Study on the economic benefits of Marine Protected Areas

Literature review analysis

Written by ICF Consulting Services Limited, in association with IEEP and PML

Sept 2017

EUROPEAN COMMISSION

Executive Agency for Small and Medium-sized Enterprises (EASME)

Unit A.3 — EMFF

E-mail: EASME-EMFF@ec.europa.eu

European Commission

B-1049 Brussels

EUROPEAN COMMISSION

Study on the economic benefits of Marine Protected Areas

Literature review analysis

Executive Agency for Small and Medium-sized Enterprises (EASME)

Contract No EASME/EMFF/2015/1.3.1.8/SI2.737373

2018 EN

Luxembourg: Publications Office of the European Union, **2018**

ISBN 978-92-9202-379-9

DOI 10.2826/40733

Report authors	Pantzar, Mia (IEEP) Russi, Daniela (IEEP) Hooper, Tara (PML) Haines, Rupert (ICF)
Quality review	Rayment, Matt (ICF) Kettunen, Marianne (IEEP)

Table of Contents

Table of Figures

Table of Tables

Table of Boxes

Executive summary

This report reviews the existing evidence of economic benefits generated from Marine Protected Areas (MPAs) and other Spatial Protection Measures (SPMs) to fisheries, maritime tourism and other blue economy sectors in Europe. It also identifies and critically analyses studies which have attempted to compare costs and benefits of MPAs and SPMs, and collates and synthesises research and known case studies about so-called 'de facto refuges'. It does not provide a detailed review of the costs of MPAs and SPMs.

MPAs are designated to provide protection for marine species and habitats while SPMs, as understood in this review, include other spatially explicit measures not necessarily designated for conservation purposes that can be of a temporal or permanent nature. De facto refuges are areas where access and activities are restricted for reasons other than conservation or natural resource management, for example for security reasons.

The review focuses, in falling order of relevance, on evidence from Europe, its Overseas Countries and Territories (OCTs) and Outermost Regions (ORs) and from geographically transferrable areas elsewhere around the world. To the extent that relevant evidence has been identified from elsewhere, this has been included primarily to provide context. The review focusses on high quality evidence demonstrating blue economy benefits – evidence which only infers economic benefits based on environmental evidence is not included. Further details about the scope of this literature review are outlined in Chapters 2 and 3.

Overview of the literature

A total of 627 studies have been assessed, whereof 94 have been identified as fulfilling the study evidence selection criteria and reviewed in detail. Of these 94 studies[1], 44 studies provide evidence of economic benefits of MPAs and/or SPMs to fisheries and 33 studies to maritime tourism. Fifteen studies compare costs and benefits of MPAs and/or SPMs to various degrees. Finally, 22 studies indicate how de-facto refuges can act as MPAs and thereby potentially benefit blue economy sectors.

The chief observation of this review is that the documented evidence base on blue economy benefits is still incomplete and largely dominated by literature on economic benefits to maritime tourism and artisanal fisheries. No evidence fulfilling the study evidence selection criteria was identified on economic benefits generated to "other" blue economy sectors in Europe. The existing evidence is also highly concentrated geographically, primarily to the Mediterranean Sea and the North-east Atlantic Ocean. No evidence fitting the selection criteria of this review has been found from MPAs or SPMs in the Baltic Sea, and only one study from the Black Sea. A number of possible reasons for the existing gaps in evidence are identified and discussed in the report.

Cost Benefit Analyses of MPAs and SPMs and cross-sectoral studies

There are relatively few comprehensive Cost Benefit Analyses (CBAs) of MPAs currently available from either within or outside Europe, making it difficult to draw comprehensive conclusions about the net benefits of individual MPAs or MPA networks in Europe. No CBAs of SPMs were identified.

Existing studies comparing the costs and benefits of MPAs use primarily an ecosystem services framework and suggest that a large proportion of the benefits is likely to relate to non-marketed improvements in welfare rather than real economy benefits to sectors. The studies that have valued blue economy benefits focus on benefits to maritime tourism and fisheries, demonstrating that individual MPAs and MPA networks can

[1] Please note that these figures do not add up as several studies looked at benefits to multiple sectors.

enhance economic activity in these sectors. However, empirical evidence of benefits in monetary terms is very limited and CBAs generally appear more complete in their monetary valuation of costs than benefits.

Despite being unable to account for a comprehensive representation of benefits, the existing studies suggest that the overall welfare benefits of MPAs exceed total costs. Generally, the benefits to fisheries seem to be smaller and, in comparison, more difficult to quantify than those to tourism.

Evidence of benefits to fisheries and aquaculture

The review has found 44 studies illustrating economic benefits of MPAs or SPMs to fisheries. A significant majority of the European literature identified is from sites in the Mediterranean Sea, some from the North-east Atlantic, although none have been identified from the Baltic Sea or the Black Sea. No studies have been identified showing such economic benefits to aquaculture.

Spillover effects from so-called "no-take" zones (areas that do not allow fishing) have been the primary focus of studied benefits and they have been found to provide positive economic impacts on fisheries. Spillover is shown to support increased catch per unit effort (CPUE) for a range of gear types and target species in waters surrounding areas closed from fishing. Only one study has compared the increase in yield resulting from spillover with the cost of lost fishing opportunities caused by the designation of the no-take zone; it concluded that there was a net gain to surrounding fisheries.

Evidence of economic benefits from multi-use MPAs include primarily increased revenue as a result of reduced competition for space and resources between fishermen within the border of MPAs. Typically, the benefits accrue to fishermen who are permitted to continue fishing within MPAs using static gears to target low-mobility species.

While there are robust studies demonstrating benefits, the existing evidence base is limited and only a handful of studies demonstrate benefits to fishermen based on empirical economic data. The existing evidence is therefore not yet sufficiently comprehensive to draw overarching conclusions for Europe.

A number of factors influencing the scale and nature of economic benefits can nevertheless be identified. Firstly, it is important to distinguish between protection designated with the purpose to enhance a population of a target species (for subsequent fishing in the case of an SPM) on the one hand, and protection designated to remove fishing pressure and the negative habitat impacts of certain types of fishing to help achieve conservation objectives, on the other. The latter may or may not benefit species targeted by commercial fishing. Further, zoning with networks of no-take areas in combination with other uses has been shown to be effective to generate economic benefits to fisheries through spillover in several occasions. Depending on which species are targeted, the size of no-take zones may affect the scale of spillover to benefit fisheries. Local habitat distribution in and around no-take areas, the level of fishing pressure in surrounding fished areas (particularly relevant for mobile target species) and the timescale since site designation seem to also influence the scale and nature of benefits to fisheries. The limited evidence base does not allow us to draw comprehensive conclusions as to which MPA or SPM factors (or combination of factors) help to optimise the generation of economic benefits to fisheries, or to what degree individual factors influence the scale such economic benefits.

No specific evidence has been identified looking at measures to ensure that the potential benefits of MPAs and SPMs can be captured by the sector without compromising conservation objectives. This might be a result of the relatively young age of many European MPAs; the fact that many of these sites do not yet have implemented management plans; that existing research is focussed on "fishing versus no fishing"; and/or that very few measures have been adopted to ensure sustainable use. However,

several studies illustrate the importance of managing displacement effects of MPAs and SPMs – both within sites and of fishing activities moving into new grounds. For instance, if the overall fishing pressure inside the site remains the same as a result of an increase in permitted gears, the objectives of the site, and hence benefits, might be compromised. Displacement of certain types of fishing from one site to another may also result in new or additional environmental costs, as well as costs to fisheries already operating in those waters.

Evidence of benefits to maritime tourism

The review resulted in 33 studies on the economic benefits of MPAs on the tourism sector, mainly focussing on specific MPAs or specific countries. Most of these studies assess the benefits to the tourism sector using interviews/surveys and/or empirical data. In a few cases, simulation models based on empirical data are used. Most of the studies are linked to multi-use MPAs or MPAs with a zoning system, and are ex-post analyses of the current value of activity or of the change in that value over time (e.g. since MPA designation).

A number of studies conclude that MPAs can be beneficial for the maritime tourism sector by increasing the number of visitors and providing additional livelihood opportunities. The increased revenues and livelihood opportunities at the local level are in many cases key to gaining local support for the designation of MPAs and ultimately to the conservation of marine biodiversity. However, it was not possible to distinguish whether increased tourism in, or in the vicinity of, MPAs results from MPA-induced environmental improvements or whether it is due to the so-called designation effect, i.e. the increased reputation of an area due to designation.

The studies recognise that recreational activities need to be managed in order to ensure that they do not result in environmental degradation, with negative effects on site conservation objectives and sector performance. This can be done adopting a mix of different strategies, which are essential if the economic benefits to the tourism sector are to be maintained in the long term:

- Effective management plan and enforcement measures are key to limit the environmental impact of recreational activities;
- Strategies aimed at reducing the impact of recreational users (e.g. improved management, better monitoring of visitors' activities and educational campaigns) can enable increased visitor numbers (and the associated revenues and jobs generated) without an associated increase in environmental impacts;
- Communication activities can play an important role in promoting good practices and reducing the environmental impact of recreational uses;
- Eco-tourism that provide revenues and jobs with limited damage to ecosystems should be promoted and supported by public policies;
- Tourism revenues and jobs can be increasingly retained in the local economy, in order to increase livelihood opportunities without the need to increase visits.

The evidence indicates that management, enforcement and educational activities require financing, but the available funds for MPAs are not always sufficient. For this reason, using tourism as source of alternative and complementary MPA finance can play a key role not only in ensuring the achievement of environmental objectives, but also in enhancing the recreational experiences of visitor, thereby further benefitting the tourism sector. In particular, visitor fees and taxes may help provide complementary funding to MPAs.

Evidence of benefits to other blue economy sectors

No existing evidence could be identified in line with the study selection criteria of benefits provided by MPAs to blue economy sectors other than fisheries and tourism. In the most relevant study identified, survey respondents from the Mediterranean and the Black Sea consider other blue economy sectors to be unaffected by the presence of an MPA.

The lack of evidence and/or studies on economic benefits provided by MPAs to other blue economy sectors might be because, while these sectors require space within the marine environment, most of them are not – or are perceived not to be – dependent on the protection of marine environmental quality. For some sectors, such as marine biotechnology, which are more closely linked to environmental quality, the lack of evidence may be related to the relative novelty of the sector and lack of instances of biotechnology activities occurring in or near MPAs.

MPAs may be able to provide indirect benefits to other blue economy sectors, for example by creating a management mechanism for marine space which enables different sectors to co-exist and for their impacts to be managed. No evidence on other such benefit pathways was identified.

Evidence of 'de facto refuges'

Out of 39 studies identified from around the world, 17 focus on the ecological changes occurring in relation to artificial reefs and energy infrastructure. The 22 studies which include any links to economic sectors focus on fisheries, angling and diving. Only four studies provide any economic information, although several studies make speculative links between de facto and economic benefits.

The evidence base shows an absence of agreement regarding the economic impacts of *artificial reefs* to fisheries, while it suggests that such structures are highly valued by divers and anglers due to the fish that aggregate at these sites and the marine life that grows on them.

The considerable, and growing, body of literature on the effects of *energy installations* show that offshore wind farms may bring potential benefits to species of commercial and recreational importance. However, evidence of any benefits to fisheries, recreation or other maritime sectors from energy installations remains very scare. What little evidence exists from Europe is usually self-reported during interviews or of an anecdotal nature.

Which sectors benefit the most?

The existing evidence indicates that MPAs and SPMs can provide benefits to the fisheries and tourism sectors. Studies assessing benefits to both tourism and fisheries seem to suggest that benefits to tourism exceed those to fisheries. However, this is a preliminary observation, which might reflect the fact that a majority of existing research has been conducted in Mediterranean MPAs. In many areas of the Mediterranean, tourism is a more socio-economically important sector than fisheries; and the scale of potential benefits that might be achieved is thereby likely to be greater.

The existing evidence is insufficient to support conclusions on whether the benefits attained by a given sector, in particular the fisheries sector, outweigh any costs that may be imposed upon them by MPA management i.e. do the benefits from spillover effects outweigh the costs of being displaced from the MPA. As mentioned, only one study is able to demonstrate a net gain in yield (in weight of lobster catches) following designation of an MPA (no-take in this case).

We also identify interesting nuances within the fisheries and tourism sectors in terms of who might benefit the most from MPAs and SPMs. For instance, fishermen using static gear targeting low-mobility and benthic species seem more likely to benefit than

fishermen using mobile, bottom-contacting gear. This is because in multi-use MPAs, the former are more likely to be considered compatible with the site objectives than the latter, enabling them to continue (and even expand) fishing within the MPA and benefit from any on-site stock improvements. Similarly, related to maritime tourism, is that divers might benefit more than recreational fishing activities in an MPA (especially where it is designated as a no-take MPA), depending on the nature of any conservation measures imposed within the site. We emphasise, however, that these are initial observations based on a limited amount of evidence.

How to realise the benefits – cross-sectoral observations

Some of the objectives of this study are cross-sectoral and have therefore been presented in a separate chapter of this report. The chapter presents insights from the literature regarding synergies or mutual reinforcements between different sectors attributable to MPAs, SPMs and de facto refuges; conflicts identified to have occurred involving sector stakeholders and examples of how these situations have been overcome; and forms of governance and stakeholder engagement approaches which have proven successful in realising blue economy benefits, while at the same time safeguarding the conservation objectives of the sites in question.

Existing evidence related to *synergies* and *conflicts* is primarily anecdotal, i.e. it should be treated as examples but is not sufficient to draw generalised conclusions. There is a lack of evidence related to synergies, although this may reflect the relatively recent focus in this area rather than the absence of – or potential for – multisector benefits. Conflicts resulting from MPAs have been noted between divers and fishermen, between different fishermen in open access areas surrounding no-take zones and between commercial fishermen and energy operators around de-facto refuges. There is also evidence of conflicts between MPA objectives and resource users; this evidence illustrates that, although local stakeholders often oppose implementation of MPA-related restrictions, their opinions can change as a result of being more actively involved, meeting MPA managers face to face or witnessing positive changes resulting from the site. Further, there is evidence suggesting that stakeholders' level of aversion to conservation measures may be influenced by demographic factors. In addition to improved engagement, evidence indicates that successful conflict resolution can occur through the adoption of different compensation schemes and zoning of MPAs to better accommodate different users' needs.

Most research related to conflicts discusses how conflict can be avoided through management and/or is affected by *governance* structures. By providing examples identified from Europe and beyond, we illustrate the widely accepted idea that stakeholders need to be actively involved in MPA planning and management for the site to be successful. However, there is also evidence suggesting that achieving successful stakeholder engagement can be challenging in practice. This is, for instance, due to potentially unequal representation of all relevant stakeholders, structural limitations of who is allowed to engage in MPA decision-making and how, and the perception of the legitimacy of the designation and what users can expect from it.

1 Context and study objectives

1.1 Context

1.1.1 The Blue Economy

Europe's seas support economic activity providing some 5.4 million jobs and a gross added value of just under €500 billion per year, according to estimates in the EU's Blue Growth Strategy (European Commission, 2012). This 'blue economy' includes sectors such as fisheries, aquaculture, tourism, shipping, transport, marine mining and bioprospecting, ocean renewable energy, aquatic products, and offshore oil and gas, among others.

The Blue Growth Strategy suggests that the blue economy offers 'new and innovative ways' of steering Europe out of its economic crisis, with the potential to support international competitiveness, resource efficiency, job creation, and new sources of growth. Changes in the value chain are expected, notably centred on technological and demographic changes, scarcity of natural resources, and growth in underdeveloped economies which will influence the dynamics of resource usage and of socioeconomic trends along the coast.

The Strategy anticipates the continued expansion of blue economy sectors, and identifies five pathways for the delivery of sustainable growth and jobs in the short- and long-term future: blue energy; fisheries and aquaculture; maritime, coastal and cruise tourism; marine mineral resources; and blue biotechnology.

All the above sectors collectively and independently exert pressure, but also depend to some degree, on the marine environment and on the general sustainable use of seas. Some of these sectors are particularly closely connected to the health of marine ecosystems and, in turn, affect other ongoing uses of the marine environment. Fisheries directly utilise stocks of marine natural resources and their collective impact is one of the main pressures on both marine life and habitats in Europe. Aquaculture relies on healthy water conditions and may itself impact wild fish stocks and water quality. Tourism values increase with the environmental and aesthetic quality improvements obtained from sustainable management, including conservation, while excessive exploitation may have negative impacts on the environment. Blue biotechnology is predicated on the study and discovery of marine organisms and thus by definition requires their prior preservation. Blue energy and marine mineral resource extraction are less directly impacted by marine ecosystems, but the general fragility of the marine environment means that any development in these sectors must be carefully managed for sustainability. There are also opportunities for synergies between sectors, offering prospects for 'multi-sectoral growth'; for example, offshore renewable energy installations may provide opportunities for aquaculture developments. The environmental implications of this are less understood.

As such, the Blue Growth strategy emphasises economic growth but recognises the need to minimise environmental impacts and to protect the marine environment and the ecosystem services that it provides.

1.1.2 The marine environment and marine protected areas

Biodiversity, including genetic, species, and landscape diversity, supports and ensures the continued functioning of marine ecosystems, and thus the services they provide. In the context of increased pressures from climate change, growing populations, and their associated impacts such as pollution, littering, further exploitation, and so forth, resilience is all the more critical.

However, marine ecosystems and biodiversity are declining across the EU (European Commission, 2015). The European Commission has suggested that the main pressures

are fishing and physical damage to the sea floor, although a range of different pressures effect all eleven of the Marine Strategy Framework Directive (MSFD) qualitative good environmental status (GES) descriptors impact marine biodiversity to some extent[2]. As of 2015, only 12% of assessed commercial EU fish stocks were in GES, while 58% were not; a further 19% were exploited sustainably and 11% displayed an intact reproductive capacity (European Commission, 2015). In addition to removing biomass from the ecosystem, fishing may also damage the seafloor, depending on the catch methods used. This affects benthic habitats and fauna which are relied on by large parts of the marine food web, including fish that are later caught.

The MSFD also recognises habitat change, over-exploitation, invasive species, and pollution as important pressures impacting marine ecosystems. Climate change is expected to compound these effects by impacting biological, chemical, and physical processes such as water temperatures, acidification levels, species reproduction patterns, the distribution of marine organisms, and the conditions of sensitive marine habitats, among others, potentially resulting in negative social and economic impacts.

Diverse marine ecosystems have been found to display stronger resilience, including a lower rate of fishery collapse and a higher rate of post-collapse recovery (Beaumont et al, 2008). Declines in diversity directly impact the carrying capacity and resilience of the ecosystem, endangering its ability to support healthy flora and fauna and to provide the variety of ecosystem services that support coastal livelihoods, whether through fishing, aquaculture, tourism, or other activities. The consequences for continued socioeconomic progress are therefore direct and serious.

The EU's various internal and international commitments envision a major role for Marine Protected Areas (MPAs) as one method of reducing anthropogenic impact and of maintaining and improving biodiversity and resilience. MPAs are 'geographically defined marine areas whose primary and clearly-stated objective is nature conservation, and which are regulated and managed through legal or other effective means to achieve this objective' (European Commission, 2015). In addition to MPAs, other Spatial Protection Measures (SPMs) may also provide conservation benefits (see Section 2.3.3 for definitions of MPAs and SPMs). The MSFD requires Member States to achieve good environmental status in their marine waters by 2020 through the adoption of Programmes of Measures, which include SPMs (Directive 2008/56/EC).

Targets 1, 2, and 4 of the EU's Biodiversity Strategy, involve requirements to improve the conservation status of species and habitats, to restore ecosystems, including marine ecosystems, and to make fishing sustainable and seas healthier. The Habitats and Birds Directives encompass the Natura 2000 network of conservation areas, which includes a significant marine component (European Commission, 2007) – Target 1 of the EU Biodiversity Strategy (European Commission, 2011) is to implement the Directives, and the Natura 2000 network. Progress in designating Natura 2000 sites has been slower than expected and a substantial increase in the number of sites is likely to be required to complete the marine network, particularly for the offshore environment (Milieu, IEEP and ICF, 2016).

The Aichi Biodiversity Target 11 under the Convention on Biological Diversity (CBD) requires ten percent of marine and coastal areas, and especially those areas of particular importance for biodiversity and ecosystem services, to be conserved through MPAs or "other area-based conservation measures"[3,4]. At the end of 2012, MPAs covered approximately 340,000 km^2, or 6%, of the EU's total marine surface area (EEA and European Commission, 2015), a figure which has since risen to 7.9%[5]. More MPAs and

[2] http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-1/index_en.htm.

[3] The full text of Target 11 can be found at: https://www.cbd.int/sp/targets/rationale/target-11/.

[4] There is no formal, widely-agreed definition of 'other areas-based conservation measures'.

[5] Personal communication. European Commission. Received 09/12/2016.

other area-based conservation measures (which might include some types of SPMs) may be needed to achieve the Aichi quantitative targets.

More generally, the Marine Spatial Planning Directive (2014/89) sets the overarching spatial framework for the coherent management of all maritime economic activities and MPAs in EU waters.

1.1.3 The blue economy and MPAs/SPMs

The marine area under MPA and SPM management is likely to increase due to these drivers and the increasing footprint of maritime activities (and implementation of maritime spatial planning), for which SPMs to facilitate sectoral activity may increase.

It is notable that a commonly held concern about MPAs in particular is that they may constrain economic activity, adding costs to businesses and restricting opportunities for growth and jobs – even for those industries which may benefit from improved marine biodiversity and environmental conditions more generally. This is despite the fact that a large majority of European MPAs allow most economic activities to continue to operate within their boundaries. There are similar concerns about SPMs. For example, exclusion areas around energy installations are often perceived to impose only costs for those excluded activities. It is feasible, however, that such SPMs may also generate conservation/ environmental protection benefits which in turn can benefit certain blue economy sectors.

In order to plan and manage MPAs and SPMs so as to maximise the flow of potential benefits – to the environment, the blue economy and society more generally – the linkages between maritime sectors and these potential benefits needs to be better understood. It is necessary to understand the nature and extent of the potential economic benefits, their influences on economic and employment outcomes, and how design and management of MPAs and SPMs can help facilitate their realisation, especially in light of a rapidly growing blue economy. Failing to do so may impede efforts to conserve and improve the marine environment and instead contribute to the continued degradation of marine ecosystems, placing also blue economy objectives, economic growth, and the wider benefits obtained through marine ecosystem services at risk.

1.2 Study objectives

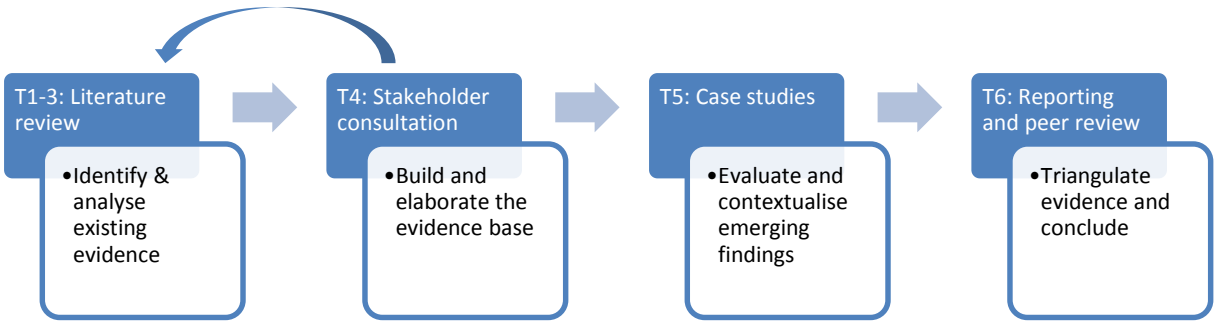
The **main objective** of this study is to evaluate how MPAs and SPMs provide benefits to specific blue economy sectors, with the aim that the study results will support relevant EU policies and policy developments. Figure 1 presents a simplified schematic overview of the study methodology.

The **sub-objectives**[6] of the study are to:

- Identify and critically analyse studies which have done a full cost-benefit analysis (CBA) for MPAs and SPMs.
- Identify and critically analyse studies which examine how MPAs and SPMs are, or can be, sustainably used.
- Identify and critically analyse studies which assess overlaps, conflicts or mutual reinforcement between blue economy sectors which are linked to MPAs and SPMs.
- Identify and critically analyse studies addressing conflict resolution, engagement with stakeholders and governance.
- Collate and synthesise research and known case studies about 'de facto refuges'.

[6] This list provides a summary of the sub-objectives. A fuller description is available in the study Terms of Reference.

Figure 1. Overall study methodology – simplified process diagram



1.3 This report

The following report presents the outcomes of study tasks 1–3, comprising a literature review, literature analysis and a gap analysis.

The report is structured as follows:

Chapter 2	Defines the scope of the overall study and what terminology and conceptual definitions are adopted.
Chapter 3	Describes in detail the methodologies applied in tasks 1–3.
Chapter 4	Provides an overview of the existing evidence base as identified in the literature review in order to provide context to subsequent chapters.
Chapter 5	Describes existing attempts to perform CBAs for MPAs and SPMs as well as other studies looking at the benefits across multiple sectors.
Chapters 6–8	Present and analyse evidence of economic benefits of MPAs and SPMs on three sector groups: fisheries and aquaculture; maritime tourism; and other blue economy sectors; including how such benefits can be realised in combination with achieving the conservation objectives of sites.
Chapter 9	Presents and analyses evidence of areas and structures that function as 'de facto refuges', with relevance to the blue economy.
Chapter 10	Presents and analyses evidence related to synergies and mutual reinforcements between sectors; conflicts and conflict resolution; and governance structures.
Chapter 11	Highlights and analyses the gaps in the existing evidence base in order to support the design of future research and initiatives.
Chapter 12	Concludes, overall, on the benefits of MPAs and SPMs to blue economy sectors and lessons learnt regarding best practices for realising such benefits.

2 Scope and definitions

The following chapter outlines the scope and conceptual definitions adopted in the study, and applied throughout this report.

2.1 Economic benefits

Under the term 'benefits', the focus is on economic benefits (increased turnover, revenue, profit, security of supply, etc.) and on related social benefits (jobs, impact of the economic benefits on local communities, etc.). In more detail:

- The principal focus is on establishing the evidence base on 'hard' economic benefits of MPAs and SPMs, i.e. effects on the real economy as indicated by changes in economic output, revenue, profits, employment, etc. in the blue economy sectors.
- Broader local economy and community benefits associated with such economic benefits are also relevant, but of secondary importance.
- The study recognises the framework of ecosystem services (see Section 2.4) as a broader narrative and context to the study, but includes ecosystem service benefits only in cases where they result in the above type of benefits in the real economy.
- The study does not include other types of ecosystem service benefits that do not directly generate market benefits for the blue economy sectors i.e. benefits affecting society as a whole, such as the mitigation of climate change, natural hazards or the preservation of cultural and non-use values. It is acknowledged that such benefits have economic value, by enhancing societal welfare and delivering outcomes for which society is willing to pay. They should therefore be taken into account when considering the overall value of MPAs and SPMs to society as a whole.
- Studies which assess ecological effectiveness of MPAs, such as higher biomass of fish within the site or better environmental quality, as a proxy for potential blue economy benefits have not been included in this review as such extrapolations are hypothetical.

2.2 Blue economy sectors

There is no single definition of the blue economy and the sectors that it constitutes. A number of different classifications have been used in support of marine conservation and blue economy research (ECORYS, Deltares and OCEANIC (2012), U.N. Sustainable Development Knowledge Platform[7] and Surís-Regueiro, Garza-Gil and Varela-Lafuente (2013)). A current study by the European Commission Directorate-General for Maritime Affairs and Fisheries[8] is working to establish a framework for analysing the blue economy, which may generate a working classification of sectors. Such a classification has not been available for the production of this report, but if forthcoming, will be adopted for the purpose of analysis and reporting later in this study, where appropriate to do so.

Within the context of this study, the need for sectoral definitions is to (i) ensure that the search for evidence is comprehensive, and (ii) to provide a consistent platform for

[7] UNSD (2014), *Blue Economy Concept Paper*, accessed March 6, 2016 from https://sustainabledevelopment.un.org/content/documents/2978BEconcept.pdf.

[8] "Study on the establishment of a framework for processing and analysing maritime economic data in Europe" (contract no EASME/EMFF/2014/1.3.1.13/si2.718095).

reporting of how economic and social benefits may accrue from MPAs and SPMs via maritime sectors. In this regard, it is also important to consider how and why maritime activities interact with MPAs and SPMs, the different benefit pathways and the extent to which evidence is transferable across them.

Table 1 shows the different sector groups included in this study. It has not been the intention to purposefully exclude any sector from the evidence review. However, analysis and presentation of the study require specific choices about how activities are grouped within sectors and how these sectors are defined.

Those sectors identified as 'other blue economy' are discussed at an aggregate level in this report. This enables evidence of benefits that may be common across them (e.g. that relate to the nature of certain activities e.g. construction of infrastructure on the seabed) to be readily presented – to the extent that such evidence is available. Sector-specific discussion is used where useful to illustrate specific points or isolate particular benefit streams that may be relevant only to one of these sectors.

Table 1. Sector groups as defined in this study

Groups	Sectors
Fisheries	Commercial fisheries
	Aquaculture
Tourism and recreation	Nautical activities such as pleasure boating, jet skiing, diving, swimming, surfing, sport fishing, etc.
	Coastal activities such as visiting the beach, coastal walking, etc.; marinas and other infrastructure serving these activities.
Other blue economy	Oil and gas
	Renewable energy
	Transport
	Ports and harbours (including dredging)
	Blue biotechnology
	Aggregate and other mining; extraction of sea salt
	Offshore construction
	Coastal and offshore defence against erosion/flooding/sea level rise
	Submarine cables, pipelines etc.
	Maritime safety and security (navigation aids like lighthouses and buoys, coast guard, navies)
	Maritime monitoring, enforcement and inspection (i.e. monitoring and management of marine regulations e.g. MPAs, fisheries)
	Marine research
	On-shore environmental services for maritime activities (e.g. water and waste disposal)

2.3 Defining MPAs and SPMs

Whilst the original study title states its focus on MPAs, the study scope is in fact broader than the standard definition of an MPA. This recognises that SPMs which are not principally designated to achieve conservation goals can still provide conservation and environmental protection benefits.

It should be recognised that there are multiple institutions and documents presenting working definitions of MPAs, SPMs and other related terminology. This study draws on these sources (see below) in order to establish appropriate terminology and research boundaries. These definitions should not be taken as being the official language of the European Commission or any other relevant body.

2.3.1 Marine Protected Areas

Definition of marine protected areas

MPAs are geographically defined areas, whose primary and clearly stated objective is nature conservation that are regulated and managed through legal or other effective means to achieve this objective.

Source: European Commission (2015).

This definition aligns with that of the Convention on Biological Diversity (CBD), which defines an MPA as: "A geographically defined area, which is designated or regulated and managed to achieve specific conservation objectives" (Article 2 of the CBD). This definition is further expanded upon under Article 8 of the same convention.

Definitions used by other international and regional organisations are aligned with the CBD definition, e.g. International Union for Conservation of Nature (IUCN) (Dudley, 2008): "A protected area is a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values."

These definitions are used in the World Database on Protected Areas (WDPA)[9] to determine whether a site should be labelled as a "protected area". The IUCN definition and associated guidelines also provide the basis for the Common Database on Designated Areas (CCDA), which is "the official source of protected area information from European countries to the World Database of Protected Areas"[10].

On this basis, the existing network of European Marine Protected Areas consists of[11]:

1. The **Natura 2000 network** consisting of Special Areas of Conservation (SACs) designated to implement the Habitats Directive, and Special Protection Areas (SPAs) designated to implement the Birds Directive.
2. Marine Protected Areas (MPAs) designated to implement **international or regional agreements** to which Member States are Parties:
   - under the Regional Sea Conventions (RSC) including MPAs in High Seas: the Baltic Sea Protected Areas (BSPA) for HELCOM, OSPAR MPAs, the List of Specially Protected Areas of Mediterranean Importance (SPAs and SPAMI) in the Barcelona Convention framework, Projects launched by the Commission for the Protection of the Black Sea against Pollution on Specially Protected Areas and MPAs;

[9] UNEP-WCMC (2016). World Database on Protected Areas User Manual 1.3. UNEP-WCMC: Cambridge, UK. Available at: http://wcmc.io/WDPA_Manual.

[10] http://dd.eionet.europa.eu/datasets/latest/CDDA#tables.

[11] Programmes of measures under the Marine Strategy Framework Directive. Recommendations for implementation and reporting. (Final version, 25 November 2014).

- the Emerald Network, Ramsar sites, Man and the Biosphere Reserves, the Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) and Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS).

3. Additional **nationally-designated MPAs**: areas additional to those identified above designated by a national designation instrument based on national legislation and classified according to the CCDA[12] as 'Category A: Designation types used with the intention to protect fauna, flora, habitats and landscapes (the latter as far as relevant for fauna, flora and for habitat protection)'.

In reality, it is anticipated that all MPAs associated with international and regional agreements (point 2. above) will in effect be designated through Natura 2000 and national instruments. In conducting a spatial analysis of MPAs, the EEA found that there were no instances of RSC/ international designations that were not in fact designated also as Natura 2000 or national instruments[13].

In this report, we use the term "MPA" collectively to cover all of the above designation types. Details regarding designation are addressed where especially relevant for the analysis.

2.3.2 Spatial protection measures

Definition of spatial protection measures

Area-based conservation measures that do not meet the criteria of marine protected areas, either because conservation is not their primary objective, or because their objective focusses on a particular activity or sector in order to protect part of the ecosystem.

Source: Adapted from European Commission (2015)

Two types of spatial protection measure can be usefully distinguished for the purposes of this study.

2.3.2.1 Type 1: Fisheries spatial protection measures

Definition of fisheries spatial protection measure

Spatial protection measures imposing spatially-specific restrictions, which may be temporary or permanent, on fisheries activities for the conservation and sustainable exploitation of marine biological resources.

Certain fisheries management measures fall under the definition of spatial protection measures (European Commission, 2015). These include:

- Fisheries management measures including special fishing permits or bans on specific fishing gears for specific areas to protect, for example, vulnerable marine ecosystems or sea grass meadows or certain conservation measures adopted under Article 7 of the Common Fisheries Policy (see article 7 paragraph 1 (a) (b) (h) (i) and paragraph 2 (c) (d) (e) of the Regulation (EU) No 1380/2013).
- In particular, Art. 8 of the reformed CFP (Regulation (EU) No 1380/2013) on 'fish stock recovery areas' stipulates that the EU "shall endeavour to establish protected areas due to their biological sensitivity, including areas where there is clear evidence of heavy concentrations of fish below minimum conservation

[12] EEA webpage. EOINET Data Dictionary. View dataset definition: CCDA. Available at: http://dd.eionet.europa.eu/datasets/latest/CDDA#tables.

[13] Pers. Com with EEA (Email: 25th October 2016).

reference size and of spawning grounds. In such areas fishing activities may be restricted or prohibited in order to contribute to the conservation of living aquatic resources and marine ecosystems" and for that MS "shall identify suitable areas", also through regionalization (art.18.7), and the "Commission may be empowered in multiannual plans to establish such biologically sensitive protected areas".

- Council Regulation (EC) No 1967/2006 (Mediterranean Regulation) establishes "fishing protected areas" with the intent of enhancing both the exploitation of marine living resources and the protection of marine ecosystems. These can go beyond territorial waters. Article 5-7 of the Mediterranean Regulation 1967/2006 stipulates that these Fishing Protected Areas can be established both at national and EU level.
- Regulation (EU) No 1343/2011, by transposing the General Fisheries Commission for the Mediterranean (GFCM) fisheries management measures, implements some "fisheries restricted areas" whose definition fully correspond to the definition of fishing protected areas stipulated by the Mediterranean Regulation. Specific rules are stipulated by the Council Regulation (EC) No 1224/2009 as far as the control of "fishing restricted areas" is concerned.
- It should be noted that the European Commission has proposed a regulation on the conservation of fishery resources and the protection of marine ecosystems through technical measures ("Regulation on Technical Measures")[14]. This Regulation amends and/or repeals several of the regulations that are relevant to this study and, while it is yet to enter into force, it should be mentioned here.
- There are also area-based fishing measures adopted (e.g. by RFMOs) to protect vulnerable marine ecosystems (VMEs), including seamounts, hydrothermal vents and coral waters.
- It is feasible that spatial protection measures may in the future also be implemented under the Maritime Spatial Planning Directive, as one of the objectives of maritime spatial plans is the protection and improvement of the environment.

2.3.2.2 Type 2: Other spatial protection measures – de-facto refuges

Definition of de-facto refuges

SPMs under sectorial legislative and administrative acts, to support the operation of industrial or leisure activities in the marine environment which, through their synergistic effects, support the conservation and protection of marine biodiversity even though they are not specifically designed to do so.

Source: Adapted from 'Programmes of measures under the Marine Strategy Framework Directive. Recommendations for implementation and reporting'. (Final version, 25 November 2014) and EEA (2013). Explanatory notes for the nationally designated marine areas. Version: December 2013.

Such measures are distinct from fisheries spatial protection measures in that they are not in place to provide any form of conservation or environmental benefit. Rather, the conservation and environmental benefit is an unintended side effect of their delivery.

[14] Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the conservation of fishery resources and the protection of marine ecosystems through technical measures, amending Council Regulations (EC) No 1967/2006, (EC) No 1098/2007, (EC) No 1224/2009 and Regulations (EU) No 1343/2011 and (EU) No 1380/2013 of the European Parliament and of the Council, and repealing Council Regulations (EC) No 894/97, (EC) No 850/98, (EC) No 2549/2000, (EC) No 254/2002, (EC) No 812/2004 and (EC) No 2187/2005.

Examples of de-facto refuges (which will be further developed during the course of this study) include:

- Spatial exclusions or restrictions of certain blue economy activities for non-conservation purposes under sectorial legislative and administrative acts e.g.
  - Maritime safety zone e.g. exclusion of gravel extraction or fisheries from within an offshore energy installation area or from within a shipping lane;
  - Areas reserved for certain recreational activities e.g. diving;
  - Cultural heritage sites e.g. protected historic wrecks and ancient monuments;
  - Anchorage areas; and
  - Military areas.
- Blue economy infrastructure which acts as an artificial reef e.g. offshore wind energy turbine bases, sunken diving wrecks.

2.3.3 Distinguishing MPAs and SPMs from terrestrial PAs

The MSFD defines 'marine waters' as being "waters, the seabed and subsoil on the seaward side of the baseline", where the baseline is typically the low water limit on the landside of the coastal area[15]. It further differentiates 'coastal waters' as a subset of marine waters falling within "one nautical mile on the seaward side from the nearest point of the baseline". EEA (2015) analysis of MPAs was undertaken in line with this definition.

Where protected areas adjoin the coast, i.e. they are close to the defined baseline (e.g. the low water limit), it may, in some instances, not be obvious from the designation whether the protected area is marine or terrestrial. A pragmatic working approach is applied in this study to determine this, drawing on the definition of marine ecosystems provided for Mapping and Assessment of Ecosystems and their Services (MAES):

"Marine inlets and transitional waters are ecosystems on the land-water interface under the influence of tides and with salinity higher than 0.5%. They include coastal wetlands, lagoons, estuaries and other transitional waters, fjords and sea lochs as well as embayments" (European Commission, 2013).

In situations where protected areas straddle both marine and terrestrial areas, the relationship between the benefits and the marine and terrestrial features will be considered, on a case by case basis, to determine the appropriateness of the evidence for inclusion in the study.

2.4 Ecosystem services framework

The Common International Classification of Ecosystem Services (CICES) definition of ecosystem services is followed in this study, as proposed by MAES, when reviewing and describing such evidence. These are not repeated here but are summarised in MAES documentation with full description available at http://cices.eu/.

2.5 Geographic scope

The study scope is to include evidence relevant to European, Outermost Regions (ORs) and Overseas Countries and Territories (OCTs) marine waters. A comprehensive review of European waters has been included, with a lower priority afforded to ORs and then, in turn, OCTs.

[15] As defined by Article 5 United Nations Convention on the Law of the Sea (UNCLOS) – Part II (1982).

In establishing the evidence base, transferable evidence from outside of these regions is drawn upon if presenting high quality evidence or identifying relevant examples. Transferability of evidence has been established based on an approximate match in climatic and environmental conditions as well as other secondary factors where appropriate e.g. socio-political conditions. The former has been used to guide the initial search for literature outside of EU. For example, European waters can be broadly considered as 'temperate' and further refined principally to 'marine west coast' and 'Mediterranean' – hence evidence from North America (especially the west coast), southwest and southeast Australia and New Zealand in particular has been targeted.

2.6 Evidence quality

The study establishes the existing state of knowledge drawing only on high-quality, robust evidence of tangible benefits to blue economy sectors as a result of MPAs and SPMs. The following hierarchy of evidence has been adopted:

Table 2. Evidence hierarchy

Evidence type	Quality score and prioritisation
Evidence linking blue economy benefits to MPAs and SPMs in a scientifically rigorous way ("this actually happened")	High quality evidence: main priority
Evidence-based scientific reasoning (ex-ante or ex-post) ("this has been observed, therefore it can be deduced that also…")	Medium quality: acceptable in absence of stronger evidence
Hypothesised studies without direct evidence base ("theoretically, it is expected that…")	Low quality: to be avoided

Studies estimating the value of services based on **revealed preference methods** (e.g. the travel cost method) or on **stated preference methods** (such as contingent valuation and choice experiment methods) have been excluded from the study as they do not provide relevant evidence of actual benefits to the blue economy.

Studies **modelling and/or simulating** impacts of MPAs and SPMs have generally been excluded from the review as these have been considered too hypothetical (see Table 5). However, in some cases where no other information is available, modelling studies have been considered. Further, relevant insights made by such studies have been mentioned to compare and contrast with findings of our preferred evidence sources.

3 Methods applied

3.1 Literature review method (Task 1)

3.1.1 Literature review protocol

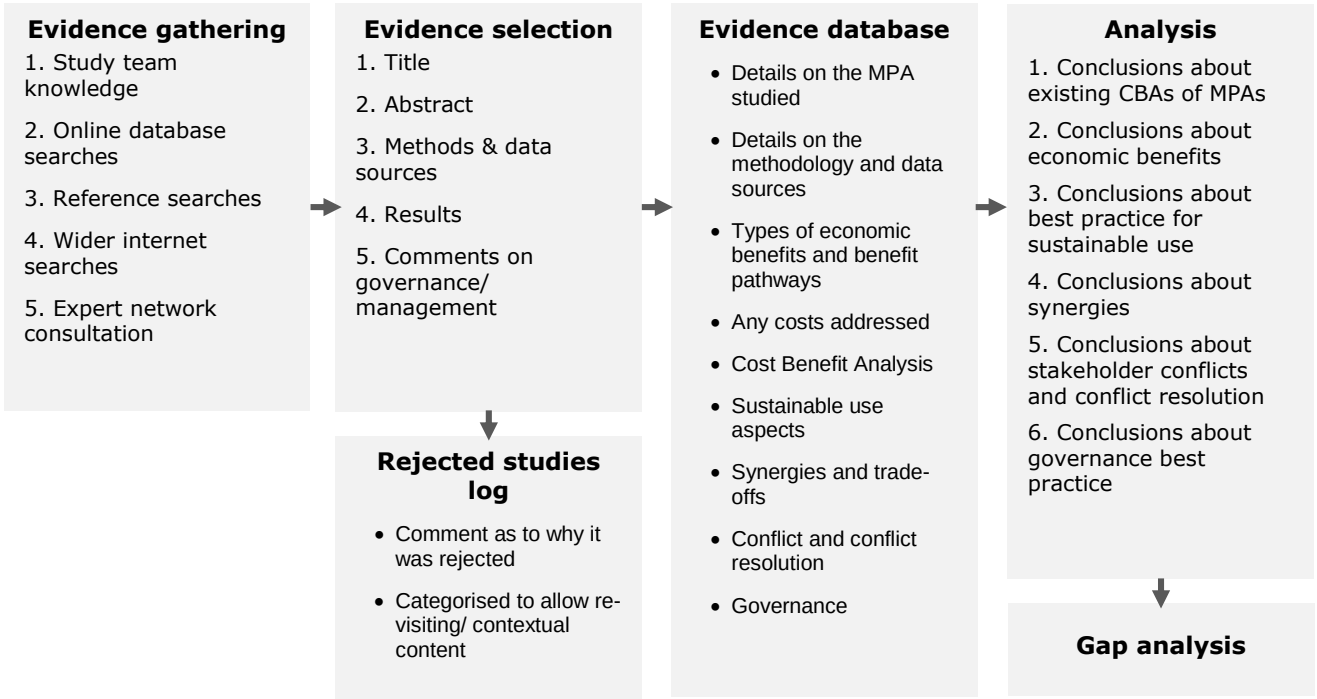
The first step of the literature review was to specify the details of the approach. A protocol was developed based on the study objectives and sub-objectives as listed in the study Terms of Reference and the ICF Technical Proposal, taking due consideration of the refinements of scope and definitions agreed at the inception meeting[16] and outlined in the project inception report.

