, it emerged that a total of 11 fishing gears are allowed in the 21 F-MPAs questioned. The most frequently used gear is the trammel net (100% of MPAs considered). Longlines, gillnets and traps are allowed in >40-50% of the MPAs analyzed. Other gears are allowed, but they are used less frequently or locally (i.e. Moruna net, Tonnarella and Muggianara) (Fig. 14).

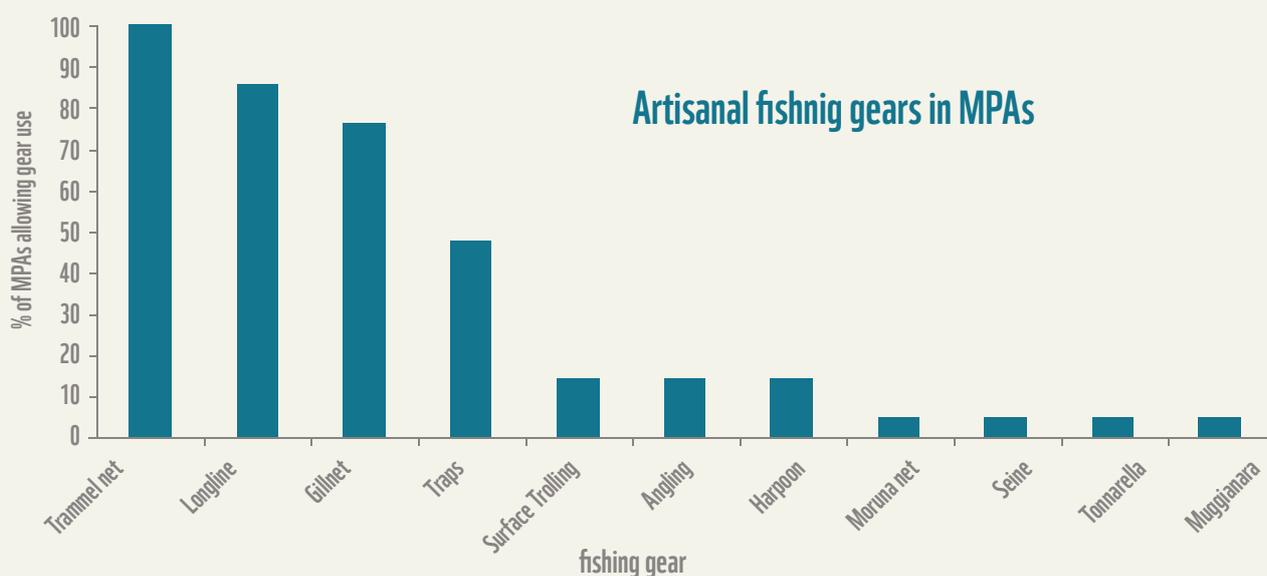


Figure 14: Percentage of MPAs in which different fishing gears are allowed. See appendix 2 for a brief description of the fishing gears cited.

4.4 MPA OUTCOMES AND EVALUATION OF MANAGEMENT SUCCESS

4.4.1 MPA ECOLOGICAL EFFECTIVENESS ON FISH ASSEMBLAGES

Focusing on F-MPAs, published information (from project reports and/or international papers) about ecological effectiveness on fish assemblages was available for 18 MPAs (86%): Torre Guaceto, Kornati, Cabo de Palos, Cabrera, Cap de Creus, Medes, Tabarca, Banyuls, Bonifacio, Côte Bleue, Port-Cros, Scandola, Portofino, Tavolara, Plemmirio, Tremiti, Penisola del Sinis and Zakynthos.

Published information reveals that in most cases (~ 78 %) MPAs are ecologically effective (Fig. 15), with a higher density and/or biomass of fish within the MPAs compared to external unprotected areas (or with an increase in density/biomass after MPA implementation).

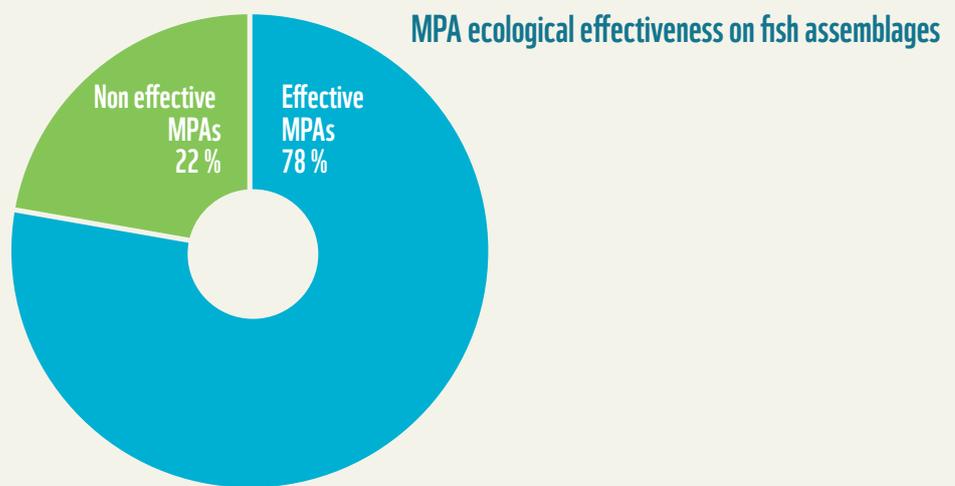


Figure 15: Results of MPA effectiveness in protecting fish assemblages (i.e. increasing density and/or biomass compared to unprotected areas and/or before MPA implementation).

4.4.2 MPA EFFECTS ON CPUE

Published information (from project reports and/or international papers) on the assessment of the putative effect of MPAs on artisanal CPUE was available for 15 MPAs (71% of cases): Torre Guaceto, Cabo de Palos, Cabrera, Cap de Creus, Medes, Tabarca, Banyuls, Bonifacio, Côte Bleue, Port-Cros, Scandola, Portofino, Penisola del Sinis, Tremiti and Zakynthos.

It is worth highlighting the considerable difference between MPAs in terms of quality/quantity of data: in some case the results published in papers are supported by very little data, while in other cases, tens or hundreds of assessments replicated across many years are available. When published information was available, the CPUE was found to have increased as a result of the MPA implementation (temporal trend analysis) or to be higher than in areas completely open to fishing (control-impact analysis or comparison with available references) in 11 MPAs (73%, Fig. 16): Torre Guaceto, Cabo de Palos, Tremiti, Cabrera, Medes, Tabarca, Banyuls, Bonifacio, Côte Bleue, Port-Cros, Scandola.

