

MARINE PROTECTED AREAS

Legal challenges between Pelagic and Benthic Protected Areas



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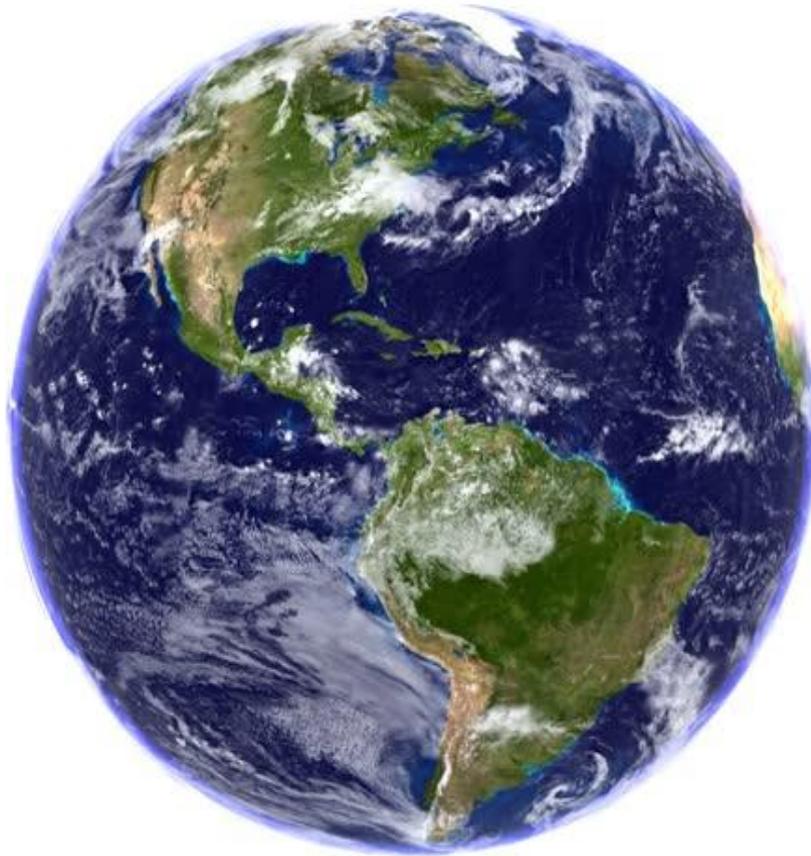
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SUMMARY

The establishment of a marine protected areas as area-based management tools have had a significant contribution to the conservation of marine ecosystems. The concept of MPAs is a paramount part of the package deal negotiated by the BBNJ Prepcom for their objectives of maintaining and protecting marine biodiversity. At the moment the oceans are in trouble, they are vulnerable to pollution, over-fishing and over-exploited for their resources. This discussion requires a hermetic research and can become quite challenging since marine ecosystems do not respect boundaries drawn by international agreements. In this sense, there are a number of factor which should be taken into account, such as the division of the ocean vertically and horizontally, which results in the creation of pelagic and benthic areas. For example, highly migratory species cannot be limited to a specific area and to create an area specific for the proliferation of said species might become difficult. Thus, in this case the answer is to implement dynamic management plan together with an ecosystem approach.

In short, there are elements of biological and physical design along, including governance issues, which need to be taken into account when selecting and analyzing data for constituting a MPA. At the level of the High-Seas and the Area there are even more factors to look into since they are governed by the principles of freedom and common heritage of mankind and do not belong to any jurisdictional power. And although, in recent years there have been improvements in marine spatial planning, with the implementation of Ross Sea as a “no-take” zone and the expansion of Papahānaumokuākea marine national monument in Hawaii, this doesn’t mean that mitigation efforts should be taken lightly and therefore not be extended to the HS and the Area as an integrated part of national and international efforts. That is why the present thesis proposes to a new approach by focusing on pelagic and benthic communities, in a way that doesn’t undermine the existing international regulations and it will bring nations together to collaborate and cooperate holistically in order to rehabilitate and reform the ecosystem and health of the oceans.

“How inappropriate to call this planet, Earth, when it is quite clearly Ocean.”