A copy of the literature review protocol in full can be found in Annex 1. Its primary content is included in the following sections.

3.1.2 Literature review process

A simplified illustration of the literature review process and its different steps is presented in Figure 2 and explained in more detail throughout this chapter.

Figure 2. Simplified schematic overview of the literature process



3.1.2.1 Evidence gathering

The evidence gathering has comprised five primary steps intended to achieve an effective and efficient search process and ensure an exhaustive coverage of the available relevant literature.

1. **Study team knowledge**

[16] The inception meeting was held in Brussels at EASME's premises on 29 September 2016 between the ICF project management team and members of the Commission's Steering Group.

Evidence already known to the study team, the Steering Group and key informants, based on their individual experience and previous research, was collated.

2. Online database searches

Searches were conducted for evidence published in peer-reviewed scientific journals using online databases, including Web of Science, Scopus, Google Scholar, Science Direct, and Research Gate. Table 3 includes the different search terms used to identify evidence.

3. Reference searches

The bibliographies of key papers identified in previous steps were searched manually in order to identify any relevant pieces of evidence that had not already been picked up.

4. Wider internet searches

Wider internet searches were conducted to identify not peer-reviewed reports, impact assessments and grey literature. This was done by using the key search terms (see Table 3) in major search engines.

5. Expert network consultation

Finally, in order to ensure a wide coverage, the study network of regional experts, including European Regional Sea experts and international experts (including contacts from New Zealand and the USA), were consulted via email and asked to identify grey literature or other research in their own regions and languages.

Table 3. Keywords used in the evidence gathering

MPA: marine- "protect* area*", "conservation zone", "reserve", "no-take zone", "park", "sanctuary"
Economic benefits: "job creation", "job generation", "employment*", "revenue", "profit", "turnover", "livelihood", "community", "blue growth", "economic growth", "blue economy", "ecosystem services", "cost benefit analysis", "cost benefit", "CBA", "impact assessment"
Sector: fisheries/ aquaculture: "fisheries", "fishermen", "fisher", "sustainable fishing", "aquaculture", "mariculture", "aquatic farming", "spillover", "spill-over", "fish biomass", "productivity", "spawning ground", "nursery ground", "feeding ground", "certification", "premium price", "labelling", "closed area"
Sector: maritime, coastal, nature/wildlife and cruise tourism: "diving", "eco-tourism", "recreation", "tourism", "angler", "snorkel", "user fees", "tax", "boating", "fishing", "recreational boating", "sport fishing"
Other Blue Economy sectors: "maritime", "oil", "gas", "transport", "shipping", "blue technology", "blue biotechnology", "ports", "harbours", "energy production", "offshore", "extraction", "gas extraction", "oil extraction", "sea mining", "dredging"
Governance aspects: "conflict", "resolution", "engagement", "participation", "stakeholder", "local community", "coastal community", "cultural", "trade-off", "synergy", "synergies", "sustainable use", "sustainable management"
De facto refuges: "De facto refuges", "incidental protection", "foundation", "offshore", "platform", "wind-energy", "infrastructure", "military"

6. Evidence selection

The list of identified references was systematically and critically assessed, according to:

7. Title

Based on researchers' judgement, supported by the list of key search terms (see Table 3).

8. **Abstract**

If the title suggested that the evidence was relevant, the abstract was studied with support of the selection criteria as outlined in the literature review protocol (see Annex 1).

9. **Methods and data sources**

If the abstract suggested relevance, or if it did not provide sufficient information, the researchers went on to assess the methodology adopted and data sources used in the study. The assessment was based on relevance according to the literature review protocol, quality and robustness.

10. **Results**

If the method applied and data used were deemed relevant, the assessment continued to examine what type of results the study had concluded, again determining relevance based on the literature review protocol.

11. **Comments on governance/ management**

Finally, and regardless of the type of results, the researchers looked at whether the piece of literature at hand made any relevant comments with regard to the sub-objectives on this study.

3.1.2.2 Evidence database

The study team constructed an Excel log to function as a database of evidence regarded as satisfying the specific requirements of the literature review protocol, and therefore deemed relevant for the subsequent analysis.

A draft version of the database was shared and discussed among the wider study team before the process began and edited mainly to improve usability and compatibility with the study sub-objectives.

All cells in the final file that were not intended for data entry were password locked by the administrator as a precaution to avoid accidental formatting or editing and to ensure process consistency. The database was then circulated to the wider research team, including regional experts, for them to log the most robust pieces of evidence identified (see Section 3.1.2 for a description of the literature review process).

The database consists of three separate sheets. The **main database sheet** containing columns for logging various details of individual pieces of literature, as well as making comments with regards to the quality and robustness of the evidence, any key points made regarding management or governance best-practice etc. In addition, a supporting **table of options** linked to the database columns was included to enable filters and drop-down lists in the database, and finally, a third sheet containing an **explanatory guide** about how to fill in the database.

A copy of the full database has been submitted separately to this report. Table 4 below presents a summary of the detail recorded for each piece of evidence. The final database resulted in 94 entries.

Table 4. Summary of aspects included in the evidence database

Database column	Description
Overview of the study	Short description what the study is about
Details on the MPA/MPAs studied (or other type of spatial protection measures or de facto)	Name, location, size, age, type of protection, designation etc.
Type of study	Ex ante or ex post? Study of impact? Robustness of methodology? Evidence quality?
Economic benefits (divided into the three key sector groups)	Benefit pathway(s)? Quantification included? Summary of economic benefits. Any costs addressed?
Are any other ecosystem services addressed?	Other than those related to blue economy sector benefits
Management costs addressed?	Does the study address costs of managing the MPA(s)/ site(s)?
Is the study conducting a CBA?	Sub-objective 1 of the study
Does the study discuss sustainable management, win/win policies and/ or management approaches?	Sub-objective 2 of the study
Does the study discuss overlaps/ conflicts/ synergies/ trade-offs between sectors?	Sub-objective 3 of the study
Are governance aspects examined?	Sub-objective 4 of the study

3.1.2.3 Rejected study log

The references reviewed but ultimately discarded as outside the study scope and therefore not relevant were systematically logged in a separate Excel file and categorised in order to keep track of studies already assessed, allow later re-visit if necessary and their potential use for contextual content in the different steps of this study. Rejected studies were also given a comment as to why they were not relevant.

The log of rejected studied resulted in 533 entries. Table 5 below provides a list of some of the categories of these rejected studies. It should be noted that this is not a comprehensive list, nor a comprehensive coverage of all evidence of these individual topics.

Table 5. Categories of rejected studies

Type of evidence	Number of studies
Choice experiment/ Willingness to Pay	24
Theoretical/ Conceptual	23
Modelling/ Simulations	42
Negative impacts of economic sectors only	10
Only ecological effects	54
Literature reviews	30
Not MPA/SPM-specific	22

3.2 Literature analysis method (Task 2)

A critical analysis has been conducted with regard to the study objectives, using primarily descriptive narrative, mindful of the sub-objectives of the study.

The evidence on economic benefits and best practice for sustainable use of sites is presented separately for each of the three sector groups (Chapters 6–8). Evidence on stakeholder conflicts and conflict resolution, synergies between sectors and the role of governance is presented from a cross-sectoral perspective as these issues are ultimately of a cross cutting nature (Chapter 10). Any sector-specific issues related to these topics have been included when particularly relevant for identifying best practice.

3.2.1 Existing Cost Benefit Analyses (CBAs) of MPAs and SPMs

The report analyses existing attempts at conducting CBAs of MPAs or SPMs and other studies exploring the economic benefits across multiple sectors. In particular, it explores how these CBAs have been conducted given the current paucity of relevant data, what they have been able to say, if anything, about the net benefits of MPAs. Methodologies applied to calculate costs and benefits are scrutinised as well as the completeness in terms of what data has been included and what values are covered. Importantly, complete CBAs will take account of non-market as well as market benefits – i.e. also benefits beyond direct sectoral benefits. Although not the primary focus of this study, we therefore acknowledge evidence of wider ecosystem service values when they are part of such CBAs.

Based on the evidence identified, the analysis highlights any key costs and/or benefits that seem to be especially difficult to attain/lacking in the evidence (with a focus on real economic data).

Depending on the evidence available, any comprehensive attempts to conduct CBAs of MPAs and/or SPMs beyond our geographical scope are also included.

3.2.2 Economic benefits

The evidence base of economic benefits of MPAs and SPMs is evaluated and overviews presented for each sector group (Chapters 6-8). Table summaries are supported by a qualitative narrative analysing – to the extent possible based on the evidence available – individual topics, patterns, results and correlations, such as what scale of benefits are generated, key stakeholder groups and their opinions in relation to economic benefits of MPAs and what factors seem to be influencing the scale and nature of economic benefits derived.

The sectoral chapters also include, where relevant, examples of individual cases, types of benefit transfers and/or other key aspects related to the study objectives that have been identified in the literature.

3.2.3 Sustainable use

Presented on a per-sector basis within Chapters 6 to 8, the report analyses the evidence regarding the role of sustainable use measures in realising blue economy benefits without jeopardising conservation values of sites. Based on the level of evidence available and its quality, it explores best practices for supporting sustainable use in each of the three sectors.

3.2.4 Conflict and conflict resolution

The evidence is critically analysed in order to determine if, and if so how, conflicts related to MPAs between sectors, and between sectors and MPA objectives, impact the realisation of blue economy benefits. We explore how such conflicts have been resolved and what, if any, lessons can be learnt and best practice identified.

3.2.5 Synergies

MPAs, SPMs and their surrounding areas are commonly used for a range of activities. The evidence is critically analysed in order to identify what synergies exist between different user groups in and around MPAs, SPMs or de facto refuges. We also explore if any conclusions can be drawn regarding best practices for how to support such synergies.

3.2.6 The role of governance

MPAs and SPMs will not achieve their objectives or contribute to potential economic benefits to blue economy sectors without effective implementation and enforcement of the measures required to reach their set objectives. As a final part of the analysis, we explore the existing evidence of the forms of governance and stakeholder engagement that influence and optimise the realisation of blue economy benefits related to MPAs and SPMs. Where possible (i.e. when the evidence base is robust enough) we analyse individual findings, discuss the success of individual approaches, and identify transferable lessons and general guidelines.

3.3 Method for gap analysis (Task 3)

As a final step of the literature review, a gap analysis has been conducted looking at topical gaps, gaps in sector coverage and gaps in geographical coverage. The gap analysis is presented as a narrative as well as matrix tables with colour grading indicating the level of evidence available.

4 Overview of the literature

A small number of studies have previously reviewed the socio-economic benefits of MPAs in Europe (or parts of Europe), in each case finding major gaps in the evidence. A comprehensive literature review in the year 2000 concluded that studies of Mediterranean MPAs had until then mainly explored their ecological impacts, while few had looked at social or economic impacts related to protection. Fewer still were able to present any quantitative analyses (Badalamenti et al, 2000). In 2003, Carter reached a similar conclusion when reviewing the international evidence on the economics of MPAs (Carter, 2003). A few years later, Remoundou et al (2009) concluded that there are "extremely few" valuation studies of marine ecosystems published from the Mediterranean and Black Sea region.

The review undertaken for this study has found that this literature gap still exists and applies to all of Europe and its OCTs and ORs to various degrees.

A total of 627 pieces of literature have been logged. Of these, 94 (~15%) were considered sufficiently robust, given the evidence selection criteria, and were logged into the master project database. The remaining 633 (~85%) were rejected as outside scope of the review protocol. As this breakdown indicates, the evidence base of tangible blue economy benefits of MPAs, SPMs and de facto refuges in Europe, and from areas transferrable to Europe, is small. Table 6 and Figure 3 below provide a breakdown of the identified literature. Graphical illustration of the evidence base per sector is provided in subsequent respective chapters.

The only evidence identified that includes the Black Sea is a qualitative stakeholder survey exploring opinions about the socio-economic impacts of MPAs (Pascual et al, 2016).

Existing studies focus primarily on economic benefits to the fisheries and maritime tourism sectors.

*Table 6. Summary of selected evidence*** (NEA: North-East Atlantic; MED: Mediterranean Sea; BLS: Black Sea; BAS: Baltic Sea; ALL: applicable to all EU seas; INT: international evidence including ORs, OCTs and transferrable evidence).*

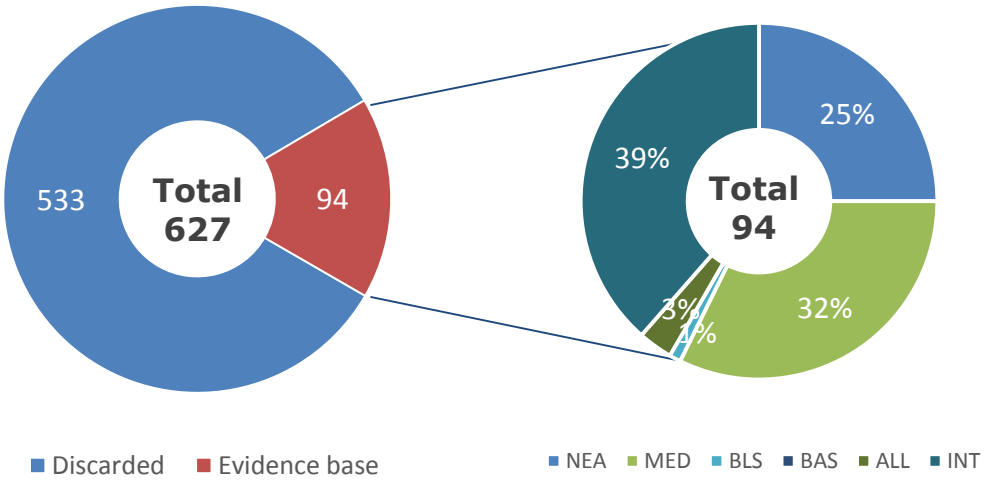
Type of evidence	Number of studies						Countries**
	NEA	MED	BLS	BAS	ALL	INT	
Cost Benefit Analyses*	4	3	0	0	0	8	UK; SE; IT; ES; US; CA; AU; NZ; Seychelles; Vanuatu and Fiji; Jamaica; Madagascar
Economic benefits to fisheries	7	21	0	0	3	15	UK; ES; FR; MT; US; IT; ZA; AU; EG; DZ; PT; NZ; BE; SE; NL; Tanzania; Vanuatu; Seychelles; Philippines; Madagascar
Economic benefits to maritime tourism	8	13	1	0	1	13	UK; ES; NL, Mexico, Australia, New Zealand, Philippines
Economic benefits to other blue economy sectors	0	0	0	0	0	0	N/A
Evidence of 'de facto refuges'	12	1	0	0	0	9	SE; ES; UK; US; NO; PT; BE; NL; AU; Malaysia; Curacao

* Note: No study is able to perform a full CBA; these pieces of literature are all partial CBAs.

** Country codes assigned by the European Union: http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Country_codes. Other countries indicated with full name.

*** Note: These figures are not mutually exclusive and should not be added up. Studies looking at both effects to fisheries and to tourism have been represented here in both sections. Studies of sites located in both the Atlantic and the Mediterranean Sea have been counted for both seas here.

Figure 3. Overview of the literature (left); Geographical distribution of selected evidence base (right). (NEA: North-East Atlantic; MED: Mediterranean Sea; BLS: Black Sea; BAS: Baltic Sea; ALL: applicable to all EU seas; INT: international evidence including ORs, OCTs and transferrable evidence).



5 Cost Benefit Analyses and cross-sectoral studies

Chapter summary

There are relatively few comprehensive Cost Benefit Analyses (CBAs) of MPAs currently available from either within or outside Europe, making it difficult to draw overall conclusions about the net benefits of individual MPAs or MPA networks in Europe. No CBAs of European SPMs were identified.

Existing studies comparing the costs and benefits of MPAs use primarily an ecosystem services framework and suggest that a large proportion of the benefits is likely to relate to non-marketed improvements in welfare rather than real economy benefits to sectors. Empirical evidence of benefits in monetary terms is very limited. CBAs generally appear more complete in their monetary valuation of costs than benefits. The studies that have valued blue economy benefits focus on benefits to maritime tourism and fisheries, demonstrating that individual MPAs and MPA networks can enhance economic activity in these sectors.

Despite being unable to account for a comprehensive representation of benefits, these studies suggest that the overall welfare benefits of MPAs exceed total costs.

Cost Benefit Analysis (CBA) is an analytical tool used to systematically assess the economic advantages and disadvantages of an intervention or investment decision. It is often applied to compare different alternatives in order to support decision making, for instance in pursuit of cost effectiveness. The values compared in a CBA can be either quantitative (usually monetary) or qualitative, however, in order to arrive at a final ratio between costs and benefits, all aspects need to be compared in the same unit.

Various guidance has been published, both related to the marine context and more broadly, including sectoral guidance, on how to assess environmental benefits in monetary terms, primarily based on the framework of ecosystem services. One of the examples relevant for this study includes World Resources Institute (WRI, 2009) which provided a template methodology for how to assess the economic contribution of fisheries and tourism provided by coral reefs and mangroves protected by an MPA. Mainly relevant to European Overseas Countries and Territories (OCTs) and Outermost Regions (ORs), the WRI template is intended to provide a snapshot of current use, but can also be applied in planning and assessing different scenarios for MPA establishment. The assessment focuses on economic impacts on residents and businesses, and includes a multiplier to allow estimations of economic impacts generated indirectly by the MPA, and not just direct benefits (see also OECD guidance from 2006 in Pearce et al, 2006).

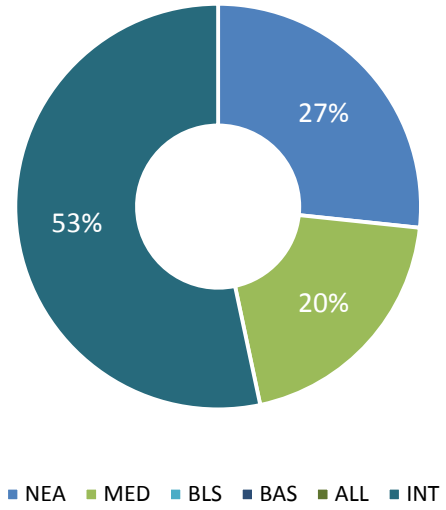
The EU Marine Strategy Framework Directive (MSFD) requires that management measures introduced by Member States to achieve or maintain Good Environmental Status in European seas (for instance the establishment of spatial protection measures, see Chapter 1) are based on CBAs (MSFD Article 13.3). The Marine Strategy Coordination Group's guidance for implementation of the MSFD states that the impacts included in these analyses do not necessarily need to be in monetary terms 9Marine Strategy Coordination Group (MSCG), 2014).

In this chapter, we describe existing attempts to perform CBAs for MPAs and SPMs and the extent to which they are able to account for economic benefits of these sites (such as increased turnover, revenue or profit for blue economy sectors). We explore the European state of the art of incorporating the value of these benefits, including ecosystem services, in monetary terms in these analyses and the methods applied to do so.

5.1 Overview of the evidence base

The review found that, across the geographic scope of the study, few studies so far have provided comprehensive comparisons of the costs and benefits of MPAs/SPMs (see Table 6 above). Very few of these include monetary values of benefits to blue economy sectors. We have not identified any analysis able to provide a full comparison of all identified benefits and costs related to marine areas managed for conservation purposes, or any that arrive at a robust estimation of the Total Economic Value (TEV) of a site or network of sites. We have not identified any CBA of European SPMs. The only CBA of SPMs identified is from Madagascar.

Figure 4. Geographical break down of the evidence base on CBAs of MPAs (n=15).



We have identified **fifteen studies,** considered to match the criteria for this review, which compare the costs and benefits of MPAs to various degree:

- Five studies are identified as the most robust European examples of CBAs available (see 0 at the end of this section). One includes quantitative benefits, while the other four account for benefits based on qualitative grounds.
- Two modelling studies have been identified that develop models to determine the costs and benefits of an MPA and apply them to a real-life case study in Europe (both studies use the Medes Island MPA in Spain).
- Eight studies compare costs and benefits of MPAs from beyond Europe, three of which are considered transferrable to European waters and five transferrable to OCT/ ORs waters (see Chapter 2 for details on transferability).

In addition, one recent study has been identified which attempts to estimate the net economic benefits of expanding a global network of no-take MPAs. This study was performed in 2015 and is mentioned here to illustrate where the application of the CBA approach to marine protection has come to from an international viewpoint.

In addition, **another 12 studies** were identified but rejected as not meeting the criteria for this review on the following grounds:

- Three are considered theoretical (Ami, Cartigny and Rapaport, 2005; Ovetz, 2006; Sanchirico, 2000);

- Two present models and simulations of hypothetical situations without relevant practical application (Boncoeur et al, 2001; Pitcher, Buchary and Hutton, 2002);
- Six are based entirely on contingent valuation and/or other choice experiments (i.e. they value non-market benefits) which are not within the scope of this study (Bosetti and Pearce, 2003; Brown et al, 2001; Burdon and Atkins, 2007; Christie and Rayment, 2012; Glenn et al, 2010; Kenter et al, 2013).

In addition to these analyses of costs and benefits, five studies are mentioned at the end of this chapter which are robust examples of cross-sectoral evaluation of economic benefits, although without comparing to costs incurred and therefore not attempting to estimate net impacts. They have all been conducted in the UK.

5.1.1 Challenges in undertaking CBAs

There are a number of challenges in undertaking CBAs for MPAs and SPMs. Identifying the nature of the relevant benefits, and costs, which are likely to occur can be challenging; valuing the potential costs of a site or network of sites is often easier than the potential benefits; and obtaining relevant spatial data.

Identifying the nature of benefits, and costs, that are likely to occur can be challenging. CBA is commonly applied ex ante. For example, it might be part of an impact assessment to support decisions regarding site location, design and most appropriate management/ conservation measures. However, identifying and estimating potential benefits of an intervention not yet in place is challenging, and ultimately relies on transferrable experiences from elsewhere (hence not site-specific) and/ or on hypothetical modelling exercises. The latter is at best based on site-specific ecological conditions and dynamics of existing users, but can also be based on transfer of experiences from other sites or, in less robust examples, on hypotheses or reasoning about likely outcomes. In both ex-ante and ex-post situations, identifying and assessing benefits can be particularly challenging where the evidence base for how a given environment will respond to protection, and hence how the flows of ecosystem services and their resulting benefits will change, is typically highly uncertain.

Valuing the potential costs of a site or network of sites is often easier than the potential benefits. For cost estimates there are a given set of conventional methods available, e.g. calculating foregone revenues of industries impacted or costs incurred for complying with monitoring rules etc. For benefits, many of the ecosystem service benefits derived from MPAs and SPMs are not marketable, except for e.g. fish and ocean minerals. Non-market valuation methods for estimating the benefits and values of ecosystem goods and services have become increasingly robust and more commonly applied in the last two decades and they are increasingly recognised as an important tool in maritime planning. Nevertheless, existing literature has pointed out that valuing marine ecosystem services and including such values in CBAs is still rarely applied in practice and ultimately obstructed by our lack of knowledge about the complex linkages between these ecosystems and socio-economic impacts (Bertram and Rehdanz, 2013; Börger et al, 2014).

An inherent lack of spatially explicit data is one of the main challenges mentioned throughout the reviewed literature. For benefits related to blue economy sectors, we find that such data is especially lacking for non-extractive activities such as sport and recreation, tourism, nature watching, and in particular over-time, before-and-after trends of different financial indicators (e.g. how income has fluctuated over time for tourism operators). In terms of overall benefits, the data most difficult to obtain seem to be different types of non-use values, such as regulatory functions of marine ecosystems,

cultural heritage values and existence values[17]. On the cost side, opportunity costs for different alternative marine uses, such as energy generation, have been mentioned as challenging to account for (Brander et al, 2015).

These challenges demonstrate that a suite of different methods is required in order to comprehensively undertake CBA for MPAs/SPMs. This can be both costly and time consuming to execute and may in part explain the relatively low number of CBA studies identified during this review. Further, CBAs conducted ex post may still be rare due to the relatively young age of many of the MPAs and SPMs in Europe.

5.2 State of the art on CBAs in Europe with the inclusion of blue economy benefits

5.2.1 Quantitative CBAs of blue economy benefits

Three studies have been identified as the most robust examples of CBAs of MPAs in Europe (see 0). One study has been identified that accounts for benefits in quantitative terms. It uses site-specific data in an ex post context.

Economic assessment of the impacts of marine and coastal protected areas in the Mediterranean, 2013

This study by Mangos and Claudot (2013), which includes five case studies[18] from the Mediterranean Sea, was conducted by Plan Bleu and facilitated by the Regional Activity Centre for Specially Protected Areas (RAC/SPA), the Network of Managers of Marine Protected Areas in the Mediterranean (MedPAN) and the WWF MedPO (World Wildlife Fund Mediterranean Programme Office).

The study aimed to qualify and quantify the socio-economic effects of five MPAs by observing changes in ecosystem services. The data obtained on the Tunisian, Spanish and Turkish sites were used to establish CBAs (the assessment of the remaining two sites was limited to an overview due to site-specific limiting conditions and lack of data). The three CBAs included benefits generated to commercial and non-commercial fishing, tourism, recreational boating, diving and from CO_2-sequestration; and costs related to operating costs and surveillance expenses. The authors acknowledge that an exhaustive inventory of costs and benefits was not possible, nor was accounting for benefits accrued beyond the sites in question, and that this was not the project aim. The benefits associated with ecosystem services were evaluated based on the revenue generated from the use of ecosystem services or based on the costs of accessing or using the ecosystem services. Quantitative assessment was only possible on the fraction of benefits stemming from the ecosystems and protective actions that are easiest to quantify because they are closest to the market. The values identified were compared with two alternative scenarios; one of increased protection and one on decreased protection.

Mangos and Claudot find, across the three CBAs, that **although the MPAs have redistributed benefits to some extent, they have had overall positive effects on local economic development.** See Section 5.4 for a summary of the Net Present Values identified by Mangos and Claudot.

[17] This report does not include for example the non-use values of MPAs and SPMs, such as bequest values. Neither does it include ecosystem service values such as regulatory values. See Chapter 0 for more details about the scope and definitions applied here.

[18] The following sites were studied: the Cap de Creus Natural Park in Spain, the Sensitive Area of the Kuriat Islands in Tunisia, the Specially Protected Area of Kas Kekova in Turkey, the National Marine Park of Zakynthos in Greece, and the Mount Chenoua and Kouali Coves protection project in Algeria.

5.2.2 Qualitative CBAs of blue economy benefits

Three examples are presented here of available CBAs that include economic benefits of MPAs in qualitative terms.

In the 2014 impact assessment of the proposed second tranche of 23 Marine Conservation Zones (MCZs) in the UK, DEFRA was able to present a comprehensive estimation of costs that would be incurred on different sectors (best estimate annual cost to business: £0.18m, primarily related to ports and shipping, oil, gas and CCS and commercial fisheries). The study is not able to provide any estimate of the monetary value of benefits that the network would provide, however. The conclusion on benefits is instead qualitative: "[The sites] are likely to result in an increase in final ecosystem services (benefits) such as increases in provisioning (i.e. fish provision), regulating (i.e. climate regulation), supporting (i.e. nutrient cycling) and cultural (i.e. recreational) services. An overall network of marine protected areas is likely to have high additional benefits (both in the short and long term) such as conservation of marine biodiversity, protection or enhancement of ecosystem services and recovery of depleted stocks of exploited species." Some quantitative attempts are made at non-market benefits (e.g., indicative monetary estimates of diving and angling based on contingent valuation and expert opinions on likely level of spillover from protected sites to surrounding fisheries) which are referred to as 'illustrative' because of uncertainty concerning the scale of benefits. The study concludes a **final net benefit (best estimate) of -£31 million over 20 years, which only reflects the expected costs incurred as all benefits were considered "Unquantified"** (DEFRA, 2015).

In the second example, Rees et al explored the percieved costs and benefits among key stakeholders of the Lyme Bay MPA (established in the UK in 2008) through 241 surveys. The most common statement under economic costs and benefits across the stakeholder groups was the potential of the MPA to provide "more fish" and the potential for increased tourism. Overall, the stakeholders perceive the **social, economic and environmental benefits of the MPA to outweigh the costs** and the support for the site is strong among a majority of stakeholder groups. The authors are not able to provide monetary estimates, however, acknowledging that benefits associated with the site may take many years to become fully apparent (Rees et al, 2013). Results from this project have also been published by (Mangi et al, 2012).

Finally, also from the UK, ABPmer (2015) develop an evidence base of the potential environmental, economic and social benefits and costs of eight recommended draft Special Areas of Conservation (dSACs) and three draft Special Protected Areas (dSPA) in UK offshore and territorial waters. The study sought to estimate effects both at site level and at network level. The study compares four management scenarios of the eleven sites with a "doing nothing" counterfactual scenario, over the period 2015 to 2034. While the study is able to account monetarily for a wide range of potential costs incurred to various sectors (see Table 9) and risks related to social impacts, potential benefits of the networks are assessed qualitatively due to "a lack of applicable quantitative evidence".

Regarding economic benefits of the network of sites, the study expects that the main ecosystem service benefits to occur relate to recreational benefits and non-use benefits. It is for example noted that the features of the proposed sites could play a significant role in wildlife tourism in the UK. It refers to a number of studies estimating the monetary value of, for instance, marine angling across the UK, and refers frequently to a contingent valuation study by Kenter et al (2013) that estimates monetary value of potential marine protected areas in the UK to divers and sea anglers (Kenter et al, 2013). ABPmer (2015) states, however, that "the ambiguity and uncertainty associated with the quantification of ecosystem services, as reflected in the evidence reviewed, reinforces the necessity for a largely qualitative approach to the assessments of benefits at a site level." The authors emphasise different uncertainties in interpreting Kenter et al (2013)'s study and the site ecosystem services assessments therefore mainly identify low-moderate

non-use values for the MPAs, with a low-moderate level of confidence. The study concludes that the proposed sites will have a significant and positive recreational and non-use benefit to people in the UK, but that the available evidence does not allow a monetary value to be estimated (ABPmer, 2015).

5.2.3 CBA modelling of blue economy benefits

Other CBA attempts that arrive at a value of economic benefits of a proposed site or network of sites base their estimates on different modelling exercises (see examples in Box 1 below).

Box 1. **Modelling the costs and benefits of Medes Island MPA in Spain**

EMPAFISH project, 2008

In the EU EMPAFISH project (Deliverable no. 25, 2008), a model is applied to the Medes Island MPA in Spain, generating four different scenarios of varying conservation measures over the following 20 years. The authors acknowledge that a fully developed CBA cannot be performed due to the limited data available from the Medes Islands, and uses the institutional costs of protection to represent costs (total approx. €400,000), and the profits of the commercial fishery (gillnet and trammel net fleet) and recreational activities (glass-bottom boat tours and SCUBA diving) to represent benefits. Recreational activities were based on field survey data collected in an earlier stage of the EMPAFISH project (Alban et al. 2007) and commercial fisheries data on a sampling programme carried out in the period 2003-2005 (under the BIOMEX and the EMPAFISH project).

The study reaches a number of conclusions. For instance, protecting a small coastal area like the one in question (1% as no-take and 10% as surrounding buffer zone) generated negligible economic benefits in the model, however, doubling the size of protection primarily raised institutional costs while it did not really impact on the economy of commercial fisheries. Further, fisheries yield directly adjacent to the no-take zone benefits from spillover of adult biomass for moderately to highly mobile species, but as the profits of fisheries are relatively low, the institutional costs of protection still exceed fisheries benefits. However, the authors stress that **if other non-extractive uses are added to the equation (such as eco-tourism) the costs are dwarfed by the benefits due to the high economic importance of eco-tourism in this region** (EMPAFISH, 2008).

Hundred-year simulation of Medes Islands

Sala et al. (2013) develop another general bio-economic model to simulate the economic value of a fishery and the value of tourism over time, for a fishery that implements a no-take zone. The authors then apply this model to the Medes Island MPA in Spain to act as a case study, using data from the local fishery and from long-term ecological monitoring of the site. The model simulates three harvest rates (representing the three protection zones of the MPA) and the biological dynamics of two representative species (red mullet as target species for fisheries and European seabass as interesting for divers to experience) and their change in biomass over time.

The simulation is run for 100 years before the no-take area was established at Medes Island and for 100 years after, showing that the total value of the reserve becomes greater than the pre-reserve value within five years of protection. A short-term loss in fisheries profits is accompanied by a steady increase in tourism values. They use a fee per dive to simulate direct benefits from tourism, while fishery profit are based on fishing costs (estimated from personal communications with fishermen) and market value of annual harvest rate (using red mullet prices

per kg to represent the price for fish). Overall, the study predicts that the **aggregate economic value of the reserve is larger than the costs incurred from protection** (Sala et al, 2013).

Table 7. Cost Benefit Analyses of European MPAs – most robust examples

Area studied	Methods used	Study results	References
Quantitative and monetary benefits			
Kuriat Islands; Cap de Creus; Kas-Kekova; Island of Zakynthos; Mount Chenoua Kouli coves. **Mediterranean**	Ecosystem services included: food production (commercial and non-commercial fisheries), tourism (diving and recreational boating) and CO_2 sequestration. Fisheries based on volume of catches, average market price and fishing method. Tourism based on no. of users and average spend. Operating costs based on costs for equipment and personnel.	Three CBAs carried out; redistribution of benefits within the area identified due to MPAs; but overall positive effect. Net present value of increasing-protection scenarios is higher than business-as-usual scenarios or decreasing-protection scenario for the three study sites, which indicates that the protection of these sites generates more benefits than costs over the period to 2030.	*(Mangos and Claudot, 2013)*
Qualitative benefits			
Network of Marine Conservation Zones, UK	Estimates net impacts over 20 years. A range of associated costs included from each relevant sector. No values of benefits included (because "they cannot be readily quantified and the majority are not traded, so cannot be easily valued")	Qualitative conclusion on benefits relevant to blue economy: Fish populations will benefit from greater protection and reductions in sea bed disturbance. Recreation (diving, angling, bird watching) can benefit from enhanced user experiences. As no benefits are valued, the quantitative best estimate of net present value is (costs only) -£31 million.	*(DEFRA, 2015)*
Lyme Bay, UK	Surveys of perceptions and levels of support of the main Lyme Bay stakeholder groups towards the closure. Questions repeated each year for three years (2008-2010).	Stakeholders perceive both tourism and fisheries benefits. Stakeholders perceive the social, economic and environmental benefits of the MPA to outweigh the costs and the support for the site is strong among a majority of stakeholder groups.	*(Rees et al, 2013)*
Recommended network of eight SACs and three SPAs, UK	Includes a wide range of sector costs and social risks with the proposed sites; refers to monetary estimates of benefits primarily to recreational users, but does not include monetary values in their	The authors emphasise uncertainties in interpreting existing data and the site ecosystem services assessments therefore mainly identify low - moderate non-use values for the MPAs, with a low-moderate level of	*(ABPmer, 2015)*

own estimates.	confidence.

5.3 Non-European examples of CBAs

The following studies have various levels of transferability to European or OCT/OR conditions. By including these studies, we hope to provide an idea of the international state of the art application of CBAs to MPAs. However, it should be noted that the review of international examples has not been as comprehensive as for studies on European MPAs.

5.3.1 Studies with transferable insights to Europe

The costs and benefits of potentially establishing a network of large scale no-take marine sanctuaries in the **Australian** South West Marine Region were estimated in 2009. The study collects no primary data but uses already published literature from Australia and internationally to estimate the net benefits for activities in the region (including fisheries and tourism activities, together with estimates from the literature on non-market values ascribed to the marine environment) as well as the non-market values ascribed to the marine environment and uses expert assessments to determine the likely effects of protected areas on these activities. Loss in net economic value of these activities is used to represent costs of the network. The study concludes that the **potential benefits of the network are dominated by non-market values and could be over AUD$100m, whereas direct economic sector losses are likely to be in the order of tens of millions thereby greatly outweighed by the potential benefits** (The Allen Consulting Group, 2009). This is an interesting conclusion in the scope of this study, as it suggests that the costs (in terms of loss of marketed outputs) are exceeded by the benefits (which are largely un-marketed) – i.e. it illustrates that blue economy losses may be compensated for by wider societal benefits.

The **New Zealand** Department of Conservation has commissioned research on the socio-economic impacts of the country's MPAs. For example, a study by Hunt in 2008 from Cape Rodney Okakari Point Marine Reserve established in 1975, shows that the reserve has had a considerable contribution to the local economy. The study measures impact on the level of employment, expenditure and incomes and estimates that the site generates about NZ$18.6m per year in total turnover, 173 FTEs in tourism-related jobs and another 10 jobs related directly to the marine reserve. Estimates are based on surveys of visitor expenditure combined with multipliers to estimate impacts on the wider local economy. The **total budget for running the reserve is about NZ$70,000 per year, which thereby is significantly exceeded by the estimated benefits** (Hunt, 2008). No other significant costs were identified in the study.

Finally, the impact analysis of a proposed MPA in the **Canadian** Hecate Strait and Queen Charlotte Sound concluded that "the **benefits generated through MPA designation would greatly outweigh its costs**", given its relatively small impact on industry. Benefits taken into consideration are qualitative and non-monetary, and include the safeguarding of species of commercial value. The impact analysis points out that the MPA can "serve to maintain and even enhance economic opportunities, such as fishing and tourism". It makes reference to potential benefits to fisheries from spillover, as well as improved clarity about long-term management and responsibility providing greater certainty for marine resource users. Some costs are presented in monetary terms, such as estimated management and monitoring costs for Government and loss of profits for fishermen due to displacement (Government of Canada, 2017).

5.3.2 Studies with transferable insights to OCT/OR

Exploring the net economic impacts of increasing the coverage of no-take zones in the Australian **Great Barrier Reef**, a study in 2003 found that the main cost of introducing a plan of increased no-take zone coverage was foregone fishing opportunities, estimated at

between AUD$0.52 and AUD$2.59m per year, including downstream impacts on fish processors. The study showed that economic-use activities undertaken in the park (including tourism, fishing and recreation, based on official, site-specific data) were worth over AUD$890m per year and employed around 10,000 people. The study also estimated the indirect economic benefits to the regional economies to be equivalent to AUD$760m per year. **The study concludes that there is a "very good case" for introducing the proposed zoning plan** and that, "given the high value of the environmental and economic benefits of the Zoning Plan relative to the modest aggregate economic cost, the Zoning Plan is likely to deliver substantial net benefits for Queenslanders and the broader Australian community" (Hand, 2003). The economic values of the Great Barrier Reef have been studied also in later research, although these studies as far as we can tell did not compare to related costs (see 0).

Pascal and Seidl (2013) conducted CBAs of 10 community-based MPAs in **Vanuatu and Fiji,** based on ecosystem service valuation, and showed that the protected sites have improved the attractiveness of the sites for nature tourism and helped to maintain coastal protection as well as fisheries production. The observed costs (including amortized investment, management and network costs) ranged between US$1.5k/ year and km^2 of protected area to US$10k per year and km^2, while the economic benefits range between US$110k per year and km^2 – US$530k per year and km^2. **All sites studied showed positive cost benefit ratios[19] over a 25-year project life time, thereby suggesting that sites like these can be effective in contributing to local economic development.** Returns on investment ranged between 5 to 10 years. Tourism benefits represented almost 6 times the fisheries benefits in the Vanuatu sites and 60 times those in the Fiji sites. The benefit pathways identified and valuation methods used on blue economy benefits are outlined below:

- *Subsistence and commercial fishing* – MPA impact on fishing productivity – producer surplus method: based on estimates of CPUE, annual fishing effort, protein content and fishery revenues. Data collected through fishing logbooks, interviews, experimental CPUE and expenditure surveys in villages.
- *Tourism and associated expenses* – MPA role on tourist visit motivation – producer surplus: based on interviews with business owners and a tourism advertising images analysis to estimate the weight that marine related activities had in their choice of destination.

The study also looked at bequest values (through value transfer) and coastal protection (through avoided damage costs).

As part of an evaluation of the socio-economic impacts of marine degradation in the **Seychelles**, Cesar et al calculate economic values and conduct CBAs for seven existing MPAs. The ecosystem services valued in monetary terms were tourism (looking at willingness to pay of visitors and residents) and fisheries (using fisheries data and using an ecological-economic model). Costs included intervention enforcement, monitoring, education, services and other fixed costs. The resulting **total net present values per site (over a 25 year period) vary between US$30 million – US$300 million**, and in all cases the recreational benefit value was by far the largest factor (Cesar et al, 2004).

An interesting case evaluating the costs and benefits of a coastal protected area (including wetlands, forests and a marine component) has been found from the Portland Bight Protected Area (PBPA) in **Jamaica** (Cesar et al, 2000). The study estimates that, in **net present value, the (incremental) costs of PBPA management are US$ 19.2 million over a 25 year time period, and the incremental benefits are US$ 52.6**

[19] The authors calculate the cost-benefit ratio as the expected net benefits of investment in an MPA over a 25 year project life and evaluated at a 10% discount rate.

million for the optimistic tourism scenario and US$ 40.8 million in the pessimistic tourism case. The study draws partly from data collected in the area but also from transfer of values estimated elsewhere. Different valuation methods are applied in combination with a qualitative system of allocating a number of stars (0, 1, 2, or 3) for each value for each of the ecosystems depending on its likely importance.

Studying the impacts on local fishing villages of periodic closures of octopus fisheries in Velondriake Locally Managed Marine Area (LMMA) in Madagascar, Oliver et al (2015) found that landings in closure sites generated more revenue than simulated landings under open-access fishing. The data was collected from landings between 2004 and 2011 and showed positive un-discounted net earnings for 27 of 36 sites, with a mean net of US$ 305 per closure and monthly internal rate of return of 58%. Village-level total fishery income saw a mean increase of 136% for the 30 days following an opening compared to the 30 days leading up to the closure. The apparent costs due to forgone catch during closure were not statistically distinguishable. Landings tended to return to a baseline level between 7-10 days after reopening. The fishery targeted four fast-growing species: *Octopus cyanea* (95% of local catches), *Callistoctopus macropus* (~4%), *Amphioctopus aegina* (~1%) and *Callistoctopus ornatus* (rare).

5.3.3 CBA of global network of MPAs

In 2015, the WWF commissioned a study looking at the economics of expanding a global network of no-take MPAs. The estimate of net economic impacts of such a network is based on existing quantitative data and calculated through a value transfer model. Included in the CBA estimate are values of MPA establishment costs, operational costs, opportunity costs to fishermen, coastal wetland ecosystem services benefits, coral reef ecosystem services benefits and mangrove ecosystem services benefits. Recreational values are included in the coral reef estimate but otherwise the authors are not able to include any real blue economy benefits. Presented as six different scenarios, the estimated net present value is in the range of US$490-920 billion over the period 2015-2050. The study suggests that the economic rate of return would be as high as 24% and greater than the discount rate (3%) in every scenario considered. Net benefits continue to accumulate as the area of protection increases, up to 30% (the extent of the analysis), but as the area of MPA coverage increases, the rate at which net benefits accrue decreases (Brander et al, 2015).

5.4 Conclusions: net benefits of MPAs

While no existing European study arrives at a comprehensive estimate of net monetary benefit of MPAs, the CBAs of MPAs (or networks of such) which are able to account for their economic benefits indicate that net impacts of these areas are positive and high (see Table 8 below). In all cases identified – although each study acknowledges that a full representation of benefits is not possible – **the benefits that are calculated are significantly higher than estimated costs**. Also Rees et al's (2013) qualitative example from the UK reaches a similar conclusion. Table 9 lists the benefits and costs accounted for by some of the CBAs of MPAs and SPM identified in this study.

The Plan Bleu study from the Mediterranean, which we consider to be the most robust CBA example from Europe, acknowledged that full representation (or Total Economic Value) of the ecosystem services provided from the studied sites cannot be established, and instead sets out to identify the economic order of magnitude of the effect that the studied MPAs have on the ties between society and the protected ecosystems. They are, nevertheless, able to estimate Net Present Values (NPV) of three scenarios for the three sites over periods of 10 to 20 years (see Table 8). As indicated earlier, the authors find that the NPV of a scenario with increased site protection, in all three cases, is higher than that of the business-as-usual or of a scenario with decreased protection levels (see Mangos and Claudot 2013 for details).