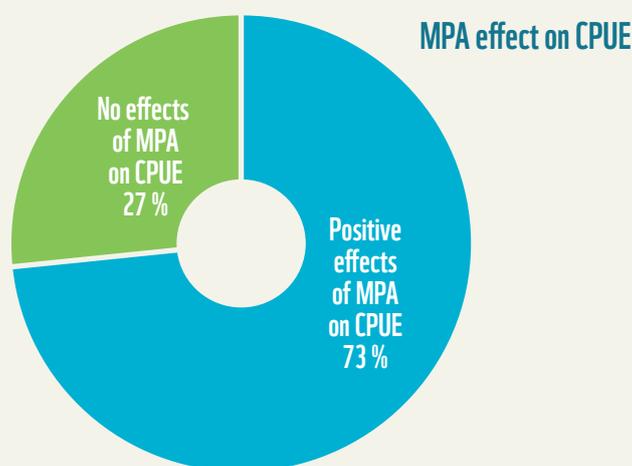


Figure 16: Results of putative effects of MPAs on artisanal CPUE. Percentage of MPAs where positive and null effects were respectively highlighted is shown.

4.4.3 ADD-ON CONSERVATION BENEFITS

In 11 of the MPAs analyzed (52%), moderate add-on conservation benefits were highlighted with artisanal fishermen acting as environmental stewards or participating in environmental/research projects: Cabrera, Medes, Tabarca, Banyuls, Port-Cros, Scandola, Penisola del Sinis, Portofino, Plemmirio, Tremiti, Kas-Kekova. The remaining MPAs were equally divided into 1) high add-on conservation benefits (i.e. artisanal fishermen acting as environmental stewards and also participating in research projects, Torre Guaceto, Cabo de Palos, Bonifacio, Côte Bleue and Tavolara) and 2) null add-on conservation benefits (i.e. artisanal fishermen not acting as environmental stewards nor participating in research projects, Kornati, Cap de Creus, Zakynthos, Torre del Cerrano and Habibas) (Fig. 17).

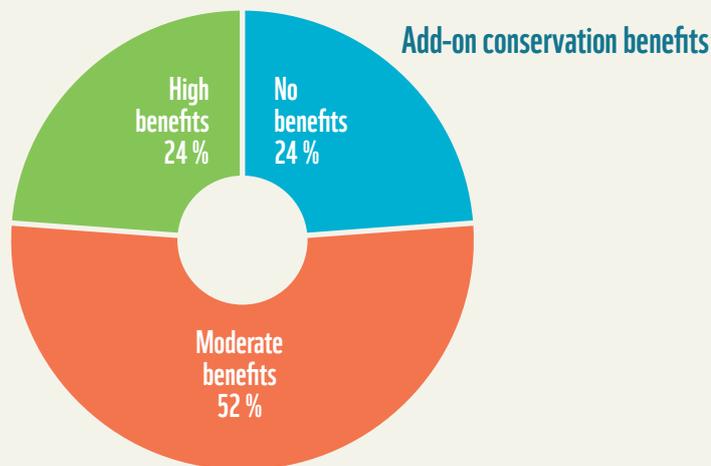


Figure 17: Add-on conservation benefits in MPAs.

4.4.4 INFO AVAILABILITY

We found a widespread scarcity of international publications assessing and reporting on the six variables crucial for evaluating the success of artisanal fishing management practices (see material and methods section). A maximum of three outcomes were assessed in six MPAs (28%, Cabo de Palos, Cabrera, Cap de Creus, Medes, Tabarca, Banyuls) and in five MPAs (24%) no studies were available at all (Kornati, Zakynthos, Torre del Cerrano, Kas-Kekova, Habibas) (Fig. 18).

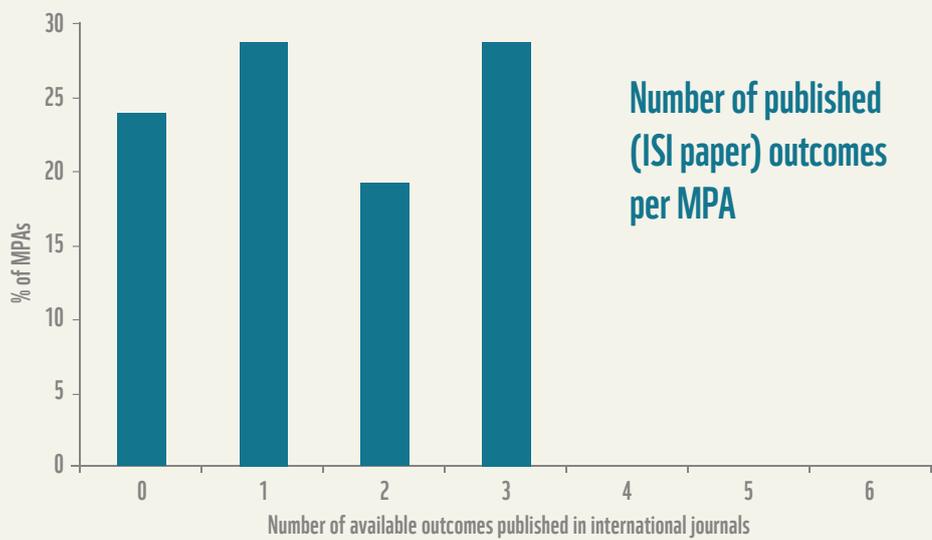


Figure 18: Percentage of MPAs per number of outcomes addressed in international publications.

Most published papers at international level addressed ecological (specifically fish response to protection) and socio-economic outcomes (e.g. CPUEs and fishermen revenues), while a substantial lack of published information was noted for strictly social outcomes (Fig. 19).