- Arthur C. Clarke

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ACRONYMS AND ABBREVIATIONS

ABNJ Areas beyond national jurisdiction

BBNJ Conservation of Biodiversity in Areas Beyond National Jurisdiction

BMPA Benthic marine protected areas

CBD Convention on Biological Diversity

CITES Convention on International Trade in Endangered Species

EEZ Exclusive economic zone

EIA Environmental impact assessment

FAO Food and Agriculture Organization

IMO International Maritime Organization

IPCC Intergovernmental Panel on Climate Change

IUCN International Union for Conservation of Nature

IUU Illegal, unreported and unregulated

IWC International Whaling Commission

MEABR Management and Exploitation Areas for Benthic Resources

MPA Marine protected area

MSR Marine scientific research

OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic

PMPA Pelagic marine protected area

RFMOs Regional Fisheries Management Organizations

SDG Sustainable Development Goal

SPAMI Specially Protected Area of Mediterranean Importance

UNEP United Nations Environment Program

UNDP United Nations Development Program

WCED World Commission of Environment and Development

WDPA World Database on Protected Areas

WIPO World Intellectual Property Organization

WSSD World Summit on Sustainable Development

WTO World Trade Organization

WWF World Wildlife Fund

Part I

1. THE TOPIC

1.1 Introduction

The topic of this thesis revolves around the legal challenges of establishing marine protected areas in and beyond the national jurisdiction from an ecosystem perspective. The concrete legal investigation which I am proposing is to present the challenges of establishing both pelagic and benthic protected areas, and how these two categories interfere with and can be integrated into the IUCN classification of marine protected areas, the efficiency of protected areas on the pelagic and benthic communities and what are the steps on developing such areas of marine conservation. The driving force behind the thesis is based on the recent interest of the international community to establish a new international agreement regarding the Area Beyond National Jurisdiction (hereafter ABNJ). This international legally binding instrument (hereafter ILBI) has four objectives: marine genetic resources, including questions regarding benefit-sharing, area-based management tools measures (including marine protected areas), environmental impact assessments and capacity building and marine technology transfer. The Preparatory Committee on Marine Biodiversity beyond Areas of National Jurisdiction (hereafter PrepCom BBNJ) are debating cross-cutting issues, such as the objectives of the ILBI and its relationship with other international and national legal instruments, as well as the governing principles.

As far as the international community, there is a generally agreed upon idea that through cooperation and implementation of an ecosystem approach for the future sustainability of the marine environment. Receding harvests in many fishing areas and the depletion of essential marine habitats, such as coral reefs, have encourages countries in establishing a more comprehensive system for marine protected areas around the world. The management of living resources demonstrate to have many challenges, especially if countries take the conventional approach which involves management of protected areas on a species-by-species basis. Here, there needs to be a better understanding of the population level dynamics of living resources.

For the past century, it has been predicted that coastal States will be strongly affected the consequences of climate change according to the Intergovernmental Panel on Climate Change

(IPCC)¹. Since the beginning of the industrial revolution the oceans' temperature has increased and is expected to continuously rise. The salinity has also been rising steadily along with the acceleration in the acidification level of the seas. This in turn creates a domino effect causing sea level rising, coastal erosion, floods and increased storm events. MPAs have an important role in providing ecosystem services, mitigation impacts and increasing ecological and socio-economical resilience of coastal communities. The protected areas act as effective coastal defenses against all these impacts caused by climate change.

At the World Summit on Sustainable Development (WSSD) in 2002 the international community proposed to establish a global system of representative MPA networks by 2012 since the previous target of Agenda 21 hadn't been entirely met². In addition to this, the States adopted the strategic plan for the biological diversity in 2010 to support the Aichi Targets, the Convention on Biological Diversity (CBD) Parties established the goal to ensure that 10% of the waters under their national jurisdiction "are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected [...] and integrated into the wider landscape and seascape."³

The first focus of this thesis will be to answer the following questions:

- *Are pelagic and benthic marine protected areas the missing link in furthering the development of marine conservation?*
- *More specifically is the current legal framework promoting a fragmented legislation? Or perhaps it can be a complementary system?*
- *And how can these two types fit into the IUCN classification?*

¹ Pachauri, Rajendra K., Leo Meyer, Gian-Kasper Plattner, and Thomas Stocker. *IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC, 2015.

² Agenda 21 – paragraph 17.21 "A precautionary and anticipatory rather than a reactive approach is necessary to prevent the degradation of the marine environment." Additionally paragraph 17.22 States have „to prevent, reduce and control degradation of the marine environment so as to maintain and improve its life-support and productive capacities."

³ Secretariat, C. B. D. "Report of the tenth meeting of the conference of the parties to the convention on biological diversity." In *The tenth meeting of the Conference of the Parties to the Convention on Biological Diversity, Nagoya, Japan, NEP/CBD/COP/10/27*. See <https://www.cbd.int/cop10/doc>. 2010.