Table 8. Estimates of net benefits of MPAs and SPMs identified in the literature (where benefits have been accounted for monetarily)

Location	Benefits	Costs	Net benefits	Author
Kuriat Islands, Tunisia (business as usual scenario)	€50,517,000	€164,000	€50,353,000	*Mangos and Claudot, 2013*
Cap de Creus, Spain (business as usual scenario)	€3,042,893,000	€28,391,000	€3,014,502,000	*Mangos and Claudot, 2013*
Kas Kekova, Turkey (business as usual scenario)	€902,548,000	€5,730,000	€896,818,000	*Mangos and Claudot, 2013*
Network of large scale no-take MPAs, Australia (ex ante)	>AUD$100m	"tens of millions" [AUD$]	Benefits would greatly exceed costs	*The Allen Consulting Group, 2009*
Cape Rodney Okakari Point Marine Reserve, New Zealand	NZ$18.6m (annual total turnover)	NZ$70,000 (annual budget)	>NZ$18m	*Hunt, 2008*
No-take zoning plan of the Great Barrier Reef, Australia	AUD$890m (annual use-values) AUD$760m (annual indirect benefits)	AUD$0.52 – AUD$2.59m (annual foregone fishing opportunities)	AUD$1,600m – 1,650m	*Hand, 2003*
10 MPAs in Vanuatu and Fiji	US$110k – US$530k (year^{-1} km^2 MPA^{-1})	US$1.5k – US$110k (year^{-1} km^2 MPA^{-1})	US$108.5k – US $420k (year^{-1} km^2 MPA^{-1})	*Pascal and Seidl, 2013*
Seven MPAs in the Seychelles (over 25 years)	N/A	N/A	US$30m – US$300m	*Cesar et al, 2004*
Portland Bight, Jamaica (over 25 years)	US$40.8m - 52.6m	US$19.2m	US$33.4m – US$21.6m	*Cesar et al, 2000*
Velondriake Locally Managed Marine Area (LMMA), Madagascar (2004-2011)	US$29,270 (total for all 36 closures)	US$18,294 (total simulated costs of foregone catch for all 36 closures)	US$10,976 total	*Oliver et al, 2015*

Global network of no-take MPAs (2015-2050)	US$620b – US$1,100b	US$44b – US$228b	US$490b-920b	*Brander et al, 2015*

Table 9. Benefits and costs accounted for in CBAs of MPAs and SPMs

Study	Benefits included	Costs included
Monetary representation of benefits		
Mangos and Claudet, 2013	Commercial and non-commercial fishing, tourism, recreational boating, diving and CO_2 sequestration.	Operating costs of MPA management body, surveillance and environmental education expenses.
The Allen Consulting Group, 2009	Fisheries and tourism activities and estimates from existing literature on non-market values ascribed to the marine environment.	Loss in net economic value from displacement of recreational and commercial fisheries and of charter fishing.
Hunt, 2008	Visitors direct spending and flow-on effects to the district economy.	Annual budget for running the MPA.
Hand, 2003	Economic-use activities undertaken in the park (including tourism, fishing and recreation, based on official, site-specific data); indirect economic benefits to regional economies.	Foregone fishing opportunities including downstream impacts on fish processors.
Pascal and Seidl, 2013	Subsistence and commercial fishing, tourism and associated expenses, bequest values (through value transfer) and coastal protection (through avoided damage costs).	Amortized investment, management and network costs.
Cesar et al, 2004	Tourism and fisheries.	Enforcement, monitoring, education, service, other fixed costs.
Cesar et al, 2000	Tourism, fishery, carbon fixation and coastal protection.	Management of the MPA.
Oliver et al, 2015	Fisheries only focus	Foregone catch (simulated)
Brander et al, 2015	Coastal wetland ecosystem services benefits, coral reef ecosystem services benefits and mangrove ecosystem services benefits. Recreational values are included in the coral reef estimate but otherwise the authors are not able to include any real blue economy benefits.	MPA establishment costs, operational costs, opportunity costs to fishermen.
Qualitative representation of benefits		

Government of Canada, 2017	Fisheries, cost savings for Government, existence value to Canadians	Management and monitoring costs, displacement and compliance costs for fishermen
ABPmer, 2015	Recreational benefits and non-use benefits	Costs to activities (in monetary terms): • Aggregates • Aquaculture - finfish • Commercial fisheries • Offshore renewables • Military activities • Oil and gas • Ports & harbours • Recreational boating • Preparation of Marine Management Schemes; • Preparation of Statutory Instruments; • Development of voluntary measures; • Site monitoring; • Additional costs for geophysical surveys; • Compliance and enforcement; • Promotion of public understanding; • Regulatory and advisory costs associated with licensing decisions; and • Costs of leasing income foregone.

5.5 Other cross-sectoral analyses of economic benefits without cost comparison

In this section, we highlight other quantitative cross-sectoral assessments of economic benefits of MPAs identified in the literature. All five studies are from the UK. Neither have compared benefits and costs and are therefore mentioned primarily as an illustration of cross-sectoral approaches to account for wider sets of benefits. These are followed by insights from assessments of the economic benefits of the Great Barrier Reef in Australia (0).

Overall, the studies suggest that, in their contexts, **MPA networks can generate significant economic benefits to individual sectors as well as in the wider local economies.**

Firstly, Moran et al (2008), commissioned by the UK Department for Environment, Food & Rural Affairs (DEFRA), present a monetary estimate of the environmental benefits expected from the implementation of nature conservation measures in the proposed UK Marine Bill. The ex-ante study estimates on-site benefits of a potential network of Marine Conservation Zones (MCZs) across the UK, in the form of changes in ecosystem goods and services, and off-site benefits to fisheries through a production function model. It includes direct and indirect use values and arrives at a present value estimate of benefits over 20 years of £10.3-£22.7 billion (Moran et al, 2008).

The method developed by Moran et al was subsequently applied to assess the socio-economic value of the proposed networks of MPAs in Scotland and Northern Ireland, respectively. The Scottish study uses benefit values transferred from other contexts due to budget and time constraints, and estimates that over a period of 20 years, the overall benefits of the network would be between £6.3 billion and £10 billion, depending on scenario and management combination (present values: 3.5% discount rate over 20 years). Undiscounted mean annual benefits range from £566m - £758m. The estimated benefits include non-use values (12-14%) and use values (86-88%) within the sites. The authors are not able to calculate possible benefits generated away from the sites, e.g. related to fish and shellfish spillover to surrounding waters, due to lack of robust and reliable valuation studies. Overall, the authors caution the many caveats of the methods applied, for example the limited data available did not allow a comparison of a larger number of studies which could have increased the reliability of the estimations (González-Álvarez, García-De-La-Fuente and Colina-Vuelta, 2012).

The study compares three hypothetical networks under two different management regimes/ levels of protection and, the results suggest that the greatest benefits would arise in networks which protect a high proportion of threatened and declining habitats and species. It also finds that restricting the most harmful activities, such as bottom-towed fishing gear, could give significant benefits, as could protection of spawning and nursery grounds (González-Álvarez, García-De-La-Fuente and Colina-Vuelta, 2012).

Barnard et al (2014) – studying the Northern Ireland network – were unable to collect primary data and instead used benefit transfer derived from estimates of the total economic value of the UK marine environment extrapolated to the estimated ecosystem services that would be delivered by the proposed MPA network. The study arrived at a present value of the proposed network of £52.98-£53.31 million – significantly lower than both the English and Scottish network value mentioned above. However, if calculated for spatial extent for the year 2012, the Northern Ireland network showed a much higher value than the other two – £163,978-£164,991/km^2 compared to the English (£98,463-£100,044) and the Scottish (£57,346-£57,808).

Also, the Centre for Marine and Coastal Policy Research at Plymouth University has assessed the potential benefits from designation of a UK network of MCZs, presenting four sites proposed for designation as demonstration case studies. The study adopted a similar method as the ones previously mentioned, analysing the provision of beneficial marine ecosystem services nationally, estimating the extent to which the proposed MCZ sites provide these benefits and assessing how this provision would change under different management scenarios. The study presents quantitative economic benefits of the fishing, nature watching and recreation already taking place within the borders of the proposed sites. However, the assessment of how designation would impact the provision of the benefits is qualitative. The authors conclude that the value of the beneficial ecosystem services for which data was available is expected to decrease in the absence of MCZ designation and increase with MCZ designation (Fletcher et al, 2012).

Finally, in February 2017, the Scottish Government published an ex-post assessment of the emerging evidence on socio-economic impacts of Scotland's MPAs following new management measures that had been introduced in early 2016, affecting fisheries in particular. Other marine activities were already being affected by the provisions introduced at designation of the sites. The assessment looked at ten MPAs governed under the Marine (Scotland) Act 2010 and ten inshore Special Areas of Conservation (SAC) governed under the EU Habitats Directive. Analysing fishing activity and fish landings data, interviewing key stakeholders and conducting case studies, the study found no evidence of significant positive or negative socio-economic impacts linked to the MPA measures. The authors conclude that it is still too early to make any judgements about socio-economic impacts. They point out, however, that there is emerging evidence of possible future benefits at the local level primarily related to tourism, but that these will take time to develop (Scottish Government, 2017).

Valuing the economic benefits of the Great Barrier Reef (without reference to costs)

The Australian Government Great Barrier Reef (GBR) Marine Park Authority commissioned a study in 2007 assessing the economic and financial value of activity undertaken within the park catchment area in 2004-05, including estimates for 2005-06. The study covered market-related transactions only, in commercial fisheries, tourism and recreational activities, using data collected from various relevant agencies. It concludes that the value added of the activities in the park is around AUD$3.7b annually, contributing to about 44,000 jobs (FTE). Tourism accounted for about 85% of both estimates (Access Economics Pty Limited, 2007).

In 2014, the Park authorities published a comprehensive strategic assessment which partly included the economics of the park. The economic data was based on a report from 2013 by Deloitte Access Economics. In their updated assessment, they state that tourism is the most significant direct use in the region and that the GBR catchment area generated about AUD$6.4b in direct expenditure in 2012, $5.2b value-added and over 64,000 full time jobs. Commercial fisheries and aquaculture in the region contributed AUD$160.3m to the Australian economy and 975 FTE jobs. Recreational activities, including recreational fishing, generated an estimated AUD$330m in 2012, and employment equivalent of 2,724 FTE jobs. The report also looks at shipping as another blue economy sector benefitting from the GBR, although only briefly. National statistics estimate that AUD$38b of Australia's export trade is carried through the region annually, noting further that the economic activity generated by this shipping traffic provides a range of social and economic benefits to catchment communities and beyond (Deloitte Access Economics, 2013).

Finally, the Strategic Assessment mentions benefits generated by the area from national defence activities. While emphasising that little is known about the economic benefits of small-scale training, they cite research suggesting local contributions of AUD$4m to one neighbouring community in the area and AUD$200,000 to another (Great Barrier Reef Marine Park Authority, 2014).

6 Evidence of benefits to fisheries and aquaculture

Chapter summary

The review found 44 usable studies illustrating economic benefits of MPAs or SPMs to fisheries. No studies have been identified showing such economic benefits to aquaculture. A significant majority of the European literature identified is from sites in the Mediterranean Sea, some from the North-east Atlantic, and none have been identified from the Baltic Sea or the Black Sea.

It is primarily spillover effects from so-called "no-take" zones that that have been studied and found to provide positive economic impacts on fisheries. Spillover is shown to support increased catch per unit effort (CPUE) for a range of gear types and target species in waters surrounding areas closed from fishing. However, only one study shows a net gain in yield following designation of an MPA (no-take in this case), i.e. the increase in yield due to spillover more than compensated for the loss of fishing opportunities inside the no-take zone.

Evidence of economic benefits identified to fisheries not directly related to a no-take zone include increased revenue for artisanal fishermen permitted to fish within MPAs using static gears to target low-mobility, benthic species. This benefit arises due to reduced competition for space and resources from other forms of fishing being excluded from the MPA. To a lesser extent, some evidence indicates increased revenue due to premium prices supported by MPA branding and quality certification.

While a number of robust studies demonstrating benefits exist, the existing evidence base is still limited and only a handful of studies demonstrate benefits to fishermen based on empirical economic data. The evidence is therefore not sufficiently comprehensive to draw overarching conclusions for Europe.

A number of factors influencing the scale and nature of economic benefits can nevertheless be identified. Firstly, it is important to distinguish between protection designated with the purpose to enhance target species (for subsequent fishing in the case of an SPM) and protection designated to remove fishing pressure and the negative habitat impacts of certain types of fishing to help achieve conservation objectives. The latter may or may not benefit species targeted by commercial fishing. Further, zoning with networks of no-take areas in combination with other uses has been shown to be effective to generate economic benefits to fisheries through spillover in several occasions. Depending on which species are targeted, the size of no-take zones may affect the scale of spillover benefitting fisheries. Local habitat distribution in and around no-take areas and the timescale since site designation seem to also influence the scale and nature of benefits to fisheries. The limited evidence base does not allow us to draw comprehensive conclusions as to which MPA or SPM factors (or combination of factors) help to optimise the generation of benefits to fisheries, to what degree individual factors influence benefits or the scale to which such benefits occur.

No specific evidence has been identified looking at measures to ensure that the potential benefits of MPAs and SPMs can be captured by the sector without compromising conservation objectives. This might be a result of the relatively young age of many European MPAs; the fact that most of these sites do not yet have implemented management plans; that existing research is focussed on "fishing versus no fishing"; and/or that very few measures have been adopted to ensure sustainable use. However, several studies illustrate the importance of managing displacement effects of MPAs and SPMs – both within sites and of fishing activities moving into new grounds. For instance, if the overall fishing pressure inside the site remains the same as a result of an increase in permitted gears, the

conservation objectives of the site might be compromised. Displacement of certain types of fishing from one site to another may also result in new or additional environmental costs, as well as costs to fisheries already operating in those waters.

In this chapter, we explore the evidence of economic benefits of Marine Protected Areas (MPAs) and Spatial Protection Measures (SPMs)[20] to the fisheries and aquaculture sectors in Europe, European Overseas Countries and Territories (OCTs) and Outermost Regions (ORs). The chapter begins by introducing how fisheries may theoretically benefit economically from these sites, and continues by providing an overview of the evidence that we have identified. It then continues to discuss what, if any, conclusions can be drawn from this evidence regarding the nature and extent of benefits. Finally, some conclusions are provided on what measures the evidence suggests as ways to ensure a sustainable co-existence between fisheries, aquaculture and MPAs/SPMs.

6.1 Introduction – economic benefits of MPAs and SPMs

Perhaps the most commonly cited potential benefit of MPAs and SPMs is that they may enhance commercially targeted fish stocks and thereby contribute to higher and better quality catches and/or reduce effort-related costs of fishing activities. However, while SPMs are usually stock-specific, per definition, MPAs are spatial conservation tools that foremost protect benthic ecosystems located within their boundaries. In other words, SPMs can be – and commonly are – used to target improvements in the stocks of commercially important species whereas MPAs focus on delivering wider conservation objectives. Most MPAs in Europe (e.g. the network of marine Natura 2000 sites which constitutes 70% of EU MPAs) only provide legal protection for the species and/or habitats for which the respective site has been designated (as the Annexes of the Birds and Habitats Directives). This EU legislative basis does not include[21] any major commercially targeted marine species.

Economic impacts aside – the nature and extent of ecological stock improvements of MPAs have been widely studied and are often distinguished as effects *inside* versus *outside* a managed area (see Box 2).

Box 2. **Ecological effects of fish stocks inside and outside MPAs – summary of evidence of environmental change**

The ecological effects of MPAs have been widely studied and are often distinguished as effects inside versus outside a site.

How can targeted species benefit from MPAs and MPA networks?

Effects inside the site

Firstly, if a commercially targeted species is dependent on the protected habitat, it might benefit indirectly from its protection (e.g. through habitat quality improvements). Secondly, depending on restrictions imposed, populations of commercially targeted species may be directly protected as an "umbrella effect"

[20] Throughout this chapter, "SPMs" refer to fisheries spatial protected measures, as described in Section 2.3.2. Other spatial protection measures are covered in Chapter 0: Evidence of 'de facto refuges'.

[21] A number of fish species with commercial interest are protected under the EU Habitats Directive Annex II. For these species, core areas of their habitat (designated as Sites of Community Importance) must be protected under the Natura 2000 network and managed in accordance with the ecological requirements of the species. These species include, for example, Atlantic salmon (only in fresh water) and Adriatic and Atlantic Sturgeon. Management of commercial fisheries is instead guided by the EU Common Fisheries Policy (Russi et al, 2016).

as long as they reside within the site boundaries and thereby avoid being caught, either as target species or as by-catch.

Both of these effects may enable individual specimens to grow older and larger, depending on rate of growth and reproduction, and thereby contribute to the genetic resilience of the population thanks to their improved reproductive capacity and ability to produce larvae with better survival rate[22] (Birkeland and Dayton, 2005). In particular, the evidence of areas closed from fishing (so-called "no-take") resulting in increased individual size as well as abundance and biomass of target species is numerous (Claudet et al, 2008; Guidetti et al, 2014; Lowe et al, 2003; Mateos-Molina et al, 2014). This effect seems to be greatest for higher trophic levels and for species with greater body size (FAO, 2011).

Effects outside the site

By improving the reproductive capacity of targeted species, as above, or by protecting the spawning grounds of targeted species, MPAs may help improve the production of eggs and larvae which in turn can serve as recruitment to neighbouring fishing grounds (Beukers-Stewart et al, 2005; Gaines, Gaylord and Largier, 2003; Harrison et al, 2012). Gaines et al (2003) argue that larval dispersal is an often-overlooked benefit of MPAs. Protecting spawning grounds may also reduce fishing mortality as adult fish aggregating at these sites to spawn might otherwise be particularly easy to catch.

In addition, increased biomass of target species within an MPA or SPM may result in juvenile and adult specimen "spill over" into surrounding fishing grounds. This has been proven to occur around no-take MPAs in a number of instances (Gell and Roberts, 2003; Halpern, Lester and Kellner, 2009; Roberts et al, 2001; Russ et al, 2004).

Key factors that determine the effects of MPAs or MPA networks in a fisheries context

The effects to target species mentioned above depend on a number of factors. The FAO (2011) list the following as key factors determining the protective effects of MOPAs on fishery resources:

- The **location of an MPA** determines what it protects, and the location of MPAs relative to each other (their connectivity) influences their networking benefits;
- The **size of an MPA**, the number of MPAs in a network and the total size of the network determine their effect. The larger the total area protected, the greater protective benefit (all else equal). However, the relative effect of a single MPA compared to a network covering the same total area is less obvious.
- The **nature of protection** measures inside the MPA. No-take zones provide greater conservation benefits than multi-use areas, but from a fisheries point of view, the role of no-take depends on, for instance, to what extent fishermen can capitalise on spillover effects.
- The **movement of organisms** in and out of the site, with less movement of a species or population out of the site, for example by low-mobility invertebrate or sedentary species, leading to greater protection benefits.
- The **activities outside the MPA** – if surrounding habitats and water quality

[22] According to data from the International Council for the Exploration of the Sea (ICES), 93% of cod in the North Sea are caught before reaching reproductive age (*COM(2009)163 final*).

are degraded, the effectiveness of the MPA may be undermined. Similarly, the greater the fishing pressure on stocks outside the MPA, the larger the share of the targeted stock protected inside the MPA must be to sustain the resources being fished.

In light of the ecological effects (as described above), the nature of any economic benefits from MPAs to fisheries and their distribution across the sector are closely linked to the types of restrictions that are adopted within the site boundaries i.e. whether fishermen are permitted to take advantage of the improvement in a given fish stock.

Many European MPAs restrict the use of certain gear types (such as bottom trawling) where this harms the biodiversity and habitats which the site has been designated to protect. Further, in particular in the Mediterranean, zoning[23] of MPAs is common, where small areas of particular concern are set aside as "no-take" areas because continued extractive activities have been deemed too harmful to the protected species or features. No-take areas are often surrounded by buffer zones and multi-use areas. Across the EU, however, only a fraction of MPAs (or zones of MPAs) are closed for all fishing. Further, a recent assessment of EU Member States' implementation of the MSFD reveals a limited ambition to tackle the negative impacts of fishing on MPA conservation objectives (OCEANA, 2017).

From an economic perspective, any benefits to fisheries resulting from MPAs or SPMs need to be set against potential costs incurred on the sector due to any technical restrictions imposed or reduction of fishing opportunities due to the designation of conservation measures. The overall economic implications of both MPAs and SPMs for fisheries thereby depend on a number of factors; not least the extent to which fishermen can capitalise on any ecological improvements of the targeted stock or healthier ecosystems.

6.2 Overview of the evidence base

6.2.1 Evidence of economic benefits to capture fisheries

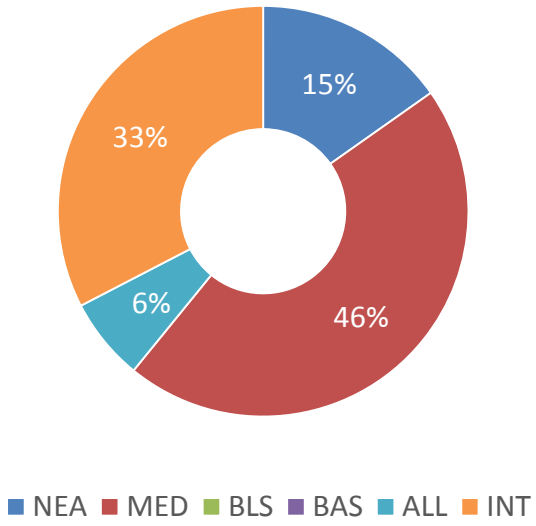
We have identified a total of 44 studies relevant to the scope and objectives of this study as outlined under Chapters 1–3 showing economic benefits from MPAs and/or SPMs to capture fisheries. Overviews of this evidence are presented in Table 10 and Table 11 below.

A number of observations are made regarding the evidence base.

The evidence base is **geographically concentrated** in the Mediterranean (19 studies), followed by the North-east Atlantic region (five studies). Two studies look at sites in both the Mediterranean and the North-east Atlantic. No evidence has been identified from the Baltic Sea or the Black Sea. This confirms a geographical pattern identified in a literature review from 2011 by Vandeperre et al. There were 15 non-European studies identified providing transferable insights from elsewhere around the world. Finally, three studies with global scope, making conclusions regarding spillover of fish from closed areas to surrounding fisheries, and one study with no particular geographical scope but relevant conceptual content have been included.

Figure 5. Geographical break down of the evidence base on economic benefits to the fisheries sector (n = 44).

[23] The WWF defines zoning in the context of protected areas as: *Zoning is a management tool for spatial control of activities with defined activities permitted (sometimes with associated conditions) or prohibited from specified geographic areas* (Gubbay, 2005).



In the Mediterranean, studies of sites in **France, Italy and Spain dominate** the evidence base (18 separate sites studied in France; 14 sites studied in Italy; 26 sites studied in Spain) (see Table 11). In the North-east Atlantic region, four of the eight site studies are from Lyme Bay in the UK, two the Monte de Guia in Portugal and one study is an ex ante assessment of a planned network of sites in the UK.

Assessing the benefits of MPAs and SPMs to fisheries is complex and several **different approaches have been identified**. The following are examples of the most common data collection methods identified. In some studies, a combination of several of these methods are used (e.g. Cadiou et al (2009)):

- Data of catch and effort collected directly on-board commercial vessels (Goñi, Quetglas and Reñones, 2006; Guidetti et al, 2010; Stelzenmüller et al, 2008);
- Industry data collected from official records and logbooks, such as market transactions (Deloitte Access Economics, 2013), volumes of catches and/or landings (Mangi, Rodwell and Hattam, 2011; Vandeperre et al, 2011), catch per unit effort (CPUE) (Kerwath et al, 2013; Mangi et al, 2012), or effort distribution based on vessel monitoring systems (Murawski et al, 2005); and
- Surveys of fishermen and/or other key stakeholders (Álvarez-Fernández et al, 2017; Galal, Ormond and Hassan, 2002; Leleu et al, 2011; Whitmarsh et al, 2002).

Experimental/scientific data collection methods, to the extent they have been conducted by studies deemed sufficiency robust for the scope of this review, include, for example, experimental catch-and-release (Forcada et al, 2009; Stobart et al, 2009), and underwater visual census (Alcala et al, 2005).

As mentioned in Box 2 above, there is ecological evidence of export of eggs and larvae from no-take MPAs in particular. However, we find no evidence of this giving rise to actual economic benefits to fisheries. This could partly be a result of the technical difficulty of assessing such effects (Buxton et al, 2014; Sale et al, 2005; Vandeperre et al, 2011).

When it comes to **type of MPAs studied**, ten studies focussed on effects in or around no-take areas explicitly (eight of which are either non-European or global in scope). 19 studies look at effects related to sites with variable levels of protection imposed, i.e. through zoning schemes (13 of which are from the Mediterranean), five studies look at effects from multi-use areas, and finally eight studies look at effects from multiple sites with different levels of protection.

Although often not explicit in the literature, the **primary pathway** through which benefits to fisheries have been illustrated is via various changes which can be categorised as changes in ecosystem services (36 of 44 studies) (see Annex 2 for definitions of pathways adopted in this study). Two studies show changes in sectoral interaction as well as ecosystem services (Mangi et al, 2012 and Whitmarsh et al 2002), one shows benefits derived from association with an MPA (Álvarez-Fernández et al, 2017) and one study shows both changes in ecosystem services and association (Taylor and Buckenham, 2003). Details about these examples are provided below.

Other observations about the evidence base include, for instance, that most of the studies included (given the protocol selection criteria) were conducted ex post (41 of 44), and thus provide evidence of actual observed benefits. Three studies are ex ante evaluations. Eleven of the identified studies are baseline studies, i.e. they look at benefits to fisheries at a given point in time, whereas 32 studies try to assess changes either over time or compared to other sites. One study applies a combined approach. Finally, 28 of the 44 studies are able to provide quantitative evidence, while the remaining 16 are not or focus explicitly on qualitative evidence.

Out of the total 44 studies selected for review, 11 studies have been identified as **robust examples of European evidence on economic benefits**. These are listed and presented in more detail in Table 12. We base this selection primarily on the project criteria and scope set out in Chapters 2 and 3, as well as additional aspects specific to the fisheries sector. In falling order of robustness, the following types of studies have been considered as this key evidence:

- Studies using site-specific economic data to show sector benefits through the adoption of an appropriate counterfactual, by comparing before (designation)-and-after data for a site and/or with data for a comparison site.
- Robust qualitative primary research, for example by interviewing fishermen or other key stakeholders about economic impacts; again, preferably comparing before-and-after data and/or with comparable sites elsewhere.
- Scientific/experimental research (for example catch-and-release) proving benefits in terms on catch per unit effort (CPUE), catch per unit area (CPUA) or other key economic indicators to fisheries.

We consider the remaining 33 studies to be of medium or weak quality. Some of them have been accepted to be reviewed in absence of other existing evidence on certain topics.

Overview of the rejected literature on fisheries and spatial protection

Our literature search resulted in a range of studies in addition to the 44 listed above, with some relevance to the review, however falling outside its immediate scope. Such studies included, for example, studies showing ecological improvements in targeted stocks but without evidence of sector economic impacts and studies suggesting economic benefits to fisheries as a logical result of ecological benefits but without proving this relationship. These studies, together with other categories of literature which we have considered beyond the scope of this review, have been logged in a list of "rejected studies" (see Table 5 in Chapter 3 for a rough breakdown of how many studies have been rejected under various categories).

Notably, there is a body of literature modelling and/or simulating ecological impacts of spatial conservation on fish stocks and attempting to estimate resulting benefits to the local fishing sector. This approach has not been considered robust enough under the scope of our study (see Chapter 2 for details about evidence selection). However, while modelling studies have their limitations, they can be appropriate means to distinguish the extent to which fisheries effects are attributable to an MPA/SPM. Such approaches are particularly relevant given that a number of factors may influence the dynamics and trends of fisheries in surrounding waters, and that there are sometimes significant challenges in demonstrating cause-and-effect in complex environments. In 2005, Grafton, Kompas and Schneider performed a literature review of bio-economic modelling studies looking at the effects of (no-take) marine reserves. The study is useful for an overview of a range of modelling results, and finds that, overall, deterministic bio-economic models can provide important insights, but often understate the economic value of reserves to fisheries by assuming steady-state of factors which in the real environment are highly fluctuating. Another conclusion by Grafton, Kompas and Schneider is that models generally show that reserves can be especially effective at restoring stocks which have previously been overexploited (Grafton, Kompas and Schneider, 2005). As a follow-up to this study, it would be relevant to assess this body of modelling literature to determine the extent to which the most relevant studies are supportive of, or contradictory to, the findings of the preferred evidence sources of this study.

Finally, we recognise that a number of still ongoing EU projects may have relevance to this study. The SafeNet project, and its sister projects Protomedea and Mantis, are funded by DG MARE to assess the potential of MPAs in the North-west Mediterranean to sustain fisheries. The projects will do this by integrating field data and economic information to build spatially explicit bio-economic models and assess the performances of different management options[24]. We will incorporate the results of these studies later in this project, depending on when they are released.

[24] http://www.criobe.pf/recherche/safenet/

Table 10. Evidence of economic benefits of MPAs and SPMs to fisheries – overview of identified evidence falling within the scope of the study (NEA: North-east Atlantic; MED: Mediterranean Sea; BLS: Black Sea; BAS: Baltic Sea; INT: international evidence including ORs, OCTs and transferrable evidence)

Type of evidence		Number of studies					
		NEA	MED	NEA + MED	BLS	BAS	INT
Total no. of studies		5	19	2	0	0	15
Benefit pathway*	Changes in ecosystem services	4	18	2	0	0	15
	Changes in sectoral interaction	1	1	0	0	0	0
	Changes in regulatory processes	0	0	0	0	0	0
	Indirect; association with MPA	1	0	0	0	0	0
General methods*	Survey of stakeholder perceptions	5	6	2	0	0	2
	Data of sector indicators	3	15	0	0	0	11
	Modelling	0	4	0	0	0	2
Type of MPA**	No-take MPA	0	2	0	0	0	8
	Multi-use MPA	0	1	0	0	0	4
	Combination/ zoning	4	13	0	0	0	2
	Multiple sites/ types of protection	1	1	2	0	0	4
	SPM	0	2	0	0	0	2
Point of study	Ex ante	0	2	0	0	0	1
	Ex post	5	17	2	0	0	17
Type of study	Assessment of change	5	14	0	0	0	13
	Baseline study	0	5	1	0	0	5
	Combination	0	0	1	0	0	0
Results	Quantitative	0	14	2	0	0	12
	Qualitative	5	5	0	0	0	6

* Some studies involved several of these categories and are therefore counted several times.

** Some studies look at multiple sites with multiple protection levels why the figures in this column may not add up.

Table 11. Geographical spread of the European evidence

MPA name	Country	Studied	Type of MPA	Implemented
Mediterranean				
Cerbère-Banyuls Marine Reserve	France	7	Multi-use + No-take zone	1974
Carry-le-Rouet	France	5	No-take	Unknown
Port-Cros National Park	France	2	Multi-use + No-take zone	1963
Parc Marin de la Côte Bleue	France	4	Multi-use + No-take zone	1983
Bonifacio Strait Marine Park	France	4	Multi-use + No-take zone	1999
Cap Roux	France	1	No-take	2003
Scandola	France	1	Multi-use + No-take zone	1975
Columbretes Islands Marine Reserve	Spain	7	Multi-use + No-take zone	1990
Medes Islands Marine Reserve	Spain	9	Multi-use + No-take zone	1983
Cabrera	Spain	2	Multi-use + No-take zone	1991
Tabarca Marine Reserve	Spain	5	Multi-use + No-take zone	1986
Cabo de Palos	Spain	8	Multi-use + No-take zone	1995
Benidorm	Spain	1	Unknown	Unknown
La Restinga	Spain	3	Multi-use + No-take zone	Unknown
Cap de Creus Natural Park	Spain	2	Multi-use + No-take zone	1998
La Graciosa	Spain	3	Multi-use + No-take zone	Unknown
Torre Guaceto	Italy	4	Multi-use + No-take zone	1991
Gulf of Castellammare	Italy	1	Multi-use	Unknown
Tavolara Punta Coda Cavallo	Italy	2	Multi-use + No-take zone	1997
Miramare	Italy	1	No-take	1986
Penisola del Sinis	Italy	3	Multi-use + No-take zone	1997
Plemmiro	Italy	1	Multi-use + No-take zone	2004

Portofino	Italy	1	Multi-use + No-take zone	1998
Torre del Cerrano	Italy	1	Multi-use + No-take zone	2009
Tremiti	Italy	1	Multi-use + No-take zone	1989
Tuscany archipelago	Italy	2	Multi-use + No-take zone	Unknown
Fisheries Management Zone	Malta	3	Multi-use	Unknown
Kuriat Islands	Tunisia	1	Unknown	Unknown
Kas Kekova	Turkey	2	Multi-use + No-take zone	1990
National Marine Park of Zakynthos	Greece	2	Multi-use + No-take zone	1999
Mount Chenoua and Kouali Coves	Algeria	1	Unknown	Unknown
Taza National Park (planned)	Algeria	1	Multi-use + No-take zone	Unknown
North-east Atlantic/ Atlantic region				
Lyme Bay	UK	3	Multi-use + No-take zone	2008 (closed area)
Monte de Guia	Portugal	2	Multi-use + No-take zone	Unknown
Os Minarzos Marine Reserve of Fishing Interest	Spain	1	Multi-use + No-take zone	2007

6.2.2 Evidence of economic benefits to the aquaculture sector

No evidence has been identified showing economic benefits of MPAs or SPMs to aquaculture in Europe. This may be a result of aquaculture not often being co-located within protected sites, a lack of research focus in this area, or a genuine reflection of the extent to which the activity may benefit from MPAs and SPMs. As our project continues, we aim to explore this further and look for literature also beyond that of direct economic impacts.

Consequently, all subsequent references in this report to "fisheries" and the "fisheries sector" implies capture fisheries only.

6.3 Insights regarding economic benefits of MPAs and SPMs to fisheries

In this section, we present key insights from the 44 studies included in the review (both for Europe and beyond, as outlined in Section 6.2.1 above). Points of interest from other literature are mentioned here where relevant.

Table 12 at the end of this section lists those studies regarded as the most robust illustrations of economic benefits to fisheries in Europe from MPAs and/ or SPMs.

6.3.1 Types of economic benefits to fishermen

Existing research show a number of ways in which fisheries have benefitted from MPAs and SPMs. The following are examples of such benefits. The individual studies listed here are discussed in more detail throughout this chapter.

- **Increased catch per unit area (CPUA)** – Surrounding no-take zones in Cerbère-Banyuls, Carry-le-Rouet, Medes Islands, Cabrera, Tabarca, and Cabo de Palos MPAs (Goñi et al, 2008); lobster fisheries surrounding Columbretes no-take zone (Goñi, Quetglas and Reñones, 2006).
- **Increased catch per unit effort (CPUE)**[25] – Artisanal fishermen in Torre Guaceto, Italy, using certain-sized trammel nets targeting different species (Guidetti and Claudet, 2010) and (Guidetti et al, 2010); variety of gears and target species surrounding no-take zones in Carry-le-Rouet, Cerbère-Banyuls, Medes Islands, Cabo de Palos, Columbretes Islands, La Graciosa and La Restinga (Vandeperre et al, 2011); lobster fisheries surrounding Columbretes no-take zone (Goñi, Quetglas and Reñones, 2006).
- **Increased yield (weight)** – Lobster fishery surrounding Columbretes no-take zone (Goñi et al 2010).
- **Increased revenue** – Felt by static gear crabs and whelk fishermen in Lyme Bay, UK (Mangi et al, 2012); achieved by small-scale artisanal fishermen fishing inside 17 Mediterranean MPAs (Di Franco et al, 2016).
- **Reduced competition for unrestricted fleets** – Artisanal fishermen (using trammel nets and set gillnets) experienced less competition for targeted species inside the Gulf of Castellammare fishery exclusive zone (Whitmarsh et al, 2002); static gear fishermen experienced less competition in terms of space to operate inside restricted zone in Lyme Bay, UK (Mangi et al, 2012).
- **Less risk to fishing gear** – Static gear fishermen inside restricted zone in Lyme Bay, UK (Rees et al, 2013).
- **Brand or quality certification for products linked to the MPA** – Perceived income-generating benefits by 23% of MPA managers from 35 MPAs in the North-east Atlantic (Álvarez-Fernández et al, 2017).

6.3.2 Pathways for economic benefits to fisheries

Changes in ecosystem services

As shown above, the ecological evidence generally demonstrates that MPAs and SPMs (in particular no-take zones) can contribute to healthier and more resilient stocks of commercially targeted species. It is commonly asserted that this in turn generates economic benefits e.g. higher and/or better quality catches via spillover from no-take zones.

The evidence identified for analysis confirms that this assertion (i.e. changes in the flow of ecosystem services due to changes in environmental condition) is the benefit pathway most frequently studied in Europe (see Table 10 above; only three studies that present evidence of other pathways for creating and delivering benefits were identified).

Spillover from no-take zones: The most studied "sub-pathway" in the literature from changes in ecosystem services within the sites is spillover of juvenile and adult fish from no-take zones, especially MPA no-take zones (however, see international examples below on SPMs contributing to spillover)[26]. Notably, only six studies are able to show empirical

[25] Note that Vandeperre et al (2011) argues that the CPUE index may underestimate fish density at locations around MPA borders with high effort concentration, suggesting that catch per unit area (CPUA) is a more suitable index.

[26] Indeed, spillover is the main ecosystem service-based pathway for no-take zones due to the management restrictions that they impose on fishing activities.

economic benefits to fishermen, and hence the evidence base should be seen as primarily anecdotal at this stage.

For instance, by comparing primary data of effort distribution and catches, a number of studies are able to illustrate economic benefits to lobster fisheries around the Columbretes Islands marine reserve in Spain. Goñi, Quetglas and Reñones (2006) compare catch and effort data of surrounding fisheries with experimental CPUE data from inside the site, showing that lobster export is sufficient to maintain stable catch rates up to 1,500 m away from the reserve boundaries. Three years later, Stobart et al. confirmed spillover at the site, but this time looking at the entire exploited assemblage of species which are caught and marketed by trammel net fishing in the area (the most commonly used gear type in the area). They study catch trends (by species and length of individual specimen) of commercial fishing in gradients from the MPA border (up to 0.5 km from the boundary) over an 8-year period post protection, and find clear evidence of spillover of fish from the site (Stobart et al, 2009). Finally, also from the Columbretes in Spain, Goñi et al (2010) claimed to be the first to illustrate net benefits to surrounding fisheries from spillover from the no-take zone (i.e. benefits from the site are higher than the costs incurred by site designation). The net benefit was >10% (in weight) of spiny lobster. The findings were based on tag-recapture data using the same fishing gear as the local fleet (wide mesh trammel nets of standard length).

In another primary study from the western Mediterranean, looking at six no-take areas, Goñi et al (2008) are able to show that the spatial distribution of fishing effort, fishery production (CPUA) and revenue for gill net fishery, trammel nets and bottom long-lines targeting sparids, mullids, serranids, scorpaenids and palinurids are generally higher closer to the borders of the no-take zones and gradually decline with distance from the sites. Also Forcada et al 2009 show evidence of spillover of a number of species from Mediterranean sites (some of which are targeted by local artisanal fisheries, i.e. *Dentex dentex*, *Mullus surmuletus*, *Phycis phycis*, *Sciaena umbra* and *Scorpaena porcus*), although this again by using an experimental approach, conducting trammel net fishing close to no-take zones compared to areas open to fishing. In this study, the authors show that spillover is dependent on the spatial distribution of habitat type (see further discussion about this study in Section 6.3.3).

In one of the more recent studies, Di Franco et al (2016) studied incomes of small-scale artisanal fishermen allowed to operate within the buffer zones surrounding no-take zones within 25 Mediterranean MPAs. Based on questionnaires to MPA managers and scientists, a review of scientific and grey literature and project reports, the authors conclude that 68% of the MPAs (17 MPAs) generate increased incomes to these small-scale artisanal fishermen (with temporally and spatially changing gear used and species targeted).

Vandeperre et al (2011) show that catch rates of fisheries adjacent to seven MPAs in Southern Europe increased by 2-4% per year for 30 years (length of study) and are particularly detectable for total marketable catch (i.e. including by-catch of non-targeted commercial species).

We would like to emphasise that relying solely on fishing effort distribution around closed areas as the only approach to illustrate sector impacts (i.e. an increase in effort must equate to some benefit in catch rates provided by the MPA or SPM) is a poor proxy for indicating actual benefits. For example, Stelzenmüller et al study spatial dynamics of artisanal fishing fleets around MPAs in the Mediterranean and find evidence of local concentration of fishing effort around MPA borders. However, such patterns cannot be unconditionally translated as fisheries benefits. Fishermen may also fish close to the MPA not in expectation of catching more fish, but because they have been displaced from their previous fishing grounds and it is the nearest remaining area of the fishing ground to their home port; or, because they expect to benefit from spill over effects, but in fact do not.

Three international studies provide insights comparable to the European context regarding economic benefits to fisheries from spillover from closed sites. Murawski et al (2005) show that average revenue per hour trawled for groundfish was about twice as high within 4 km of the boundary of five year-round and seasonal fishery closures (SPMs)[27] off the North-east USA, compared to more distant catches. The study analysed fishing effort, catch, and revenue data. Galal, Ormond and Hassan (2002) study six no-take reserves at Nabq, South Sinai in Egypt, showing a two-thirds increase in mean recorded CPUE in the fishery adjecent to the closed areas after five years of protection compared to data from before the restrictions were imposed. Data was collected by intercepting landings (sampled on a multiple stratified-random design) and recording weight of total catch and where possible weight of individual species. Fishing method and effort was recorded based on interviews with fishermen. Finally, Kelly, Scott and MacDiarmid (2002) studied spillover of spiny lobster from a closed area in New Zealand compared to two other sites away from the no-take area. The study found that overall returns to commercial fishermen per trap haul around the no-take area were comparable with the other localities, and that catch around the no-take area consisted of fewer and larger lobsters than the site furthest away from the site. These results indicated that concerns among the lobster fishing industry that the no-take MPA would lead to a reduction in catch rates due to reduced access, may have been unfounded.

Five other international studies are transferable to OCT and/or OR conditions. Pascal and Seidl's (2013) study of 10 community-based MPAs in Vanuatu and Fiji, presented in Chapter 5 of this report, shows that the sites support 140 full-time fishermen jobs (baseline study). Oliver et al (2015) – also mentioned in Chapter 5 – show positive un-discounted net earnings for 27 of 36 periodical closures of octopus fishing in Madagascar, with a mean net of US$ 305 per closure and monthly internal rate of return of 58%. Village-level total fishery income saw a mean increase of 136% for the 30 days following an opening compared to the 30 days leading up to the closure. The sites are located within the Velondriake Locally Managed Marine Area. In an example from the Goukamma MPA in South Africa (an MPA which prohibits all boat-based fishing), Kerwath et al (2013) show that CPUE of the commercially important roman (*Chrysoblephus laticeps*) increased in the vicinity of the MPA shortly after its establishment thanks to spillover and larval dispersal. After 10 years, this led to a doubling of the pre-MPA CPUE. Thanks to good availability of catch and effort data, the authors were given a "rare opportunity" to study the before and after effects of the MPA.

Studies from the fishing grounds surrounding a no-take MPA in the Philippines (in place since the early 1980s) show higher catch rates, lower fishing effort and increased or at least maintained total catches of the locally important Acanthuridae (surgeonfish) and Carangidae (jacks) when assessed 20 years after protection. The effects are attributable to spillover. The authors compared catches at different distances away from the reserve boundaries (based on estimates of interviewed fishermen of where they had fished in relation to boys at 100, 200 and 300m from the reserve border) (Abesamis, Alcala and Russ, 2006; Russ et al, 2004).

Finally, McClanahan (2010) studied SPMs in Kenya over a 12-year period, comparing costs and benefits to local fishermen of ending the use of small-meshed beach seine nets, also in combination with a complete fishery closure. The study looked at changes in fish catches, prices, revenues and costs, comparing with another area where fishing remained unregulated. Overall, per capita daily wet weight yield increased by 20% after the restriction. "The per person daily fishing income adjacent to the closed areas was 14 and 22% higher than the fishing income at areas with only gear restrictions before and after the seine-net restriction, respectively". The authors showed that profits increased

[27] Since closure in the mid-1990s, the only gears allowed in these areas have been lobster traps, midwater trawls (for Atlantic herring, *Clupea harengus*), and some limited dredge fishing for sea scallops.

because larger fish were being caught as a result of spillover close to fishery closures. The larger fish fetched a higher per weight price in the market.