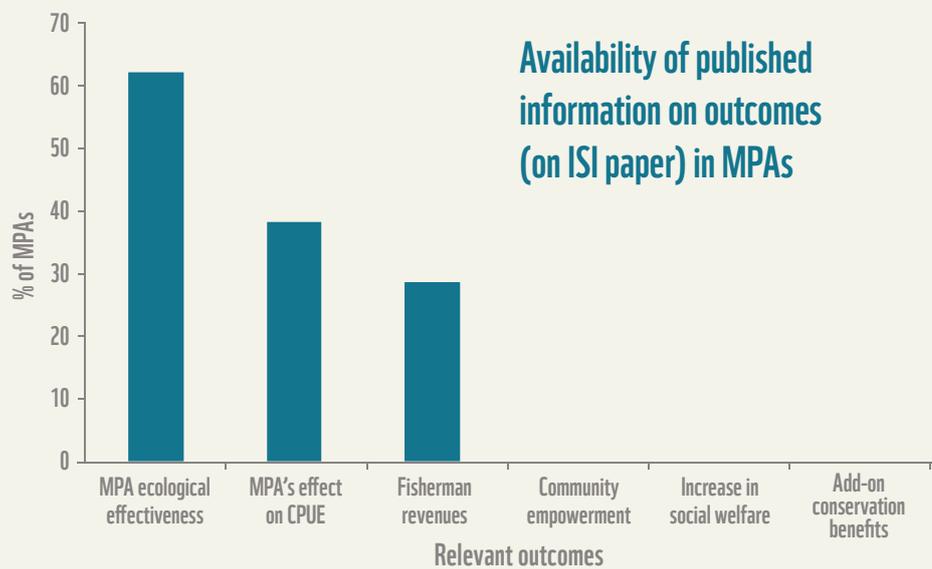


Figure 19: Percentage of MPAs for which information (published in ISI journals) about relevant outcomes is available.

4.4.5 EXISTENCE OF A SPECIFIC STUDY ON ARTISANAL FISHING MANAGEMENT

This study showed that at least one specific study on the management of artisanal fishing published in an international ISI journal is available for only three MPAs out of 21 (namely Torre Guaceto, Port-Cros and Bonifacio). Reports of projects on the management of artisanal fishing are available for Tremiti, Portofino, Tavolara, Penisola del Sinis-Isola Mal di Ventre, Banyuls, Côte Bleue, Scandola, Cabrera and Zakynthos.

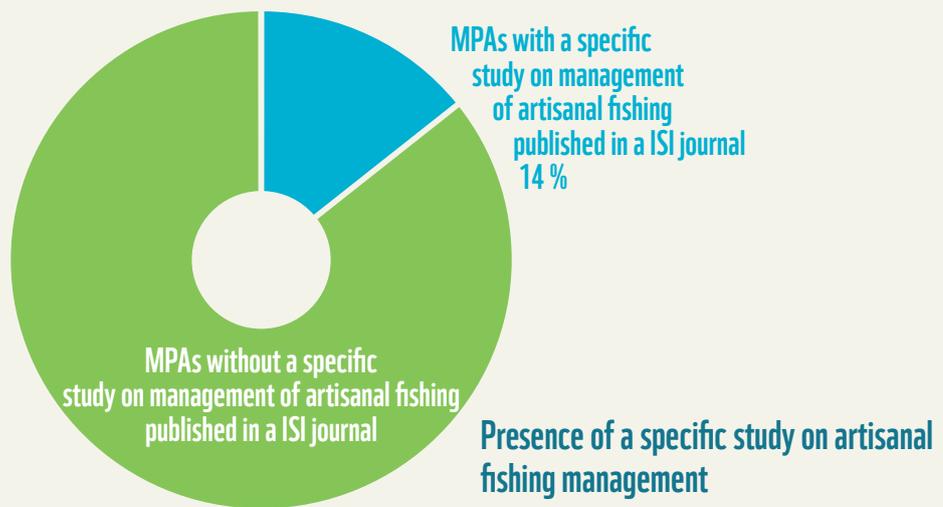


Figure 20: Presence of a specific study on artisanal fishing management in MPAs.

4.4.6 EVALUATING THE SUCCESS OF ARTISANAL FISHING MANAGEMENT

Overall success score ranged from 7% to 82%, with 65% of the MPAs having a score equal to or above 50% (Fig. 20). In our PCA analysis, the first principal component (PC1, from which we calculated the synthetic success score) is mainly determined by CPUE, Ecological effectiveness, Add-on benefits and Info availability (in order of importance but with quite similar contributions), and less by the existence of a specific study on management of artisanal fishing.

Dolphinfish freshly caught



© MARINE COLOMBET

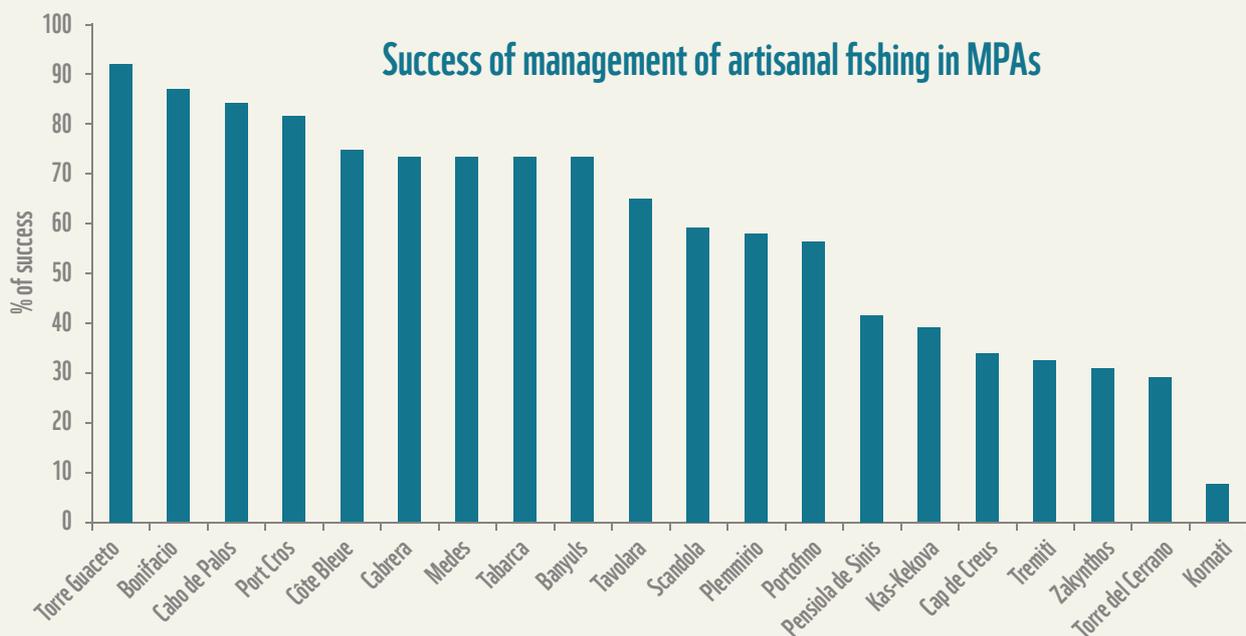


Figure 21: Success score (in %) of artisanal fishing management at each MPA.