- *The two types of MPAs promote an ecosystem approach as the main marine area based conservation tool, however is it compatible with the current framework?*

The idea of differentiating between benthic and pelagic MPAs is contemplated and supported by both science and scholarly works as will be seen throughout the entire thesis. The reason behind applying a different ecosystem approach for pelagic protected areas than for benthic protected areas, is in accordance with ecosystem science and will be presented in chapter 2 and 3, where the ecosystem characteristics are explained showing the differences between the environments' conservation necessities.

1.2 Structure of thesis

The structure of the thesis is composed of two parts, in which the first part is focused on giving the reader knowledge on MPAs, while as the second part intends to illustrate the different ecosystem approaches of benthic and pelagic protected areas.

The thesis begins in Chapter Two by providing an overview of marine protected areas from the presentation of a historical background to understanding the legal challenges of a general MPA.

Chapter Three provides the explanation of what a pelagic marine protected area (PMPA) encompasses and how does this particular type of MPA change or improves the standard way of marine conservation management. It outlines the research questions, of how the ecosystem approach will be incorporated into the management design.

Chapter Four introduces the idea of benthic marine protected area (BMPPA) and provides the contextual information which underpins the creation of such a MPA and the depiction of how an ecosystem approach based management will improve the environment.

Finally, Chapter Five summarizes the key findings of this research and provides a number of responses to these findings based around benthic and pelagic marine protected areas.

1.3 Source of law and methods used

The research performed for the construction of the thesis is a mixture of methods, although primarily I have used the qualitative method. For the research project I have incorporated a range of research methods and data sources.

Intrinsically, of great importance is the Statute of the International Court of Justice (ICJ) which recounts in article 38 how the court will apply the law when deciding cases which are submitted to it. The enumeration presented here is generally considered to be the most authentic list of the sources of International Law. Article 38 and its framework indicate the heart of the international legal system, meaning it reflects what would qualify as a viable source of international law or applicable law. As such, the primary legal sources in public international law, mentioned in article 38 (a) and (b), are international conventions and international custom. The thesis uses UNCLOS as one of the written convention in regard to law of the sea issues, of which MPAs are a significant part. Marine biodiversity and ecosystem conservation appear as one of the Aichi Target under the CBD. Likewise, are international court decisions and opinions considered of significance when trying to understand international law, although for this issue there have not been many cases relating to MPAs brought before the international courts.

Due to the lack of detailed and comprehensive legal sources regulating to benthic and pelagic marine protected areas, this thesis must draw from related areas and their respective regulation. Additionally, such marine areas incorporate regulation relating to biological diversity, fisheries and general public international law. This fact suggests that the thesis beforehand will hypothesize based on related material such as the CBD, UNCLOS, resolutions and reports from recognized institutions, scholar articles etc.

1.4 Introduction of key concepts

Ecosystem approach can be regarded as a governance approach based on the ecological boundaries of an ecosystem, rather than jurisdictional set by (in this case) UNCLOS through the maritime boundaries. This approach has the objective of both sustainably using and protecting the ecosystem integrity.⁴

In order to better understand what a ecosystem approach is a short definition of ecosystem must be given. The Convention on Biological Diversity (CBD), defines the ecosystem as:

“...a dynamic complex of plant, animal and micro-organism communities and their nonliving environment interacting as a functional unit”

⁴ Platjouw, Froukje Maria. *Environmental Law and the Ecosystem Approach: Maintaining Ecological Integrity Through Consistency in Law*. Routledge, 2016.

Even though this concept has enabled countries to adopt a holistic approach to conservation management as opposed to the traditional species-based approaches, the term has ecosystem based approach is still considered an unclear concept and contested by many scholars.⁵

Nevertheless, an ecosystem approach aims at narrowing the gap between science and law, engaging the stakeholders and managers in a more in depth understating of the physical underwater world. And so, the emergence of the ecosystem approach has become widely endorsed in international and European legal instruments.⁶

The topic of law *fragmentation* has been in the attention of many scholars over the last decade, although the phenomenon has long been observed. The concept of fragmentation of public international environmental law has been a phenomenon detected years ago, which demonstrates irregular regulated and institutional development and evolution of international relations. Independent legal norms and organizations have developed mostly set apart from one another, often initiated by non-identical regional groups of states as a response to certain functional issues.⁷

The phenomenon of legal fragmentation is both horizontal and vertical fragmentation. In addition, each of the existing international laws has weaknesses and gaps. These issues must be addressed if the international regulatory framework for MPAs proposed by IUCN.⁸

Horizontal fragmentation occurs when laws have been developed within international environmental law for governing different aspects of marine environment. Therefore, creating a rooted tension between marine conservationists effort to protect ecosystems and the regional fisheries organization regulations in marine environmental laws. This fragmentation is synthesized by the inadequacies and inconsistencies of regulations at the national or international level.