Economic benefits of MPAs or SPMs to fisheries generated via changes in ecosystem services that are not examples of spillover: There is little evidence analysing these types of benefits. The primary example is presented by Roncin et al (2008) in the form of perceived benefits among fishermen. The study looks at 12 different MPAs in Southern Europe[28] and surveys different users about any income and jobs generated by the MPAs. The study estimates, based on the survey responses, that annual income to commercial fishermen from use of the MPA ecosystem services is €720,000 per MPA, and that the services generate an equivalent 54 jobs per MPA. The authors also ask users about the perceived relative contributions of the sites, for example whether professional fishermen think the MPA helps to enhance fish abundance outside the protected areas. From two of the case studies (Monte da Guia and La Restinga), a majority of fishermen display positive opinions about such a relationship. In four other cases (Cabo de Palos, Columbretes, La Graciosa and Sinis), a majority of fishermen are negative about this relationship. Consequently, we consider this piece of evidence as useful primarily to indicate the current value of MPA-related ecosystem services for fisheries, although it does not provide a clear answer to the relative effect of the MPAs in these cases.

At a workshop organised by MedPAN in 2015, MPA stakeholders discussed the socio-economic benefits of protected areas and marine spaces in the Mediterranean. Round table discussions included anecdotal evidence from individual sites, including an example of economic benefits to local fisheries in the Gulf of Gökova in Turkey. According to MedPAN records of the discussions, fishing revenues were said to have increased by 53% by 2013 thanks to MPA protection (Rodríguez-Rodríguez, Kersting and Webster, 2017). To our knowledge, no systematic research has been published showing these effects, but the example is mentioned here as it illustrates that the lack of published material may not be a reflection of there being no benefits.

The study by Deloitte Access Economics (2013) could be relevant to an European context, showing that commercial fisheries and aquaculture in the Great Barrier Reef region in Australia contributed AUD$160 million added value to the Australian economy and 975 FTE jobs in 2012. In an earlier study, Access Economics Pty Limited (2007) estimated that commercial fishing at the Great Barrier Reef contributed AUD$273 million (total value added) to the Australian economy in 2004-05.

In one study identified with relevance to European OCT/OR conditions, Januchowski-Hartley, Cinner and Graham (2014) study periodical fishing closures (SPMs) in Vanuatu and their impact on CPUE (kg/person/h) for spearfishers. The study compared the impacts of two periodically harvested closures with two no-take marine reserves, and two open fished areas, prior to and after harvest of the periodically harvested closures. They collected data by sampling catches and interviewing fishermen. Their results showed that CPUE differed significantly between regular fishing trips to open grounds and fishing trips for the periodic harvest for all types of fishes, with periodic harvest trips having a CPUE almost double that of regular fishing activities. Also, the average size (kg) of individual fishes in catches from the periodically harvested closures was 45% greater than fishes from open areas.

In a qualitative study of fisheries effects of a multi-use MPA in Tanzania (with potential application to OCT/OR contexts) Barley Kincaid, Rose and Mahudi (2014) found that 60% of fishermen had experienced an increase in target fish size since the site was established.

[28] 5% of the total surfaces of these MPAs are no-take zones; sites are located in the Mediterranean and the North-east Atlantic.

Association with a protected site

Only one European study shows relatively clear evidence of economic benefits to the fisheries sector generated via association with MPAs. The study is based on the perception of 35 MPA managers in the North-east Atlantic. The authors, Álvarez-Fernández et al (2017), find that 77% of managers feel that socio-economic benefits have accrued as a result of implementing the MPAs. 23% mention that new income-generating activities related to fishing activities have occurred, e.g. by implementing a brand or quality certification for products linked to the MPA. The authors say that managers consider these new activities as economically sustainable, operational and long-term, although no details are given about what indicators would confirm these trends. These findings suggest that there is ongoing economic development in line with site conservation measures in Europe.

Box 3 below illustrates an example of this that has been identified in a case study by the Mediterranean Protected Areas Network (MedPAN). Notably, the success of this scheme has not been assessed to our knowledge, hence it should only be treated as an illustration.

Box 3. **Iroise Marine National Park, France – label for "Molène abalones"**

Part of the objective of the park is sustainable development of sea related activities. In 2008, the park authorities – together with the Brest Fish auction and local fisheries committee – launched a quality label for abalones fished around the Molène Island located in the MPA. The fishery is managed by capped quotas and the abalones are harvested by diving. Initially, the costs for the label were agreed to be covered by the park budget (about €3,000/yr) allowing the fishermen to keep all benefits. No assessment has been found of the success of this initiative (either ecologically or economically) but according to a project manager at the French Marine Protected Areas Agency, responsible for managing the Iroise MPA, the ambitions of ensuring a sustainable abalone fishery has received a positive reception among the locals.

Source: Eynaudi, A. 2010. Accessed via the MedPAN case study website

Changes in sectoral interaction

Three European examples of induced changes in sectoral interaction leading to economic benefits to fishermen have been identified in the literature.

The main example is the research conducted on the socio-economic effects of restricting fishing within a 60nm^2 zone in the Lyme Bay MPA in the UK. The area was protected from mobile gear in 2008. In 2011, Mangi, Rodwell and Hattam presented initial findings of qualitative surveys with stakeholders suggesting that static gear fishermen inside the site boundaries had been able to increase their fishing effort as a result of reduced competition for space. However, static gear fishermen operating outside the site expressed that they had experienced increased competition and conflict with the towed gear fishermen who had been displaced from the MPA (we discuss this type of conflicts further in Chapter 10 of this report). Meanwhile, towed gear fishermen were impacted by the displacement of having to target new fishing grounds. Interestingly, however, the study showed that a year after the closure was established (i.e. in the short-term perspective), fishing in the Lyme Bay area remained profitable with minimal impacts on average incomes or financial profits of fishermen and fish merchants (Mangi, Rodwell and

Hattam, 2011). In 2012, Mangi et al published another paper based on stakeholder surveys from Lyme Bay supported by secondary commercial fisheries data such as wet weight value of landings, showing that the static gear fishermen inside the restricted zone had experienced increased incomes as a result of the new dynamics. Towed gear fishermen who were displaced to surrounding areas had, on the contrary, experienced increased costs by having to fish elsewhere since the site was established.

In a similar example of benefits accrued through sector interaction, Whitmarsh et al (2002) reported on the effects to artisanal fishermen of a trawl ban introduced in the Gulf of Castellammare, Sicily, in 1990, to reduce fishing pressure on severely depleted local demersal resources, provide safer fishing conditions for small-scale artisanal operators (using primarily trammel nets and set gillnets) and generate stock recovery to benefit those small-scale operators. By collecting data on the structure and composition of the artisanal fleet permitted to fish in the trawl ban area (weight of catches and net length and duration of fishing trips), the authors calculated indirectly artisanal fishermen's gross revenue by imputing market prices for catch weight. This was compared to artisanal fishermen operating outside the area. The results showed that the ban on trawling benefitted the artisanal fishermen permitted to operate in the area in terms of improved financial returns. The authors supported their study by also conducting biological research demonstrating large increases in demersal biomass inside the area since the ban was introduced. Finally, the authors showed that artisanal fishermen outside the area had been adversely affected following the increased activity by displaced trawlers in their fishing grounds. Their revenues were still positive on average, but by comparing catch data for vessels belonging to different ports in the wider area, the authors show that catch rates (weight of fish caught per 1,000 m of net per trip) were between one-half and two-thirds of those artisanal fishermen operating inside the trawl ban area. The study further illustrates how fishermen outside the area adopted various adaptation behaviour to avoid the "crowding" resulting from increased presence of displaced trawlers, for example by travelling longer distances. This resulted in higher expenditure on fuel as proportion of total costs among outside fleets than those fishing inside the trawl ban. Further details on these interactions are discussed in Chapter 10.

In a follow-up study published one year later, Whitmarsh et al (2003) perform an ex ante estimation of potential financial effects to artisanal fishermen of lifting the trawl ban. They then concluded that lifting the ban would undermine the sustainability that had been achieved, by reduced stocks and subsequent compromised financial viability of artisanal vessel operators within the site.

Barley Kincaid, Rose and Mahudi (2014) report similar findings in their study of a multi-use MPA in Tanzania mentioned above. Static gear fishermen (using hook and line, dema traps, fence traps and fishing by hand) were generally more supportive of the MPA and its regulation than net fishermen. The latter expressed in interviews that the sustainable gear that they are required to use since the establishment of the site are less efficient than what they used to use and that fishing is taking longer time. In the community expressing the highest support for the notion that the site has led to increased catches, over 70% of fishermen used static gear.

6.3.3 Factors influencing the scale and nature of economic benefits

The FAO (2011) provides a useful overview of MPA factors influencing their effects on fishery resources from a biological perspective (see Box 2). Based on other literature found in this review, we are able to make further observations about what factors of MPAs and SPMs influence the generation of real economy benefits to fisheries in contexts relevant to Europe. This includes the potential role of no-take zones, the effect of local habitat distribution, the effect of what species are targeted and of the time protection has been in place.

However, the limited evidence base does not allow us to draw any definitive conclusions regarding which MPA or SPM factors (or combination of factors) help optimise the

generation of economic benefits to fisheries, to what degree individual factors influence benefits or the scale to which such benefits occur.

The effect of MPA type – the role of no-take zones

As Box 2 indicates, no-take is clearly a factor influencing the scale and nature of benefits to commercially targeted stocks, but it is less clear how this factor should be designed to optimise economic benefits to fisheries. The impact of **the size of no-take areas** and the distance between them on their fisheries effects has been frequently studied. Grafton, Kompas and Schneider (2005) support, for instance, the idea that the more mobile a target species is, the larger a no-take zone has to be in order to maintain the same level of protection from fishing.

Further, in a meta-study by Halpern, Lester and McLeod, the authors suggest that, for no-take MPAs to play a role in sustaining and replenishing larger-scale stocks of fished species, **networks of such areas** may be necessary. Arguing that adult spillover is a relatively small-scale phenomenon, the authors suggest that "networks of small- to medium-sized reserves that are large enough to protect mobile species within their boundaries, as have been recently established in California and the Great Barrier Reef, are probably preferable to larger fewer reserves" (Halpern, Lester and Mcleod, 2010). In a study of a network of no-take areas in Egypt, Galal, Ormond and Hassan (2002) argue that no-take reserves of 1-3 km in length tend to be enough to enhance stocks of a wide range of coral reef species which support the argument of introducing a network rather than one large area for low mobility species such as reef species. The authors argue further that, in a multi-species fishery, a network will better accommodate for the fact that different species prefer different habitats and locations to spawn. When surveying MPA stakeholders in Southern Europe about what they think about zoning, Mangi and Austen (2008) in fact show a strong preference among respondents for having MPAs with different use zones, including areas set aside for recreational fishing, diving as well as full protection of species and ecosystems.

Claiming to be the first to conduct multiple comparative analysis of the influence of MPA features on their export functions, Vandeperre et al (2011) evaluate how **MPA size and age** impact the effects on adjacent fisheries. Their study is based on 28 sets of catch and fishing effort data from seven MPAs in Southern Europe, covering different gear types and target species. Some observations of interest include that catch rates (CPUE) of gears targeting a particular species/group were higher for larger no-take areas, while the opposite was observed for standardized gears (combining CPUEs from all the gears that intentionally or unintentionally catch those species/groups).

Finally, an interesting finding by Goñi et al (2008) is that a range of different types of fishing (gill nets, trammel nets and bottom long-lines targeting sparids, mullids, serranids, scorpaenids and palinurids) can gain economic benefits generated via spillover from no-take zones. Goñi et al argue that their findings may be transferrable to the rest of the western Mediterranean, as the fishing tactics included in their study are typical for the region.

The effect of localised habitat distribution

There is very little evidence regarding the impact of local habitat distribution to the generation of benefits to fishing from MPAs and SPMs. In the only study we have identified fulfilling the evidence selection criteria of this study, Forcada et al conclude that spillover effects from three MPAs in the Mediterranean (Tabarca Marine Reserve, Carry-le-Rouet Marine Reserve and Cerbère-Banyuls Marine Reserve) are related to the distribution of habitats inside and around MPAs. They show, through experimental trammel net fishing of a number of species, that spillover from these no-take areas benefits fisheries catches on seagrass meadow habitats, but not on sandy bottoms. The authors conclude that spillover effects were limited in these cases by a lack of continuous suitable habitat across the boundaries of the MPA. They argue that this should be

acknowledged in general when planning MPAs in temperate waters, and that spillover should not be taken as a universal consequence of MPAs (Forcada et al, 2009).

The effect of target species

As illustrated in Box 2 earlier in this chapter, links have previously been established between species mobility and the extent to which protection can be provided by MPAs or SPMs, showing that low-mobility target species are more likely to benefit from spatial protection measures. We note that a majority of the research of spillover effects to commercial fisheries identified under the study selection criteria has been conducted on low-mobility species, in particular lobster populations. The number and range of studies are not sufficient to determine the relative importance of target species mobility to potential economic effects to fisheries from spillover. This pattern in the literature could also partly be a result of current research focus in Europe.

More mobile target species that move in and out of protected areas are also impacted to a greater extent by the fishing pressure in surrounding fished waters. This is likely to influence the extent to which an MPA or SPM will generate economic benefits to fisheries targeting mobile species and might be part of the explanation why much of the current evidence of spillover is on low-mobility populations.

In the study of periodical fishing closures in Vanuatu mentioned above, with relevance to European OCTs/ORs, Januchowski-Hartley, Cinner and Graham (2014) set out to understand the sustainable limits of periodically harvested closures by studying flight initiation distance (FID) of two primary target species (Acanthuridae and Scaridae). The authors perform in-water monitoring of FID combined with creel surveys in two periodically harvested closures, two no-take marine reserves, and two open fished areas, prior to and after harvest of the periodically harvested closures. The results show that when some fishes are protected temporarily from fishing, their wariness decreases, which makes them more easily catchable when fishing is reinstated and thereby improves fishing effectiveness of those species. For instance, the authors showed that CPUE of Acanthuridae during harvest of closed areas was almost double that of normal fishing activities. The authors argue that this may lead to contrasting outcomes for different target species of periodically harvested management regimes. They also stress that the effects of protection on target species behaviour was rapidly lost, illustrating that periods of harvest need to remain short and compliance with the period capture schedule kept high (Januchowski-Hartley, Cinner and Graham, 2014).

The effect of time of protection

Finally, economic benefits to fisheries seem to also depend on for how long a site has been protected. Halpern, Lester and Mcleod (2010) show that spillover from a protected area may take time to accrue and compensate for any short-term costs incurred on fishermen, and Vandeperre et al (2011) show that this reflects for example the time it takes for individual species to recover and to reach reproductive age.

Table 12. European evidence of economic benefits of MPAs and SPMs to fisheries – most robust evidence

Area studied	**MPA type studied**	Methods used	Benefit pathway	Benefits identified	References
Quantitative evidence					
Columbretes Islands Marine Reserve, Spain	No take zone	Tag-recapture data of spiny lobster (*Palinurus elephas)* gathered over a ten-year period (not before-after) within 1,500 m around the no-take zone. Using same fishing method as commercial fisheries (wide mesh trammel nets of standard length).	Ecosystem service pathway; spillover sub-pathway. Annual lobster spill-over of 7% of the protected population.	Net gain >10% of local lobster fishery catch (in weight). Benefits outweighed the costs of reserve creation.	*(Goñi et al, 2010)*
Columbretes Islands Marine Reserve, Spain	No take zone	Commercial catch and effort data collected on board fishing boats in the adjacent spiny lobster fishery, combined with CPUE data from monitoring surveys conducted annually inside the zone. Relationships examined of CPUE and CPUA as a function of distance to zone boundaries.	Ecosystem service pathway; spillover sub-pathway. Gradient of lobster density from centre of zone up to 4 km from its boundary.	Lobster export sufficient to maintain stable catch rates up to 1,500 m from the boundary. Fishing effort concentration at zone boundary. CPUE showed significant non-linear decline with distance from centre of the zone, with a depression at boundary followed by plateau. CPUA declined linearly with distance from the no-take zone.	*(Goñi, Quetglas and Reñones, 2006)*
Columbretes Islands Marine Reserve, Spain	No take zone	Assessed multiple species inside and around zone 8 to 16 years after fishing ceased. Sampling by annual experimental trammel net fishing inside zone, and on-board commercial vessels in adjacent fishing grounds. In all cases, data on net length, soak time, fishing location and depth along with catch by species and individual	Ecosystem service pathway; spillover sub-pathway. Relative to nearby fished areas the site fish community had (1) higher abundance and biomass, (2) lower species diversity and higher taxonomic distinctness, (3) larger	Clear evidence of spillover of fish from the site (<0.5 km from the boundary) to the adjacent fishery based on continuously increased commercial fish yields at the zone border during the study period, despite being locally depleted due to fishing effort concentration.	*(Stobart et al, 2009)*

Area studied	**MPA type studied**	Methods used	Benefit pathway	Benefits identified	References
		size of all fish were recorded.	relative body size and (4) no difference in mean trophic level.		
Carry-le-Rouet, Cerbère-Banyuls, Medes Islands, Cabo de Palos, Columbretes Islands, La Graciosa and La Restinga	No take zone + multi-use area	28 sets of catch and landings data from seven MPAs (with various sized no-take zone) in Southern Europe; time range 0-30 years of protection, compared to comparable areas far from the MPAs using meta-analysis. Fisheries used variety of gears (seine nets, gillnets, trammel nets, longlines, traps and hand lines), and target many different species depending on season.	Ecosystem service pathway; spillover sub-pathway.	Gradual increase of CPUE of 2–4% per year for the study period (30 years).	*(Vandeperre et al, 2011)*
Cerbère-Banyuls; Carry-le-Rouet, France **Medes; Cabrera; Tabarca; Cabo de Palos, Spain**	No take zone + multi-use area	Spatial distribution of effort, fishery production (CPUA of combined catch) and revenues per unit area analysed from data of 14 different 'fishing tactics' around no-take zones (gill nets, trammel nets and bottom long-lines targeting sparids, mullids, serranids, scorpaenids and palinurids).	Ecosystem service pathway; spillover sub-pathway.	Evidence of effort concentration and high fishery production (CPUA) near fisheries closures for all fishing tactics; significant negative slopes with distance from no-take zones; and revenues generally followed trends similar to CPUA.	*(Goñi et al, 2008)*
Tabarca; Cerbère-Banyuls and Carry-le-Rouet marine	No take + multi-use area	Experimental fishing using the same gear as local fishers (trammel nets); collected data on species, individual length and wet weight along the MPA borders compared to grounds away from	Ecosystem service pathway; spillover sub-pathway.	Significantly higher catches (biomass of total catch) for some target species near MPA borders when fishing on seagrass meadows, but not on sandy bottoms, concluding that	*(Forcada et al, 2009)*

Area studied	**MPA type studied**	Methods used	Benefit pathway	Benefits identified	References
reserves, Spain and France		site; across two habitat types (seagrass meadows and sandy bottoms)		spillover is related to distribution of habitat across MPA borders. Spillover was sufficient to provide local benefits to artisanal fisheries (through juvenile and adult spillover).	
Torre Guaceto, Italy	Multi-use	Catch data (4 years) in previous fishing closures reopened under co-management scheme (effort limited to once per week; only certain trammel nets allowed). Mullus surmuletus, Scorpaena scrofa, Symphodus tinca, and Octopus vulgaris represented >55% and 40% of mean CPUE inside area and outside MPA, respectively. Analysed temporal trends in CPUE inside reopened areas, in areas reopened but under no management scheme and areas not part of MPA.	Changes in ecosystem services leading to higher catches than in other areas.	CPUE fell after opening the MPA buffer zone to fishing, then stabilised after three years at levels more than twice that of catches outside the MPA. In other reopened MPAs without co-management, CPUE continued to decline similar to areas outside MPAs.	*(Guidetti et al, 2010; Guidetti and Claudet, 2010)*
Gulf of Castellammare, Italy	Fishery exclusion zone	Collection of primary economic data on the artisanal fisheries of the Gulf (landings, gear type, fishing patterns, fishermen's onions). Landings based on weight of each species fished; also source of costs and revenues (weight x market value). Supported by biological study (experimental trawl surveys) to	Changes in ecosystem services and sector interaction. Sub-pathways: change in productivity of vessels based on location, partly illustrated by large increase in target biomass since ban was imposed.	Artisanal vessels operating inside the trawl ban area (using trammel nets and set gillnets) achieve higher catch rates than those outside. Artisanal vessels outside the ban area have become worse off due to increased activity of displaced trawlers.	*(Whitmarsh et al, 2002)*

Area studied	MPA type studied	Methods used	Benefit pathway	Benefits identified	References
		link state of stocks and fishery performance.			
Qualitative evidence					
Lyme Bay, UK	Multi-use	Looking at socio-economic changes resulting from banning mobile gear in 60nm^2 of Lyme Bay. Commercial fisheries data (wet weight and value of landings of crabs and whelk) combined with questionnaires, interviews, stakeholder workshops and data of enforcement costs.	Changes in ecosystem services and in sector interaction. Sub-pathways: static gear fishermen within the 60nm^2 can deploy more gear, enjoy better gear safety and less competition.	Income of static gear fishermen has increased and remained consistently high.	*(Mangi et al, 2012)*
Lyme Bay, UK	Multi-use	Surveys of main stakeholder groups' perceptions and levels of support to the closed area; repeated annually for two years following closure.	The potential of the MPA to provide more fish; improved gear safety.	Overall, stakeholders perceive the social, economic and environmental benefits of the MPA to outweigh the perceived costs.	*(Rees et al, 2013)*
66 MPAs in the North East Atlantic (England, France, Spain and Portugal)		Three questionnaires sent to MPA managers of the 66 MPAs in the North-east Atlantic which are managed (i.e. have staff and resources to operate the management plan). Managers from 57 MPAs responded; 35 responses were included in the socio-economic assessment.	Association with the MPA	77% of managers perceived socio-economic benefits as result of MPA implementation; 23% mentioned new income-generating activities related to fishing activities, e.g. implementing a brand or quality certification for products linked to the MPA. Considered by managers as economically sustainable, operational and long-term, although no details regarding how.	*(Álvarez-Fernández et al, 2017)*

6.4 Evidence on sustainable use – striking a balance

Fishing has been identified as the main pressure to marine ecosystems and biodiversity in Europe (see Section 1.1.2). As the chief purpose of MPAs and SPMs is to protect the marine environment and/or certain species, it is important to ensure that fishing and aquaculture in or around these sites are in balance with the site conservation objectives.

MPA and SPM management may prevent some types of fishing activity in order to reduce fishing pressures to levels at which the site conservation objectives can be achieved. Such different management and governance schemes are discussed in Chapter 10. Sustainable use measures, as discussed here, seek to ensure that potential benefits of the MPA – to fishers permitted to operate within or outside of the MPA or SPM – are realised.

In the context of this review, we have identified very little research from Europe exploring measures that enable different types and levels of fishing or aquaculture to sustainably co-exist with conservation objectives inside protected sites. One example is an experiment conducted in the Torre Guaceto MPA in Italy in the early 2000s, where the researchers involved aimed to illustrate how commercial fishing and conservation objectives can co-exist. Between the years 2000 and 2005, the entire MPA was an effectively enforced no-take zone protected from all extractive activity. The researchers opened a zone for fishing under strict conditions agreed together with local fishermen and allowed four boats (40-50% of the original fleet) to fish with trammel nets inside the MPA once per week for four years. The gears used were agreed in collaboration with the fishermen and with the aim to minimise harm to bottom habitats. Although it declined initially, CPUE stabilised after three years at a level more than twice as high as that achieved in surrounding, unprotected areas (Guidetti and Claudet, 2010). Since this study was conducted, the project has continued and more recent results (based on data from 2012-2013) have shown that the new catch levels have remained at this level over time[29].

While this is an interesting example, due to the limited evidence, we are not able to determine the importance of sustainable use measures in ensuring the realisation of blue economy benefits to fisheries or to suggest any best practices for supporting sustainable use (beyond that of different types of management and governance schemes).

The lack of evidence might be a result of different factors. Firstly, many European MPAs are still relatively newly designated without a management plan yet in place. The sustainable use measures and management scheme set up in Torre Guaceto mentioned above was part of a research experiment rather than a more widely adopted approach to MPA management. Secondly, there seems to have been a focus in this area on "fishing versus no fishing". The nature of MPAs in Europe (with few areas closed from fishing) suggest that there is a significant evidence gap here. For instance, a few studies have been identified which look at the design of no-take marine reserves to achieve both conservation and fisheries management results (see eg Gaines et al (2010) and Hastings and Botsford (2003) from the US). Finally, it is possible simply that not many measures have been implemented in European MPAs to ensure their sustainable use.

Similarly, no evidence has been identified focusing on the extent to which fishermen operating within the boundaries of an MPA or SPM, take the conservation objectives into account in undertaking their activities. Analysis of compliance data for European MPAs would provide one route for exploring this, to the extent such information is available. However, this has not been possible within the scope of this study.

[29] A case study presented by MedPAN, http://www.medpan.org/en/torre-guaceto

Similarly, no indication has been found as to what extent fishermen in surrounding waters take the MPA objectives into account.

Management of areas surrounding a protected site

While the lack of evidence prohibits analysis of sustainable use within sites, we have identified literature suggesting different elements of best practice regarding ensuring sustainable use surrounding protected sites. Two general themes should be acknowledged and addressed. Firstly, the importance of the management of fished areas surrounding the MPA or SPM for the realisation of sustainable blue economy benefits, and secondly considering and addressing any displacement effects caused by the designation of MPAs and SPMs.

An important point raised by White et al. is the need to coordinate the planning and management of an MPA with the management of fisheries in surrounding waters, as any changes in fish populations within the MPA partly depend on how fisheries are managed outside them (White et al, 2013). In a concrete example of this, Hilborn, Micheli and de Leo find that, based on a modelling exercise in a fishery regulated by Total Allowable Catches (TAC), even if the stock is overfished, "MPA implementation may not improve overall stock abundance or increase harvest unless catch is simultaneously reduced in the areas outside the MPA" (Hilborn, Micheli and De Leo, 2006). In fact, in an Australian study modelling the interaction between a no-take reserve and surrounding fisheries management, Yamazaki et al. suggest that, for a wide range of scenarios, the modelled fishery is better off in terms of both conservation and economic objectives when the no-take reserve is established in conjunction with a target biomass correlating to Maximum Economic Yield rather than Maximum Sustainable Yield (Yamazaki et al, 2014).

Acknowledging that European marine waters are to be managed from an ecosystem perspective[30], it is also important to consider impacts on areas around MPAs and SPMs due to displacement of fisheries. In their example from Lyme Bay in the UK mentioned throughout this report, Rees et al quote one of their interviewees discussing business impacts of trawlers displaced from the now protected area: "Swyre Ledges have been ruined in the last two seasons. I have a group [of divers] from Yorkshire who used to come every year but now they say the ledges are like a ploughed field". The authors also show how displacement of some types of fishing methods from the protected area has increased competition for resources in other areas, pushing smaller operators out of business (Rees et al, 2013). In their study of fisheries closures off the North-eastern American coast, Murawski et al study and discuss the effort concentration effect along the boundaries of the protected areas, and whether this has potentially net negative impact on a species to species basis. Taken together, about 10% of trawling effort occurs at distances <1 km from the year-round closures, with about 25% of effort located within 5 km (Murawski et al, 2005). An interesting point in this context is that over-time heterogeneity of fishing patterns has been suggested to create de facto refugia for elasmobranchs in the Celtic Sea. Displacing fishing effort into areas which have been fished in a heterogeneous pattern for a long time might impair such refuge effects (Shephard et al, 2012).

[30] For examples as stipulated in the EU Marine Strategy Framework Directive.

7 Evidence of benefits to maritime tourism

Chapter summary

The review found 33 studies on the economic benefits of MPAs to the tourism sector, mainly focussing on specific MPAs or specific countries. Most of these studies assess the benefits to the tourism sector using interviews or surveys and/or empirical data. In a few cases, simulation models based on empirical data are used. Most of the studies are linked to multi-use MPAs or MPAs with a zoning system, and are ex-post analyses. No existing studies and/or evidence on the economic benefits of SPMs to the tourism sector were found in the review.

A number of studies found that MPAs can be beneficial for the maritime tourism sector by increasing the number of visitors and providing additional livelihood opportunities. However, it was not possible to distinguish whether increased tourism results from changes in MPA-induced environmental improvements or whether it is due to the so-called designation effect, i.e. the increased reputation due to designation.

Recreational activities might need to be regulated in order to ensure that they do not result in environmental degradation, which ultimately damages not only the environment, but also the recreational sector itself. This can be done by adopting a mix of different strategies, which are essential if economic benefits to the tourism sector are to be maintained in the long term. These include effective regulation and enforcement, communication and education activities and promotion of eco-tourism.

The evidence also indicates that management, enforcement and educational activities require financing, but the available funds for MPAs are not always sufficient. For this reason, finding alternative and complementary ways to finance MPAs can play a key role not only in ensuring the achievement of their environmental objectives, but also in enhancing the recreational experiences of visitor, thereby benefitting the tourism sector. In particular, visitor fees and taxes may help provide complementary funding to MPAs. Green marketing of tourism products can also help raise additional funding to support MPAs.

In this chapter, we explore the evidence of economic benefits of MPAs on the tourism sector in Europe, European Overseas Countries and Territories (OCTs) and Outermost Regions (ORs). First of all we provide an overview of the literature we have found and then we analyse it to discuss what evidence is available and how robust it is. After that, we discuss sustainable use practices that can help to maximise the economic benefits of the tourism sector without compromising the sustainability of ecosystems. Finally, we provide indications as to how the tourism sector can help finance management and enforcement activities in European MPAs.

7.1 Introduction – economic benefits of MPAs and SPMs

MPAs are thought to benefit the maritime tourism sector through different pathways:

- **Maintenance and enhancement of ecosystem services**. The improved condition of ecosystems and the related increase in cultural ecosystem services linked to the establishment and management of MPAs can make sites more attractive to tourists and local residents.
- **Sector interactions.** Regulation of professional fishing often linked to MPA management objectives may provide the opportunity for increased recreational

activities (e.g. prohibition of mobile gear can result in improved access for recreational fishers).

- **Regulatory issues.** Sustainable use measures ensure the quality of ecosystems and therefore tend to enhance people's enjoyment of wildlife, thereby attracting visitors.
- **Other indirect effects linked to the association with a MPA**. Irrespectively of the state of ecosystems, the so-called "designation effect" (i.e. the increased reputation due to the MPA designation) may improve the awareness of people on natural areas and therefore increase the number of visitors to the area. It can also allow marketing of tourism products with a premium price with respect to the same service and products sold elsewhere.

All these pathways can result in an increase in the number of visitors to MPAs (and/or the prices paid by visitors), which generates income for companies and individuals providing services to visitors and indirect benefits upward the value chain, both locally and at a regional, national and international level. Increased revenues and business opportunities generate new jobs, which can enhance livelihood options for local communities.

The remainder of this chapter provides information on the existing evidence on the economic benefits provided by MPAs to the maritime tourism sector.

7.1.1 Overview of the evidence base

The review found 33 studies on the impact of MPAs on the tourism sector, mainly focussing on specific MPAs or specific countries. Most of these studies assess the benefits to the tourism sector using interviews/surveys and/or empirical data. In a few cases, simulation models based on empirical data are used. Most of the studies are linked to multi-use MPAs or MPAs with a zoning system and ex-post analyses.

- We found 33 references assessing the benefits of MPAs to the maritime tourism sector:
- 14 focus on a specific MPA in Europe (seven in Spain[31], five in the UK[32], two in Greece[33]);
- Three focus on Overseas Territories – two on Bonaire and one on Saba (all Dutch terretories) ;
- Six on non-European countries (five on Australia and one on New Zealand);
- Four analyse multiple MPAs in a specific country (Italy, the Philippines, New Zealand);
- Seven focus on MPAs in a specific region (the Mediterranean Sea, Southern Europe, the Caribbean, the Mediterranean and the North East Atlantic Ocean, the South Pacific Ocean, the Mediterranean and the Black Sea);
- One is a global survey combining data from a wide range of MPAs across a variety of geographical areas.

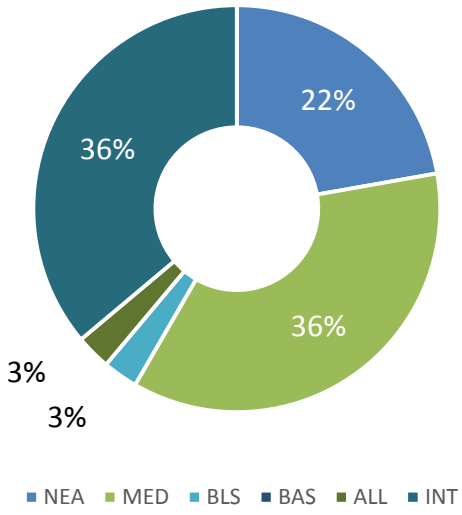
All studies matching the review criteria focus on MPAs and no studies were found assessing the impact of SPMs on tourism.

[31] Three of them in Cap de Creus, three in the Medes Islands and one in the Os Miñarzos Marine Reserve of Fishing Interest.

[32] All of them in Lyme Bay.

[33] Both in Alonissos National Marine Park.

Figure 6. Geographical break down of the evidence base on economic benefits to the maritime tourism sector (n=33).



Of the above studies, 10 are assessed to provide robust, high quality evidence, i.e. they can demonstrate the benefits in a scientifically rigorous way, and 22 references are considered to be of medium quality, which in the absence of further stronger evidence is deemed acceptable for the purposes of this study. The remaining study is Sala et al (2016), which presents the results of a model that simulates the economic benefits provided by an hypothetical reserve financed by private investments (using existing data referring to the Medes Islands Marine Reserve).

The available studies employ a range of different methods to assess benefits to the tourism sector, including surveys/interviews, collection of empirical data and qualitative discussion. We included in our literature review six studies collecting the views of relevant stakeholders (mostly local residents, operators and visitors) on the benefits of MPAs to maritime tourism. We found 15 studies that examine and discuss relevant empirical data, e.g. on changes in expenditures, accommodation places and job creation and ten references that combine the collection of empirical data with the analysis of the perceptions of stakeholders. These two different approaches do not necessarily give the same results, as subjective views can be influenced by many factors, including the socio-economic and institutional context and the specific situation of the respondent. Finally, we included in our review two studies presenting the results of modelling exercises based on empirical data.

Most of the existing evidence on MPA benefits to tourism comes from MPAs which are managed through a combination of multi-use and no-take areas. This may simply be because most European MPAs are multi-use. Only two of the references included in this review are about no take zones, both of which are non-European MPAs, located in the Philippines (Alcala, 1998) and New Zealand (Hunt, 2008). Three references are about multi-use MPAs, where a variety of uses is allowed but with limitations. 17 references are about MPAs with a zoning system, i.e. a combination of multi-use and no-take areas. Finally, eleven studies are about multiple sites, with different levels of protection.

Three of our references are ex-ante evaluations, discussing the potential future benefits of planned or hypothetical MPAs, whereas the remaining 30 are ex-post analyses, which study benefits of already established MPAs.

17 studies are baseline studies, i.e. they provide a snapshot assessment of the benefits to the maritime tourism sector at a certain point in time, whereas 15 studies attempt an assessment of the change in benefits over time or since designation. One study (Roncin et al, 2008) adopts a combination of these two approaches – while the article summarises the revenues and jobs generated by Southern European MPAs at the time when the study was carried out, it also includes an assessment of the designation effect in some of the analysed case studies.

Table 13 provides an overview of the evidence found on the economic benefits provided by MPAs and other SPMs to the maritime tourism sector.

Table 13. Evidence of economic benefits of MPAs and SPMs to the tourism sector identified in the literature review – overview

Type of evidence*		Number of studies					
		NEA	MED	NEA+ MED	MED + BLS	BAS	Global/ multiple
Total Number of references		6	10	2	1	0	14
General methods	Surveys/interviews	3	1	0	1	0	1
	Surveys/interviews + collection of empirical data	2	4	2	0	0	2
	Collection of empirical data	1	3	0	0	0	11
	Modelling using empirical data	0	2	0	0	0	0
Type of MPA	No-take MPA	0	0	0	0	0	2
	Multi-use MPA	1	0	0	0	0	2
	Combination/zoning	5	8	0	0	0	4
	Multiple sites with different kinds of protection	0	2	2	1	0	6
Point of study	Ex ante	0	2	0	0	0	1
	Ex post	6	8	2	1	0	13
Type of study	Assessment of change (over time, since designation or inside vs outside MPA)	5	6	0	1	0	3
	Baseline study	1	4	1	0	0	11
	Combination	0	0	1	0	0	0
Results	Quantitative	3	9	2	0	0	13
	Qualitative	3	1	0	1	0	1

All studies analysing single MPAs focus on inshore sites. This is what would be expected, as offshore MPAs are less accessible and hence less visited and relevant for tourism.

Studies specifying the category of visitors mostly focus on divers and recreational fishermen, with only a few analysing recreational boating (e.g. (Lloret and Riera, 2008; Rees et al, 2015)). Given the greater relevance of interactions with marine species and habitats for the former, this is not surprising.

The available evidence does not allow one to assess the extent to which geographic factors (e.g. size, shape, relative position of the MPA to other MPAs or mainland), management characteristics and effectiveness of enforcement influence the scale and nature of tourism related economic benefits.

Most of the studies do not explicitly identify the pathways through which MPAs provide benefits to the tourism sector. While it is clear that the presence of MPAs can have a positive impact on the numbers of visitors / frequency of visits to the area, it is less clear whether this is caused by the designation effect (and perception that an area will be 'better') or an actual enhancement of the environmental quality of the area or change in accessibility.

In this report, tourism and recreation are considered as one sector. This is because most studies do not distinguish between the two. In general, the benefits related to this sector are due to 1) increased expenditures and 2) cultural ecosystem services linked to the improved recreational experience. As regards the first category, the benefits tend to be higher for tourists than for non-touristic recreational users, as the first ones spend more in hotels, restaurants, guides and other services designed for tourists.

As regards the second category of benefits, they are not covered in this study, because they tend to be assessed using non-market valuation methods based on willingness to pay, which are outside the scope of this literature review.

Table 14 summarises the most robust studies on the economic benefits to the tourism sector provided by MPAs in Europe, i.e. those which are carried out with a rigorous methodology and provide solid quantitative or qualitative evidence. This evidence base is focussed on four MPAs in particular, i.e. Lyme Bay in the UK, the Medes Island and Cap de Creus in Spain and Alonissos in Greece.

Table 14. European evidence of economic benefits of MPAs and SPMs to maritime tourism identified in the literature review – examples

Area studied	Methods	Benefits identified	Baseline study / assessment of impact	Ex ante / ex post	References
Several MPAs in Southern Europe	Survey (748 questionnaires, covering 7 MPAs, on recreational fishery; 2,489 questionnaires, covering 13 MPAs, for scuba diving).	Mean expenditure: €1,022/yr for recreational fishers, €1,307/yr for scuba divers. Mean local added value due to the expenditures of non-resident MPA recreational fishers and scuba divers: respectively €88,319/yr and €551,481/yr per MPA. Yearly local income related to services to non-resident recreational users: €640,000/yr per MPA. Mean jobs created for MPA management: 8/yr. Mean jobs generated by local expenditures of non-resident recreational fishers and scuba divers: respectively 2.1 and 13 yearly full time equivalent.	Baseline study and assessment of impact	Ex post	*(Alban et al, 2008), also summarised in (Roncin et al, 2008)*
Medes Island (Spain)	Simulation model applied to empirical data.	The model provides a business plan for a hypothetical reserve based on data from the Medes Island reserve. It assumes that the tourism sector covers the costs of the reserves and that fishers receive income from tourist access fees. The total annual profits are estimated to increase from €254,000 (fishing only) to €3.3 million eight years after the creation of the reserve. The net present value of the reserve can be between 4 and 12 times greater than that of the same area before the reserve.	Baseline study	Ex post	*(Sala et al, 2016)*
Cap de Creus (Spain)	Survey of fishing activities (409 recreational fishers on board 192 boats) + data gathering (CPUE on boat and socioeconomic data).	Recreational boat fishers spend approximately 500€/yr/angler on goods and services directly relating to angling, 57.5% do so on one of the villages of the park.	Baseline study	Ex post	*(Lloret et al, 2008)*

Cap de Creus (Spain)	Survey (84 fishermen).	Recreational shore fishermen spend about €600/yr. in fishing supplies and car fuel. However, only 20% of the expenditures in fishing supplies are made in the villages of the Park.	Baseline study	Ex post	*(Font and Lloret, 2011)*
Lyme Bay (UK)	Surveys (40 anglers, harbour masters in 8 ports, 51 charter boat operators, 6 dive businesses) + data-gathering.	Total expenditure for recreation activities = £18M/yr (sea anglers= £14M/yr; divers=£1 M/yr; boat charter and dive businesses=£3 M/yr).	Baseline study	Ex post	*(Rees et al, 2010)*
Lyme Bay (UK)	Survey (4 questionnaires targeting 10 dive businesses, 724 divers, 2016 anglers and 51 charter boat operators, repeated each year from 2008 to 2011 – only a share of the surveyed stakeholders answered).	Three years after the MPA designation, the income generated inside it had increased by £2.2 M. In particular, expenditures of anglers and divers have increased by respectively £1,544,068 and £488,613 (due to an increase in visits of 19% and 35%), whereas the turnover of charter boat operators and dive business have increased by respectively £108,427 and £39,864 (due to an increase in their activities by 51% and 201%). Part of this increase may be due to a decrease in activities outside the MPA. In fact, in the same period the expenditures of anglers operating outside the MPA decreased by £1,544,068, whereas the turnover of charter boat operators outside the MPA decreased by £108,427. The expenditures of divers and the turnover of dive business operating outside the MPA increased by respectively £488,613 and 39,864.	Assessment of impact	Ex post	*(Rees et al, 2015)*
Lyme Bay (UK)	Small group semi-structured interviews (15 fishermen, 5 charter boat and dive businesses, 6 sea anglers, 2 divers).	Charter boat operators, dive businesses and recreational users believe that the designation did not have immediate effects (e.g. no increased number of trips of sea anglers and divers). However, all sea anglers and one diver expressed an improvement in their recreational	Assessment of impact	Ex post	*(Hattam et al, 2014)*

		experiences as a result of the designation.			
Alonissos (Greece)	13 preparatory interviews with institutional stakeholders + survey (96 questionnaires to local residents, 101 questionnaires to visitors) + data gathering.	40% of the residents believe that the MPA designation results in a considerable increase in local tourism and 44% that it has a positive impact on the livelihood of people working in the tourism sector.	Assessment of impact	Ex post	*(Trivourea et al, 2011)*
Alonissos (Greece)	Survey (30 fishermen; 4 owners of tourist agencies; 25 hoteliers and owners of rooms to let, 6 students, 4 representatives of government bodies, 2 representatives of nongovernmental bodies, 76 foreign tourists, 34 Greek tourists).	Owners of tourist agencies, hoteliers and owners of rooms to let felt strongly to have benefited the most by the MPA. Tourists believe that the MPA constituted a significant advantage for Alonissos compared to other destinations.	Assessment of impact	Ex post	*(Oikonomou and Dikou, 2008)*

7.1.2 Analysis of the evidence base

Most studies conclude that MPAs are beneficial for the maritime tourism sector by increasing the number of visitors and providing additional livelihood opportunities.

7.1.2.1 Studies based on perceptions

We found 16 references exploring stakeholders' views through interviews and/or surveys. Nine of them combine interviews and/or surveys with data gathering (some of them are mentioned in the following section). Seven presents exclusively results from interviews and/or surveys (one of which combining them with the use of maps, i.e. Rees et al, 2015).

Most of these references report positive opinions on the impact of MPAs on the tourism sector, and we found no evidence about stakeholders reporting a negative impact on tourism due to an MPA designation. The increased revenues and livelihood opportunities at the local level are in many cases key to gain local support to the designation of MPAs and ultimately to the conservation of marine biodiversity (Ruiz-Frau et al (2013).

As regards the visitors' point of view, the evidence shows that the designation of a MPAs can increase the number of visits. For example, 7% of the visitors interviewed by Trivourea et al (2011) chose Alonissos (Greece) as a destination because of the MPA designation (see Box 4). Roncin et al (2008) asked recreational fishers and scuba divers about the impact of the MPA designation on their activities in respectively five and eleven Southern European MPAs. They found that the importance was greater for scuba divers than for recreational fishers, who did not place a great importance on the MPA designation. The percentage of recreational fishermen declaring that their choice of fishing site had been influenced by the existence of the reserve was below 50% in all five investigated MPAs and below 25% in three of them. Whereas in six out of eleven MPAs, more than 50% of scuba divers claimed that the MPA influenced their choice of dive site and only in two MPA the share was below 25%. According to Pizzolante (2009), 36% of the visitors she interviewed in Tavolara Punta Coda Cavallo (Italy) stated that the designation influenced their choice of North-Eastern of Sardinia as a holiday location. The impact of the designation of a MPA on tourism can depend on a range of factors, including for example the age of the MPA, the cultural context, the number and quality of communication activities carried out and also the established reputation of a specific area, e.g. if the area is already well known, the designation effect is less significant because the area already has a good reputation as a destination for tourists. As a non-European example, Hunt (2008) reports that 54% of the day visitors in Cape Rodney Okakari Point Marine Reserve (New Zealand) believe it unlikely they would have visited the area if it had not been a MPA.