The regression tree statistical technique showed that the most important variable determining high values of success of artisanal fishing management in MPAs is the level of fishermen engagement in management practice (Fig. 21). In particular, MPAs with fishermen engagement level 3 significantly showed a higher average success score than MPAs with lower fishermen engagement levels (respectively $66.5 \pm 4.1\%$ and $36.6 \pm 5.6\%$, mean \pm s.e.).

In order of relevance, after fishermen engagement, regression tree identified other variables as relevant in explaining the success of management in MPAs, namely: presence of a management plan, number of vessels, and the coverage of the no-take zone(s). In greater detail, MPAs with a management plan have a higher success compared to MPAs without a management plan. The success, moreover, is inversely related to the number of boats and the size of the no-take area(s) (Fig. 22).



Figure 22: Schematic representation of the most relevant variables explaining management success (identified through regression tree analysis). Directionality of each variable (indicated by the direction of the blue arrow) in determining success (i.e. if the increase of a variable leads to an increase or a decrease in the success) was assessed through PCA analysis. The conditions (i.e. level of the variables) explaining high success scores are indicated in red; in light blue the conditions explaining low success scores.

5. DISCUSSION

Here we carried out an investigation on the scale of the Mediterranean Sea with the aim of identifying the potential factors that may determine the success or failure of artisanal fishing management in MPAs. This is a crucial issue considering that in the Mediterranean basin artisanal fishing is a traditional activity involving a significant number of employees (about 280,000, Griffiths *et al.* 2007) in a region where MPAs are particularly concentrated (~170, Gabrié *et al.* 2012).

Findings from the present report are based on a pool of MPAs spread all over the Mediterranean. A marked geographic imbalance is evident with a significant number of MPAs belonging to Italy, Spain and France. This reflects the fact that these countries accommodate 54% of the total number of Mediterranean MPAs (considering only national status MPAs, Gabrié *et al.* 2012).

In conducting the present analysis we faced several difficulties relating to the availability of data, since crucial information is missing for a substantial percentage of MPAs. Knowledge of and data on the ecological status of fish resources (as part of fish assemblages), catches, revenues, fleets, fishing effort and many social aspects of artisanal fishing are limited. Particularly scant are studies concerning social and economic aspects of fishing management (as already reported by Badalamenti *et al.* 2000 and Himes 2003).

To build sound fishery management, data concerning a number of features (ecological, economic and social) is crucial (Ostrom 2009, Gutiérrez *et al.* 2011). It is also important that this information be disseminated on both a local and a broad scale (i.e. through reports, meetings and scientific papers) clearly showing the status of artisanal fishing management in each MPA in order to: 1) legitimate this process in the eyes of all the stakeholders involved and 2) provide examples to other MPAs, where management plans still need to be improved or implemented.

We found that “fishermen engagement in artisanal fishing management at each MPA” is the most important attribute to secure effective management, which should encompass ecological, economic and socio-cultural components. The more the fishermen are engaged in management processes, the more successful the management is. Fishermen engagement is a rising issue in Mediterranean MPAs (Piante 2012) despite very little scientific information being available until now (Claudet and Guidetti 2010).

Fishermen engagement is a time-consuming process that can be envisaged in multiple steps, the first being the initial approach to fishermen and the most mature stage corresponding to true co-management (see Walton *et al.* 2013 for a detailed discussion). This process requires a major effort in building trust between fishermen and MPA management bodies, as highlighted by MPA managers during this study. In this context, the role of Civil Society Organizations (CSOs, defined as “legal entities that are nongovernmental, non-profit-making, not representing commercial interests and pursuing a common aim in the public interest”) is extremely valuable to drive the process. An interesting example in the Mediterranean can be found in the “Grupos de Desarrollo Pesquero” which function increasingly in Spain, (see for example <http://www.levantalmariense.org/gdp/index.php>). An additional element that can foster fishermen engagement and drive successful management is the leadership of influential fishermen, who are able to convince the other fishermen in the community of the benefits of participating in co-management schemes (Gutiérrez *et al.* 2011).

Here we take the opportunity to do a careful analysis of the term “co-management”. The term co-management (sharing decision-making power between stakeholders and managers) is widely used in the context of fishing management on a global scale (see Gutiérrez *et al.* 2011). This term has also been applied to artisanal fisheries’ management within MPAs, but its use, especially in the Mediterranean context, can be considered as largely improper. An incorrect understanding of this point could affect the perception managers

have of their governance. We found that fishing management in the MPAs analyzed here is often at an initial stage and co-management (frequently misconceived) is more a vision than a reality. Currently, no “real” co-management is in place in Mediterranean MPAs. This is primarily due to: (i) the legal framework of MPAs that generally does not allow fishermen to have any formal decision-making power (except in France where, since a law passed in 2006, fishermen may have one or more representative(s) sitting on the governance body of national parks, natural marine parks or regional parks, usually amongst tens of other members); (ii) the traditional top-down decision process in Europe and in the Mediterranean countries. Generally, the management of fisheries resources in the Mediterranean is highly centralized and state-controlled, being implemented within the framework of the EU Common Fisheries Policy (CFP) (Arceo *et al.* 2013). On the other hand, a number of co-managed MPAs can be found in developing countries, including in the Philippines which has the widest range of experience in co-management of fishing resources (see Arceo *et al.* 2013 for a detailed discussion).

The most advanced state of fishermen engagement that we identified occurs in MPAs where fishermen participate in decision-making processes. They are allowed to express their opinion on artisanal fishing management (in meetings and/or roundtables) and give advice to MPA management bodies, legally empowered to make decisions in MPAs. MPA management bodies may take them into account or not. As an important stakeholder, the artisanal fishing community should be keenly involved in fishing management. All MPA management bodies should take artisanal fishermen into consideration as valuable interlocutors within the fishing management framework. High fishermen engagement leads to increased participation, inclusion, expression and empowerment (Evans *et al.* 2011, Arceo *et al.* 2013). On the other hand, in the Mediterranean Sea some CBRM (Community Based Resource Management) situations exist, such as in the case of French prud’homies (see chapter 1.2). However, in France, the reserves established by prud’homies, the so-called “cantonnements de pêche”, are not included in the list of MPAs according to the law of 14th April 2006 and as such are not officially acknowledged as MPAs by the French national Marine Protected Areas Agency. Consequently, the efforts made by fishermen to properly manage their activities are not always recognized, which may not encourage artisanal fishermen to persevere (see discussion in Arceo *et al.* 2013).