Vertical fragmentation is the result of different levels of governance, international, regional, national and local jurisdictions, which have divergent legal approaches on the same issue. This

⁵ De Lucia, Vito. "Competing narratives and complex genealogies: the ecosystem approach in international environmental law." *Journal of Environmental Law* 27, no. 1 (2014): 91-117.

⁶ Platjouw, Froukje Maria. *Environmental Law and the Ecosystem Approach: Maintaining Ecological Integrity Through Consistency in Law*. Routledge, 2016

⁷ Young, Margaret A., ed. *Regime interaction in international law: Facing fragmentation*. Cambridge University Press, 2012.

⁸ Underdal, Arild. "Integrated marine policy: what? why? how?" *Marine Policy* 4, no. 3 (1980): 159-169.

comes across quite clearly from the vast number of international, regional and national regulations available on MPAs as well as pelagic and benthic.

In the correct conditions, consistency and uniformity in MPA practice will strengthen the rules of law and will create a better system for governing protected areas. The focus of the present thesis is to explore the possibility of new approach to marine conservation by suggesting pelagic and benthic protected areas as a possible solution for maintaining a healthy ecosystem. These ideas will be examined with the help of the ecosystem approach, which will answer the challenging questions posed in the research.

2. MARINE PROTECTED AREAS

This chapter is focused on addressing the shortcomings of the classification made by the IUCN and to discuss whether benthic and pelagic specific marine protection are reflected in the classification. Since threats in the ocean are obviously less visible than the terrestrial ones and, accordingly, humanity's knowledge about on land ecosystems and to what extent does anthropological activities impact this area than we understand the ecosystem of the sea.⁹ Regardless of the fact that recently the international community has focused on this issue, marine conservations methods have historically faltered compared to the terrestrial mitigation methods.¹⁰

2.1 What is a MPA?

Marine Protected Area (MPA) is a broad term that encompasses all types of protected areas for marine conservation around the world. The first international definition specifically for MPAs, evidently different from the general definition of a protected area, was adopted by the IUCN in 1999.¹¹ The definition was amended later on in 2008 removing the distinction between a marine and terrestrial protected area, aligning the definition of MPAs with the definition of a 'protected area' as "*a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values*".¹² In order for MPAs to be included within the World Database on Protected Areas (WDPA), these areas must be sites, located in the marine environment, that meet the most recent IUCN protected area definition.

Marine protected areas have become, nowadays, the most important area based management tool for marine conservation.¹³ Currently around 17,000 MPAs exist, but since many of these have overlapping objectives the number isn't a good index, and so the total coverage of MPAs is a better metric for measuring conservation progress. MPAs now cover only 3.41% of the

⁹ Hoekstra, Jonathan M., Timothy M. Boucher, Taylor H. Ricketts, and Carter Roberts. "Confronting a biome crisis: global disparities of habitat loss and protection." *Ecology letters* 8, no. 1 (2005): 23-29.

¹⁰ Ban, Natalie C., Nicholas J. Bax, Kristina M. Gjerde, Rodolphe Devillers, Daniel C. Dunn, Piers K. Dunstan, Alistair J. Hobday et al. "Systematic conservation planning: a better recipe for managing the high seas for biodiversity conservation and sustainable use." *Conservation Letters* 7, no. 1 (2014): 41-54.

¹¹ Kelleher, Graeme. *Guidelines for marine protected areas*. IUCN, Gland, Switzerland and Cambridge, UK, 1999.

¹² Dudley, Nigel. *Guidelines for applying protected area management categories*. IUCN, 2008.

¹³ Halpern, Benjamin S., Sarah E. Lester, and Karen L. McLeod. "Placing marine protected areas onto the ecosystem-based management seascape." *Proceedings of the National Academy of Sciences* 107, no. 43 (2010): 18312-18317.

ocean's surface and out of this percentage about 0.59% of the global ocean is protected by no-take areas.¹⁴