Box 4. **The Socioeconomic Impacts of the National Marine Park of Alonissos, Northern Sporades, Greece**

Trivourea et al (2011) carried out 13 interviews with institutional stakeholders and a survey to 96 local residents and 101 visitors in order to explore the attitudes of residents and visitors of Alonissos (Greece) towards the local MPA and to assess its social and economic impacts.
Of particular interest for the scope of this chapter are the answers of residents regarding the impact of the MPAs on tourism, which are summarised below:

The majority of residents believe that the MPA played a significant role in promoting Alonissos (49% believed that the MPA designation helped Alonissos become famous within Greece and abroad to a large degree and 34% to a moderate degree)

Many residents think that the MPA provided an important opportunity for the socioeconomic development of the island (48% to a large degree and 19% to a moderate degree).

- 40% of residents claim that the designation of the MPA resulted in a considerable increase in local tourism
- 44% of the residents think that the MPA has a positive impact on the livelihood of people working in the tourism industry and 46% that it has no impact.
- *Source: (Trivourea et al, 2011)*

Tourism stakeholders (e.g. hotels, tour operators, restaurants) and residents often state that the designation of an MPA favours the tourism sector. For example, the majority of the residents of the National Marine Park of Alonissos (Greece) surveyed by Trivourea et al (2011) recognise the importance of the park in promoting the public image of the island (see Box 4). Roncin et al (2008)´s survey of Southern Mediterranean MPAs shows that in six out of the eight MPAs where this issue was investigated, over 75% of scuba dive operators considered the MPA designation as having a positive impact on their business; and for the remaining two MPAs this figure was over 50%. Similarly, all business operators interviewed in the Leigh reserve (New Zealand) by Taylor and Buckenham (2003) agreed that the reserve has had a positive impact on the local economy. This is confirmed by the increase in the number of accommodation facilities, restaurants and cafes in the area.

Managers also have a positive opinion on the contribution of MPAs to local economies. Of the 68 MPA managers in the North-east Atlantic Ocean surveyed by Álvarez-Fernández et al (2017), 57 believe that eco-tourism activities linked to the establishment of MPAs (e.g. bird and nature watching) can play a key role in generating new income for the areas included in MPAs.

However, there are other studies showing no major impact of MPAs on tourism. Oikonomou and Dikou (2008) surveyed 181 stakeholders, including fishermen; owners of tourist agencies, hoteliers and owners of rooms to let, students, representatives of governmental and nongovernmental bodies, foreign and Greek tourists in the National Marine Park of Alonissos (Greece). They found that the majority of each group agreed that the MPA contributed to tourism development to a small degree (except for the student group), which contradicts Trivourea et al (2011)'s results on the same MPA. However, the majority in all groups claimed that the development of eco-tourism could constitute an important pillar for the future tourism development. Hattam et al (2014) found that for the Lyme Bay MPA, charter boat operators and dive businesses had not witnessed any increase in the number of visitors. It is interesting to note that this conclusion is not confirmed by Rees et al (2015)'s results, which do show an increase in the turnover of dive business charter boat operators around the Lyme Bay MPA (see Table 14 and the section below). This may relate to the fact that Hattam et al (2014)'s survey took place only one year after designation, whereas Rees et al (2015)' study was carried out three years after that. Differences between the survey designs employed in the studies can also partly explain the divergence of results - whereas Hattam et al (2014) directly asked for the perception of businesses, Rees et al (2015) calculates the expected increase in turnover based on the increase in the number of visits.

The impact of the designation of a MPA can increase over time. For example, the divers, anglers and charter boat operators in the Lyme Bay MPA surveyed by Rees et al (2015) in the designation year reported that the MPA designation had a small to moderate effect on their decision as to their destination in the Lyme Bay area. However, these results changed when annual surveys were carried in the two subsequent years, showing an

increasing impact of the MPA on the choice of a location for recreational activities since designation.

7.1.2.2 Studies collecting empirical data or modelling the benefits

We found 25 studies that collect empirical data about current or future revenues and/or jobs generated by the visitors' expenditures. Ten of them combined the analysis of data with surveys or interviews.

Eight of these references estimate the change in recreational activities after the designation of an MPA, six of which in Europe. For example, Trivourea et al (2011) show that in the seven years after the designation of the national marine park of Alonissos (Greece), the number of available beds (which can be taken as an indicator for the number of visits) increased by 10.5%, whereas in the neighbouring islands of Skiathos and Skopleos the change was respectively 2.4% and -9.5%. Rees et al (2015) estimate the change in revenues generated by the expenditures of anglers and divers and the change in turnover of boat operators and divers businesses inside the Lyme Bay reserve. They find that three years after the MPA designation, the generated income had increased by £2.2 M, due to the increase in visitors and recreational activities. Some of this increase may be due to the displacement of anglers and charter boat activities from outside to inside the MPA. On the contrary, Lloret and Riera (2008) report that local employment, business and number of accommodations (tourist places) did not increase following the designation of the Cap de Creus MPA. However, the study also concludes that this lack of impact might be explained by an earlier expansion of recreational boating and cruising industry predating the establishment of the MPA. Pizzolante (2005) discusses the impact of the Italian MPA Tavolara Punta Coda Cavallo on the tourism sector. Marino et al. (2012) provide an analysis of recreational fishing in Italian MPAs and uses a survey to estimate the number of recreational fishermen in each of them. Mangi et al. (2012) assesses costs and benefits of the Lyme Bay MPA (UK) and finds that the designation of the MPA resulted in an increase of recreational activities (and consequently benefitted the local tourism sector). The two non- European studies that assess the benefits to the tourism sector due to the designation of a MPA are Lynch et al (2013) and Alcala (1998). The first one shows that the number of dives and diver trips quadrupled after the designation of the Jervis Bay Marine Park (Australia). The second one discusses the economic benefits resulting from the designation of the Sumilon Marine Reserve in the Philippines.

16 references providing empirical data are baseline studies. Five of them are on European MPAs. One is the study by Rees et al (2010), who estimate the total expenditures for recreational activities of sea anglers, divers, boat charter and dive businesses in Lyme Bay. The other two European baseline studies reporting empirical data are those of Font and Lloret (2011); Lloret et al (2008), who estimate the expenditures of recreational boat and shore fishing in Cap de Creus, Spain (more details in Box 5). Alban et al (2008) calculate the expenditure of recreational fishers in seven MPAs and those of scuba divers in 13 MPAs (see Table 14 for a summary of their results). Mangos and Claudot (2013) assess costs and benefits of 5 Mediterranean MPAs in Spain, Tunisia, Turkey, Greece and Algeria, focussing, among other benefits, on recreational fishing, tourism, recreational boating and diving.

Box 5. **Recreational boat and shore fishing in Cap de Creus, Spain**

Lloret et al (2008) surveyed 409 recreational fishers on 192 boats, investigating catch composition and abundance, catch per unit effort (CPUE), as well as fishing effort and expenditures. Recreational fishing causes an important environmental impact in the area as it is responsible for about 30% of the total catches. They found that while recreational fishery exerts a significant pressure on littoral and demersal fish communities, it also generates a significant revenue to local communities. In fact,

fishers spend about €500 per year per person on goods and services related to their fishing activities (i.e. around €200,000 per year in total), most of which is in a village inside the park.

According to Font and Lloret (2011)'s survey of 84 recreational shore fishermen, they spend about €600 per year in fishing supplies and car fuel. However, only 20% of the expenditures in fishing supplies were made in the villages belonging to the Park, because most fishers are not lodged elsewhere.
Source: (Font and Lloret, 2011; Lloret et al, 2008)

The eleven non-European baseline studies included in our database aim to assess the direct expenditure related to tourism in the Great Barrier Reef (Access Economics Pty Limited, 2007; Deloitte Access Economics, 2013; Great Barrier Reef Marine Park Authority, 2014; Hand, 2003), in the Bonaire Marine Park (Dixon, Scura and Hof, 1995; Post, 1994), in Cape Rodney Okakari Point Marine Reserve, New Zealand (Hunt, 2008), in Fuji and Vanuatu (Hand, 2003; Pascal and Seidl, 2013), in Saba Natural Park, in the Antilles (Buchan, Framhein and Fernandes, 1997) and 30 countries in the Caribbean and Central America (Green and Donnelly, 2003).

One of the baseline studies collecting empirical data is Gravestock, Roberts and Bailey (2008), who developed a predictive model to determine the income requirements of MPAs, based on data from a global survey of 79 MPAs. This is relevant when discussing maritime tourism because the authors discuss visitor fees as a way to finance MPAs and cover their costs (see section 7.2.2).

Roncin et al (2008) combine a baseline assessment of revenues and jobs created by Southern European MPAs with interviews assessing the impact of the MPA designation (Box 6 summarises their main results).

Box 6. **Local income and job creation in Southern Mediterranean MPAs**

Roncin et al (2008) summarise the results of the EMPAFISH project (http://www.um.es/empafish), which explored the impact of Southern European MPAs on local economies by conducting surveys with fishermen and divers (1,836 questionnaires completed) and collecting empirical evidence.

According to their calculation, a mean of 13 jobs and 2.1 jobs per MPA were generated by expenditures of, respectively, scuba divers and recreational fishers. The MPAs attract mean revenues of €88,000 per year to businesses providing services to non-resident recreational users, i.e. recreational fishers and scuba divers. The total income generated locally (including also professional fishermen) is on average 2.3 times higher than the MPA management costs. These estimates are highly conservative, because they do not take into account non-cash income and indirect and induced effects, and only cover non-resident recreational users.

Source: (Roncin et al, 2008)

Finally, we found two studies that apply modelling to empirical data of the Medes Islands – Sala et al (2016) and Merino, Maynou and Boncoeur (2009). We report here a summary of the data they use for their model because, even if they are not primary data, they provide interesting information about economic benefits to the tourism sector. Sala et al (2016) note that whereas before the creation of the Medes Islands Marine Reserve there were only four diving centres in the area, generating a revenue of about €0.5 million, at the moment the reserve attracts expenditures of at least €10 million to the

local economy, supporting 200 full-time jobs, including in diving and snorkelling centres, glass bottom boats, kayaks, hotels and restaurants, as well as €364,000 expenditures per year in fuel, gear and bait for recreational fishing boat trips. This includes the current diver access fee, which provides €234,500 per year and covers half of the annual budget of the reserve. Merino, Maynou and Boncoeur (2009) claims that tourism generates €5.9 million in revenues, including €2.71 million generated by scuba diving, €2.55 million by glass-bottom boats and €0.67 million by other activities (e.g. snorkelling, excursions).

7.2 Sustainable use – striking a balance

Maritime tourism can have a negative impact on wildlife and contribute to the degradation of valuable ecosystems (see Burgin and Hardiman (2015); Milazzo et al (2002)). For example, in the Medes Islands intensive diving has damaged benthic organisms such as gorgonians, bryozoans and the Posidonia meadows (Badalamenti et al, 2000); and recreational fishing is exerting an increasing pressure on fish communities, particularly on littoral, demersal ones in Cap de Creus, Spain (Lloret et al, 2008).

In general, there is a trade-off between the level of environmental protection provided and income generation related to recreational activities. As noted by Dixon, Scura and Hof (1995), up to a point recreational uses and environmental conservation can be compatible, but after that point recreational activities result in environmental degradation, which ultimately damages not only the environment but also the recreational sector itself. For example, the interviews carried out by Taylor and Buckenham (2003) in the Cape Rodney Okakari Point Marine Reserve (New Zealand) reveal that the local beach is overcrowded with visitors at weekends, public holidays, and during the summer, resulting in a worrying amount of litter dropped by visitors around the reserve and in residents avoiding the beach.

For this reason, the evidence indicates that marine tourism in MPAs needs to be managed in order to make sure that recreational activities are carried out in a sustainable way, i.e. that the carrying capacity of ecosystems is not exceeded and the environmental benefits supported by the exclusion of activities seen to be more damaging are not nullified (Lloret and Riera, 2008). This is also the key to ensuring the long-term viability of the economic benefits provided by the sector. For example, no-take zones exclude angling because it causes an unacceptable pressure, but may allow other recreational activities, provided that measures are taken in order to ensure that that ecosystems are not damaged. In multiple-use MPAs a variety of activities may be permitted, but often with sustainability measures in place.

7.2.1 Strategies to support maritime tourism and to reduce the environmental impact of recreational uses

The evidence indicates that ensuring tourism does not compromise the sustainability of MPAs requires good management, enforcement and communication practices. Key aspects of this are:

- Effective management plan and enforcement measures are key to limit the environmental impact of recreational activities
- Strategies aimed at reducing the impact of recreational users (e.g. improved management, better monitoring of visitors' activities and educational campaigns) can enable to increase visitor numbers (and the associated revenues and jobs generated) without an associated increase in environmental impacts.
- Communication activities can play an important role in promoting good practices and reducing the environmental impact of recreational uses.
- Policies and activities should be put in place to support eco-tourism, which provide livelihood opportunities to local communities, with limited damage to ecosystems.

- Policies that favour the retention of tourism revenues and jobs in the local economy can provide local economic benefits without the need to increase visits.

The existing studies demonstrate that minimising the environmental impact of maritime tourism requires a mix of different regulatory, governance and communication tools, including education and training, involvement of relevant stakeholders in the decision-making processes, monitoring activities of visitors and their impact on the marine environment. These practices are key not only to ensure environmental sustainability, but also to make sure that MPAs can provide economic benefits to the tourism sector in the long run. In fact, environmental degradation inevitably damages the interests of tourism operators by diminishing the number of visitors and consequently their expenditures.

First of all, it is important to ensure that all MPAs have an effective management plan, which may include limits to recreational activities (e.g. seasonal closures, use of licences, interdiction of specific fishing gears for recreational fishermen), as well as effective enforcement measures (Lloret and Riera, 2008). In particular, ensuring that enough monitoring and enforcement activities are put in place by competent authorities is key to ensure that the measures that are put in place are complied with (Marino et al, 2012). For example, Lloret et al (2008) observe that the level of compliance with boat-based recreational fishing[34] regulations is low in Cap de Creus (Spain), in particular as regards the minimum landing sizes of certain species and the possession of a fishing license and this is undermining attainment of the conservation objectives for the site.

Secondly, voluntary commitments and initiatives of individuals and companies operating in the maritime tourism sector is also key to ensure that recreational activities are carried out without compromising environmental sustainability. One example is the use of marine wildlife-watching codes of conduct, which have been created in the UK (Inman et al, 2016).

Thirdly, communication can play an important role in promoting good practices as regards recreational activities. For example, some Italian MPAs have developed educational material to inform recreational fishers, including brochures and leaflets providing information on sustainable local fish consumption and existing regulations on recreational fisheries. In some cases, ad hoc logbooks have been designed to be given to recreational fishermen together with fishing licenses (Marino, Tempesta and Teofili, 2012). Another good practice in this sense can be found in the three MPAs in New Zealand that have been studied by Taylor and Buckenham (2003), where signage and brochures with maps of reserve boundaries and rules for appropriate behaviour have been produced.

Promotion activities supporting green tourism are often key to improve the potential of MPAs to attract visitors, and thereby revenues and jobs in the tourism sector, with limited damages to ecosystems. For example, the village of Lira (Galicia, Spain) promoted green tourism through different initiatives, including gastronomic workshops, sub-marine photography competitions and fishing tourism. Also, the reserve benefitted from local initiatives to increase awareness on the importance of marine sustainability. All these activities contributed to an increase in tourism in the area (De Oliveira, 2013).

Small-scale eco-tourism, where local people have competitive advantages with respect to big companies due to their presence in the territory, their knowledge and their network of contacts seems to provide a promising approach in this sense. In the case of this kind of venture profits are not large enough to attract large companies, limiting the risk of negative environmental impacts. Small-scale local tourism business can be fostered by investing in improvements to the existing infrastructure and upgrading accommodations and other services provided (Trivourea et al, 2011). In addition, 'green' marketing of

[34] In the Mediterranean Sea, recreational fishing is responsible for more than 10% of the total fisheries production.

tourism products (Jones, Qiu and De Santo, 2011) generating profits through premium prices could provide an addition means of revenue supporting the eco-tourism sector.

In certain contexts, the stress threshold and carrying capacity of ecosystems can actually be increased with strategies aiming at reducing the impact of recreational uses and thereby allowing more visitors. For example, Dixon, Scura and Hof (1995) suggest the following strategies to reduce the environmental impact of diving on the reef ecosystems in Bonaire (in the Caribbean):

- improved park management, i.e. rotating dive sites, spacing out divers, regulation of underwater photography (e.g. ban tripods, promoting better buoyancy control),
- putting in place policies to minimise land-based pollution and waste generation in order to reduce the environmental impact of visitors on reef ecosystems;
- diver education to improve their diving skills, as an environmentally aware diver generates less impacts on reef ecosystems than a novice diver.

In this way, according to their calculation, the number of dives in Bonaire (Caribbean Sea) could be doubled, from 200,000 up to 400,000 dives per year, resulting in an increase in gross revenues of $20 million or more per year.

Another approach to maximise the positive impact of maritime tourism on local economies is to put in place policies that increase the share of income retained in / generated for the local economy, in order to increase revenue captured at the local level without increasing the number of visitors (Dixon, Scura and Hof, 1995). This is relevant also because tourism does not automatically benefit local populations; tourism packages might be solely offered by international tourism companies or, depending on the location of accommodation, the visitor expenditures might take place outside the settlements within the park boundary (Dixon, Scura and Hof, 1995; Font and Lloret, 2011) or along the local coastline to the MPA. Financial support to and training of local business can support supply-side investment and information campaigns in favour of local touristic products can support demand, helping to increase local expenditure.

7.2.2 The tourism sector can help finance sustainability measures

The evidence indicates that management, enforcement and educational activities require financing, but the available funds for MPAs are not always enough to support them. Tourism can provide alternative and complementary ways to contribute to the financing of MPAs and in this way play a key role in ensuring further positive ecological and socio-economic impacts from MPAs. In particular, visitor fees and taxes may help cover the funding needs due to increased number of visitors.

Management, enforcement and educational activities require financing, which is not always fully available. The examples above suggest that MPAs can attract substantial revenues to the wider economy, but these flow into the tourism sector as a whole and therefore do not necessarily help to finance the management of the MPA. The existing evidence shows that in many cases the reduced availability of funds is one of the main reasons for the inadequate management of MPAs, which may jeopardise the realisation of MPA-induced benefits by the tourism sector. For example, De Oliveira (2013) reports that the effectiveness of the Os Miñarzos Marine Reserve of Fishing Interest (Portugal) decreased significantly over the last years due to the reduction of financial state support for enforcement. More broadly, 67% of the 57 MPA managers surveyed by Álvarez-Fernández et al (2017) claim that the available budget is not sufficient to implement the management plans in their MPA and 65% said that more staff were needed. Similar issues can be found in MPAs outside of Europe; for example, Taylor and Buckenham (2003) found that all three MPAs it analysed in New Zealand did not have enough funding to be properly managed and monitored.

For this reason, using tourism to find alternative and complementary ways to contribute to the financing of MPAs can play an important role in ensuring further positive environmental and socio-economic impacts. In this sense, the tourism sector is not only a beneficiary of MPAs but is also a potential source of MPA funding.

Tourism-related visitor fees and taxes may help cover the increased funding needs due to rising number of visitors, and reduce the need for public funding (Dixon, Scura and Hof, 1995; Sala et al, 2016). Recreational fishing licences, which are often granted against a payment, can also be a way to control recreational fishery and raise funding that can potentially be used for MPA management. For example, in many Italian MPAs recreational fishing licences require a payment (Marino, Tempesta and Teofili, 2012).

Even though they entail administrative costs and tend to generate opposition (but not necessarily, see below), tourism fees may be an interesting option where there is concentrated recreational activity. They can be used not only to reduce pressure on ecosystems by discouraging access to the most vulnerable areas and to raise additional revenues to finance management and enforcement activities, but they can also give a signal of the high biodiversity importance and vulnerability of specific places. For example, Fouad (2010) argues that the entry fee in Samadai (Red Sea Egypt) is important not only in contributing to the local economy, but also in highlighting the economic value of tourism to local agencies, stakeholders, tourists and general public, making a case for environmental conservation.

Dixon, Scura and Hof (1995) suggest the establishment of multi-layered fees, whose cost would reflect how close any given site is to the threshold level, thereby imposing a higher fee for the site under most pressure from visitors. This would maximise the impact of fees in terms of both environmental impact and environmental education, but would also have higher transaction costs with respect to a system based on a single fee.

Access fees are still rare in Europe, but there are some interesting examples, such as the diver access fee in the Medes Island Marine Reserve (Spain) (€ 3.5), which generates a revenue of €235,000 per year, covering half of the annual budget for the reserve (Sala et al, 2016). Another example is the transport tax applied to all maritime passenger travelling to the Îles du Ponant (France), a group of 15 islands that are located within a MPA (between 1.5% and 7% of the ticket price) (Ecorys, S.Pro and MRAG, 2016). Also, the National Park Service (NPS) of Turks and Caicos Islands (a British Overseas Territory) is funded by a 1% value-added tax on hotel accommodation and meals (Rudd et al, 2001). As an international example, Edmund and Rachel (2003), who carried out a survey of dive operators working in the Caribbean and Central America, claim that increased entry or user fees would provide an important contribution to the cost of marine conservation (actually only 25% of the analysed MPAs have a fee).

It is also important to note that, based on the existing studies, visitor fees are not necessarily opposed. For example, Font and Lloret (2011) found that 65% of the anglers they surveyed in Cap de Creus (Spain) were willing to pay a fee of between €5 and €60, with a mean value of €20, and only 26% were against the idea. Trivourea et al (2011) found that 78% of the visitors they interviewed would be willing to pay an entrance fee in order to visit the uninhabited areas of Alonissos MPA (Greece). According to Green and Donnelly (2003), tourists visiting the Caribbean island are willing to pay a fee of around US$ 25 per person, even though the actual fees are at about US$2-3 per diver.

8 Evidence of benefits to other blue economy sectors

Chapter summary

No evidence could be identified of benefits provided by MPAs or SPMs to blue economy sectors other than fisheries and tourism. In the most relevant study identified, respondents from the Mediterranean and the Black Sea consider other blue economy sectors to be unaffected by the presence of an MPA.

The lack of evidence and/or studies on economic benefits to other blue economy sectors might be because, while these sectors require space within the marine environment, most of them are not – or are perceived not to be – dependent on the marine environmental and its quality. For some sectors, such as marine biotechnology, there is a closer link and the lack of evidence is likely to be related to the relative novelty of the sector.

MPAs and SPMs may provide indirect benefits to other blue economy sectors by creating a management mechanism for marine space which enables different sectors to co-exist and for their impacts to be managed. No evidence on other such benefit pathways was identified.

In this chapter, we discuss the existing evidence on the benefits provided by Marine Protected Areas (MPAs) and Spatial Protection Measures (SPMs) to other blue economy sectors in Europe and its Overseas Countries and Territories (OCTs) and Outermost Regions (ORs), or any insights from elsewhere that are transferable to European, OCT or OR conditions.
Other blue economy sectors, are those not already covered under previous chapters, include, for instance, blue energy, marine mineral resources, blue biotechnology and transport (see Table 1 in Chapter 2 for a full list of sectors).

8.1 Introduction – economic benefits of MPAs and SPMs

Of the different industries operating at sea, some are particularly dependent on the health of marine ecosystems.

Sectors such as blue biotechnology and marine research are founded on the existence of marine organisms, ecosystems, and habitats. MPAs and other types of SPMs are established with the intention to protect marine biodiversity and resilience and may thereby also provide direct and indirect benefits to these industries operating at sea. However, they may also generate costs by prohibiting access to the marine resources sought by these sectors.

Other sectors, such as blue energy, marine mineral resource extraction and marine transport do not obviously rely on good status of the marine environment, but can have impacts on marine ecosystems which make them less compatible with the conservation objectives of protected sites. Consequently, development of these sectors must be carefully managed to reduce their environmental impact and improve their sustainability. De facto refuges, discussed in Chapter 9 of this report, provide some evidence on opportunities in this regard.

8.1.1 Overview of the evidence base

Following the review protocol described in Chapter 2, we have not been able to identify any studies providing evidence on tangible economic benefits generated from MPAs or SPMs to other blue economy sectors in Europe. We are consequently not able to provide informed evidence at this stage about what types of benefits these would be, what impact pathways they might be generated via, or the scale of such benefits.

One study collects stakeholder opinions about the socio-economic impacts of MPAs in the Mediterranean and the Black Sea, but does not find evidence suggesting such benefits occur. Instead, the 97 respondents from the region generally considered biological resource extraction and underwater archaeology as being "unaffected" by the presence of MPAs (most respondents from the Mediterranean answered "not applicable" and most from the Black Sea answered "neutral"). Also non-biological resources extraction, energy production activities (offshore wind farms and wave farming infrastructures), transport, building, and military uses were considered unaffected by MPAs (Pascual et al, 2016).

According to Deloitte Access Economics (2013), mentioned in Chapter 5, an estimated AUD$38 billion of Australia's export trade (shipping) is carried annually through the (GBR) Region. However, the study is not able to link the existence of the MPA to the ongoing shipping trade.

We do identify some literature discussing the use of MPAs for marine research, although these do not provide evidence of tangible economic benefits generated.

Research opportunities in MPAs

Baxter, Laffoley and Simard (2016) mention the possibility of MPAs, and primarily no-take areas, to act as "observatories" or reference areas for research and academia. We find a practical example of this from northern Europe; the project Seafarm (part of the European Blue Growth initiative and run by five Swedish universities). Seafarm has a permit to cultivate brown macro algae (*Saccharina latissima*) in Kosterhavet marine national park (Sweden) with the aim to explore the opportunities for sustainable large-scale production of macro algae and to identify the most economically viable combination of its different applications. The manager of Seafarm believes that enabling innovative projects like Seafarm within the protected area has helped boost acceptance for the area from the local community (Russi et al, 2016).

Deloitte Access Economics (2013) estimate that in 2012, more than AUD$98 million revenue was generated through the conduct of scientific research into the (Great Barrier Reef) World Heritage Area, supporting over 880 FTEs. Reef-related projects attracted Australian Research Council funding in 2010 alone of over AUD$8 million.

Hartmann, Bode and Armsworth (2007) show that MPAs can help improve our understanding of fisheries dynamics which in turn can help to optimise fisheries management. The authors develop a stochastic dynamic programming framework for calculating the economic benefit of creating an MPA exclusively for learning about fishery population dynamics. They find that the objective works best (in relation to the cost of establishing the MPA) when species are low migratory and MPAs are small, when active adaptive fisheries management cannot be practiced (and hence understanding improved via its variation); and when the dynamics inside the MPA are similar to those outside it (i.e. the MPA is not set up to protect a certain life-stage of the population). The authors argue that this is a benefit of MPAs that has been largely overlooked (Hartmann, Bode and Armsworth, 2007).

8.2 Sustainable use – striking a balance

Different marine ecosystems have different degrees of ecological resilience and, therefore, their ability to accommodate the range and intensity of economic activities currently developing in European seas differs, e.g. depending on their ecological characteristics and the level of stress that they already experience. For this reason, economic activities in the marine environment should be carefully regulated and monitored in order to avoid compromising the overall sustainability of marine environment. Declines in marine biodiversity are known to directly impact the carrying capacity and resilience of ecosystems therefore endangering their ability to support healthy populations of flora and fauna and to provide a variety of ecosystem services, whether through fishing, aquaculture, tourism, or other activities.

As there is no evidence of the benefits of MPAs for other blue economy sectors, it is not feasible to investigate the question of what measures might be put in place to ensure that MPA benefits are realised by these sectors.

A possible reason behind the lack of evidence and/or studies on economic benefits provided by MPAs to other blue economy sectors is that, while these sectors (e.g. oil and gas platforms, harbours, mining and construction sites) require space within the marine environment, most of them are not – or are perceived not to be – dependent on the protection of marine environmental quality. As exception is marine biotechnology, for which one of the possible reasons explaining the lack of data is the novelty of this sector.

On the contrary, several of these other sectors are known to have negative impacts on marine conservation. However, to achieve sustainable blue growth in Europe and achieve targets and commitments made for safeguarding marine biodiversity and ecosystems, it is important to find ways whereby spatial environmental protection can be effective alongside economic activities. In this regard, MPAs may provide indirect benefits to other blue economy sectors by creating a management mechanism for the marine space which allows different sectors to co-exist and for their impacts to be managed.

9 Evidence of 'de facto refuges'

Chapter summary

De facto refuges are areas where access and activities are restricted for reasons other than conservation or natural resource management, for example for security reasons. Out of 39 studies identified from around the world, many focus on the ecological changes occurring in relation to artificial reefs and energy infrastructure. Studies which include links to economic sectors focus on fisheries, angling and diving. Only four studies provide any economic information, although several studies make speculative links between de facto and economic benefits.

The evidence base shows an absence of agreement regarding the economic impacts of *artificial reefs* to fisheries, while it suggests that such structures are highly valued by divers and anglers due to the fish that aggregate at these sites and the marine life that grows on them.

The considerable, and growing, body of literature on the effects of *energy installations* show that offshore wind farms may bring potential benefits to species of commercial and recreational importance. However, evidence of any benefits to fisheries, recreation or other maritime sectors from energy installations remains very scare. What little evidence exists from Europe is usually self-reported during interviews or of anecdotal nature.

In this chapter, we collate and synthesise research and known studies about 'de facto refuges' or de facto marine reserves. De facto marine reserves are areas where access and activities are restricted for reasons other than conservation or natural resource management (Micheli et al, 2008; National Marine Protected Areas Center, 2008). Examples of these include areas to which access is restricted due to safety or security reasons or private ownership of a particular area (Micheli et al, 2008). Due to the limited amount of research on this subject, we have taken a somewhat wider geographical approach in this chapter and focused equally on European studies and studies from elsewhere around the world with transferable context to either Europe or its Overseas Countries and Territories (OCTs) and Outermost Regions (ORs).

9.1 Introduction

The study by the National Marine Protected Areas Centre (2008) lists 12 types of de facto marine reserves that occur in the US, which encompass anchorages and shipping routes together with a range of safety and security zones and restricted areas related to military and other Government operations and the protection of infrastructure. Energy structures such as wind farms and oil and gas platforms are typical examples of infrastructures around which de facto refuges become established (National Marine Protected Areas Center, 2008) because structures on the seabed such as cables can be a hazard for trawling operations, often resulting in wide statutory or informal exclusion zones. Bridges or breakwaters also make seafloor inaccessible for fisheries, as do communication cables or ship wrecks. Wrecks or other structures may be deliberately installed on the sea bed in order to form artificial reefs to attract marine life. Temporary de facto refuges may also occur due to conflict restricting fishing activity, such as the recovery of fish stocks in the North Sea during the Second World War when fishing effort was massively reduced (Beare et al, 2010). De Groot and Bush (2010) describe one further type of marine protected area. These are called entrepreneurial MPAs and they give two examples of these in Curacao. Such reserves are organised by the private sector for example dive operators. The main objective of such MPAs is not protection of large marine ecosystems but to protect discrete habitats and marine life that are attractive to dive tourists.

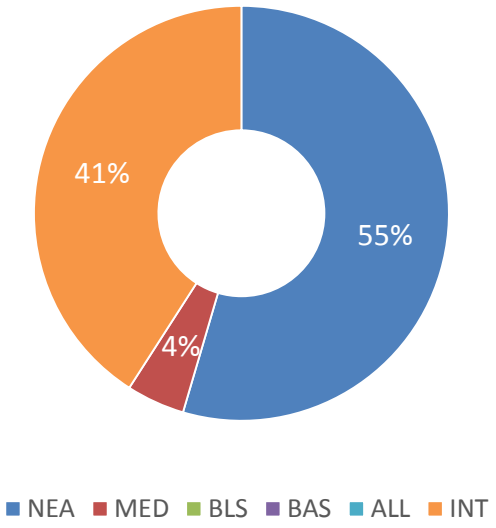
In some cases, the exclusion zones that led to the creation of de facto reserves will restrict access by all vessels (for example around oil and gas platforms in UK waters) and this lack of access will limit the economic benefits that are generated to those depending on spillover effects. However, other de facto reserves are open to activities such as recreational diving or angling and so have the potential to provide both on-site and off-site economic benefits.

The absence of conservation objectives for de facto reserves may allow for greater economic exploitation of the environmental benefits compared to MPAs, as the scope and extent of activities permitted in de facto refuges may be less controlled.

9.2 Overview of the evidence base

The evidence base for economic benefits of de facto refuges is small. We identified and examined 39 studies, including peer reviewed scientific papers and grey literature, of which 17 focused on the ecological changes occurring within de facto reserves. Of the remaining 22 studies, only four provided any economic information, although others did examine the behaviour of fishers and recreational users around and in de facto reserves and so provides some evidence for inferring economic benefit. Often, the link between the de facto reserve and benefits accrued from it was speculative. None of the assessments from locations in Europe provided direct evidence of economic benefits received by active users such as fishers or leisure operators. Instead, potential benefits were inferred from frequency of use of de facto refuges and fish catches made by researchers.

Figure 7. Geographical break down of the evidence of 'de factor refuges'.



Most of the available evidence concerns refuges related to artificial reefs and energy infrastructure, and the studies tend to concentrate on the effects on fisheries, angling and diving. Other papers consider the benefits obtained to the industry that set up the de facto reserve (for example, artificial reefs created to enhance diving look only at economic benefits obtained by that sector). No evidence was found for economic benefits to other marine industry sectors.

Table 15. Evidence of economic benefits of de facto refuges identified in the literature review – most robust studies

Area studied	Methods	Benefits identified	Benefit pathway	References
United Kingdom	Online question-naire	Sea anglers have made use of offshore wind farms for angling and some report that catches have increased compared to their success prior to offshore wind farm construction	Attraction of fish to offshore wind farm infrastructure increases the likelihood of catch success	(Hooper, Hattam and Austen, 2017)
Waikiki Artificial Reef Hawaii, US	Stakeholder interviews and observations	Revenue generated through dive operations, submarine tours and fisheries	Income generated through the attraction of visitors to the site either as tourists or divers, also fishermen catching fish in the area	(Brock, 1994)
Algarve, Portugal	Fish catches (by researchers)	Value of catch was higher at artificial reef than control sites	Catch is larger/contains more valuable species	Santos and Monteiro (1998) Whitmarsh et al (2008)
United Kingdom	Face to face question-naire	Crab/lobster fishermen have placed pots near offshore wind farm infrastructure (particularly around the edges of the wind farms and close to cable) in the expectation of catch success	Artificial reef effects attract target species to offshore wind farm infrastructure allowing them to be more easily targeted than in open water.	(Hooper et al, 2015)

9.3 Artificial reefs

Artificial reefs have been defined by the European Artificial Reef Research Network as a submerged structure placed on the substratum deliberately to mimic some characteristics of a natural reef (Baine, 2001; García-Gómez et al, 2015). Artificial reefs can include any man-made structure made for the purpose of attracting fish either for fishing/angling or diving. Ship wrecks sank with this purpose in mind are also included in this category (Dowling and Nichol, 2001). For example, Brock (1994) describes an artificial reef created as a dive site in Hawaii. Here, fishing is still legal but greatly reduced due to the dive operations taking place during each day.

Benefits to fisheries

There is an absence of agreement on the economic impacts of artificial reefs for fisheries. Within Europe, there have been a number of studies that consider fish yield from artificial reefs in the Algarve, Portugal, which show that relative fish catches are consistently higher at artificial reefs than at control sites (Santos and Monteiro, 2007). However, any assessment of economic benefits has been largely hypothetical and results from scientific research that demonstrates that increased return is possible from fishing near the reefs, but contains no evaluation of whether fishers use the reefs and subsequently see an increase in catch success, size or value. Santos and Monteiro (1998) used a typical local Portuguese fishing method and calculated the commercial value of the haul. This suggested that at larger structures (concrete blocks of 130-174m^3) the value of the catch increased relative to the control site by US $23.77, while small reefs (designed to provide juvenile habitat and comprising blocks of 2.7 m^3) resulted in an increase of US $9.41 compared to the control. Using a similar approach, Whitmarsh et al (2008) showed that the value per unit effort of the catch at artificial reefs was 1.73 times that of control sites

when the reef was first installed, and also that the catch value increased the longer the reef system had been deployed. Ramos et al (Ramos et al, 2006) did consider actual behaviour in that they observed the position of fishing vessels in relation to artificial reefs and estimated revenue from catch data reported to authorities. They concluded that fishing at artificial reef sites was profitable but as there was no comparison of catches from vessels selecting other sites, it is not possible to determine the economic benefit derived from the artificial reef.

Studies from developing countries suggest that the incomes of fishers who use artificial reefs are no different (Koeck et al, 2011) or lower (Islam et al, 2014) than those who exploit other grounds within the vicinity.

Benefits to recreation and tourism

Only a few studies assessed the benefits of artificial reefs on local communities and economies within Europe. Artificial reefs such as ships sank for this purpose are highly valued to divers and anglers due to the fish that aggregate around them as well as the marine life that grow on such structures (Kenter et al, 2013). For example, wrasse have colonised the *HMS Scylla* artificial reef in Whitsand Bay, Cornwall as well as many characteristic wreck species that are attractive species to divers (Hiscock et al, 2010). Within the first five years after the sinking of the *HMS Scylla*, managers of the site from the National Marine Aquarium have counted 42,000 divers on 7,000 dive boats and it is estimated that it may have contributed £25-30 million to the local community.

Dowling and Nichol (2001) describe economic benefits of a ship that has been sunk deliberately to be used as a dive site. The study was carried out in Australia. The authors calculate the economic benefits from this project by multiplying the numbers of divers with the average amount they spend on dives at the site to come to the total expenditure of US$1.4 million in the first two years of the wreck being accessible to divers. This study is one of few that calculate revenue for such a dive site but it is based on estimates only.

Another artificial reef located in Hawaii created for different types of diving operations reduced the amount of time the site is open to fishermen due to the diving taking place during daylight hours and maintenance being carried out in the evenings. Within the first year of this area being used for diving (1990-1991), SCUBA diving produced a profit of US$20,000 (with revenue created of US$356,000 and costs amounting to US$336,000). Additionally, a tourist submarine created an income of US$8.05 million, and a profit of US$1.05 million (Brock, 1994).

Artificial surf reefs (ASR) are coastal engineering structures that promise to enhance local biodiversity, provide coastal protection and improve surf wave quality (Rendle and Rodwell, 2014). One study using face to face interviews with seafront visitors assessed the economic benefits of the Boscombe ASR in the UK. They collected data on the expenditure spent per day in Boscombe, including parking, food, drinks and accommodation to evaluate the contribution of the ASR to the local economy. Their results show that surfers and other water users are low spenders for example do not stay overnight in general. However, more affluent non-surfer visitors were attracted to the area by marketing of it as a surfing resort which did bring in additional economic benefits though these were mainly felt by businesses in close proximity to the reef (Rendle and Rodwell, 2014).

9.4 Energy installations

The foundations for oil and gas platforms and wind turbines, as well as the associated infrastructure such as cables and rock armouring, also have the potential to serve as artificial reefs. The refuge effects may be further enhanced by the exclusion of some or all fishing activity from energy sites; it is generally considered to be impractical and unsafe to operate towed gears within offshore wind farm sites (Mackinson et al, 2006)

while, in the UK for example, section 23 of the Petroleum Act (1987) prohibits vessels from approaching closer than 500m from any part of an oil or gas installation.

There is a considerable, and growing, body of literature on the artificial reef effects of energy installations. This research shows that offshore wind farms may bring potential benefits to species of commercial and recreational importance, as evidenced by increases in the abundance of species including mussels, cod, pouting and eels (Bergström, Sundqvist and Bergström, 2013; Birklund, 2005; Bunker, 2004; Reubens et al, 2013a; Reubens, Degraer and Vincx, 2011; Wilhelmsson and Malm, 2008) site fidelity by commercial species (Reubens et al, 2013b; Winter, Aarts and Van Keeken, 2010) and the provision of nursery habitat for fish and invertebrates (Bunker, 2004; Leonhard et al, 2006; Reubens et al, 2013a; Winter, Aarts and Van Keeken, 2010). Similar results have been found for offshore oil and gas platforms (Fabi et al, 2004; Fujii, 2015; Jørgensen, Løkkeborg and Soldal, 2002; Scarcella, Grati and Fabi, 2011).

Ecological evidence for other species such as marine mammals, which are of importance to recreation through wildlife watching, has tended to focus on potentially harmful impacts particularly from noise during the construction phase. However, there have been studies that show increased mammal activity within operational offshore wind farms which has been linked to the refuge effects of improved foraging opportunities or increased shelter (Russell et al, 2014; Scheidat et al, 2011).

However, the evidence on whether these ecological effects translate into benefits for fisheries, recreation of other maritime sectors remains very scarce.

Benefits to fisheries

It has been suggested that an insufficient density of cod and saithe was present at offshore platforms in Norway to be of interest to commercial fisheries (Valdemarsen, 1979), although the design of this study is questionable. Conversely, another study estimated that a decommissioned platform (also in Norwegian waters) supported 12 tonnes of cod and saithe (Soldal et al, 2002). Both studies remain speculative, however, and do not document actual experience of fishers.

It has been reported that trawlers congregate at the edges of the exclusion zones around oil fields in Norway and Belgium (Osmundsen and Tveterås, 2003; Valdemarsen, 1979; Vandendriessche et al, 2013). However, it is not known whether this represented fishers attempting to exploit benefits from spillover effects resulting from the site acting as a refuge, or whether they were merely seeking to fish as close as possible to historic fishing grounds from which they were now excluded. In contrast, an Irish Sea trawlerman reported that his attempt to fish within an offshore wind farm had produced no marketable fish (Ashley, 2014). This anecdotal evidence does not allow robust conclusions to be drawn about benefits for trawl fisheries.

Static gear fishermen are expected to benefit more from the artificial reef effects of offshore energy structures than those using towed gear (Alexander, Potts and Wilding, 2013; Hooper and Austen, 2014). Mobile gears that drag the seabed are less compatible with energy infrastructure such as cables, due to the potential for the gear to snag resulting in loss or damage to both the gear and the cables. Of 46 crab/lobster fishers working out of ports on the east coast of England, 44% reported that they had set pots around the outside of an offshore wind farm, and usually also fished close to the cables (Hooper, Ashley and Austen, 2015). This would suggest that the fishers receive some benefit, but, again, changes to catches and incomes as a result of the artificial reef effects do not appear to have been documented.

Benefits to recreation and tourism

In the Gulf of Mexico, oil and gas platforms have long been a significant draw for recreational angling (Ditton and Auyong, 1984; Gordon Jr, 1993; Stanley and Wilson, 1989). Decommissioned rigs are considered a cost effective tool for fisheries

enhancement, which led to the establishment of "rigs to reefs" programmes and the conversion of over 330 platforms into artificial reefs for fishery use (LDWF, 2013; Reggio, 1987).

There is very little information on use of energy infrastructure by anglers in European waters, and what evidence does exist is usually self-reported during interviews or is anecdotal. During a consultation exercise for offshore wind in the UK, sea anglers expressed an expectation of some overall benefit to their sector but did not foresee large market demand (Mackinson et al, 2006). Two charter boat operators working in the Irish Sea reported an unsatisfactory experience and did not feel the site sustained the mature individuals that would attract anglers (Ashley, 2014). Recreational angling has been observed within Belgium's Thorntonbank offshore wind farm, although levels of use were variable and did not appear to be sustained over time (Vandendriessche et al, 2013).

A larger, more recent study (Hooper, Hattam and Austen, 2017) involved interviews with 199 recreational sea anglers in the UK. One quarter of those responding had already been angling within an offshore wind farm site, and 73% of those who had not would be willing to do so in future. The anglers recognised that artificial reef effects could occur around offshore wind turbines, and felt that their role as a "safe haven" for wildlife (particularly through the exclusion of commercial fisheries) was important. Catch success within offshore wind farms was mixed, with approximately equal numbers of anglers reporting that their catches had improved, declined or stayed the same. The species most commonly landed were bass, dogfish and cod and other whitefish. However, Hooper et al (2017) go on to suggest that the economic benefits that accrue to recreational angling from the refuge effects of offshore wind farms are unlikely to be significant. This is because anglers exploit offshore wind farms within their usual fishing areas but appear unwilling to travel in order to access an offshore wind farm site. The survey respondents were also unlikely to change their behaviour in response to new developments.