It became clear that MPAs play a crucial role as tools capable of coping with the heterogeneity and small size of artisanal fishing communities as a result of the proximity to the fishing communities. In many cases, fishermen are linked to specific ecosystems and resources, and the task of understanding and managing them is compatible with administrative and management structures at local level (Guyader *et al.* 2013). However, at high administrative levels (e.g. EU), management and regulation of artisanal fisheries become more difficult due to their very diversity. At present, artisanal fishing complies both with national regulations set out under the Common Fisheries Policy (CFP) for vessels in the under 12-metre overall length segment, and with CFP regulations on fleet capacities and technical measures. So far, artisanal fishing has not yet been identified as a special case by the European Fisheries Commission and sometimes by Member States, and in terms of policy it has been largely ignored. Bottom-up decision-making structures thus appear more accessible and friendly to artisanal fishing than centralized top-down decision systems (Guyader *et al.* 2013).

Power sharing, whether formal (co-management) or informal (high level of fishermen engagement), should be seen more as an outcome than a starting point. We should consider that participatory management needs participatory roots (Borrini-Feyerabend *et al.* 2004), with effective dialogue, discussion of issues and participatory democracy. From this perspective, participatory research could be part of the participatory roots needed for (co-)management of artisanal fishing, given that it involves power sharing for making decisions among expert and non-expert participants, from defining the research in question to deciding on the dissemination of findings. Thus, the exercise of sharing power amongst stakeholders during participatory research is likely to be important for future power-sharing in management.

In this study, we equated stakeholders with fishermen, the latter being individuals

who make their livelihood harvesting and exploiting marine and coastal resources. From this perspective, they can be regarded as “primary stakeholders” in the context of fishing management in MPAs. There are nevertheless a number of other stakeholders that should be involved in the participatory process as secondary stakeholders in the strict context of fishing management, such as recreational fishermen and tourist operators (e.g. scuba diving centers). Stakeholders are important because their support for management determines its success or failure (Pomeroy and Rivera-Guieb 2006). Having different groups of stakeholders involved in discussions on management is complicated, but excluding certain groups could lead to failure in the long-term (Pomeroy and Rivera-Guieb 2006). This can be particularly crucial in multiple use MPAs, like the majority of Mediterranean MPAs (Hogg *et al.* 2013). In this context, an analysis of social capital and of institutional and personal networks should be more than welcome.

Our analyses highlighted the significant role of management plans in driving overall success of artisanal fishing management. Although having a management plan can be considered a really basic element for MPAs, our investigation revealed that more than 40% of the 26 MPAs we investigated do not currently have any fisheries management plan.

The number of artisanal vessels and the no-take zone extension were identified as the third and fourth outcome, respectively, contributing to overall management success. A small number of vessels identifies an MPA where a small community of fishermen operates locally, with this case representing an easier condition compared to an MPA accommodating a large fishing community (i.e. a high number of vessels). As far as the extension of the no-take zone is concerned, a reduced surface area possibly favors fish spillover thus increasing catches in the buffer zones. However, no-take zone extension only marginally contributes to the overall success of management and its role should be considered with caution. The effect of no-take zone extension on overall management success can also be mediated by logistics requirements more than by ecological effects: small no-take zones are more easily enforced and patrolled, and can thus provide more benefits to external fished areas (i.e. spillover, larval export) than large no-take zones.

We cannot exclude the potential influence of other predictors (e.g. MPA enforcement, surveillance effort, MPA fund availability, etc.) that we did not include in our analyses due to a lack of information for Mediterranean MPAs. A recent paper by Jones *et al.* (2013) highlighted that the use of different incentives to support sustainable resource management may lead to functional diversity and redundancy in the governance system, resulting in stability in MPA governance systems. For example, economic incentives provide for livelihood security and equitable sharing of resource benefits; knowledge incentives (e.g. maximizing scientific knowledge to guide/inform MPA decision-making and monitoring/evaluation) promote understanding of the ecosystem and collaborative learning; and participative incentives empower local users in decision-making, all of which have been identified as important sources of resilience in social-ecological systems (Jones *et al.* 2013). In addition, legal incentives have been identified as having important stabilizing effects on MPA governance, providing legal certainty regarding the objectives of MPAs, principles for decision-making, responsibilities of different organizations and property rights.

Considering the above issues and our findings, the relevance of combining different incentives emerges (e.g. stakeholder engagement, scientific research on multidisciplinary themes, adaptive management, enhancement of eco-labeling practices and fish-tourism, etc.) to build sound artisanal fishing management in the MPA context.

6. RECOMMENDATIONS

Here we provide some recommendations for improving artisanal fishing management in MPAs. These recommendations are based both on output from the present report and on the authors' experience gained from long-term involvement in scientific programs on artisanal fishing management in MPAs.

Many players are involved in fishing management processes in the MPA context: MPA managers (M), researchers (R), national/local governments (G), international authorities (IA, e.g. European Commission) and fishermen (F). These recommendations are addressed to them.

6.1 RESEARCH AND MONITORING

In this section, we propose a series of recommendations that we consider to be important for improving future studies and monitoring of artisanal fishing in MPAs.

6.1.1 ENHANCE RESEARCH AND MONITORING OF FISHERIES IN MPAs (M,R,G,F)

We would particularly like to stress the relevance of: 1) carrying out sound scientific studies of ecological and socio-economic aspects related to artisanal fishing management in order to gather data about a number of relevant outcomes (e.g. MPA ecological effectiveness, MPA effect on CPUE, fishermen revenues, community empowerment, increase in social welfare) that are crucial to implement an effective management strategy based on comprehensive knowledge of the complex social-ecological systems that artisanal fisheries represent; 2) perform multi-year monitoring studies in order to evaluate temporal trends of assessed outcomes.

6.1.2 DRAW UP A METHODOLOGICAL GUIDE FOR MEDITERRANEAN MPA MANAGERS (M)

A handbook specific to MPA managers on how to study ecological and socio-economic aspects of artisanal fisheries in MPAs and how to develop and adapt an effective fisheries management strategy would be particularly useful in the Mediterranean. This would serve as a reference for future studies on artisanal fishing in all Mediterranean MPAs. Future comparisons between studies and between MPAs would then be much more effective and simple. These comparisons would allow large scale analyses and a better understanding of the overall situation.

6.1.3 DEVELOP CLOSE COLLABORATION BETWEEN MANAGEMENT AND RESEARCH (M, R).

MPAs may have scientific or technical personnel in their own staff. Scientific studies, however, should be conducted in partnership and sometimes under the guidance of researchers to make sure that the methods chosen, the way the monitoring is actually conducted in the field and the way data is analyzed allow proper conclusions to be drawn. Logically, in any case, monitoring the performance of MPAs should not be

done by or strictly by the personnel working at the MPA. The validation of the MPA's results should also be done by or at least also involving third-party entities with a high-level scientific profile (i.e. scientific institutions), which could also help disseminate and publish results at national and international level.

6.1.4 MAKE RESEARCH AND MONITORING INFORMATION LARGELY AVAILABLE (M, R).

We would like to stress the importance of publishing studies in international journals. Publishing at international level means that: 1) the information and methods adopted have been evaluated by international and anonymous peer reviewers; 2) the information is therefore generally more reliable and credible than that contained in reports, local/national journals, congress publications, etc.; 3) the information is available on a world-wide scale, becoming useful to improve not only the management of the MPA paying for/producing the information, but also to other MPAs. The publication of results in international journals is a guarantee of the high standard of the studies that the MPAs fund and this represents important added value.

Further to publishing such work, we also recommend that a wider community, which is generally not used to looking through scientific journals, is made aware of these outcomes via other means, such as newsletters, conferences, web sites, publicity materials, brochures, etc.

6.2 FISHERMEN ENGAGEMENT

Here we propose a series of recommendations for increasing fishermen involvement in MPA management practices concerning artisanal fishing.

6.2.1 ENGAGE FISHERMEN IN MANAGEMENT PRACTICES (M, R, G, IA, F)

Fishermen engagement is a long-term process that can be envisaged in multiple steps, as clearly highlighted in Walton *et al.* 2013, which reports on examples in the Mediterranean context. This recommendation is directed mainly at MPA managers. Their role is crucial in bridging relationships with fishermen and constantly interacting with them. Our results show that the more fishermen are involved in management, the higher the success of artisanal fishing management. We therefore recommend promoting examples of how to involve fishermen in the management of an MPA among MPA planners and managers.

6.2.2 ENGAGE FISHERMEN IN RESEARCH PROGRAMS (M, R, F)

Several Mediterranean MPAs have been conducting collaborative fisheries projects that use the expertise of both scientists and fishermen to investigate the ecological status of fish assemblages and marine ecosystems. Similar projects could be useful for several reasons: 1) the expertise of fishermen may help better develop and execute a scientifically sound research program, 2) data collected may help assess the effectiveness of MPAs on coastal fish assemblages and benefits for fisheries, 3) collaborative work may help raise fishermen awareness of monitoring and management of the MPA and build mutual trust, creating opportunities for sharing information, identifying areas of common interest between managers, researchers and fishermen.

We therefore recommend that examples and benefits of involving fishermen in research programs be disseminated throughout the Mediterranean MPAs.

6.2.3 ADAPT THE LEGAL FRAMEWORK TO ENABLE FISHERMEN CONSULTATION AND PARTICIPATION (G, IA)

Regardless of the efforts that MPA managers and researchers can make, without the intervention of national governments and international authorities, no real co-management (the most mature stage of fishermen engagement) can be achieved. In order to progress from the current situation to a high level of fishermen involvement (true co-management), an appropriate legal, institutional and policy framework needs to be developed to allow fishermen to be officially involved and eventually have formal decision power. In French National Parks and Natural Marine Parks for instance, since 2006 (Law no. 2006-436 of April 14th, 2006) professional fishermen have been able to sit on the governance bodies of national parks, natural marine parks and regional nature parks. However, fishermen are underrepresented compared to the total number of members of the MPA Board of Directors and from this perspective their influence on final decisions is quite limited. This can be seen as a first legal step that needs to be further improved to provide fishermen with more decision power.

6.3 MANAGEMENT

Here we propose a series of recommendations for developing and implementing a sound fisheries management plan.

6.3.1 DEVELOP A FISHERIES MANAGEMENT PLAN (M, R, F)

The Technical Guidelines on Fisheries Management (FAO 1997) describe a fisheries management plan as “a formal or informal arrangement between a fisheries management authority and stakeholders which identifies the partners in the fishery and their respective roles, details the agreed objectives for the fishery and specifies the management rules and regulations which apply to it and provides other details about the fishery which are relevant to the task of the management authority”. All MPAs where fishing activities take place should develop their own fisheries management plan.

The following implementation and administration functions should be covered:

- Defining, interpreting and implementing rules and regulations that apply to the MPA;
- Ensuring compliance and enforcement;
- Implementing activities that support MPA management, such as capacity building and incentives;
- Providing and communicating information about the MPA;
- Addressing and mitigating conflicts, as required;
- Promoting management effectiveness and carrying out monitoring and performance evaluation;
- Ensuring that experiences and lessons inform decisions and practices through adaptive management mechanisms;
- Resourcing MPA implementation and ensuring sustainability.

The fisheries management plan should take into account recreational fisheries, the impacts they generate on resources and ecosystems, and the conflicts arising with professional fisheries.

We therefore recommend that “young” MPAs receive support in implementing fisheries management plans. An international database of MPA fisheries management plans already implemented and which could be made available to MPA managers would be a useful tool.

6.3.2 IMPLEMENT SPECIFIC REGULATIONS ADAPTED TO THE ECOLOGICAL AND SOCIAL BACKGROUND OF EACH MPA (M, R, F).

The management plan enables the definition and implementation of rules and regulations that apply specifically to the MPA and that might be more restrictive than national and international regulations. Whatever the formal framework, MPA regulations should take into account both the ecological roles of species and their socio-economic implications.

Specific regulations may apply to fishing effort (e.g. number of vessels, net length etc.), types of gear, fishing areas, timing and species.

For instance, some species such as the dusky grouper may require restrictive regulations for a number of reasons: groupers are charismatic species ecologically important as high-level predators within coastal ecosystems in the Mediterranean that also play a fundamental role for the MPA economy due to their high non-extractive economic value for tourists (e.g. scuba divers). Stocks of other species, like many sea breams, should be specially preserved (e.g. banning the gears that efficiently target them or adopting technical choices to impede overfishing) as they are ecologically important for the health of entire ecosystems. Finally, there are other species, like the red striped mullet, that could be concerned by special regulations in MPAs (e.g. the use of large mesh size) simply to avoid the stocks being overfished, as this may have deleterious consequences on local artisanal fisheries.

6.4 MPAs AND OVERALL FISHERIES MANAGEMENT PLANS

MPAs are one tool among many other fisheries management and biodiversity conservation measures. When establishing an MPA, fishing effort in a certain area could be displaced. For this reason, MPAs must be considered as an integral part of fisheries management plans on a larger scale.