10 How to realise the benefits – cross-sectoral observations

Chapter summary

The chapter presents insights from the literature regarding synergies or mutual reinforcements between different blue economy sectors attributable to MPAs, SPMs and de facto refuges; conflicts identified to have occurred involving sector stakeholders and examples of how these situations have been overcome; and forms of governance and stakeholder engagement approaches which have proven successful in realising blue economy benefits, while at the same time safeguarding the conservation objectives of the sites in question.

Existing evidence related to *synergies* and *conflicts* between different blue economy sectors due to MPAs is still primarily anecdotal. There is a lack of evidence related to synergies between sectors, although this may reflect the relatively recent focus in this area rather than the absence of – or potential for – multisector benefits. Conflicts between sector-specific stakeholders resulting from MPAs have been noted between divers and fishermen, between different fishermen in open access areas surrounding no-take zones and between commercial fishermen and energy operators around de-facto refuges.

In addition to conflicts between sectors, evidence of conflicts between MPA objectives and different resource users illustrate that, although different local stakeholders often oppose implementation of MPA-related restrictions, their opinions can change as a result of being more actively involved, meeting MPA managers face to face or witnessing positive changes resulting from the site. Further, there is evidence suggesting that stakeholders' level of aversion to conservation measures may be influenced by demographic factors. In addition to improved engagement, evidence indicates that successful conflict resolution can occur through the adoption of different compensation schemes and zoning of MPAs to better accommodate different users' needs.

Most research related to conflicts discusses how conflict can be avoided through management and/or is affected by *governance* structures. By providing case examples from Europe and beyond, we illustrate the widely accepted idea that stakeholders need to be actively involved in MPA planning and management for the site to be successful – it can support more efficient MPA design and more effective enforcement and adherence to management results; overall increasing the likelihood that the potential economic benefits can be realised. Meanwhile, there is also evidence suggesting that achieving successful stakeholder engagement can be challenging in practice. This is for instance due to potentially unequal representation of all relevant stakeholders, structural limitations of who is allowed to engage in MPA decision-making and how, and the perception of the legitimacy of the designation and what users can expect from it.

The preceding chapters have outlined and analysed existing evidence on the different observed and potential benefits of MPAs and SPMs (including de facto refuges) to blue economy sectors in Europe. In this context, it is important to note that many factors – from site-specific to global – influence the effectiveness of marine spatial protection and thereby the realisation of potential economic benefits. Such factors include, for example, ecological dynamics at individual sites, regional fisheries dynamics, and the dynamics of and between other activities that depend on the ecosystems in question (Boncoeur et al, 2001).

In contexts where the above factors allow for economic benefits to occur, there are also a number of cross-sectoral and governance issues which influence the extent to which

benefits may be realised. In this chapter, we present insights from the identified literature regarding such cross-sectoral and governance aspects, specifically:

- Synergies or mutual reinforcements between economic sectors attributable to MPAs, SPMs and de facto refuges;
- Conflicts identified to have occurred involving sector stakeholders, and examples of how these situations have been overcome; and,
- Forms of governance and stakeholder engagement approaches which have proven successful in realising blue economy benefits, while at the same time safeguarding the conservation objectives of the sites in question.

10.1 Synergies and sectoral reinforcements

MPAs, SPMs and their surrounding areas are commonly used for a range of activities. Theoretically, synergistic effects – or "win-wins" – between different users may occur, for example, mussel cultivation in combination with offshore energy installations located in an MPA.

In this section, we assess the available evidence from Europe and any transferable insights from around the world of these types of synergies occurring between different users in and around MPAs, SPMs or de facto refuges. We also explore if any conclusions can be drawn regarding best practices for how to support such synergies.

10.1.1 Overview of the evidence base

We find very little evidence of how synergies or mutual reinforcements between multiple economic sectors linked to MPAs and SPMs are creating opportunities for the European blue economy. The existing findings relate primarily to job diversification opportunities from the establishment of MPAs, although the evidence base is largely anecdotal.

This lack of evidence on cross-sector synergies may reflect the relatively recent focus in this area, rather than the absence of – or potential for – multisector benefits.

10.1.2 Job diversification generating economic benefits

When certain activities are restricted from operating in an MPA while others are allowed to continue, changes may occur in the dynamics of the local economy which in some instances could be interpreted as synergies between sectors. A common argument linked to the establishment of MPAs is that they may provide an opportunity for local job diversification, especially from commercial fishing into different activities related to maritime tourism (see, e.g. Charles and Wilson (2009); Gómez et al (2006); O'Malley, Lee-Brooks and Medd (2013).

In this context, we have identified some evidence of fishermen diversifying into different tourism activities after the establishment of an MPA. Stakeholder interviews at Lyme Bay MPA in the UK by Hattam et al. (2014) show, for example, that some static gear fishermen successfully switched from commercial fishing to providing fishing trips for visitors (Hattam et al, 2014). Meanwhile, Jentoft et al. (2012) report that stakeholders in La Restinga in Spain, although initially sceptical, now see the MPA as an opportunity to diversify their livelihoods into tourism while still maintaining their traditional culture and identity (Jentoft et al, 2012). A study from the National Marine Park of Alonissos in Greece suggests similarly that synergies may be achieved among fisheries, tourism and the local community by increased involvement of fishermen in local tourism (Trivourea et al, 2011). The available evidence does not provide any quantitative information indicating the scale of benefits, or clarity regarding whether benefits are sufficient to compensate any losses that may be incurred due to restriction on fishing imposed by the MPA.

However, some research finds examples of MPA designation in Europe that has not led to successful job diversification (see e.g. Rodríguez-Rodríguez et al (2015).

In some regions in Europe, tourism is more socio-economically important than fisheries. A shift in the workforce towards more maritime tourism may therefore generate greater economic benefits to the local economy. However, there is not enough research of this linkage from Europe to be able to draw any conclusions.

While the above evidence should be considered as anecdotal, it suggests that the opportunities for job diversification depend considerably on the ecological and socio-economic dynamics of the site. Consequently, the literature finds examples that both support and contradict the hypothesis.

10.2 Conflict and conflict resolution

Restricting certain activities in a defined area of the sea is frequently met by opposition from those affected by the restrictions. Furthermore, in MPAs and SPMs, certain activities might be restricted while others are allowed to continue, (e.g. low-impact fishing or recreational diving). This can in turn create conflicts between or within different user groups due to changes in dynamics and competition. Globally, conflicts between stakeholders are believed to be one of the reasons for the high rate of MPAs failing to achieve their management goals (Hargreaves-Allen, Mourato and Milner-Gulland, 2011).

It is clear that the success of MPAs and SPMs, as well as the realisation of their potential economic benefits to blue economy sectors, requires a solid understanding of the nature of the possible conflicts, including when they occur, what trade-offs are involved and what can be done to avoid or alleviate them.

10.2.1 Overview of the evidence base

The different conflicts related to MPAs have been categorised in the literature as either internal (between users) or basic (between users and conservation) (Jones, 2001). We have identified examples of these types of conflicts from Europe and beyond and reflect on these in Sections 10.2.2 and 10.2.3 below. This evidence should only be taken as examples of the types of conflicts that might occur as the overall evidence base is not comprehensive enough to draw general conclusions.

There is also limited evidence showing how conflicts have been **resolved, or impacts of them mitigated or compensated for**. The evidence available primarily relates to how to avoid conflicts to occur by, for example, supporting the involvement of stakeholders in MPA management. A discussion on the role of management for economic benefits of MPAs/SPMs is presented in Section 10.3.

10.2.2 Internal conflicts – between resource users

Conflicts between fisheries and tourism interests

Some studies show that local residents perceive MPA designation as having contrasting impacts, for example compromising the interests of fishermen while benefitting those working in the tourism sector. These dynamics have been documented to create conflicts in some instances.

For example, by conducting a survey in the National Marine Park of Alonissos (Greece), Trivourea et al (2011) shows that, while most local residents feel that the park designation has significantly hampered the functioning of the fishery sector, 40% think that the tourism sector has benefitted. Most respondents believe that fishermen should be compensated for damages to their fishing gear caused by the monk seal – the species that the park has been established to protect.

Conflicts between fishermen and divers have also been noted elsewhere in the Mediterranean. For instance, at the Tabarca marine reserve in Spain established in 1986,

Badalamenti et al (2000) describe how a significant increase in the number of diving licenses following the establishment of the reserve generated opposition from local fishermen. As a result of this opposition, diving was restricted in 1993 and the number of licenses stabilised or declined slightly thereafter. The authors conclude in their study, which includes other similar examples from Spain, France, Italy and Greece, that planning and management of MPAs should be conducted as a multidisciplinary endeavour. They argue further that no single management model is valid equally for all of the Mediterranean, since the characteristics of its coastal areas vary greatly.

Conflicts among fishermen

When MPAs or SPMs impose restrictions based on for example gear type or vessel capacity, any benefits generated or costs incurred will impact differently on different fishermen and the nature of economic benefits generated will depend on the dynamics of the local fishing fleets.

The establishment of **MPAs having reduced pre-existing conflicts** is exemplified in two cases where removal of trawlers from an area has reduced the level of conflict for those fishermen using other types of gears permitted to continue fishing in the area (e.g. Mangi et al, 2012 and Whitmarsh et al, 2002; both of which are discussed below in more detail as well as in Chapter 6). Furthermore, in a recent modelling study by Xuan and Armstrong (2016) it is suggested that the introduction of an MPA could reduce conflicts between wild capture fisheries and aquaculture. The rationale is based on an assumption that aquaculture limits the growth rate of the wild fish stock because it uses wild caught juveniles as seeds for farming, thereby influencing commercial wild harvest. Although a modelling exercise, the numerical results of this study suggests that MPAs of a certain size and under optimal management conditions may in fact increase economic benefits for both fishermen and aquaculture farmers (Xuan and Armstrong, 2016).

As indicated in Chapter 6, we have identified some examples where **MPAs have created conflict**: where gear restrictions in an area have led to displacement and subsequent conflicts among different types of fishermen in other fishing grounds. For example, when towed gear fishing was banned in a 60nm^2 area of Lyme Bay MPA in the UK in 2008, the dynamics of the surrounding fisheries changed. Through interviews and surveys with different stakeholder groups, it has become evident that static gear fishermen who fish outside the closed area have experienced increased conflicts with the towed gear fishermen who were displaced and now fish regularly in their traditional grounds. Mangi et al (2012) report that the static gear fishermen feel they have been "sold out" by the closure, their revenues had decreased and their fishing experiences have worsened as a result. Another observation from the Lyme Bay closure is that recreational users of the site have ended up in conflict with the local mobile gear fishing community, as the latter feels underrepresented in the decision making process (Hattam et al, 2014).

Similar to the above, a trawl ban in Sicily has been documented to have resulted in the displacement of trawlers into the areas where artisanal fishermen operate. Although their revenues were still positive, the artisanal fishermen's catch rates in their usual areas were noted to be between one-half and two-thirds of those inside the trawl ban area. The fleet has adopted various adaptation behaviour to avoid the "crowding" resulting from increased presence of displaced trawlers, for example by travelling longer distances which led to higher costs of fuel (Whitmarsh et al, 2002).

Conflicts related to de facto refuges

Hooper et al, (2015) describe the conflicts between commercial fishers, seeking to exploit de facto reserves around offshore wind structures in the UK and the energy developers. They find developers reporting that fishers had engaged in behaviours that deliberately obstructed or purposely hindered operation and maintenance activities. In turn, fishers reported that the maintenance activities carried out by the energy developers had

resulted in their gear being displaced or lost or that their fishing effort had been disrupted by the need to move gear in advance of scheduled maintenance.

The interviews with both commercial and recreational fishermen (Hooper et al, 2015; 2017) also demonstrated that effective governance is essential if the economic benefits from de facto refuges around energy structures are to be realised. Access rights and issues of safety, liability and insurance were key factors in the reticence of fishers to exploit the de facto reserves around offshore wind infrastructure. Improved consultation and communication between the energy and fishing/angling sectors has been identified as the principal mechanism by which the refuges around energy structures could be better exploited for economic benefit. Licenced, as opposed to open access, fisheries were also identified as a mechanism by which accountability and liability would be more transparent as well as enhancing opportunities for engagement and dialogue (Hooper et al, 2015).

In studying artificial reefs in Hawaii, Brock (1994) calculated that the economic benefit to dive operators exceeded that of fishermen by an order of magnitude. He also suggests that there is a potential conflict between fisheries and dive operators: fishing and angling removed fish unsustainably and this may have an impact on the experience that divers and submarine tourists will have if large fish are removed at such levels. This is expected to then impact the dive operators' revenue and so it is suggested to protect the artificial reef through the designation of Marine Life Conservation District which would prohibit the capture fishery. The study offers no suggestion as to how to compensate the fishermen.

10.2.3 Basic conflicts – between resource users and MPA objectives

Conflicts between MPA objectives and blue economy resource users have been identified in relation to, for instance, expansion of blue economy activities into MPAs (such as expansion of a port and a marine wind power park into a marine Natura 2000 site in Sweden (Stepanova, 2015)). Although there are many examples of different local stakeholders opposing the implementation of MPA-related restrictions, examples in the literature can also be found where, once sites have been established, the feared negative impacts to stakeholders have not emerged (Alcala et al, 2005; Kerwath et al, 2013). Trivourea et al (2011) argue that management deficiencies, bureaucratic delays and lack of compensatory measures result in most local residents believing that the MPA in Alonissos (Greece) does not benefit the economic and social development of the island. However, when looking at the available data the authors find an increase in public infrastructure, number of tourists, local bank deposits and banking activities of foreign visitors after designation, which all suggest a benefit to the tourism sector (Trivourea et al, 2011).

Similarly, there are studies suggesting that initial opposition towards the designation can change. For example, the experiences from partial closures in combination with collaborative and adaptive co-management between key stakeholders in Torre Guaceto in Italy, as previously mentioned, show that fishermen's scepticism towards scientists has been alleviated by incorporating fishermen's input. According to Guidetti and Claudet (2010) this approach can be one of the most important criteria for successful fisheries management. In another case, Boubekri and Djebar (2016) find that artisanal fishermen expressed strong opposition to the establishment of an MPA in Taza, Algeria, but that they became much more favourable to it after some of them were invited to visit the Scandola Marine Reserve in France, where they learnt from the experience of local French fishermen.

Also Jentoft et al (2012), Leleu et al (2011) and van de Walle et al (2015) find similar examples of stakeholders initially sceptical towards MPA designation and later changing their views as a result of becoming more actively involved, meeting MPA management representatives face to face and witnessing the positive changes within the wider community.

While the literature suggests that initial stakeholder perceptions are not set in stone, Dimech et al (2009) argue that, while a new management action or tool may change fishers' short-term behaviour, fishermen may defy the new management and revert to their traditional behavioural patterns if the management is not accompanied by changes in fishers' perception and social norms. This regress could compromise long-term fisheries sustainability. The authors go on to argue that fishermen are more likely to comply with management measures and persuade others to do so if they have been consulted in the design and implementation of the site.

We also identify an example of fishermen's length of experience fishing in an MPA as a factor affecting their level of acceptance towards the implementation of conservation measures. Leleu et al (2012) study the opinions of local fishermen towards the two no-take zones in the Parc Marin de la Côte Bleue in France. The authors find that fishermen who have been fishing in an MPA for a shorter period (based on number of days the fisherman has operated in the MPA) express more positive perceptions about the no-take zones and spend more time fishing close to the MPA boundary to benefit from spillover, than their more experienced colleagues. Martin et al (2016) reached a similar conclusion when studying the acceptance and awareness of an Australian MPA (Port Stephens-Great Lakes Marine Park) by 79 recreational fishermen using the MPA (using anonymous questionnaires). They found, for instance, that fishermen who had used the site for more than 20 years were five times more likely to oppose the MPA than those having fished the site for less than 20 years. Further, a majority of fishermen who opposed the site where over 55 years of age (Martin et al, 2016).

10.2.4 Conflict resolution

While some evidence suggests that initial opposition might fade with time, with growing knowledge about a site (and its potential costs and benefits) or with increased responsibility in site management, other studies suggest solutions to resolve conflicts between users and conservation and between user groups.

The two conflicts occurring between MPA objectives and different blue economy sectors at the Swedish marine Natura 2000 Torsviken, as mentioned above, shed some insights as to how such conflicts may be resolved. Firstly, in the case of the Port of Gothenburg expanding into the site, a temporary resolution to the subsequent conflict was met through an open forum dialogue with stakeholders led by an external moderator. Following negotiations, the port expansion was stopped and compensatory habitat creation initiated. As it had proven successful in the previous case of conflict, the same approach was taken when a new conflict arose due to suggested expansion of wind energy in the area. This time, however, the stakeholder constellation and power relations were different and the resolution failed and was settled in court. These findings highlight the importance of adopting a combination of formal and informal resolution strategies, the role of successfully combining and complementing different types of stakeholder knowledge, achieving joint learning and the importance of power imbalances among stakeholders for conflict resolution (Stepanova, 2015).

Conflicts between users may be indirectly resolved by one party choosing to, or being necessitated to, adopt a new behaviour. The study by Whitmarsh et al from 2002 illustrates how fishermen outside an Italian trawl ban area adopted various adaptation behaviour to avoid the "crowding" resulting from increased presence of displaced trawlers, for example by travelling longer distances. This resulted in higher expenditure on fuel as proportion of total costs among outside fleets than those fishing inside the trawl ban. Fleets operating in waters to which trawling activities where displaced also spent fewer days at sea per year, on average, than at other ports. Based on interviews with fishermen, the authors explain this as a 'crowding out' effect caused by the presence of trawlers.

Sala et al. (2016) suggest that fishermen's concerns can be addressed with an "appropriate business plan" which includes various financing mechanisms. Fishermen can

be compensated for any loss incurred, as it is done for example in the Great Barrier Reef Marine Park (Jones et al., 2011). In some cases, compensation can be funded using revenues produced by the tourism sector (e.g. through taxes and fees). As an example, Sala et al. (2016) modelled the functioning of a hypothetical MPA, using data from the Medes Island Marine Reserve (Spain). They show that, assuming that all eco-tourists pay a fee (actually only scuba-divers do) the generated revenues would allow 1) fishermen to be compensated for their reduced income, potentially increasing the social acceptance of the MPA; and 2) the costs related to the establishment of the reserve and part of the management costs to be covered. In their model, the increase in the tourism value (including the existing fee per dive and the consumer surplus, i.e. the additional amount that visitors would have been willing to pay for those dives) is anticipated to more than compensate the short term loss of income to the fishery sector. The model also shows that the negative economic impact on the fishing sector is only temporary, due to the improvement in fish populations allowed by the increased protection afforded by the MPA.

In the Soufriere Marine Management Area (SMMA) in St Lucia, MPA managers have been able to achieve compliance with the MPA regulations by offering a compensation of US$150/month for a year to 20 of the fishers who were considered to be the most dependent on fishing for food and income. This allowed stocks time to replenish within the closed areas and provided fishermen time to witness the benefits of the area. After the initial year, the fishermen could start benefiting from the spillover from the protected sites (Lutchman, 2005).

The revenues generated by MPAs to maritime tourism and related sectors can provide additional livelihood opportunities for local communities and potentially help compensate for any negative economic impacts that might have been incurred on the fishery sector. In some cases, the scale of income generated by maritime tourism is comparable with – even bigger than – the one by fisheries. For example, Merino, Maynou and Boncoeur (2009) calculate that in the Medes Islands Marine Reserve, revenues from touristic activities are one order of magnitude higher than revenues from fishing.

In order to avoid conflict, the EMPAFISH project in 2008 recommended to clearly separate the areas of an MPA where recreational activity and artisanal fishing take place, as the negative impact of fisheries on habitats where ecotourism is a paramount activity can adversely affect recreational activities, both in terms of frequentation and economic profits.

In the Os Miñarzos Marine Reserve of Fishing Interest in Galicia, fishermen need to register in a census in order to have the right to fish in the MPA. Membership is conditional on fishermen spending a minimum number of days per year spent fishing in the area. In the beginning of the scheme, a large number of neighbouring fishermen signed up to the register to keep their fishing rights. Over time, however, fishermen from ports further away found it increasingly complicated to make the effort, hence allowing local fishermen to benefit from reduced competition for fishing opportunities in the MPA. This indirect allocation of fishing rights was intended to cause less conflict than directly giving user rights to local fishermen. However, initially, the introduction of the census was the most controversial in the set-up of the MPA, causing opposition from fishermen from neighbouring ports (Perez de Oliveira, 2013).

In cases where major conflicts occur in the early stages of designation of MPAs, e.g. where collective action problems are severe, Jones and Burgess (2005) argue that it is often appropriate to adopt a top-down government approach in order to find a solution. Presenting a preliminary analysis of 15 case studies of inshore MPAs in the UK, the authors find that it is not always true that local initiatives are necessarily better than centralised ones for achieving conservation objectives and that they could even undermine the potential for cooperation.

10.3 The role of governance

MPAs and SPMs will not achieve their objectives or contribute to potential economic benefits to blue economy sectors without effective implementation and enforcement of the measures required to reach their set objectives. Internationally, this is a considerable challenge as there is no global enforcement body to help ensure that nations deliver on their commitments. The EU is therefore a particularly interesting arena for pursuing sustainable blue growth. The EU policy framework applies an integrated, ecosystem-based and systematic approach to ocean governance, guided by principles of precaution and adaptive management. Perhaps most importantly, however, the EU collaboration offers supra-national enforcement mechanisms and the influence this imposes on achieving Union-wide commitments on ocean management.

The implementation and enforcement of EU-wide legislation and policy are ultimately in the hands of individual Member States. When it comes to management of MPAs and SPMs and enforcement of any rules imposed, it is the site-specific, local and regional scales that are responsible for securing effective outcomes.

Here we explore the existing evidence of the forms of governance and stakeholder engagement that influence and optimise the realisation of blue economy benefits related to MPAs and SPMs. Where possible (i.e. when the evidence base is sufficiently robust) we analyse individual findings, discuss the success of individual approaches, and identify transferable lessons and general guidelines. Bearing in mind that a large proportion of MPAs in the EU are considered to lack efficient management, any lessons learnt regarding successful governance solutions are important.

10.3.1 Overview of the evidence base

The literature identified discusses governance and management aspects at different levels. It is roughly divided into seminal pieces presenting wider guidance/lessons learnt, and research from individual sites or regions in Europe where either effective management (or lack thereof) is discussed as an important aspect of achieving blue economy benefits, or different management solutions that have been particularly successful in achieving blue economy benefits are illustrated.

10.3.2 Governance and stakeholder engagement to optimise blue economy benefits

It is widely accepted that in order for MPA management to be successful in the longer term, stakeholders need to be actively involved in the process. Furthermore, management needs to be adaptive towards changing environmental and social contexts (see e.g. Álvarez-Fernández et al (2017); Badalamenti et al (2000); (Bennett and Morris, 2017a); Camargo et al (2009); Ferse et al (2010); Lundquist and Granek (2005); Taylor and Buckenham (2003)).

For example, when assessing the factors contributing to success in 26 Mediterranean MPAs, Di Franco et al (2014) show that the most important variable determining high values of success of artisanal fishing management in MPAs is the level of fishermen engagement in management practices. Also Batista and Cabral (2016), studying 134 MPAs in Portugal, France and Spain, establish that high MPA effectiveness levels are associated with high stakeholder involvement in MPA processes, even for MPAs were fishing restrictions are in place. In 2016, Di Franco et al published another study, this time establishing the link between MPA attributes and their economic effects to fishermen. The authors show that fish stocks targeted by small-scale fisheries within 25 Mediterranean MPA buffer zones are healthier, fishermen incomes are higher and the social acceptance of management practices is fostered in the presence of five main attributes. These were established based on a literature review and through interviews and include:

- High MPA enforcement;

- Presence of a management plan;
- Fishermen engagement in MPA management;
- Fishermen representative on the MPA board, and
- Promotion of sustainable fishing.

Alvarez Fernandez et al (2017) arrive at a similar conclusion, based on interviews with 57 managers of MPAs in the North-east Atlantic (located in Spain and the UK). MPAs with the highest ratios of fulfilment of the objectives stated in their management plans are those with stakeholder involvement and where MPAs have been designed following a bottom-up approach. In another recent example, WWF-UK and Natural England developed a toolkit under the UK SEAS project for effective MPA network management, based on desk research and interviews with key contacts. A key conclusion from the study was that the costs to relevant public authorities for MPA management in the absence of local partnerships would be greater than the contributions made to existing partnerships. The primary value of local partnerships was found to be their detailed understanding of local issues and their networks with, and engagement of, local stakeholders (Bennett and Morris, 2017b).

In order to illustrate this further, the following examples (and Box 7) have been identified to showcase particularly successful management and implementation.

- **Belle-Île Natura 2000 Special Area of Conservation (SAC), France**: van de Walle et al (2015) show the role of Fisheries Local Action Groups (FLAGs) (established under the European Fisheries Fund) in establishment of an MPA. In 2010, the previous one-nautical mile from the coast marine designation was expanded to cover up to three nm in some places, with potentially greater impacts on the local fisheries. FLAG funding was used to coordinate collaborative design of the new site together with local fishermen through initial consultation. The resulting list of proposed measures included several examples of increased control on fisheries, as well as suggestions to introduce pesca tourism. Van de Walle et al conclude that the project led to new dynamics between fishermen and environmental managers, and that, although fishermen were hesitant at first, meeting different stakeholders face-to-face allowed them to highlight their priorities and gain understanding of the process. Overall, fishermen gradually became more interested in the sustainable management of the area. The authors argue that the fishermen appear more comfortable in imposing stricter regulations on themselves rather than having such restrictions imposed by someone else. Finally, the study shows that fishermen in the region explore ways to capitalise on the MPA by seeking support to develop a promotional labelling scheme, although the study does not follow up on whether or not this has been implemented.
- **Torre Guaceto MPA, Italy:** Another example is the research presented in 2010 by Guidetti and Claudet mentioned in Chapter 6, showing the results of an experiment that they have conducted together with local fishermen in the Torre Guaceto MPA in Italy. The aim of the experiment was to illustrate how commercial fishing and conservation objectives can co-exist. Between the years 2000 and 2005, the entire Torre Guaceto MPA was an effectively enforced no-take zone protected from all extractive activity. The authors opened a zone for fishing under strict conditions agreed together with local fishermen and allowed four boats (40-50% of the original fleet) to fish with trammel nets inside the MPA once per week for four years. Although it declined initially, CPUE stabilised after three years at a level more than twice as high as that achieved in surrounding, unprotected areas (Guidetti and Claudet, 2010). Since this study was conducted, the project has continued and more recent results (based on data from 2012-2013) have shown that the new catch levels have remained at this level over time. Based on their experiences in Torre Guaceto, Guidetti and Claudet conclude that effective enforcement; determination that fish density and size are increased before fishing

can be resumed; and an adaptive co-management plan are required in order to successfully enable an MPA to provide on-site benefits for fisheries. Further, MedPAN conclude in their subsequent case study that other benefits with this approach have been that fishermen have been educated about sustainable fisheries management and that the process has also improved the dialogue and cooperation between the MPA manager and the local fishermen.

- **Future marine protected area of Taza National Park, Algeria:** A good example of a participatory approach to the designation of an MPAs is provided by the marine section of the Taza National Park in Algeria, which is being planned using a multi-use management approach combining conservation and sustainable use (Boubekri and Djebar, 2016). A consultation process consisting of public meetings, hearings and inquiries was carried out between 2009 and 2011, involving relevant stakeholders (the project working group, experts, scientific researchers, fishers associations, municipalities, NGOs, the local population and the press). It resulted in seventeen activities being allowed or prohibited within three differentiated zones. The Park authorities involved representatives of local stakeholders and authorities in the development of the Taza MPA management plan through the foundation of a Steering Committee. The Committee was led by the Governor and provided technical guidance and supported the planning team. It is hoped that this participatory process will favour long term commitments during the implementation phase of the MPA.
- **Marine Protected Areas to support small-scale artisanal fisheries in Morocco:** A Plan Bleu report by Sauzade and Rousset from 2013 shows how MPAs have been recognised as fisheries management tools in Morocco. Through a national initiative, MPAs are being established in full cooperation with small-scale artisanal fishermen with the aim to protect some critical habitats and stocks from destructive fishing practices, at least during part of their life stages (such as around breeding grounds and nurseries). The expected benefits to fishermen are increased biomass in waters surrounding the MPAs (Sauzade and Rousset, 2013).
- **Network of no-take reserves in Nabq, South Sinai, Egypt:** The Nabq Natural Resource Protected Area, in the Egyptian Red Sea, is a success story, partly due to the involvement of local fishermen in the designation and management of the MPA. A multi-use MPA was created in the area in 1992, followed by five no-take zones in 1995. The estimates of reef fish abundance carried out by Galal et al (2002) in 1995, 1997 and 2000 through underwater visual census and analysis of fishermen's catch and effort showed an increased abundance of key fish populations and an increase in catch per unit effort of local fishermen. The authors argue that the involvement of the local Bedouin community and of local, artisanal fishermen was key to the success. Local fishermen and community leaders have been involved in discussions about the design of the MPA, which resulted in their support of new fishery regulations, including a ban on the use of destructive. When the creation of no-take zones was considered, local fishermen were involved in the decisions regarding their number, location and size though a number of community gatherings, and were allowed to suggest where to place the no-take zones. Furthermore, local Bedouins were employed as community rangers to carry out management work in the MPA, fostering a sense of ownership and providing alternative livelihood opportunities.
- **Pulmo National Park, Gulf of California, Mexico:** Aburto-Oropeza et al (2011) argue that the success of Pulmo National Park (a no-take area in the Gulf of California, Mexico) can be partly explained by social factors including strong community leadership, social cohesion, effective self-enforcement by local stakeholders, and community support. This no-take zone is reported to be the only one that is well enforced in the Gulf of California and the increase in fish biomass

inside the reserve following designation is said to be the largest measured in an MPA worldwide. According to the authors, this is partly due to a model of locally managed protected areas and stakeholder buy-in, which has resulted in the widespread support of the local community. In the Park, local communities participate in different management activities including surveillance, fauna protection and beach and sea cleaning. This approach creates robust social bonds within the communities, successful management, as well as increased local livelihoods (the recovery of fish biomass inside the reserve is said to have resulted in significant revenues for the tourism sector in the local community).

Box 7. **The Marine Reserve of Fishing Interest of Os Miñarzos – a case of bottom-up designation and management**

To address overfishing and illegal fisheries, the fishermen's association of Lira, a small fishing village in North Western Spain, with a population of 1000 inhabitants, proposed the creation of the Os Miñarzo Marine Reserve of Fishing Interest (OMMRFI), in collaboration with biologists, social scientists, environmentalists and the autonomous government of Galicia.

The OMMRFI covers 21 km^2. It is a multi-use MPA that includes two no-take zones (6.75% of the reserve). It aims to protect both fisheries and biodiversity, with the emphasis on the former. The two no-take zones have been created to preserve spawning and breeding grounds, in order to allow larval and juveniles export to the fishing areas.

The MPA design process was a bottom-up initiative. Rather than responding to a legal obligation or a conservation objective, it was proposed by the fishery community, which created a partnership with a team of biological and social scientists from the Coruña university. The idea of creating a MPA resulted from conversations between fishermen and researchers. The former were worried about the declining state of the fishing stock, and the latter suggested a MPA as a managing tool.

One of the reasons for the success of the process was the key role of a local anthropologist, who chose not to use a language that is normally associated with environmental conservation. It was called Marine Reserve of Fishing Interest, rather than an MPA. This made it clear that its priority would be to support fishing activities. In addition, two fishermen from a successful MPA in the Canary Island were invited to discuss their experiences with the fishers of Lira, which was key in overcoming the initial scepticisms of some of the fishermen.

The process of creating the OMMRFI was highly participatory. It involved the creation of a working group to facilitate a dialogue among different stakeholders, and benefitted from the support of a local NGO, Fundación Lanxanet, and an international one, WWF/Adena.

The reserve is managed by a body comprising four members of the government and four representatives of the fishing sector. The management body is fully independent in the administration of the MPA, regulation of the different kinds of uses and enforcement activities.

The inclusion of fishers in the decision- making process and the use of their ecological knowledge in the design of the reserve resulted in the MPA being effective with a high degree of compliance, at least in the first years. After that, the reduction of funding for enforcement activities reduced the effectiveness of the reserve, showing that an adequately funded governmental enforcement capacity is key even in MPAs with a high level of participation and governance.

Source: de Oliveira, 2013

Finally, Jones et al (2011) explore different approaches to the governance of MPAs across 20 case studies at the global level, analysing related advantages and challenges. Based on their findings, the authors suggest that an MPA requires an appropriate combination

of three governance approaches, based on the institutional context, the economic situation and the characteristics of the site. These three approaches are:

- **Top-down management**, based on state control through laws and other regulations**;**
- **Bottom-up management**, through community-based governance and decentralisation;
- **Market incentives** to support livelihoods that are compatible with environmental protection, to provide compensation to stakeholders whose economic interests are impacted by MPA designation, etc.

Box 8 provides a summary of the different governance models they defined, based on the prevalence of one or more of these approaches.

Box 8. **Different approaches to MPA governance**

1. **MPAs managed primarily by the government under clear legal framework.** This includes objectives, restrictions on different uses, jurisdictions and responsibilities of different governmental bodies, rights and obligations of the public, and, in some cases, some participatory mechanisms. This approach is particularly appropriate for more economically developed countries with strong state-federal governance frameworks. These MPAs tend to mostly rely on regulation, but in some cases, they also use economic incentives. Examples in the EU include Darwin Mounds candidate Special Area of Conservation, North-East Kent European Marine Site, and Wash and North Norfolk Coast European Marine Site, all in the UK. A challenge of this kind of governance structure is the fact that the managing responsibilities is under different jurisdictions, thereby requiring cross-sectoral and cross jurisdictional coordination and integration, which may be difficult to achieve. The implementation of marine spatial planning processes and an increase in participation can improve the overall effectiveness and efficiency of the MPA management.
2. **MPAs managed by the government with significant decentralisation and/or influences from private organisations;** including lower levels of government, NGOs and private entities. These kind of MPAs are managed in accordance with formal regulation and/or through partnerships and negotiations between different parties. In many cases, economic incentives are used to improve effectiveness. This approach is mostly used in less economically developed countries with a degree of commitment to conservation but weak state capacity. Frequent weaknesses of this kind of management are the lack of governmental involvement to address environmental degradation and the lack of appropriate incentives to improve fairness and equity in the sharing of benefits provided by MPAs. The authors did not find an EU example of this kind of approach among their twenty case studies.
3. **MPAs managed primarily by local communities under collective management arrangements (community-led)**. In this type of MPA, local institutions such as local fishing cooperatives are allowed to determine the MPA managing rules. External organisations (e.g. government departments and NGOs) tend to play a key role in supporting such community initiatives and making sure the management arrangements are compatible with existing fisheries and biodiversity conservation objectives and obligations. In many cases, economic incentives are used to promote community ownership. This kind of MPA tends to be vulnerable to changes in the political and economic environment (e.g. a decrease in price of products and services coming from MPAs or increasing pressure from corporate tourism interests). There may also be equity concerns as regards benefit sharing with stakeholders outside the community. One example is the Os Miñarzos Marine Reserve of Fishing Interest in Spain.
4. **MPAs managed primarily by the private sector and/or NGOs granted with property/management rights (private-led).** In this kind of MPA, non-governmental or private organisation are granted permanent property rights or temporal management rights, and are asked to fulfil conservation and resource management responsibility. They often work together with public organisations. As in the previous category, a possible weakness of this kind of approach is vulnerability to changes in the political and economic environment (e.g. changes in the land lease and management agreements entrusted to companies or NGOs; changes in the

political will to support enforcing of conservation rules). Economic incentives are used to promote effective governance. There are no examples from the EU of this kind of management arrangement among the twenty case studies analysed by the authors.

5. **No clearly recognisable effective governance framework in place.** In this kind of MPAs, effective governance structures are lacking, due to a lack of political will, leadership and capacity. In these cases, incentives are not often applied. An EU example is Cres-Lošinj Special Marine Reserve (Croatia).

Source: (Jones et al, 2011)

10.3.3 Improving the dialogue between blue economy sectors and MPA managers

In line with the above findings, results by Mangi et al (2012) show that increased management of both the closed area in Lyme Bay, UK, and its surrounding open access fishing grounds is likely to gain support among all stakeholder groups as long as they can engage with the decision-making process that introduces new management measures. However, engaging all relevant stakeholders and ensuring their fair representation can be challenging. Based on their experiences from Lyme Bay, Rees et al (2013) argue that this is particularly difficult in local level decision making. The authors emphasise that workshops and forums for collaborative MPA management risk being influenced by particularly powerful or vocal individuals or groups, while the relative influence of these stakeholders may be disproportionate to the economic importance of their activity. As has been indicated in previous sections, the socio-economic importance of marine nature-based tourism to the local economy can often exceed that of professional fishing (especially in the Mediterranean as previously mentioned, but see also Ruiz-Frau et al (2013) presenting an example from Wales, UK). In an example from a multi-use MPA in Tanzania, Barley Kincaid, Rose and Mahudi (2014) find, by interviewing fishermen, that involvement in MPA-related policy and management had little impact on the level of support for the joint management goals of conservation and sustainable fishing. Fishermen that were more actively involved were less supportive of both the location of the site and of the idea of fisheries and conservation synergies. However, the authors believe that more detailed survey methods would have revealed that this reflected the *type* of involvement rather than involvement per se. For example, more supportive fishermen were more involved in planning and execution of management plans, whereas less supportive fishermen were more recipients of, for example, attempts to replace gear.

Furthermore, Verweij and van Densen (2010) find that much time in multi-stakeholder settings is lost due to diverging opinions, because of repetitive discussions mainly about the relative importance of 'nature' versus 'man'.

In an illustration of the widely diverging opinions among MPA stakeholders, Pascual et al (2016) explore stakeholder perceptions about the socio-economic implications of MPAs in the Mediterranean and the Black Sea (see Box 9) by conducting online questionnaires with key stakeholder groups. The authors stress that there is currently limited understanding about these perceptions and that existing evidence is limited to only a few geographic areas. Pascual et al claim, and appears to be, the first and only study to explore socio-economic aspects of MPAs in the Black Sea.

Box 9. **The perception of relevant stakeholders on the socio-economic impacts of MPAs – Insights from the Mediterranean and the Black Sea**

By conducting an extensive literature review and an online survey with local MPA stakeholders, Pascual et al (2016) find a variety of different perceptions in

the Mediterranean and the Black Sea regarding the socio-economic impacts of MPAs. With particular relevance to blue economy sectors, the authors find that some stakeholders in the Black Sea felt MPA impacts were very negative to industrial fishing. Overall, responses regarding MPA impacts on a range of activities were systematically shifted towards a more negative opinion compared to those from the Mediterranean. Interestingly, however, respondents from both regions expressed clearly positive impacts of MPAs on tourism, recreational and cultural activities.

The authors cite existing literature suggesting that opposition and negative perceptions could be overcome by successful stakeholder engagement from the start of the MPA designation process, to allow stakeholders to develop a sense of stewardship, ownership and responsibility.
Source: Pascual et al (2016)

According to Hattam et al (2014), the governance of spatially protected marine areas (including the institutions with whom key stakeholders interact and how this interaction occurs) will influence the perceptions of stakeholders about the legitimacy of spatial protection measures. The authors argue that **perception of legitimacy is one of the most important aspects for the success of MPAs** (Hattam et al, 2014). Perceptions of the reasons behind designating sites and what stakeholders can expect to happen as a result are also important, according to Jones (2008). Based on interviews with fishing industry representatives in south west England, the study argues for the importance of transparency regarding the role of MPAs (e.g. that no-take zones are intended to achieve biodiversity benefits) and the uncertainty regarding potential sector benefits (such as spillover of fish from the site). The study recommends justifying sites on an "objective, rational basis rather than on a subjective, precautionary basis". In 2013, Roberts and Jones published another study from the UK where the success of the North East Kent European Marine Site is ascribed to demonstrating to the local authority and businesses prior to site designation that it would bring economic benefits to stakeholders, primarily related to eco-tourism. Initially, these stakeholders were negative to the proposed designation and concerned that it would further limit economic development in the already economically deprived region. The concept of economic development in tandem with conservation has contributed to a growth in "green tourism" with people visiting the area to view the natural environment in relation to the MPA (Roberts and Jones, 2013).

Environmental Impact Assessments (EIA) are one of the few conventional and broadly accepted tools which are used to identify potential costs and benefits of proposed developments as well as spatial conservation measures, and could thereby help clarify to stakeholders what they can expect from designation. With EIA, benefits are not necessarily assessed in monetary terms but can include quantitative and qualitative indicators. National law and political processes often require economic impact assessments to inform designation decisions (e.g. in the UK) and these often find it difficult to account for non-monetary values and to value market and non-market benefits (as seen for the English Marine Conservation Zone Impact Assessment by Defra (2015), discussed in Section 5). This is problematic, particularly as support for protection of sites among local communities and stakeholders can be largely determined by the availability of projected monetary costs and benefits (Pantzar, 2014). As we illustrate in Chapter 5 of this report, fair representation of economic benefits of MPAs and SPMs in impact assessments and cost-benefit analyses remains a considerable challenge in Europe and beyond.

Considering the relative consensus emerging from the literature on the need for stakeholder engagement in management, we find interesting insights in the Mediterranean indicating that achieving this remains a structural challenge across the establishment and management of MPAs. Di Franco et al (2014) study 26 MPAs in the Mediterranean and point out that co-management is still primarily "a vision rather than a reality". The study argues that no "real" co-management is yet in place in the Mediterranean, as the legal framework rarely allows fishermen, for instance, to have any formal power in MPA decision making. The only identified exception to this rule is France where a law adopted in 2006 allows fishermen to have representatives on governance bodies of natural marine parks. Another reason according to Di Franco et al is the traditional top-down decision making process in Europe. A similar point is made by Boubekri and Djebar (2016) in an article discussing the most frequent governance problems in Mediterranean MPAs. The authors suggest that the most common issue is the involvement of various ministries with different responsibility, resulting in a lack of coordination and co-operation from other stakeholders.

11 Gap analysis

The chief observation of this review is that **the evidence base on blue economy benefits of MPAs and SPMs is still limited**. The currently available evidence is dominated by literature on the economic benefits to maritime tourism and artisanal fisheries. No evidence could be found to show economic benefits generated to "other" blue economy sectors in Europe.

Further, and partly as a consequence of this evidence gap, **the distribution of benefits and their relative scale compared to costs remains poorly understood**. It is an important gap, as benefits are likely to be of a more diffuse nature and accrue to a number of different stakeholders over time, while costs incurred are likely to be immediate and more concentrated to specific stakeholder groups (Hattam et al, 2014).

The existing evidence is **highly concentrated geographically**, primarily for the Mediterranean Sea and the North-east Atlantic Ocean. Notably, no evidence fitting the criteria of this review has been found from MPAs or SPMs in the Baltic Sea, and only one study from the Black Sea. While significant research has been conducted in the Baltic Sea regarding, for instance the value of marine ecosystem services (see e.g. BalticSTERN Secretariat (2013); Swedish Agency for Marine and Water Management (SwAM) (2015)), no evidence has been identified as to the links between such values and MPAs or SPMs. The evidence gap from the Black Sea has, as mentioned in this report, been highlighted by many previous authors.

One study from **European OCTs/ORs** has been identified, looking at tourism benefits of the Saba Marine Park (Buchan, Framhein and Fernandes, 1997). This study was conducted twenty years ago and illustrates a significant gap in evidence of economic impacts of MPAs, SPMs and de facto refuges from European OCTs/ORs.

Existing evidence related to **synergies and conflicts** primarily contains a number of indicative examples. There is considerable lack of information in the evidence related to synergies between sectors, although this is likely to reflect the relatively recent focus in this area rather than the absence of – or potential for – multisector benefits. In addition, from a European perspective, few studies have looked at conflicts and changing relationships across the full range of stakeholder groups of temperate MPAs, but rather of specific groups in particular cases (Hattam et al, 2014).

There are a **number of factors which may explain the lack of research** of the blue economy benefits of MPAs. These include the limited time that many MPAs have been in place for; greater importance being placed on understanding costs; and emphasis on non-market rather than market benefits.

Many European MPAs have only recently been designated and many are still without management plans. Where management is in place, insufficient time may have passed for meaningful environmental change and/or for impact evaluation research to have been conducted. Preconceived ideas regarding the costs and benefits of MPAs (and hence the commonly held position of many stakeholder groups to oppose planned MPAs – see Section 10) can result in research effort focussed on MPA costs – either to support or to placate MPA opposition. To date, most research effort has been to understand the ecological effects of MPAs, and this evidence base is only recently emerging as robust enough to support research to translate those ecological changes into economic evidence. The mainstreaming of ecosystem service assessments and the concept of Total Economic Value, may have shifted research focus away from market benefits (e.g. potential fisheries benefits) towards non-market benefits studies as these are seen to be the more significant (as shown in Section 5).

Finally, as a follow-up to this study and to further improve the understanding of economic benefits of MPAs, SPMs and de facto refuges, it would be relevant to assess the identified body of modelling literature to, for instance, determine the extent to which the

most relevant studies are supportive of, or contradictory to, the findings of the preferred evidence sources of this study.

11.1 Fisheries and aquaculture

Two significant gaps in the literature are whether MPAs and SPMs in the Black Sea or the Baltic sea have provided any economic benefit to the sector, and whether the MPAs and SPMs across Europe (or internationally) have provided any benefits to the aquaculture industry.

- There is a need for research to explore the potential for benefits in the Black Sea and Baltic sea, and
- There is a need for research into whether aquaculture can benefit.

Research to-date has principally focussed on no-take zones – MPAs that exclude fishing. There is a need to improve the understanding of benefits to fisheries from multi-use MPAs and SPMs, to complement the body of literature studying effects surrounding "no-take" zones. The nature of MPAs in Europe, with only a small proportion of the total MPA area closed from fishing, suggests that there is a significant evidence gap here. Much of the existing evidence base infers likely economic benefits for fisheries on the basis of evidenced ecological improvements. Where empirical research has been undertaken, a majority of it is on spillover benefits for a relatively small number of commercial species, principally lobsters.

- There is a need for more empirical research into economic benefits, for example based on logbook data of landings and revenue over time with the adoption of appropriate counterfactuals.
- There is a need for research into economic benefits of multi-use MPAs, as these are the dominant type in Europe.
- There is a need for a broader analysis of spillover effects to identify conditions under which economic benefits can be realised; particularly for mobile gear fishermen who are the fleet segment more commonly excluded from multi-use MPAs.
- There is a need for more empirical research of distributional effects resulting from displaced activities surrounding MPAs and SPMs, to support the planning and design of future sites.
- There is a need for more empirical research on the net impacts on fisheries, comparing benefits with costs incurred and/or opportunities forgone; whether net benefits arise and, if so, where and to what extent.

Similarly, information regarding user compliance with site conservation measures, for instance in relation to fishing, could help determine to what extent fishermen operating within the boundaries of an area managed for conservation purposes take the conservation objectives into account. Although we have found studies illustrating effort concentration along MPA borders, no indication has been found as to what extent fishermen in surrounding waters take the MPA objectives into account. In combination, this information could help determine how and to what extent various measures might ensure sustainable co-existence between conservation objectives of protected sites and fishing.

Studies looking at effects of no-take zones as well as those studying other categories of spatially managed areas are often unable to compare current effects with site conditions prior to the establishment of protection measures. Baseline data cannot be established retrospectively.

- To support future assessments of the economic impact of MPAs and SPM, spatially explicit data on environmental conditions and economic activities in and around sites should be systematically collected prior to designation and as part of a regulator monitoring programme. Monitoring and evaluation plans should be put in place for MPAs to support this.

The evidence to-date is focussed on the potential benefits to fisheries through changes in ecosystem services. Other benefit pathways have been less explored. As a vast majority of European MPAs allow some forms of fishing, there is potential – if appropriate management and enforcement can be assured – to introduce quality certification or MPA brand labelling to allow fishermen and aquaculture producers to charge premium prices for their MPA produce. We identify some recent studies showing that this is already happening in some areas and that there seems to be both an interest in the sector as well as a consumer market in Europe.

- There is a need for empirical research about the scale of benefits generated from these schemes and/or the contexts in which they are particularly feasible; in order to support the potential establishment of similar schemes elsewhere.

Table 16 and Table 17 illustrate the level of evidence available about the economic benefits of MPAs and SPMs to fisheries and aquaculture in Europe.

Table 16. Data gaps – European fishery sector

	Evidence available on benefits to the sector	Evidence available on comparison of costs and benefits (full CBAs)	Evidence available on sustainability measures in place	Evidence available on management of conflicts	Evidence available on participation processes	Evidence available on governance features
No-take MPAs and zones						
Multi-use MPAs						
SPMs						

Solid evidence available | No evidence available | Scarce evidence available

Table 17. Data gaps – European aquaculture sector

	Evidence available on benefits to the sector	Evidence available on comparison of costs and benefits (full CBAs)	Evidence available on sustainability measures in place	Evidence available on management of conflicts	Evidence available on participation processes	Evidence available on governance features
No-take MPAs and zones						
Multi-use MPAs						
SPMs						

Solid evidence available | No evidence available | Scarce evidence available

11.2 Maritime tourism

Most European studies on the economic benefits of MPAs to maritime tourism focus on the Mediterranean and North-east Atlantic Ocean, and in particular on Spain, Greece and the UK. We have not found any studies on this topic of MPAs located in the Baltic Sea, and only one with relevance to the Black Sea.

- More countries and MPAs need to be studied in order to build up a suitable evidence base from which analysis of similarities and differences could be robustly undertaken and generalised from.

This is particularly important in order to determine what role specific factors play in the scale of benefits of MPAs to the tourism sector (e.g. location, size and relative position of the MPA to other MPAs or mainland, infrastructure, baseline level of activity, publicity and other active policies from local governmental bodies, interaction with the fishery sector).

There is a need for research which seeks to understand the pathway through which tourism benefits are generated. In particular, it would be interesting to have more studies specifically analysing the impact of the 'designation effect', i.e. the improvement in reputation of a location due to the designation of an MPA. A better understanding of the designation effect can provide an important argument for the expansion or better management of the current European MPA network.

Another important point to explore is the carrying capacity of ecosystems in MPAs, as done e.g. by Dixon et al (1995), who calculated how many divers can visit the Great Barrier Reef before damaging the ecosystems, comparing this figure with the current number of visitors and future scenarios.

- Evidence could usefully be expanded on the most effective ways to maximise the tourism sector economic benefits of MPAs without compromising environmental sustainability, either by increasing the number of visitors while minimising their environmental impact or by increasing the income retained locally.

Articles discussing best practices on how to promote eco-tourism in MPAs will support the establishment of tourism practices that generate livelihood opportunities without compromising the environmental sustainability. Moreover, additional guidance is needed on strategies to finance MPAs through tourism, and in particular on the opportunity of introducing visitor fees and taxes to finance the management of MPAs, including the potential willingness to pay of visitors and the comparison of the potential revenues with the management costs.

Finally, there is not enough evidence on potential synergies with other sectors, and primarily with fisheries. Evidence on conflicts with fishers and on ways to mitigate them is primarily anecdotal and needs to be expanded. Table 18 summarises the available evidence and the data gaps about the economic benefits to maritime tourism.

Table 18. Data gaps – European maritime tourism sector

	Evidence available on benefits of MPAs on the sector	Evidence available on comparison of costs and benefits (full CBAs)	Evidence available on sustainability measures in place	Evidence available on management of conflicts	Evidence available on participation processes	Evidence available on governance features
No-take MPAs and zones						
Multi-use MPAs						

Solid evidence available | No evidence available | Scarce evidence available

11.3 Other blue economy sectors

No evidence could be identified of benefits provided by MPAs or SPMs to blue economy sectors (other than fisheries and tourism), illustrating a significant evidence gap (see Table 19).

A possible reason behind the lack of evidence and/or studies on economic benefits provided by MPAs to other blue economy sectors is that, while these sectors (e.g. oil and gas platforms, harbours, mining and construction sites) require space within the marine environment, most of them are not – or are perceived not to be – dependent on the protection of marine environmental quality. On the contrary, several of the other sectors are known to have negative impacts on marine conservation. However, if to achieve sustainable blue growth in Europe and achieve targets and commitments made to safeguarding marine biodiversity and ecosystems, it is important to find ways whereby spatial environmental protection can be effective alongside economic activities.

For other sectors, such as marine biotechnology, the lack of evidence may be related to the relative novelty of the sector.

- There is a need for ecological research exploring whether changes in environmental condition due to MPAs provide any benefit to the operation of blue economy sectors.
- There is a need for exploration of alternative pathways, for example how MPA governance regimes influence planning efficiency for proposed blue economy projects; to what extent co-location of blue economy activities and MPAs influence the image of the protected area, etc.

Considering the rapid increase in number and scale of different sector activities at sea, it would seem particularly important to establish an understanding of the links between marine conservation objectives and the economic viability of these sectors.

Table 19. Data gaps – other European blue economy sectors

	Evidence available on benefits of MPAs on the sector	Evidence available on comparison of costs and benefits (full CBAs)	Evidence available on sustainability measures in place	Evidence available on management of conflicts	Evidence available on participation processes	Evidence available on governance features
No-take MPAs and zones						
Multi-use MPAs						

Solid evidence available | No evidence available | Scarce evidence available

11.4 De facto refuges

- There is a need to assess in more detail any commonalities between different refuges that appear to be supporting marine biodiversity in order to determine best practice in terms of, for example, material choices and optimal geographical and physical conditions. This is also important for exploring appropriate policy responses.

- Ashley (2014) and Bergstrom et al (2014) identify effects on species abundance and economic effects on fishing to be key evidence gaps when it comes to the impacts of offshore wind farms on marine ecosystems and social and economic activities.
- Information on the rate of use of de facto refuges by fishers, anglers and recreational users is sparse (for example, the only studies found on recreational use that documented numbers of users were from Australia and the United States).
- Empirical measurement of changes in catches (and associated value) by commercial and recreational fishers is lacking, but is an essential component of the evidence base if economic benefits are to be robustly calculated.
- Evidence of benefits to recreational sectors beyond angling and diving, and to any other marine sectors beside fisheries and recreation is also lacking.
- The status of benefits from de facto reserves around offshore wind farms should be revisited in the future. This is a new sector, so it may take more time for the reefs to become mature and significant economic benefits from the refuges to accrue (Hooper et al, 2017).

Table 20 illustrates the literature gaps identified regarding de facto refuges and their potential to act as MPAs and thereby potentially generate economic benefits to blue economy sectors in Europe.

Table 20. Data gaps – de facto refuges

	Evidence available on benefits of de facto refuges to economic sectors	Evidence available on comparison of costs and benefits (full CBAs)	Evidence available on sustainability measures in place	Evidence available on management of conflicts	Evidence available on participation processes	Evidence available on governance features
De facto refuges						

Solid evidence available | No evidence available | Scarce evidence available

12 Conclusions

12.1 The evidence base

This literature review concludes that Marine Protected Areas (MPAs) and other Spatial Protection Measures (SPMs) have been shown to deliver concrete benefits to blue economy sectors. However, the review also shows that the economic benefits of MPAs and SPMs to fisheries, maritime tourism and other blue economy sectors in Europe still remain poorly understood – both the nature of such benefits and the extent to which they occur. The body of evidence is growing, however it is not yet sufficiently comprehensive to draw any detailed overall conclusions.

Of the total of 627 reviewed studies, 94 were identified as falling within the selection criteria for this review. Of these 94 studies, 44 studies show evidence of economic benefits of MPAs and/or SPMs to fisheries and 33 studies to maritime tourism. Fifteen studies compare costs and benefits of MPAs and/or SPMs to various degrees, and finally 22 studies indicate how so-called de-facto refuges can act as MPAs and thereby potentially benefit blue economy sectors.

The existing evidence is largely dominated by literature on economic benefits to maritime tourism and artisanal fisheries. The evidence is also highly concentrated geographically, primarily to the Mediterranean Sea and the North-east Atlantic Ocean. No evidence fitting the criteria of this review has been found from MPAs or SPMs in the Baltic Sea, and only one study partly including the Black Sea. While significant research has been conducted in the Baltic Sea regarding, for instance the value of marine ecosystem services (see e.g. BalticSTERN Secretariat (2013)), no evidence has been identified of any links between such values and MPAs or SPMs. Literature is scarce from the Black Sea on marine conservation in general, and we can confirm previous authors' observations of the close to non-existent literature base on economic benefits of MPAs (or SPMs) in the Black Sea.

We note that no studies could yet be found fulfilling the study evidence selection criteria to show economic benefits generated to "other" blue economy sectors. This evidence gap may have different explanations. Beyond the use of marine space as a vector or for infrastructure installation, most 'other' blue economy (but not all) sectors are not thought to rely in a meaningful way on inputs stemming from ecosystem services. Hence there may be limited interest in exploring how MPAs may benefit other blue economy sectors in this way. Another potential explanation is that the gap may be a result of the relatively rare occurrence of such activities operating inside MPAs, providing few opportunities to study any links and interactions. For other sectors, such as marine biotechnology, for which there is a theoretical ecosystem service benefit pathway, the lack of evidence may be related to the relative novelty of the sector. MPAs may provide indirect benefits, for example by creating a management mechanism for marine space which enables different sectors to co-exist and for their impacts to be managed, however no evidence was found on such benefits.

12.2 Economic benefits of MPAs and SPMs

Benefits to fisheries and aquaculture

Examples of identified economic benefits to the fisheries sector include primarily increased catch per unit effort for a range of gear and target species in waters surrounding areas closed from fishing as well as increased revenue for fishermen permitted to continue fishing within MPAs using static gears to target low-mobility, benthic species as a result of reduced competition for space and resources from those fishermen excluded from the MPA. No evidence was found on potential economic benefits to aquaculture.

Spillover effects from so-called "no-take" zones have been the primary focus of existing studies and they have been found to provide positive economic impacts on fisheries. However, while a number of robust studies demonstrating benefits exist, it should be noted that the existing evidence base is limited and only a handful of studies demonstrate benefits to fishermen based on empirical economic data. Only one study has been found that compares the increase in yield resulting from spillover with the loss of fishing opportunities caused by the designation of the no-take zone; it shows a net gain. Few existing studies and/or evidence has been found showing economic benefits from spillover effects without the impact of a no-take zone.

A number of factors influencing the scale and nature of economic benefits can nevertheless be identified. Firstly, it is important to distinguish between protection aimed at enhancing target species (for subsequent fishing in the case of an SPM) and protection that removes fishing pressure to reduce the negative habitat impacts of certain types of fishing in order to help achieve conservation objectives. The latter may or may not benefit species targeted by commercial fishing. Further, zoning with networks of no-take areas in combination with other uses has been shown to be effective in generating economic benefits to fisheries through spillover. Depending on which species are targeted, the size of no-take zones may affect the scale of spillover benefits. Local habitat distribution in and around no-take areas and the timescale the site has been under protection seem to also to influence the scale and nature of benefits. The limited evidence base does not allow us to draw comprehensive conclusions as to which MPA or SPM factors (or combination of factors) help to optimise the generation of benefits to fisheries, to what degree individual factors influence benefits or the scale to which such benefits occur.

The extent of spillover effects is influenced by, for example, the size and location of no-take zones, the target species (whether it is afforded meaningful protection by the MPA, yet also sufficiently mobile to leave the MPA), local habitat distribution (i.e. the nature and extent of habitats across the boundaries of a protected area), the level of fishing pressure in surrounding fished areas (particularly relevant for mobile target species) as well as the length of time that the site has been under protection. However, the limited evidence base does not allow us to draw any comprehensive conclusions as to which MPA or SPM factors (or combination of factors) help to optimise the generation of benefits to fisheries, to what degree individual factors influence benefits or the scale to which such benefits occur.

No specific existing evidence has been identified looking at measures to ensure that the potential benefits of MPAs and SPMs can be captured by the sector without compromising conservation objectives. For instance, to enable fishers who would otherwise be excluded to retain access to the MPA and thereby realise on-site benefits of improved fish stocks. This might be a result of the relatively young age of many European MPAs; the fact that many of these sites do not yet have implemented management plans; that existing research is focussed on "fishing versus no fishing"; and/or that very few such measures have been adopted to ensure sustainable use. However, several studies illustrate the importance of managing displacement effects of MPAs and SPMs – both within and outside of sites. For instance, if the overall fishing pressure inside the site remains the same as a result of an increase in effort with permitted gears, the conservation objectives of the site might be compromised. Displacement of certain types of fishing from one site to another may also result in new or additional environmental costs, as well as costs to fisheries already operating in those waters.

Benefits to maritime tourism

The evidence available on economic benefits of MPAs to maritime tourism is primarily based on interviews/surveys and collection of empirical data. Those providing quantitative information are mostly baseline studies, i.e. providing information on economic benefits in a specific point in time, without attempting to assess changes over

time, e.g. since designation. The majority of studies analyse a specific MPA or the MPAs in a country or region and are on multi-use MPAs.

Most studies conclude that MPAs are beneficial for the maritime tourism sector by increasing the number of visitors and providing additional livelihood opportunities. The increased revenues and livelihood opportunities at the local level are in many cases key to gain local support to the designation of MPAs and ultimately to the conservation of marine biodiversity.

In order for the benefits to the tourism sector to be realised, the studies recognise that it is important that the environmental impact of recreational activities is minimised through proper management and enforcement activities. Communication activities can play an important role in promoting good practices to reduce the environmental impact of visitors, thereby contributing to maintaining the economic benefits to the tourism sectors in the long run.

Eco-tourism should be actively supported by local and national policies, in order to promote the generation of livelihood opportunities that do not degrade the environment. In addition, it is important to put in place policies that favour the retention of tourism revenues and jobs in the local economy.

The evidence also indicates that management, enforcement and educational activities require financing, but the available funds for MPAs are not always sufficient to ensure proper environmental protection. For this reason, using tourism to find alternative and complementary ways to contribute to the financing of MPAs can play a key role in further improving environmental quality for recreational activities, thereby ensuring that the economic benefits to the tourism sector are maintained and increased in the long run. In particular, visitor fees and taxes may help cover the funding needs of MPAs and green marketing of tourism products can help raise additional funding to support MPAs.

Which sectors benefit the most?

Studies assessing benefits to both tourism and fisheries seem to suggest that benefits to tourism exceed those to fisheries, however this is a preliminary observation and might be a reflection of the fact that a majority of existing research has been conducted in Mediterranean MPAs. In many areas of the Mediterranean, tourism is a more socio-economically important sector than fisheries; and would no doubt still be in the absence of the MPA.

It is also not possible to say whether the benefits attained by a given sector, in particular the fisheries sector, are sufficient to outweigh any costs that may be imposed upon them by MPA management i.e. do the benefits from spillover effects outweigh the costs of being displaced from the MPA. As mentioned, only one study is able to demonstrate a net gain in yield (in weight of lobster catches) following designation of an MPA (no-take in this case).

We identify nuances within the fisheries and tourism sectors in terms of who might benefit the most from MPAs and SPMs. For instance, fishermen using static gear targeting low-mobility benthic species seem more likely to benefit than fishermen using mobile, bottom-contacting gear. This is likely a result of the incompatibility of the latter with MPA conservation objectives and such activities therefore being more restricted inside MPAs than other gear types. Another observation, related to maritime tourism, is that divers might benefit more than recreational fishing activities in an MPA, depending on the nature of any conservation measures imposed within the site. We emphasise, however, that these are initial observations based on a highly limited amount of evidence.

Comparisons of costs and benefits of MPAs and SPMs

There are relatively few comprehensive Cost Benefit Analyses (CBAs) of MPAs currently available from either within or outside Europe, making it difficult to draw overall

conclusions about the net benefits of individual MPAs or MPA networks in Europe. No CBAs of European SPMs were identified.

Existing studies comparing the costs and benefits of MPAs use primarily an ecosystem services framework and suggest that a large proportion of the benefits is likely to relate to non-marketed improvements in welfare rather than real economy benefits to sectors. The studies which have valued market benefits focus on benefits to maritime tourism and fisheries, demonstrating that individual MPAs and MPA networks can enhance economic activity in these sectors. These studies are especially in areas important for tourism, while the benefits to fisheries seem to be smaller and, in comparison, more difficult to quantify.

However, empirical evidence of benefits in monetary terms is very limited and CBAs generally appear more complete in their monetary valuation of costs than benefits. Despite being unable to account for a comprehensive representation of benefits, these studies suggest that the overall welfare benefits of MPAs exceed total costs.

Evidence of 'de facto refuges'

Much of the evidence of so-called de facto refuges focuses on the ecological changes occurring in relation to artificial reefs and energy infrastructure. Studies which include any links to economic sectors focus on fisheries, angling and diving. Only four studies provide any economic information, although several studies make speculative links between de facto refuges and economic benefits.

The evidence base shows an absence of agreement regarding the economic impacts of *artificial reefs* to fisheries, while it suggests that such structures are highly valued by divers and anglers due to the fish that aggregate at these sites and the marine life that grows on them.

The considerable, and growing, body of literature on the effects of *energy installations* show that offshore wind farms may bring potential benefits to species of commercial and recreational importance. However, evidence of any benefits to fisheries, recreation or other maritime sectors from energy installations remains very scare. What little evidence exists from Europe is usually self-reported during interviews or of an anecdotal nature.

12.3 How to maximise benefits while ensuring conservation objectives

Theoretically, maximising benefits may involve optimising synergies between different sectors while avoiding and alleviating potential conflicts arising between sectors and between sector interests and conservation objectives as a result of spatial conservation measures.

There is a lack of evidence related to synergies or mutual reinforcements between different blue economy sectors with links to MPAs or SPMs, although this may reflect the relatively recent focus in this area rather than the absence of – or potential for – multisector benefits. Research of the opportunities for job diversification as a result of MPA designation find examples that both support and contradict the hypothesis that this would occur.

Conflicts between sector-specific stakeholders resulting from MPAs have been noted between divers and fishermen, between different fishermen in open access areas surrounding no-take zones and between commercial fishermen and energy operators around de-facto refuges.

Further to conflicts between sectors, evidence of conflicts between MPA objectives and resource users illustrates that, although different local stakeholders often oppose implementation of MPA-related restrictions, their opinions can change as a result of being more actively involved, meeting MPA managers face to face or witnessing positive changes resulting from the site. Further, there is evidence suggesting that stakeholders'

level of aversion to conservation measures may be influenced by demographic factors. In addition to improved engagement, evidence indicates that successful conflict resolution can occur through the adoption of different compensation schemes and zoning of MPAs to better accommodate different users' needs.

Most research related to conflicts discusses how conflict can be avoided through management and/or is affected by governance structures. There is general agreement in the literature that stakeholders need to be actively involved in MPA planning and management for the site to be successful. Meanwhile, there is also evidence suggesting that achieving successful stakeholder engagement can be challenging in practice. This is for instance due to potentially unequal representation of all relevant stakeholders, structural limitations of who is allowed to engage in MPA decision-making and how, and the perception of the legitimacy of the designation and what users can expect from it.

ANNEXES

Annex 1 Literature review protocol

Introduction

The following document sets out a protocol for the literature review carried out in Task 1 of the study. The protocol is based on the overall study objectives and sub-objectives as listed in the EASME Terms of Reference and the ICF Technical Proposal (a summary of which are included under Objectives below), and the refinements of scope and definitions as agreed with the Client at the inception meeting[35] and outlined in the project inception report.

Study objectives

The main objective of this study is to evaluate how MPAs provide benefits to specific blue economy sectors, with the aim to feed the results into relevant EU policies.

The sub-objectives are:

- Identify and critically analyse studies which have done a full cost-benefit analysis (CBA) for MPAs.
- Identify and critically analyse studies which examine how MPAs are, or can be, sustainably used.
- Identify and critically analyse studies which assessed overlaps, conflicts or mutual reinforcement between blue economy sectors which are linked to MPAs.
- Identify and critically analyse studies addressing conflict resolution, engagement with stakeholders and governance.
- Collate and synthesize research and known case studies about 'de facto refuges'.

Evidence gathering

The evidence gathering will have five primary components. It is anticipated that this will support a more effective and efficient formal search process and ensure a broad overview of all available literature. These components will be conducted in parallel to some extent.

Study team knowledge

The initial stage of the evidence gathering will collate evidence that is already known to the study team, the Steering Group and key informants. Examples of such key references are included in the ICF Technical Proposal, pages S2-32.

Searching databases

The second component will be to search for scientific papers published in peer-reviewed scientific journal databases. A range of search terms will be used to identify evidence (see box below) in, for instance, Web of Science, Scopus, Google Scholar, Science Direct, and Research Gate.

Reference searches

The bibliographies of key papers identified in other steps will be searched in order to identify any relevant evidence that has not already been picked up.

Searching the internet

In the third step, a broader internet search will be conducted to reports and identify grey, including using the key search terms in internet search engines and by exploring the websites of relevant institutions and organisations (such as DG Environment, MPA management sites, marine infrastructure projects).

[35] The inception meeting was held in Brussels at EASME's premises on 29 September 2016 between the ICF project management team and members of the Commission's Steering Group.

Expert network consultation

Finally, in order ensure a wide coverage of European languages, the network of study experts, including Regional Sea experts, will be consulted by email to identify grey literature or research in their own regions and languages.

Keywords

The box below outlines the principal keywords which will be used in the primary evidence search, including the keywords identifying studies related to MPAs. In order to identify evidence on fisheries closures, de facto refuges and other non-MPA managed areas, searches will also be made where the MPA-related terms below are omitted.

The list below is not exclusive as additional relevant terms might be identified along the way and used to broaden the search further.

Keywords for evidence search

MPA: marine- "protect* area*", "conservation zone", "reserve", "no-take zone", "park", "sanctuary"

Economic benefits: "job creation", "job generation", "employment*", "revenue", "profit", "turnover", "livelihood", "community", "blue growth", "economic growth", "blue economy", "ecosystem services", "cost benefit analysis", "cost benefit", "CBA", "impact assessment"

Sector: fisheries/ aquaculture: "fisheries", "fishermen", "fisher", "sustainable fishing", "aquaculture", "mariculture", "aquatic farming", "spillover", "spill-over", "fish biomass", "productivity", "spawning ground", "nursery ground", "feeding ground", "certification", "premium price", "labelling", "closed area"

Sector: maritime, coastal, nature/wildlife and cruise tourism: "diving", "eco-tourism", "recreation", "tourism", "angler", "snorkel", "user fees", "tax", "boating", "fishing", "recreational boating", "sport fishing"

Other Blue Economy sectors: "maritime", "oil", "gas", "transport", "shipping", "blue technology", "blue biotechnology", "ports", "harbours", "energy production", "offshore", "extraction", "gas extraction", "oil extraction", "sea mining", "dredging"

Governance aspects: "conflict", "resolution", "engagement", "participation", "stakeholder", "local community", "coastal community", "cultural", "trade-off", "synergy", "synergies", "sustainable use", "sustainable management"

De facto refuges: "De facto refuges", "incidental protection", "foundation", "offshore", "platform", "wind-energy", "infrastructure", "military"

Exclusion criteria – keywords

The primary evidence search will focus on European/temperate managed areas, and will therefore include the following exclusion criteria:

NOT (tropic* OR coral* OR Caribbean OR Philippines OR Indonesia OR Thailand OR Tanzania OR Mexico OR Bahamas OR Belize OR Grenada OR Jamaica OR Kenya)

Studies from tropical/non-temperate areas have nevertheless value to this review, as the study covers also European, Outermost Regions (ORs) and Overseas Countries and Territories (OCTs) marine waters (see below). A secondary evidence search will therefore include, rather than exclude, the keywords listed above.

Evidence selection

High quality evidence will be prioritised, according to the following evidence quality hierarchy as agreed in the project inception meeting:

Evidence linking blue economy benefits to MPAs in a scientifically rigorous way (*"this actually happened"*)	**High quality evidence: main priority**
Evidence-based scientific reasoning (ex-ante or ex-post) (*"this has been observed, then it is likely that also…"*)	**Medium quality: acceptable in absence of stronger evidence**
Hypothesised studies without evidence base (*"theoretically, it is likely that…"*)	**Low quality: preferably avoided**

Selection criteria

- Studies which provide a baseline/snapshot or counterfactual evidence of impacts over time, comparison between inside and outside protected areas etc. The latter are preferred but both relevant to log.
- Studies which have done a full cost-benefit analysis (CBA) for MPAs.
- Studies which examine how MPAs are, or can be, sustainably used in relation to blue economy sectors.
- For fisheries, studies of impacts on catches or catch effort thanks to MPAs are relevant as they can be seen as proxies for economic sector impacts. Not a priority, however.
- Studies which assessed overlaps, conflicts or mutual reinforcement between blue economy sectors which are linked to MPAs.
- Studies addressing conflict resolution, engagement with stakeholders and governance of MPAs in relation to economic benefits to blue economy sectors.
- Studies/research and known case studies about 'de facto refuges' (with particular emphasis on reports for specific infrastructure developments).
- Studies of 'hard' economic benefits of MPA, i.e. effects on the real economy as indicated by changes in economic output, revenue, profits, employment, etc. in the blue economy sectors.
- Studies of broader local economy and community benefits associated with such economic benefits (*secondary importance*).
- Studies of ecosystem service benefits where such result in the above type of benefits in the real economy.

Exclusion criteria

- Editorials, newspaper articles and other forms of popular media will be excluded.
- Other types of 'economic benefit' than those listed above, i.e. non-market benefit such as willingness to pay for certain changes, will be excluded.
- Studies looking only at changes in biomass, size of species and other ecological/conservation effects of MPAs, without connection to blue economy sector effects, are excluded.

Scope and definitions

Blue economy sectors

The review takes a broad view of what constitutes the blue economy. Table 21 outlines how these sectors are classified in the literature review.

Table 21. Blue economy groups and indicator group sectors

Groups	Sectors
Fisheries	Commercial fisheries
	Aquaculture

Tourism and recreation	Maritime tourism
	Coastal tourism
	Recreation
Other blue economy	Transport
	Ports and harbours
	Aggregate and other mining
	Oil and gas
	Renewable energy
	Blue biotechnology
	Other: offshore construction, desalination, defence, shipbuilding/repair, etc.

Types of MPAs

The following types of managed areas[36] are included in the literature review:

- **Marine Protected Areas (MPAs)** – including Natura 2000; MPAs designated to implement international or regional agreements to which Member States are Parties i.e. under UNCLOSE, the CBD and Regional Sea Conventions; and nationally-designated MPAs.
- **Spatial protection measures** – area-based environmental protection measures that do not meet the criteria for MPAs, such as fisheries measures imposing spatial restrictions to achieve commitments under e.g. the Common Fisheries Policy.
- **De-facto refuges** – structures and other forms of spatial management of activities which create unintended side effects in the form of conservation and environmental benefits, such as military zones or offshore wind farms.

Geographic scope

The study scope will be to build evidence relevant to European, Outermost Regions (ORs) and Overseas Countries and Territories (OCTs) marine waters. The greatest focus will be on European waters, with a lower priority afforded to ORs and then, in turn, OCTs.

The literature search and review will also include transferable evidence from outside of these regions. Transferability of evidence is established at this stage based on an approximate match in climatic and environmental conditions. For example, European waters can be broadly considered as 'temperate' and further refined principally to 'marine west coast' and 'Mediterranean' - hence evidence from North America (especially the west coast), southwest and southeast Australia and New Zealand in particular will be targeted.

Logging evidence

Evidence will be systematically logged in an Excel spreadsheet to identify key aspects of relevance to the study for each literature item.

The spreadsheet has been developed by IEEP in collaboration with ICF and will be populated primarily by IEEP researchers who lead Task 1, 2 and 3 of the study. The spreadsheet will also be circulated to study partners as well as the study expert network to be filled in in accordance with the rationale outlined under "Evidence gathering" above.

[36] See closer definitions in the project inception report.

To ensure coherent use of the spreadsheet, it contains guidance explaining its different components and of how to use it.

Annex 2 Definitions of benefit pathways

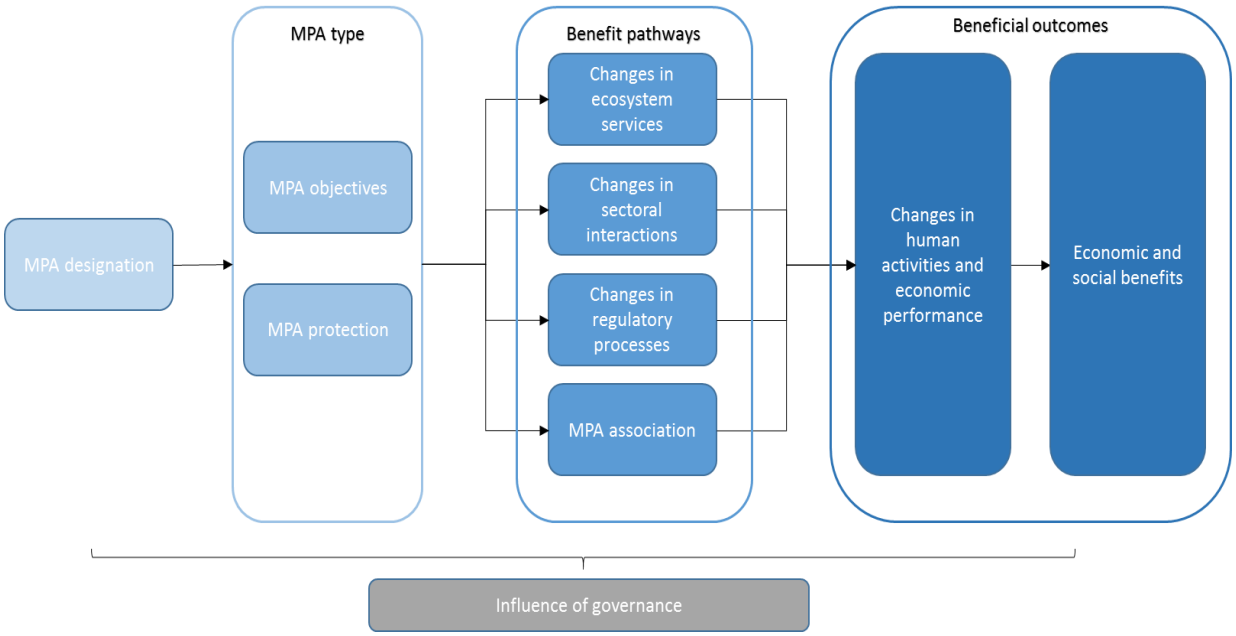
Four benefit pathways were identified to guide the review of evidence – each enabling a logic model approach to tracing how MPAs may deliver benefits:

- The maintenance and enhancement of ecosystem services, creating direct economic or social improvements e.g. for provisioning services-based sectors that use natural resources as an input e.g. fisheries; or sectors linked to cultural services e.g. recreation, tourism and coastal development. This recognises that the distribution of ecosystem service benefits may extend to operations located outside of the MPA itself.
- Changes in interactions and mutual reinforcements between sectors through MPA management and governance arrangements i.e. where changes in the distribution of economic activity present opportunities for sectors, in particular 'win-win' opportunities e.g. opportunities for aquaculture development around wind farms.
- Changes in regulatory processes e.g. where cooperative management, or increased regulatory certainty, provides opportunities for more efficient regulation thereby reducing costs to operators and providing a more stable platform for long term investment.
- Other indirect improvements linked to association with an MPA, but with no direct mechanism e.g. reputational or branding prominence resulting from sectors being associated with an MPA.

To satisfy this objective, it is necessary to determine the extent to which benefits to the blue economy from MPAs may be delivered through these pathways and to understand the role of MPA design and management in facilitating their realisation.

Figure 7 provides a theoretical framework, presented as a logic model depicting how MPAs deliver through different benefit pathways.

Figure 8. Conceptual framework of MPA benefits pathways. Source: Own representation



The links between marine biodiversity, ecosystem resilience, and continued provision of ecosystem services have been well established, and continue to be clarified and refined, e.g. through the TEEB project for assessments of monetary value. The programme on Mapping and Assessment of Ecosystems and their Services (MAES) contributes to the development of these linkages through efforts to connect ecosystem services and their

values to changes in the marine environment so as to better integrate them into blue growth and marine planning decisions. This provides an adequate framework for considering ecosystem service benefit pathways, although the study will need to build out the evidence to better understand the blue economy linkages. (Figure 9 below offers an overview of the MAES framework structure[37].).

Frameworks for explaining and investigating the other benefit pathways are less well developed, and a critical aim of this study will be to build an understanding of what these look like.

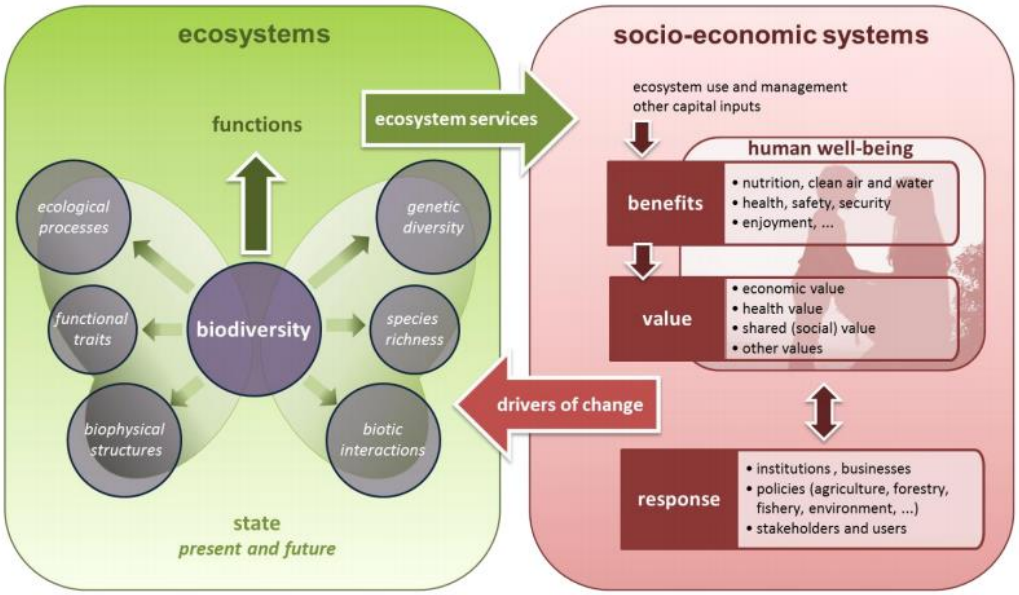


Figure 9. MAES Framework. Source: Mapping and Assessment of Ecosystems and their Services (MAES), accessed February 26, 2016 from http://biodiversity.europa.eu/maes

[37] Biodiversity Information System for Europe (2015), *Mapping and Assessment of Ecosystems and their Services (MAES)*, European Commission, Brussels. Retrieved from http://biodiversity.europa.eu/maes

Annex 3 References

Abesamis, R A, Alcala, A C and Russ, G R (2006) How much does the fishery at Apo Island benefit from spillover of adult fish from the adjacent marine reserve? *Fishery Bulletin* No 104 (3), 360-375.

ABPmer (2015) *Developing the Evidence Base for Impact Assessments for Recommended dSACs and dSPAs*. Report and appendices, Joint Nature Conservation Committee, UK.

Aburto-Oropeza, O, Erisman, B, Galland, G R, Mascareñas-Osorio, I, Sala, E and Ezcurra, E (2011) Large recovery of fish biomass in a no-take marine reserve. *PLoS ONE* No 6 (8), 7.

Access Economics Pty Limited (2007) *Measuring the Economic & Financial Value of the Great Barrier Reef Marine Park, 2005-06*. Great Barrier Reef Marine Park Authority, Townsville.

Alban, F, Person, J, Roncin, N and Boncoeur, J (2008) *Analysis of Socio-Economic Survey Results*. EMPAFISH Project, Brest, France.

Alcala, A C (1998) Community-based coastal resource management in the Philippines: a case study. *Ocean and Coastal Management* No 38 (2), 179-186.

Alcala, A C, Russ, G R, Maypa, A P and Calumpong, H P (2005) A long-term, spatially replicated experimental test of the effect of marine reserves on local fish yields. *Canadian Journal of Fisheries and Aquatic Sciences* No 62 (1), 98-108.

Alexander, K A, Potts, T and Wilding, T A (2013) Marine renewable energy and Scottish west coast fishers: exploring impacts, opportunities and potential mitigation. *Ocean & Coastal Management* No 75, 1-10.

Álvarez-Fernández, I, Fernández, N, Sánchez-Carnero, N and Freire, J (2017) The management performance of marine protected areas in the North-east Atlantic Ocean. *Marine Policy* No 76, 159-168.

Ami, D, Cartigny, P and Rapaport, A (2005) Can marine protected areas enhance both economic and biological situations? *Comptes Rendus Biologies* No 328 (4), 357-366.

Ashley, M (2014) The implications of co-locating marine protected areas around offshore wind farms, Doctor of Philosophy, School of Marine Science and Engineering, University of Plymouth.

Badalamenti, F, Ramos, A A, Voultsiadou, E, Snchez Lizaso, J L, Danna, G, Pipitone, C, Mas, J, Fernandez, J A R, Whitmarsh, D and Riggio, S (2000) Cultural and socio-economic impacts of Mediterranean marine protected areas. *Environmental Conservation* No 27 (2), 110-125.

Baine, M (2001) Artificial reefs: a review of their design, application, management and performance. *Ocean & Coastal Management* No 44 (3–4), 241-259.

BalticSTERN Secretariat (2013) *The Baltic Sea – Our Common Treasure*. 2013:4, Swedish Agency for Marine and Water Management, Stockholm.

Barley Kincaid, K, Rose, G and Mahudi, H (2014) Fishers' perception of a multiple-use marine protected area: Why communities and gear users differ at Mafia Island, Tanzania. *Marine Policy* No 43, 226-235.

Barnard, S, Burdon, D, Strong, J and Atkins, J (2014) *The Ecological Coherence and Economic & Social Benefits of the Northern Ireland MPA Network*. YBB238-F-2014, Institute of Estuarine & Coastal Studies (IECS), The University of Hull, Hull, UK.

Batista, M I and Cabral, H N (2016) An overview of Marine Protected Areas in SW Europe: Factors contributing to their management effectiveness. *Ocean and Coastal Management* No 132, 15-23.

Baxter, J M, Laffoley, D and Simard, F (2016) *Marine protected areas and climate change : adaptation and mitigation synergies, opportunities and challenges*. IUCN, Gland.

Beare, D J, Hoelker, F, Engelhard, G H, McKenzie, E and Reid, D G (2010) An unintended experiment in fisheries science: a marine area protected by war results in Mexican waves in fish numbers-at-age. *Naturwissenschaften* No 97 (9), 797-1042.

Beaumont, N J, Austen, M C, Mangi, S C and Townsend, M (2008) Economic valuation for the conservation of marine biodiversity. *Marine Pollution Bulletin* No 56 (3), 386-396.

Bennett, T and Morris, R (2017) *How to determine governance requirements and structures for MPAs*. WWF-UK and Natural England, Woking, UK.

Bergström, L, Sundqvist, F and Bergström, U (2013) Effects of an offshore wind farm on temporal and spatial patterns in the demersal fish community. *Marine Ecology Progress Series* No 485, 199-210.

Bertram, C and Rehdanz, K (2013) On the environmental effectiveness of the EU Marine Strategy Framework Directive. *Marine Policy* No 38, 25-40.

Beukers-Stewart, B D, Vause, B J, Mosley, M W J, Rossetti, H L and Brand, A R (2005) Benenfits of closed area protection for a population of scallops. *Marine Ecology Progress Series* No 298 (1), 189-204.

Birkeland, C and Dayton, P K (2005) The importance in fishery management of leaving the big ones. *Trends in Ecology & Evolution* No 20 (7), 356-358.

Birklund, J (2005) *Surveys of Hard Bottom Communities on Foundations in Nysted Offshore Wind Farm and Schönheiders Pulle in 2004*. Report by DHI and ENERGI E.

Boncoeur, J, Alban, F, Guyader, E and Thebaud, O (2001) Cost and benefits of implementing a marine reserve facing prey-predator interactions, in *XIIIth Conference of the European Association of Fisheries Economists*. Salerno, Italy.

Börger, T, Hattam, C, Burdon, D, Atkins, J P and Austen, M C (2014) Valuing conservation benefits of an offshore marine protected area. *Ecological Economics* No 108, 229-241.

Bosetti, V and Pearce, D (2003) A study of environmental conflict: the economic value of Grey Seals in southwest England. *Biodiversity & Conservation* No 12 (12), 2361-2392.

Boubekri, I and Djebar, A B (2016) Marine protected areas in Algeria: Future marine protected area of "Taza" (SW Mediterranean), continuing challenges and new opportunities facing an integrated coastal management. *Ocean and Coastal Management* No 130, 277.