Because MPAs may decrease the previously accessible fishing area (e.g. via creation of no-take areas) or reduce access to already overfished resources (e.g. via the enlargement of fixed net mesh size), their establishment may involve lower yields or higher costs in the short term for fishermen displacement towards fishing grounds open to fishing. Whenever similar situations are created after an MPA establishment (which is not a general case; see also Kerwath *et al.* 2013), efforts should be made to assess impacts, identify potential alternative livelihoods and strategies to address disruptions of livelihoods. It would be useful to take advantage of the social and economic role that MPAs can play for fishermen communities, for example, helping fishermen to increase the value of their catches by cooperating in eco-labelling initiatives or allowing and favoring fishing-tourism activities. Most of the time, catches are sold to fishmongers at very low prices compared to the final price (Battaglia *et al.* 2010). Some solutions could include 1) fishermen autonomy in trading catches directly to consumers, by adopting food safety rules and in accordance with EU law on the traceability of fishery products (EU Reg. 2065/2001); 2) promotion of MPA-labeled fish products. MPAs could help to achieve these or other similar targets which, besides allowing fishermen to increase their revenues, could further legitimate the MPA's role in artisanal fishing management in the eyes of fishermen, strengthening the relationship between them and the MPA management bodies.

6.5 COMMUNICATION AND AWARENESS-RAISING

Successful Mediterranean case studies about artisanal fisheries and MPAs, along with the lessons learnt from adaptive management should be disseminated among MPA managers and fishermen, and proper tools developed to make these issues easily understood. Fishermen need to be aware that MPAs represent an invaluable tool to increase their pay-offs and preserve artisanal fishing traditions and revenues. A good communication strategy, outlining means and processes for sharing information with stakeholders, local politicians, national decision-makers and other targets is essential for mainstreaming MPA benefits to fisheries and the conditions in which artisanal fisheries can be sustainable. As an example, in 2012, a two-day meeting held in Carovigno (Brindisi, Italy) brought together fishermen and MPAs from several Mediterranean countries to exchange views on MPAs and fisheries. The meeting proved useful to develop mutual understanding and a vision for the future among participants (Piante 2012).

Fishermen should also be given support developing negotiating skills with a view to their cooperation with all the other actors involved in this process. We therefore recommend building the ability of fishermen to participate in and contribute to managing MPAs.

Figure 23: Brochure on professional fisheries -
Cap d'Agde MPA, France



7. CONCLUSIONS

Artisanal fishing plays a fundamental role in Mediterranean coastal areas and its socio-economic role and culture have long been recognized. While the ageing and disappearance of the artisanal fishermen community are currently a threat to the cultural heritage of the Mediterranean Sea (Gómez *et al.* 2006), there is a shared interest in securing sustainable artisanal fisheries all around the basin. This must go hand in hand with the preservation of the natural heritage of Mediterranean coastal areas. From this perspective, MPAs seem to be one of the most powerful ways of positively addressing this issue and fishermen engagement, through effective participatory processes and/or co-management mechanisms, should be considered a priority.

Artisanal Fisherman in Cabrera National Park - Spain



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APPENDIX 1:

QUESTIONNAIRE SENT TO THE MPA MANAGERS AND SCIENTISTS

Name of your marine protected area (MPA):

Country:

Name of the person answering this questionnaire:

Role of the person answering this questionnaire:

Email and phone:

In this questionnaire, the term “artisanal fishing” follows the FAO definition (<http://www.fao.org/fi/glossary/default.asp>) and tends to imply a small-scale, individual (self-employed) or family type of enterprise (as opposed to an industrial company), most often run by the owner (even though the vessels may sometimes belong to the fishmonger or some external investor). The term has no obvious reference to size but tends to have a connotation of small boats with relatively low levels of technology (but this may not always be the case).

ARTISANAL FISHING WITHIN YOUR MPA

1. Is artisanal fishing allowed within your MPA (or at least in some zone of your MPA) ? If it is, please specify the zonation of your MPA (including the area of each zone as a percentage of the total area of the MPA) and fishing regulations in each zone. Is artisanal fishing regulation more restrictive within your MPA than regulation in external unprotected areas ?

If artisanal fishing is not allowed within your MPA (e.g. in the case of a no-take reserve), go to question #23

2. Who is allowed to fish within your MPA (e.g. local fishermen residing in the MPA territory) ?
3. Was the area where your MPA is located an area where fishermen traditionally operated before the MPA establishment? (if information is available)
4. Is there any information about fleet and gears used for artisanal fishing within your MPA?
5. To be answered only if the response to question #4 was “Yes”: What kind of artisanal fishing (i.e. please specify the length of the vessels, gears and/or other limitations) is allowed within your MPA ?

6. How many vessels and/or persons are allowed to carry on artisanal fishing within your MPA ?
7. Has a socio-economic assessment of the fishermen community fishing in your MPA been carried out ? Do you have any papers, reports and/or datasets concerning this issue ?
8. Do artisanal fishermen perform any alternative revenue-generating activities such as “fishing-tourism” ?

ARTISANAL FISHING MANAGEMENT AND GOVERNANCE WITHIN YOUR MPA

9. Were fishermen involved in the MPA implementation ? If they were, how did they participate in this process (e.g. through a consultative process ? Did they have any decision-making power ? Was a specific committee or round-table set up ?)
10. Are artisanal fishermen involved in decision-making and the governance of your MPA ? If so, how are they involved (e.g. through a consultative process ? Do they have any decision-making power ?)
11. Is there any form of management of artisanal fishing within your MPA? If there is, what type of activities do you implement? Please specify how the management was set up (i.e. were fishermen consulted/involved ?).

If your answer to question #11 was “No, there is no form of management”, go to question #23

12. Were fishing limitations (e.g. weight, species, etc.) agreed jointly with fishermen?
13. How do you communicate with fishermen? How are they organized (in any professional associations or any organization specific to the MPA’s context) ?
14. Do fishermen need any authorization to fish within your MPA ? If they do, who provides it ?
15. **To be answered only if the response to question #14 was “Yes”:** If fishermen need an authorization: how many applications for artisanal fishing authorization do you receive annually (if possible, please provide information for each year after MPA implementation) ? How many authorizations do you provide ? Is there any “numerus clausus” (i.e. a maximum number of authorizations set up a priori) ? Based on which factors do you accept or reject applications ?
16. Are artisanal fishermen required to fill in a fishing logbook registering the time, location and catches for each day fished and/or any other similar information (please specify which) ? Have you got this data ?
17. Are artisanal fishermen involved in any scientific program carried out in your MPA ? If they are, in which program/s are they involved ?