Brander, L, Baulcomb, C, Amrit Cado van der Lelij, J, Eppink, F V, McVittie, A, Nijsten, L and Van Beukering, P (2015) *The benefits to people of expanding Marine Protected Areas*. Report R-15/05, Institute for Environmental Studies (IVM), Amsterdam.

Brock, R E (1994) Beyond Fisheries Enhancement: Artificial Reefs and Ecotourism. *Bulletin of Marine Science* No 55 (F0020002), 1181-1188.

Brown, K, Adger, W N, Tompkins, E, Bacon, P, Shim, D and Young, K (2001) Trade-off analysis for marine protected area management. *Ecological Economics* No 37 (3), 417-434.

Buchan, K, Framhein, R and Fernandes, L (1997) *An Economic and Social Study of the Saba Marine Park, Saba, Netherland Antilles*. Technical Report 262, Caribbean Natural Resources Institute (CANARI).

Bunker, F (2004) *Biology and video surveys of North Hoyle wind turbines 11th-13th August 2004*. A report to CMACS Ltd. By MarineSeen, Hundleton, UK.

Burdon, D and Atkins, J P (2007) *An Initial Economic Evaluation of Marine Goods and Services at Flamborough Head, UK*. Report SBB231-D1-2007, Institute of Estuarine and Coastal Studies (IECS), University of Hull, Hull, UK.

Burgin, S and Hardiman, N (2015) Effects of non-consumptive wildlife-oriented tourism on marine species and prospects for their sustainable management. *Journal of Environmental Managemenet* No 151C, 11.

Buxton, C D, Hartmann, K, Kearney, R and Gardner, C (2014) When is spillover from marine reserves likely to benefit fisheries? *PLoS ONE* No 9 (9), e107032.

Cadiou, G, Boudouresque, C F, Bonhomme, P and Le Diréach, L (2009) The management of artisanal fishing within the Marine Protected Area of the Port-Cros National Park (northwest Mediterranean Sea): a success story? *ICES Journal of Marine Science* No 66 (1), 41-49.

Camargo, C, Maldonado, J, Alvarado, E, Moreno-Sánchez, R, Mendoza, S, Manrique, N, Mogollón, A, Osorio, J, Grajales, A and Sánchez, J (2009) Community involvement in management for maintaining coral reef resilience and biodiversity in southern Caribbean marine protected areas. *Biodivers Conserv* No 18 (4), 935-956.

Carter, D W (2003) Protected areas in marine resource management: another look at the economics and research issues. *Ocean and Coastal Management* No 46 (5), 439-456.

Cesar, H, van Beukering, P, Payet, R and Grandourt, E (2004) *Evaluation of the Socio-economic Impacts of Marine Ecosystem Degradation in the Seychelles*. Cesar Environmental Economics Consulting, Arnhem, the Netherlands.

Cesar, H S J, Ohman, M C, Espeut, P and Honkanen, M (2000) Economic Valuation of an Integrated Terrestrial and Marine Protected Area: Jamaica's Portland Bight, in Cesar, H S J (ed), *Collected Essays on the Economics of Coral Reefs*, pp203-214. CORDIO, Kalmar Univeristy, Sweden.

Charles, A and Wilson, L (2009) Human dimensions of Marine Protected Areas. *ICES Journal of Marine Science* No 66 (1), 6-15.

Christie, M and Rayment, M (2012) An economic assessment of the ecosystem service benefits derived from the SSSI biodiversity conservation policy in England and Wales. *Ecosystem Services* No 1 (1), 70-84.

Claudet, J, Osenberg, C W, Benedetti-Cecchi, L, Domenici, P, García-Charton, J-A, Pérez-Ruzafa, Á, Badalamenti, F, Bayle-Sempere, J, Brito, A, Bulleri, F, Culioli, J-M, Dimech, M, Falcón, J M, Guala, I, Milazzo, M, Sánchez-Meca, J, Somerfield, P J, Stobart, B, Vandeperre, F, Valle, C and Planes, S (2008) Marine reserves: size and age do matter. *Ecology Letters* No 11 (5), 481-489.

de Groot, J and Bush, S R (2010) The potential for dive tourism led entrepreneurial marine protected areas in Curacao. *Marine Policy* No 34 (5), 1051-1059.

De Oliveira, L P (2013) Fishers as advocates of marine protected areas: a case study from Galicia (NW Spain). *Marine Policy* No 41, 95.

DEFRA (2015) *Designation of the second tranche of Marine Conservation Zones in waters for which the Secretary of State has responsibility (English inshore, English, Welsh and Northern Irish offshore)*. Defra 1810, Department for Environment, Food and Rural Affairs.

Deloitte Access Economics (2013) *Economic contribution of the Great Barrier Reef*. Great Barrier Reef Marine Park Authority, Townsville.

Di Franco, A, Bodilis, P, Thiriet, P, Francour, P and Guidetti, P (2014) *Fishermen engagement, a key element to the success of artisanal fisheries management in Mediterranean marine protected areas*. MedPAN North Project WWF France, France.

Di Franco, A, Thiriet, P, Di Carlo, G, Dimitriadis, C, Francour, P, Gutiérrez, N L, De Grissac, A J, Koutsoubas, D, Milazzo, M, Otero, M D M, Piante, C, Plass-Johnson, J, Sainz-Trapaga, S, Santarossa, L, Tudela, S and Guidetti, P (2016) Five key attributes can increase marine protected areas performance for small-scale fisheries management. *Scientific Reports* No 6, 9.

Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). Official Journal of the European Union L 164, pp19-40. 6/17/2008.

Ditton, R B and Auyong, J (1984) *Fishing offshore platforms central Gulf of Mexico: an analysis of recreational and commercial fishing use at 164 major offshore petroleum structures*. 21, Government Reports, Announcements and Index, National Technical Information Service (NTIS), US Department of Commerce.

Dixon, J A, Scura, L F and Hof, T v t (1995) *Ecology and microeconomics as "joint products": the Bonaire Marine Park in the Caribbean*. LATEN Dissemination Note #6, The World Bank.

Dowling, R K and Nichol, J (2001) The HMAS Swan Artificial Dive Reef. *Annals of Tourism Research* No 28 (1), 226-229.

Dudley, N. (Editor) (2008). Guidelines for Applying Protected Area Management Categories. Gland, Switzerland: IUCN. p8.

ECORYS, Deltares and OCEANIC (2012) *Blue Growth - Scenarios and drivers for Sustainable Growth from the Oceans, Seas and Coasts*. ECORYS, Rotterdam, the Netherlands.

Ecorys, S.Pro and MRAG (2016) *Study on specific challenges for a sustainable development of coastal and maritime tourism in Europe*. EUROPEAN COMMISSION. Executive Agency for Small and Medium-sized Enterprises (EASME) Covent Garden.

Edmund, G and Rachel, D (2003) Recreational Scuba Diving in Caribbean Marine Protected Areas: Do the Users Pay? *Ambio* No 32 (2), 140-144.

EEA (2015). Spatial analysis of marine protected area networks in Europe's seas. EEA Technical report No 17/2015

EEA and European Commission (2015), Mid-term Review of the EU Biodiversity Strategy to 2020 (page 4). Available at: http://www.eea.europa.eu/themes/biodiversity/mid-term-review-of-the/view.

EMPAFISH (2008) *Results of the bio-economic and costbenefit analysis of selected case studies*. EMPAFISH Project, Brest, France.

European Commission (2007) *Guidelines for the establishment of the Natura 2000 network in the marine environment. Application of the Habitats and Birds Directives*. European Commission, Brussels.

European Commission (2011). Our life insurance, our natural capital: an EU biodiversity strategy to 2020. COM/2011/0244 final.

European Commission *Blue Growth: Opportunities for Marine and Maritime Sustainable Growth.* Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2012)494, European Commission, Luxembourg.

European Commission (2013). Mapping and Assessment of Ecosystems and their Services. An analytical framework for ecosystem assessments under Action 5 of the EU Biodiversity Strategy to 2020. Discussion paper – Final, April 2013. Technical Report - 2013 – 067

European Commission (2.10.2015) *Mid-term Review of the EU Biodiversity Strategy to 2020.* Report from the Commission to the European Parliament and the Council, Mid-term Review of the EU Biodiversity Strategy to 2020, 2.10.2015, European Commission, Brussels.

European Commission (2015). ANNEXES to the Report from the Commission to the European Parliament and the Council on the progress in establishing marine protected areas (as required by Article 21 of the Marine Strategy Framework Directive 2008/56/EC). Brussels, 01.10.2015.

Fabi, G, Grati, F, Puletti, M and Scarcella, G (2004) Effects on fish community induced by installation of two gas platforms in the Adriatic Sea. *Marine Ecology Progress Series* No 273, 187-197.

FAO (2011) *Fisheries Management: 4. Marine protected areas and fisheries*. Food and Agriculture Organization of the United Nations (FAO), Rome.

Ferse, S C A, Manez Costa, M, Manez, K S, Adhuri, D S and Glaser, M (2010) Allies, not aliens: increasing the role of local communities in marine protected area implementation. *Environmental Conservation* No 37 (1), 23-34.

Fletcher, S, Rees, S, Gall, S, Jackson, E, Friedrich, L and Rodwell, L (2012) *Securing the benefits of the Marine Conservation Zone Network*. A report to The Wildlife Trusts by the Centre for Marine and Coastal Policy Research, Plymouth University, Plymouth, UK.

Font, T and Lloret, J (2011) Socioeconomic implications of recreational shore angling for the management of coastal resources in a Mediterranean marine protected area. *Fisheries Research* No 108 (1), 214-217.

Forcada, A, Valle, C, Bonhomme, P, Criquet, G, Cadiou, G, Lenfant, P and Sánchez-Lizaso, J (2009) Effects of habitat on spillover from marine protected areas to artisanal fisheries. *Mar. Ecol. Prog. Ser.* No 379, 197-211.

Fouad, M (2010) *Samadai model of protecting spinner dolphin using resources in a sustainable way, Red Sea, Egypt*. Case study. Accessed February 22, 2017

Fujii, T (2015) Temporal variation in environmental conditions and the structure of fish assemblages around an offshore oil platform in the North Sea. *Marine Environmental Research* No 108, 69-82.

Gaines, S D, Gaylord, B and Largier, J L (2003) Avoiding Current Oversights in Marine Reserve Design. *Ecological Applications* No 13 (1), S32-S46.

Gaines, S D, White, C, Carr, M H and Palumbi, S R (2010) Designing marine reserve networks for both conservation and fisheries management. *Proceedings of the National Academy of Sciences* No 107 (43), 18286-18293.

Galal, N, Ormond, R F G and Hassan, O (2002) Effect of a network of no-take reserves in increasing catch per unit effort and stocks of exploited reef fish at Nabq, South Sinai, Egypt. *Marine and Freshwater Research* No 53 (2), 199-205.

García-Gómez, J C, Guerra-García, J M, Espinosa, F, Maestre, M J, Rivera-Ingraham, G, Fa, D, González, A R, Ruiz-Tabares, A and López-Fé, C M (2015) Artificial Marine Micro-Reserves Networks (AMMRNs): an innovative approach to conserve marine littoral biodiversity and protect endangered species. *Marine Ecology* No 36 (3), 259-277.

Gell, F R and Roberts, C M (2003) Benefits beyond boundaries: the fishery effects of marine reserves. *Trends in Ecology & Evolution* No 18 (9), 448-455.

Glenn, H, Wattage, P, Mardle, S, Rensburg, T V, Grehan, A and Foley, N (2010) Marine protected areas—substantiating their worth. *Marine Policy* No 34 (3), 421-430.

Gómez, S, Lloret, J, Demestre, M and Riera, V (2006) The Decline of the Artisanal Fisheries in Mediterranean Coastal Areas: The Case of Cap de Creus (Cape Creus). *Coastal Management* No 34 (2), 217-232.

Goñi, R, Alvarez-Berastegui, D, Renones, O, Adlerstein, S, Forcada, A, Valle, C, Sanchez-Lizaso, J, Criquet, G, Lenfant, P, Planes, S, Polti, S, Perez-Ruzafa, A, Garcia-Charton, J, Cadiou, G, onhomme, P, Bernard, G and Stelzenmiiller, V (2008) Spillover from six western Mediterranean marine protected areas: Evidence from artisanal fisheries. *Marine Ecology Progress Series* No 366, 159-174.

Goñi, R, Hilborn, R, Díaz, D, Mallol, S and Adlerstein, S (2010) Net contribution of spillover from a marine reserve to fishery catches. *Marine Ecology Progress Series* No 400, 233-243.

Goñi, R, Quetglas, A and Reñones, O (2006) Spillover of spiny lobsters Palinurus elephas from a marine reserve to an adjoining fishery. *Mar. Ecol. Prog. Ser.* No 308, 207-219.

González-Álvarez, J, García-De-La-Fuente, L and Colina-Vuelta, A (2012) *Valuing the benefits of designating a network of Scottish MPAs in territorial and offshore waters*. A report by the Institute of Natural Resources and Spatial Planning at the University of Oviedo, Scottish Environment LINK, Perth.

Gordon Jr, W R (1993) Travel characteristics of marine anglers using oil and gas platforms in the central Gulf of Mexico. *Marine Fisheries Review* No 55 (1), 25-31.

Government of Canada (2017) *Hecate Strait and Queen Charlotte Sound Glass Sponge Reefs Marine Protected Areas Regulations*. http://www.gazette.gc.ca/rp-pr/p2/2017/2017-02-22/html/sor-dors15-eng.php Accessed 17/08/2017

Grafton, R Q, Kompas, T and Schneider, V (2005) The Bioeconomics of Marine Reserves: A Selected Review with Policy Implications. *Journal of Bioeconomics* No 7 (2), 161-178.

Gravestock, P, Roberts, C M and Bailey, A (2008) The income requirements of marine protected areas. *Ocean & Coastal Management* No 51 (3), 272-283.

Great Barrier Reef Marine Park Authority (2014) *Great Barrier Reef Region Strategic Assessment: Strategic assessment report*. GBRMPA, Townsville.

Green, E and Donnelly, R (2003) Recreational scuba diving in Caribbean marine protected areas: Do the users pay? *Ambio* No 32 (2), 140-144.

European Commission (22.4.2009) *Green Paper: Reform of the Common Fisheries Policy.* Green Paper, COM(2009)163 final, 22.4.2009, European Commission, Brussels.

Gubbay, S (2005) *Marine Protected Areas & Zoning In a System of Marine Spatial Planning. A discussion paper for WWF-UK*. WWF UK, Surrey, UK.

Guidetti, P, Baiata, P, Ballesteros, E, Di Franco, A, Hereu, B, Macpherson, E, Micheli, F, Pais, A, Panzalis, P, Rosenberg, A A, Zabala, M and Sala, E (2014) Large-Scale Assessment of Mediterranean Marine Protected Areas Effects on Fish Assemblages. *PLoS ONE* No 9 (4), e91841.

Guidetti, P, Bussotti, S, Pizzolante, F and Ciccolella, A (2010) Assessing the potential of an artisanal fishing co-management in the Marine Protected Area of Torre Guaceto (southern Adriatic Sea, SE Italy). *Fisheries Research* No 101 (3), 180-187.

Guidetti, P and Claudet, J (2010) Comanagement Practices Enhance Fisheries in Marine Protected Areas

Las Prácticas de Co-Manejo Enriquecen las Pesquerías en Áreas Marinas Protegidas. *Conservation Biology* No 24 (1), 312-318.

Halpern, B S, Lester, S E and Kellner, J B (2009) Spillover from marine reserves and the replenishment of fished stocks. *Environmental Conservation* No 36 (04), 268-276.

Halpern, B S, Lester, S E and Mcleod, K L (2010) Placing marine protected areas onto the ecosystem-based management seascape. *Proceedings of the National Academy of Sciences* No 107 (43), 18312.

Hand, T (2003) *An economic and social evaluation of implementing the representative areas program by rezoning the Great Barrier Reef Marine Park*. Great Barrier Reef Marine Park Authority, Sydney.

Hargreaves-Allen, V, Mourato, S and Milner-Gulland, E (2011) A Global Evaluation of Coral Reef Management Performance: Are MPAs Producing Conservation and Socio-Economic Improvements? *Environmental Management* No 47 (4), 684-700.

Harrison, Hugo B, Williamson, David H, Evans, Richard D, Almany, Glenn R, Thorrold, Simon R, Russ, Garry R, Feldheim, Kevin A, van Herwerden, L, Planes, S, Srinivasan, M, Berumen, Michael L and Jones, Geoffrey P (2012) Larval export from marine reserves and the recruitment benefit for fish and fisheries. *Current Biology* No 22 (11), 1023-1028.

Hartmann, K, Bode, L and Armsworth, P (2007) The economic optimality of learning from marine protected areas. *ANZIAMJ* No 49, 307.

Hastings, A and Botsford, L W (2003) Comparing Designs of Marine Reserves for Fisheries and for Biodiversity. *Ecological Applications* No 13 (1), S65-S70.

Hattam, C E, Mangi, S C, Gall, S C and Rodwell, L D (2014) Social impacts of a temperate fisheries closure: understanding stakeholders' views. *Marine Policy* No 45, 269-278.

Hilborn, R, Micheli, F and De Leo, G A (2006) Integrating marine protected areas with catch regulation. *Canadian Journal of Fisheries and Aquatic Sciences* No 63 (3), 642-649.

Hiscock, K, Sharrock, S, Highfield, J and Snelling, D (2010) Colonization of an artificial reef in south-west England—ex-HMS 'Scylla'. *ournal of the Marine Biological Association of the United Kingdom* No 90 (1), 69-94.

Hooper, T, Ashley, M and Austen, M (2015) Perceptions of fishers and developers on the co-location of offshore wind farms and decapod fisheries in the UK. *Marine Policy* No 61, 16-22.

Hooper, T and Austen, M (2014) The co-location of offshore windfarms and decapod fisheries in the UK: Constraints and opportunities. *Marine Policy* No 43 (0), 295-300.

Hooper, T, Hattam, C and Austen, M (2017) Recreational use of offshore wind farms: Experiences and opinions of sea anglers in the UK. *Marine Policy* No 10.1016/j.marpol.2017.01.013, 55-60.

Hunt, L (2008) *Economic Impact Analysis of the Cape Rodney Okakari Point (Leigh) Marine Reserve on the Rodney District*. 4052, A report prepared for the Department of Conservation, Wellington.

Inman, A, Brooker, E, Dolman, S, McCann, R and Wilson, A M W (2016) The use of marine wildlife-watching codes and their role in managing activities within marine protected areas in Scotland. *Ocean & Coastal Management* No 132, 1-11.

Islam, G M N, Noh, K M, Sidique, S F and Noh, A F M (2014) Economic impact of artificial reefs: A case study of small scale fishers in Terengganu, Peninsular Malaysia. *Fisheries Research* No 151, 122-129.

Januchowski-Hartley, F A, Cinner, J E and Graham, N A J (2014) Fishery benefits from behavioural modification of fishes in periodically harvested fisheries closures. *Aquatic Conservation: Marine and Freshwater Ecosystems* No 24 (6), 777-790.

Jentoft, S, Pascual-Fernandez, J, De la Cruz Modino, R, Gonzalez-Ramallal, M and Chuenpagdee, R (2012) What stakeholders think about Marine Protected Areas: case studies from Spain. *Human Ecology* No 40 (2), 185-197.

Jones, N, Panagiotidou, K, Spilanis, I, Evangelinos, K I and Dimitrakopoulos, P G (2011) Visitors' perceptions on the management of an important nesting site for loggerhead sea turtle (Caretta caretta L.): The case of Rethymno coastal area in Greece. *Ocean and Coastal Management* No 54 (8), 577-584.

Jones, P (2001) Marine protected area strategies: issues, divergences and the search for middle ground. *Reviews in Fish Biology and Fisheries* No 11 (3), 197-216.

Jones, P J S and Burgess, J (2005) Building partnership capacity for the collaborative management of marine protected areas in the UK: A preliminary analysis. *Journal of Environmental Management* No 77 (3), 227-243.

Jones, P J S, Qiu, W and De Santo, E M (2011) *Governing Marine Protected Areas - Getting the Balance Right*. Technical Report UNEP, Nairobi-Kenya.

Jørgensen, T, Løkkeborg, S and Soldal, A V (2002) Residence of fish in the vicinity of a decommissioned oil platform in the North Sea. *ICES Journal of Marine Science* No 59 (suppl), S288-S293.

Kelly, S, Scott, D and MacDiarmid, A B (2002) The Value of a Spillover Fishery for Spiny Lobsters Around a Marine Reserve in Northern New Zealand. *Coastal Management* No 30 (2), 153-166.

Kenter, J O, Bryce, R, Davies, A, Jobstvogt, N, Watson, V, Ranger, S, Solandt, J-L, Duncan, C, Christie, M, Crump, H, Irvine, K N, Pinard, M and Reed, M S (2013) *The value of potential marine protected areas in the UK to divers and sea anglers*. UNEP-WCMC, Cambridge, UK.

Kerwath, S E, Winker, H, Götz, A and Attwood, C G (2013) Marine protected area improves yield without disadvantaging fishers. *Nature Communications* No 4 (2347), 6.

Koeck, B, Pastor, J, Larenie, L, Astruch, P, Saragoni, G, Jarraya, M and Lenfant, P (2011) Evaluation of impact of artificial reefs on artisanal fisheries: need for complementary approaches. *Brazilian Journal of Oceanography* No 59 (SPE1), 1-11.

LDWF (2013) *Louisiana Department of Wildlife and Fisheries 2012-2013 Annual Report*.

Leleu, K, Alban, F, Pelletier, D, Charbonnel, E, Letourneur, Y and Boudouresque, C F (2011) Fishers' perceptions as indicators of the performance of Marine Protected Areas (MPAs). *Marine Policy* No 10.1016/j.marpol.2011.06.002, 414-422.

Leonhard, S, Pedersen, J, Moeslund, B and Spanggaard, G (2006) *Benthic communities at Horns Rev before, during and after construction of Horns Rev Offshore Wind Farm*. Final report to Vattenfall A/S. Bio/Consult, Aarhus, Denmark.

Lloret, J and Riera, V (2008) Evolution of a Mediterranean Coastal Zone: Human Impacts on the Marine Environment of Cape Creus. *Environmental Management* No 42 (6), 977-988.

Lloret, J, Zaragoza, N, Caballero, D and Riera, V (2008) Biological and socioeconomic implications of recreational boat fishing for the management of fishery resources in the marine reserve of Cap de Creus (NW Mediterranean). *Fisheries Research* No 91 (2), 252-259.

Lowe, C, Topping, D, Cartamil, D and Papastamatiou, Y (2003) Movement patterns, home range, and habitat utilization of adult kelp bass Paralabrax clathratus in a temperate no-take marine reserve. *Marine Ecology Progress Series* No 256, 205-216.

Lundquist, C J and Granek, E F (2005) Strategies for Successful Marine Conservation: Integrating Socioeconomic, Political, and Scientific Factors

Estrategias para la Conservación Marina Exitosa: Integración de Factores Socioeconómicos, Políticos y Científicos. *Conservation Biology* No 19 (6), 1771-1778.

Lutchman, I (2005) *Marine Protected Areas: Benefits and Costs for Islands*. WWF the Netherlands, Hilversum.

Lynch, T, Harcourt, R, Edgar, G and Barrett, N (2013) Conservation of the Critically Endangered Eastern Australian Population of the Grey Nurse Shark (Carcharias taurus) Through Cross-Jurisdictional Management of a Network of Marine-Protected Areas. *Environmental Management* No 52 (6), 1341-1354.

Mackinson, S, Curtis, H, Brown, R, McTaggart, K, Taylor, N, Neville, S and Rogers, S (2006) *A report on the perceptions of the fishing industry into the potential socio-economic impacts of offshore wind energy developments on their work patterns and income*. Science Series Technical Report-Centre For Environment Fisheries And Aquaculture Science.

Mangi, S, Rodwell, L and Hattam, C (2011) Assessing the Impacts of Establishing MPAs on Fishermen and Fish Merchants: The Case of Lyme Bay, UK. *Ambio* No 40 (5), 457-468.

Mangi, S C and Austen, M C (2008) Perceptions of stakeholders towards objectives and zoning of marine-protected areas in southern Europe. *Journal for Nature Conservation* No 16 (4), 271-280.

Mangi, S C, Gall, S C, Hattam, C, Rees, S and Rodwell, L D (2012) *Lyme Bay – a case-study: measuring recovery of benthic species; assessing potential "spillover" effects and socio-economic changes; 3 years after the closure. Report 2: Assessing the socio-economic impacts resulting from the closure restrictions in Lyme Bay*. Report to the Department of Environment, Food and Rural Affairs from the University of Plymouth-led consortium, Plymouth.

Mangos, A and Claudot, M-A (2013) *Economic study of the impacts of marine and coastal protected areas in the Mediterranean*. Plan Bleu Papers 13, Plan Bleu, Valbonne.

Marine Strategy Coordination Group (MSCG). (2014). Programmes of measures under MSFD: towards recommendations for establishment / implementation and related reporting (No. MSCG_13-2014-04). DG ENV + WG ESA in collaboration with WG GES and DIKE. Retrieved from http://www.fishsec.org/wp-content/uploads/ 2014/05/ MSCG-Draft-Recommendation-PoM.pdf

Marino, R, Tempesta, M and Teofili, C (2012) *Summary report on recreational fishing in Italian Marine Protected Areas*. 2016 Forum of MPAs, MedPAN, Tangier, Morocco.

Martin, C L, Momtaz, S, Jordan, A and Moltschaniwskyj, N A (2016) Exploring recreational fishers' perceptions, attitudes, and support towards a multiple-use marine protected area six years after implementation. *Marine Policy* No 73, 138-145.

Mateos-Molina, D, Schärer-Umpierre, M T, Appeldoorn, R S and García-Charton, J A (2014) Measuring the effectiveness of a Caribbean oceanic island no-take zone with an asymmetrical BACI approach. *Fisheries Research* No 150, 1-10.

McClanahan, T R (2010) Effects of fisheries closures and gear restrictions on fishing income in a Kenyan coral reef. *Conserv Biol* No 24 (6), 1519-1528.

Merino, G, Maynou, F and Boncoeur, J (2009) Bioeconomic model for a three-zone Marine Protected Area: a case study of Medes Islands (northwest Mediterranean). *ICES Journal of Marine Science* No 66 (1), 147-154.

Micheli, F, Shelton, A O, Bushinsky, S M, Chiu, A L, Haupt, A J, Heiman, K W, Kappel, C V, Lynch, M C, Martone, R G, Dunbar, R B and Watanabe, J (2008) Persistence of depleted abalones in marine reserves of central California. *Biological Conservation* No 141 (4), 1078-1090.

Milazzo, M, Chemello, R, Badalamenti, F and Riggio, S (2002) The impact of human recreational activities in Marine Protected Areas: What lessons should be learnt in the Mediterranean Sea? *Marine Ecology* No 23 (1), 11.

Milieu, IEEP and ICF (2016) *Evaluation Study to support the Fitness Check of the Birds and Habitats Directives*. Milieu Ltd, Institute for European Environmental Policy and the ICF International, Brussels.

Moran, D, Hussain, S, Fofana, A, Frid, C, Paramour, O, Robinson, L and Winrow-Giffin, A (2008) *The Marine Bill – Marine Nature Conservation Proposals – Valuing the Benefits*. DEFRA.

Murawski, S A, Wigley, S E, Fogarty, M J, Rago, P J and Mountain, D G (2005) Effort distribution and catch patterns adjacent to temperate MPAs. *ICES Journal of Marine Science* No 62 (6), 1150-1167.

National Marine Protected Areas Center (2008) *State of the Nation's De Facto Marine Protected Areas*. National Marine Protected Areas Center, Silver Spring, Maryland.

O'Malley, M, Lee-Brooks, K and Medd, H B (2013) The global economic impact of manta ray watching tourism. *PLoS ONE* No 8 (5), 11.

OCEANA (2017) *Towards a coherent, well-managed network of EU Marine Protected Areas by 2020: Assessing Member States' Programmes of Measures under the Marine Strategy Framework Directive*. OCEANA, Madrid, Spain.

Oikonomou, Z-S and Dikou, A (2008) Integrating Conservation and Development at the National Marine Park of Alonissos, Northern Sporades, Greece: Perception and Practice. *Environmental Management* No 42 (5), 847-866.

Oliver, T A, Oleson, K L L, Ratsimbazafy, H, Raberinary, D, Benbow, S and Harris, A (2015) Positive Catch & Economic Benefits of Periodic Octopus Fishery Closures: Do Effective, Narrowly Targeted Actions "Catalyze" Broader Management? *PLoS ONE* No 10 (6), 24.

Osmundsen, P and Tveterås, R (2003) Decommissioning of petroleum installations—major policy issues. *Energy Policy* No 31 (15), 1579-1588.

Ovetz, R (2006) The bottom line: An investigation of the economic, cultural and social costs of industrial longline fishing in the Pacific and the benefits of sustainable use marine protected areas. *Marine Policy* No 30 (6), 809-820.

Pantzar, M (2014) Towards Ecosystem-Based Protection of Marine Environments, Master of Science in Environmental Management and Policy, Lund University.

Pascal, N and Seidl, A (2013) *Economic benefits of marine protected areas: case studies in Vanuatu and Fiji, South Pacific*. AFD/IUCN, Mooréa, French Polynesia.

Pascual, M, Rossetto, M, Ojea, E, Milchakova, N, Giakoumi, S, Kark, S, Korolesova, D and Melià, P (2016) Socioeconomic impacts of marine protected areas in the Mediterranean and Black Seas. *Ocean & Coastal Management* No 133, 1-10.

Pearce, D. et al. (2006) – Cost Benefit Analysis and the Environment (Paris, OECD

Perez de Oliveira, L (2013) Fishers as advocates of marine protected areas: A case study from Galicia (NW Spain). *Marine Policy* No 41, 95-102.

Pitcher, T J, Buchary, E A and Hutton, T (2002) Forecasting the benefits of no-take human-made reefs using spatial ecosystem simulation. No 59 (suppl), S17-S26.

Pizzolante, F (2009) Impatto socio-economico della conservazione dell'ambiente marino in Italia, Doctoral thesis, Universita' del Salento.

Post, J C (1994) The economic feasibility and ecological sustainability of the Bonaire Marine Park, Dutch Antilles, pp333-338. World Bank, Washington, D.C.

Ramos, J, Santos, M N, Whitmarsh, D and Monteiro, C C (2006) Patterns of use in an artificial reef system: a case study in Portugal. *Bulletin of Marine Science* No 78 (1), 203-211.

Rees, S E, Attrill, M J, Austen, M C, Mangi, S C and Rodwell, L D (2013) A thematic cost-benefit analysis of a marine protected area. *Journal of Environmental Management* No 114, 476-485.

Rees, S E, Mangi, S C, Hattam, C, Gall, S C, Rodwell, L D, Peckett, F J and Attrill, M J (2015) The socio-economic effects of a Marine Protected Area on the ecosystem service of leisure and recreation. *Marine Policy* No 62, 144-152.

Rees, S E, Rodwell, L D, Attrill, M J, Austen, M C and Mangi, S C (2010) The value of marine biodiversity to the leisure and recreation industry and its application to marine spatial planning. *Marine Policy* No 34 (5), 868-875.

Reggio, V C (1987) *Rigs-to-Reefs: The use of obsolete petroleum structures as artificial reefs*. US Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, Mexicopp.

Remoundou, K, Koundouri, P, Kontogianni, A, Nunes, P A L D and Skourtos, M (2009) Valuation of natural marine ecosystems: an economic perspective. *Environmental Science and Policy* No 12 (7), 1040-1051.

Rendle, E J and Rodwell, L D (2014) Artificial surf reefs: A preliminary assessment of the potential to enhance a coastal economy. *Marine Policy* No 45, 349-358.

Reubens, J T, Braeckman, U, Vanaverbeke, J, Van Colen, C, Degraer, S and Vincx, M (2013a) Aggregation at windmill artificial reefs: CPUE of Atlantic cod (Gadus morhua) and pouting (Trisopterus luscus) at different habitats in the Belgian part of the North Sea. *Fisheries Research* No 139, 28-34.

Reubens, J T, Degraer, S and Vincx, M (2011) Aggregation and feeding behaviour of pouting (Trisopterus luscus) at wind turbines in the Belgian part of the North Sea. *Fisheries Research* No 108 (1), 223-227.

Reubens, J T, Pasotti, F, Degraer, S and Vincx, M (2013b) Residency, site fidelity and habitat use of Atlantic cod (Gadus morhua) at an offshore wind farm using acoustic telemetry. *Marine Environmental Research* No 90, 128-135.

Roberts, C M, Bohnsack, J A, Gell, F, Hawkins, J P and Goodridge, R (2001) Effects of marine reserves on adjacent fisheries. *Science* No 294 (1920), 1923.

Roberts, T and Jones, P J S (2013) North East Kent European marine site: Overcoming barriers to conservation through community engagement. *Marine Policy* No 10.1016/j.marpol.2012.12.016, 33-40.

Rodríguez-Rodríguez, D, Kersting, D and Webster, C (2017) *Healthier seas, healthier people - Socioeconomic benefits of Marine Protected Areas*. Newsletter MedPAN, Marseille, France.

Rodríguez-Rodríguez, D, Sánchez-Espinosa, A, Schröder, C, Abdul Malak, D and Rodríguez, J (2015) Cumulative pressures and low protection: a concerning blend for Mediterranean MPAs. *Marine Pollution Bulletin* No 101 (1), 288-295.

Roncin, N, Alban, F, Charbonnel, E, Crechriou, R, de la Cruz Modino, R, Culioli, J-M, Dimech, M, Gong, R, Guala, I, Higgins, R, Lavisse, E, Le Direach, L, Luna, B, Marcos, C, Maynou, F, Pascual, J, Person, J, Smith, P, Stobart, B, Szelianszky, E, Vallek, K, Vasellio, S and Boncoeur, J (2008) Uses of ecosystem services provided by MPAs: How much do they impact the local economy? A southern Europe perspective. *Journal for Nature Conservation* No 16 (4), 256-270.

Rudd, M A, Danylchuk, A, Gore, S A and Tupper, M (2001) *Are marine protected areas in the Turks and Caicos Islands ecologically or economically valuable?* UBC Fisheries Centre, Vancouver, Canada.

Ruiz-Frau, A, Hinz, H, Edwards-Jones, G and Kaiser, M J (2013) Spatially explicit economic assessment of cultural ecosystem services: Non-extractive recreational uses of the coastal environment related to marine biodiversity. *Marine Policy* No 38, 90-98.

Russ, G R, Alcala, A C, Maypa, A P, Calumpong, H P and White, A T (2004) Marine reserve benefits local fisheries. *Ecological Applications* No 14 (2), 597-606.

Russell, D J, Brasseur, S M, Thompson, D, Hastie, G D, Janik, V M, Aarts, G, McClintock, B T, Matthiopoulos, J, Moss, S E and McConnell, B (2014) Marine mammals trace anthropogenic structures at sea. *Current Biology* No 24 (14), R638-R639.

Russi, D, Pantzar, M, Kettunen, M, Gitti, G, Mutafoglu, K, Kotulak, M and ten Brink, P (2016) *Socio-Economic Benefits of the EU Marine Protected Areas*. Institute for European Environmental Policy, London / Brussels.

Sala, E, Costello, C, De Bourbon Parme, J, Fiorese, M, Heal, G, Kelleher, K, Moffitt, R, Morgan, L, Plunkett, J, Rechberger, K D, Rosenberg, A A and Sumaila, R (2016) Fish banks: An economic model to scale marine conservation. *Marine Policy* No 73, 154-161.

Sala, E, Costello, C, Dougherty, D, Heal, G, Kelleher, K, Murray, J H, Rosenberg, A A and Sumaila, R (2013) A General Business Model for Marine Reserves. *PLoS ONE* No 8 (4), 9.

Sale, P F, Cowen, R K, Danilowicz, B S, Jones, G P, Kritzer, J P, Lindeman, K C, Planes, S, Polunin, N V C, Russ, G R, Sadovy, Y J and Steneck, R S (2005) Critical science gaps impede use of no-take fishery reserves. *Trends in Ecology & Evolution* No 20 (2), 74-80.

Sanchirico, J N (2000) Marine Protected Areas as Fishery Policy: A Discussion of Potential Costs and Benefits. No, 19.

Santos, M N and Monteiro, C C (1998) Comparison of the catch and fishing yield from an artificial reef system and neighbouring areas off Faro (Algarve, south Portugal). *Fisheries Research* No 39 (1), 55-65.

Santos, M N and Monteiro, C C (2007) A fourteen-year overview of the fish assemblages and yield of the two oldest Algarve artificial reefs (southern Portugal). *Hydrobiologia* No 580 (1), 225-231.

Sauzade, D and Rousset, N (2013) *Greening the Mediterranean fisheries: tentative assessment of the economic leeway*. Plan Bleu, Valbonne.

Scarcella, G, Grati, F and Fabi, G (2011) Temporal and spatial variation of the fish assemblage around a gas platform in the northern Adriatic Sea, Italy. *Turkish Journal of Fisheries and Aquatic Sciences* No 11 (3).

Scheidat, M, Tougaard, J, Brasseur, S, Carstensen, J, van Polanen Petel, T, Teilmann, J and Reijnders, P (2011) Harbour porpoises (*Phocoena phocoena*) and wind farms: a case study in the Dutch North Sea. *Environmental Research Letters* No 6 (2), 025102.

Scottish Government (2017) *Scottish Marine Protected Areas Socioeconomic Monitoring - 2016 Report*. Marine Scotland Science, Scottish Government.

Shephard, S, Gerritsen, H, Kaiser, M and Reid, D (2012) Spatial Heterogeneity in Fishing Creates de facto Refugia for Endangered Celtic Sea Elasmobranchs. *PLoS ONE* No 7 (11), 8.

Soldal, A V, Svellingen, I, Jørgensen, T and Løkkeborg, S (2002) Rigs-to-reefs in the North Sea: hydroacoustic quantification of fish in the vicinity of a "semi-cold" platform. *ICES Journal of Marine Science* No 59 (suppl), S281-S287.

Stanley, D and Wilson, C (1989) Utilization of offshore platforms by recreational fishermen and scuba divers off the Louisiana coast. *Bulletin of Marine Science* No 44 (2), 767-776.

Stelzenmüller, V, Maynou, F, Bernard, G, Cadiou, G, Camilleri, M, Crec'hriou, R, Criquet, G, Dimech, M, Esparza, O, Higgins, R, Lenfant, P and Pérez-Ruzafa, Á (2008) Spatial assessment of fishing effort around European marine reserves: Implications for successful fisheries management. *Marine Pollution Bulletin* No 56 (12), 2018-2026.

Stepanova, O (2015) Conflict resolution in coastal resource management: Comparative analysis of case studies from four European countries. *Ocean and Coastal Management* No 103, 109.

Stobart, B, Warwick, R, Gonzalez, C, Mallol, S, Diaz, D, Renones, O and Goni, R (2009) Long-term and spillover effects of a marine protected area on an exploited fish community. *Marine Ecology Progress Series* No 384, 47-60.

Surís-Regueiro, J C, Garza-Gil, M D and Varela-Lafuente, M M (2013) Marine economy: A proposal for its definition in the European Union. *Marine Policy* No 42, 111-124.

Swedish Agency for Marine and Water Management (SwAM) (2015) *God havsmiljö 2020 - Marin strategi för Nordsjön och Östersjön*. Dnr 3563-14, Swedish Agency for Marine and Water Management (SwAM), Gothenburg, Sweden.

Taylor, N and Buckenham, B (2003) Social impacts of marine reserves in New Zealand. *Science for Conservation* No (217), 5-51.

The Allen Consulting Group (2009) *The economics of marine protected areas - Application of principles to Australia's South West Marine Region*. Report to the Conservation Council of Western Australia, Sydney.

Trivourea, M, Karamanlidis, A, Tounta, E, Dendrinos, P and Kotomatas, S (2011) People and the Mediterranean Monk Seal (Monachus monachus): A Study of the Socioeconomic Impacts of the National Marine Park of Alonissos, Northern Sporades, Greece. *Aquatic Mammals* No 37 (3), 305-318.

UNEP-WCMC (2016). World Database on Protected Areas User Manual 1.3. UNEP-WCMC: Cambridge, UK. Available at: http://wcmc.io/WDPA_Manual

Valdemarsen, J W (1979) *Behaviour aspects of fish in relation to oil platforms in the North Sea*. Report C.M. 1979/B:27, ICES.

van de Walle, G, Gomes da Silva, S, O'Hara, E and Soto, P (2015) Achieving Sustainable Development of Local Fishing Interests: The Case of Pays d'Auray flag. *Sociologia Ruralis* No 55 (3), 360-377.

Vandendriessche, S, Hostens, K, Courtens, W and Stienen, E (2013) Fisheries activities change in the vicinity of offshore wind farms, in Degraer, S, Brabant, R, Rumes, B (eds), *Environmental Impacts of Offshore Wind Farms in the Belgian Part of the North Sea: Learning From the Past to Optimise Future Monitoring Programs*, pp81-85. Royal Belgian Institute of Natural Sciences, Brussels.

Vandeperre, F, Higgins, R M, Sanchez-Meca, J, Maynou, F, Goni, R, Martin-Sosa, P, Perez-Ruzafa, A, Afonso, P, Bertocci, I, Crec'hriou, R, D'Anna, G, Dimech, M, Dorta, C, Esparza, O, Falcon, J M, Forcada, A, Guala, I, Le Direach, L, Marcos, C and Ojeda-Martinez, C (2011) Effects of no-take area size and age of marine protected areas on fisheries yields: a meta-analytical approach. *Fish and Fisheries* No 12 (4), 412-426.

Verweij, M C and van Densen, W L T (2010) Differences in causal reasoning about resource dynamics and consequences for the participatory debate on North Sea fisheries. *Marine Policy* No 34 (6), 1144-1155.

White, J W, Scholz, A J, Rassweiler, A, Steinback, C, Botsford, L W, Kruse, S, Costello, C, Mitarai, S, Siegel, D A, Drake, P T and Edwards, C A (2013) Comparison of approaches used for economic analysis in marine protected area network planning in California. *Ocean & Coastal Management* No 74, 77-89.

Whitmarsh, D, James, C, Pickering, H, Pipitone, C, Badalamenti, F and Anna, G (2002) Economic Effects of Fisheries Exclusion Zones: A Sicilian Case Study. *Marine Resource Economics* No 17 (3), 239-250.

Whitmarsh, D, Pipitone, C, Badalamenti, F and D'anna, G (2003) The economic sustainability of artisanal fisheries: the case of the trawl ban in the Gulf of Castellammare, NW Sicily. *Marine Policy* No 27 (6), 489-497.

Whitmarsh, D, Santos, M N, Ramos, J and Monteiro, C C (2008) Marine habitat modification through artificial reefs off the Algarve (southern Portugal): An economic analysis of the fisheries and the prospects for management. *Ocean and Coastal Management* No 51 (6), 463-468.

Wilhelmsson, D and Malm, T (2008) Fouling assemblages on offshore wind power plants and adjacent substrata. *Estuarine, Coastal and Shelf Science* No 79 (3), 459-466.

Winter, H, Aarts, G and Van Keeken, O (2010) *Residence time and behaviour of sole and cod in the Offshore Wind farm Egmond aan Zee (OWEZ)*. IMARES Wageningen UR.

WRI (2009) *Manual: Marine Protected Area Economic Impact Template. Version Beta 2.0*. World Resources Institute (WRI), Washington, USA.

Xuan, B B and Armstrong, C W (2016) Marine reserve creation and interactions between fisheries and capture-based aquaculture: A bio-economic model analysis: Natural Resource Modeling. *Natural Resource Modeling* No 00, 1-16.

Yamazaki, S, Grafton, Q R, Kompas, T and Jennings, S (2014) Biomass management targets and the conservation and economic benefits of marine reserves. *Fish and Fisheries* No 15 (2), 196-208.

HOW TO OBTAIN EU PUBLICATIONS

Free publications:

- one copy:

via EU Bookshop (http://bookshop.europa.eu);

- more than one copy or posters/maps:
  from the European Union's representations
  (http://ec.europa.eu/represent_en.htm);
  from the delegations in non-EU countries
  (http://eeas.europa.eu/delegations/index_en.htm);
  by contacting the Europe Direct service
  (http://europa.eu/europedirect/index_en.htm) or calling 00 800 6 7 8 9 10 11
  (freephone number from anywhere in the EU) (*).

  (*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you).

Priced publications:

- via EU Bookshop (http://bookshop.europa.eu).

Priced subscriptions:

- via one of the sales agents of the Publications Office of the European Union
  (http://publications.europa.eu/others/agents/index_en.htm).

EA-03-18-223-EN-N

doi: 10.2826/40733