SURVEILLANCE WITHIN YOUR MPA

- 18.** Is there any kind of surveillance on catches (e.g. control at landing or on boat) and/or surveillance on engine power, gears, etc. for artisanal fishermen ?
- 19.** To be answered only if the response to question #18 was “Yes”: How is fishing surveillance performed in your MPA ? Does the MPA personnel have any policing power to record an offence and fine offenders within your MPA? Is the surveillance performed by any other organization (e.g. coastguard) ?
- 20.** To be answered only if the response to question #18 was “Yes”: Do any fishermen participate in surveillance ? If so, how ?
- 21.** Is there any type of fine specifically dedicated to professional fishing regulation within your MPA? What sort ? Do you have any information about the number of fines/year since the regulation was introduced ?
- 22.** If any offenses have occurred, were the persons fined among those authorized to fish within your MPA ?
- 23.** To be answered only if there is no form of artisanal fishing management within your MPA: Are you planning to develop any management activities for artisanal fishing within your MPA ? And if you are planning to do so, are you going to involve fishermen in this process ?

The next two questions should only be answered if artisanal fishing is not allowed within your MPA:

- 24.** Do you monitor fishing activities around your MPA ?
- 25.** Do fishermen support and comply with the fishing ban within the MPA ?

ECOLOGICAL AND SOCIO-ECONOMIC EFFECTIVENESS OF THE MPA

- 26.** Do you have any evidence of reserve effect (i.e. increase in fish density and/or size and/or biomass) for your MPA ? Do you have any papers, reports and/or datasets concerning this issue ?
- 27.** Do you have any evidence of fish spillover and/or larval export from within and/or around your MPA ? Do you have any papers, reports and/or datasets concerning this issue ?
- 28.** Do you have any evidence of CPUE (catch per unit of effort) increase within and/or around your MPA since its implementation ? Do you have any papers, reports and/or datasets concerning this issue ?
- 29.** Do you have any evidence of an increase of fishermen’s income since your MPA implementation ? Do you have any papers, reports and/or datasets concerning this issue ?

MAIN LESSONS LEARNED FROM YOUR EXPERIENCE OF FISHERIES MANAGEMENT IN YOUR MPA

30. From your perspective, what are the key factors of successful fisheries management in MPAs ?

The next two questions should only be answered if you did not contribute to the previous study carried out by the MedPAN North project on recreational fishing (Font et al., 2012).

RECREATIONAL FISHING

31. Is any form of recreational fishing (including spearfishing) allowed within your MPA ? If it is, which fishing methods and how is it limited ?

32. If recreational fishing is allowed within your MPA: is there any data about recreational catches within your MPA ?

APPENDIX 2:

BRIEF DESCRIPTION OF THE FISHING GEARS CITED IN THE TEXT

Angling: Angling is a method of fishing involving the use of one or more “angles”, i.e. fish hooks. The hook is usually attached to a fishing line and the line is often attached to a fishing rod. Fishing rods are usually fitted with a fishing reel that functions as a mechanism for storing, retrieving and paying out the line. The hook itself can be dressed with lures or bait. A bite indicator such as a float is sometimes used.

Gillnet: The gillnet catches fish as they try to pass through the meshes, by snagging on the gill covers. Once trapped, the fish can neither advance through the net nor retreat. Gillnets, anchored to the sea floor, are equipped with a system of floats and weights which allow the vertical extension of the net.

Harpoon: A harpoon is a long spear-like instrument used to catch fish. It accomplishes this task by impaling the target animal, allowing the fishermen to use a rope attached to the butt of the projectile to catch the animal.

Longline: This gear consists of a long line, called the main line, with baited hooks attached at intervals by means of branch lines, called snoods. A snood is a short piece of line attached to the main line using a clip or swivel, and a hook at the end. Longlines are classified mainly by where they are placed in the water column, i.e. at the water surface or on the bottom. Lines can be anchored or left to drift. Hundreds or even thousands of baited hooks can hang from a single main line.

Moruna net: it is a Spanish traditional fishing gear (called “morunas”) composed by several pieces of net: a main net perpendicular to the coast (traversia or rabera), ended on each side by a snail-shape net (caracoles or rotlos), ending in a triangle shaped dead-end (el copo). The net is connected to the coast and in this way fish are obliged to follow the “travesia”, then entering in the “caracoles”, remaining trapped in the final “copo”. Leerfish (*Lichia amia*) is one of the most common target species, especially in October-November.

Mugginara: This is a sac-shaped net with a single opening at the top. At the Portofino MPA, it is traditionally deployed in relatively deep water by fisherman. From land, a watchman is responsible for alerting the boats when the fish (usually mugilid fish) is on top of the net opening. Once alerted, other fishermen on boats move close to the mugginara, push the fish into the net and close the opening.

Seine net: A seine is a large fishing net that may be arranged in a number of different ways. In purse seine fishing, the net hangs vertically in the water by attaching weights along the bottom edge and floats along the top. A simple and commonly used fishing technique is beach seining, where the seine net is operated from the shore. The net is also operated using boats.

Tonnarella: This is a traditional fixed net made using intertwined coconut fibers which, in seawater, are quickly colonized by marine organisms. This makes it difficult for pelagic fish that are the target of this gear to identify the net. This particular fishing gear (which looks and works like a sort of “tonnara” - tuna trap - but far smaller in size and simpler in structure), generally targets amberjacks, bonitos and mackerels. It is deployed perpendicularly to the coast and ends with a dead-end where fish are finally trapped.

Trammel net: A trammel is a fishing net with three layers of net that is used to entangle fish, mollusks and crustaceans. A slack central layer with a small mesh is sandwiched between two outer layers with a much larger mesh size. The net is kept vertical by floats on the head-rope and weights on the bottom-rope.

Fish traps: These gears may have various forms and sizes and they can be made of a variety of materials. Historically, traps were constructed using wood and plant fibers while nowadays they are commonly made of a steel wire frame stretched around with chicken wire. The mesh wraps around the frame and then tapers into the inside of the trap. When a fish swims inside through this opening, it cannot get out, because the trap is arranged in such a way that it is much more difficult to exit than to enter.

Trolling or Surface trolling: trolling is a method of fishing where one or more fishing lines, baited with lures or bait fish, are drawn through the water. This may be behind a moving boat, or by slowly winding the line in when fishing from a static position, or even sweeping the line from side-to-side, e.g. when fishing from a jetty.

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