The extremely limited scale of MPA protection reflects a failure to achieve the Aichi Biodiversity Targets of the Convention on Biological Diversity, which require members to create a MPA from 10% of their coastal and marine areas. All the protected areas should be integrated into the wider seascapes by 2020, sadly this goal cannot be reached since most of the countries are missing the mark as by said Deon Nel, Global Conservation Director of WWF International. Without a doubt, it is a very difficult goal to achieve since, on one hand, human interest seems to be intertwined with proximity, prominence and consequence. Therefore, the loss of marine habitat doesn't create an immediate response in that it appears to have less impact on people's daily lives.¹⁵ The ugly truth about ocean pollution or overexploitation doesn't have such a pressing effect and it becomes omitted from global concerns. On the other hand, developing countries located in disadvantaged parts of the world are suffering now the consequences of climate change and ocean pollution. The Earth's climate is changing at a rate that has exceeded most scientific forecasts. As a result, families and communities have been forced to leave their homes and seek refuge. A terribly accurate example of this is the case of Kiribati, a small Pacific island on the brink submerging under waters. This situation calls for new governance. The thesis intends to outline and discuss the model for a global governance architecture for the protection and conservation of MPAs by applying an ecosystem approach.

Does the current system allow countries to establish a proper management plan for pelagic or benthic protected areas or is the IUCN classification system too vague not leaving room for progress? Are pelagic and benthic MPAs the new model of governance? These are but a few questions that will be explained and also that might create a significant difference in ocean conservation action plan and lead to a better understanding of area based management tools. Considering the fact that many of the MPAs are located in remote areas, lack solid management plans, some allow a number of extractive activities and are not monitored. It seems as though MPAs are distancing themselves from the scope of restoring biological diversity, embracing a commercial interest in turn. In the following subchapters the history, conservation objectives,

¹⁴ <https://www.cbd.int/decision/cop/default.shtml?id=12268> CBD Secretariat. Strategic Plan for Biodiversity 2011 – 2020 and the Aichi Targets. 1, (2012).

¹⁵ Board, Ocean Studies, and National Research Council. *Marine Protected Areas: Tools for Sustaining Ocean Ecosystem*. National Academies Press, 2001.

classification of MPAs and the legal framework will be analyzed in order to grasp the legal gaps and what can countries build on to reach the conservation objectives.

Recently, the international community has made some progress regarding marine conservation in ABNJ. At the third Session of the Preparatory Committee on Marine Biodiversity beyond Areas of National Jurisdiction (hereafter BBNJ PrepCom) in April 2017 state representatives meet to discuss area based management tools of which MPAs are a subset. These negotiations are of importance because it will establish a new regime for the area beyond national jurisdiction and possibly enhance the conservation effort in that area. There were suggestions of a process to establish and manage a coherent MPA network in ABNJ in order to contribute to the Aichi Targets and Sustainable Development Goal (SDG)¹⁶. Some countries were concerned this might supersede the mandates of existing bodies like the International Maritime Organization (IMO), regional fisheries management organizations (RFMOs) and the International Seabed Authority (ISA); while others considered the RFMOs mandate limited, leaving way for the possibility of establishing a new intergovernmental body to consistently identify “ecologically or biologically significant areas” (EBSAs) and give guidelines for designing networks of MPAs.¹⁷ The idea of creating a new entity, or the expansion of the mandate of an existing entity, which has the mandate to establish MPAs with measures binding on all State Parties to the IA, without the involvement of RFMOs¹⁸. This solution is appealing because it avoids inconsistency and supports an ecosystem approach. The focus of this paper, however, is not centered on the drafting process of the BBNJ due to its uncertainty. Nevertheless, the potential international agreement is building on the already existent regulations at an international or regional level.

The IUCN 2012 guidelines¹⁹ for the application of MPA management categories maintained a level of ambiguity since: i) the main objectives of MPAs are many times vaguely mentioned in management plans; ii) regulations may be inconsistent with the stated objectives, with

¹⁶ Target 11: By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascapes. (https://www.iucn.org/sites/dev/files/import/downloads/iucn_policy_brief_aichi_targets_and_sdgs_jan.pdf)

¹⁷ <http://enb.iisd.org/vol25/enb25129e.html>

¹⁸ Tladi, Dire. "The proposed implementing agreement: options for coherence and consistency in the establishment of protected areas beyond national jurisdiction." *The International Journal of Marine and Coastal Law* 30, no. 4 (2015): 654-673.

¹⁹ Day, Jon, Nigel Dudley, Marc Hockings, G. Holmes, Dan d'A. Laffoley, Sue Stolton, and Susan M. Wells. *Guidelines for applying the IUCN protected area management categories to marine protected areas*. IUCN, 2012.

misinterpretations likely to occur; and iii) many MPAs are multi-purpose and comprise different zones which, although having different rules, are not being effectively differentiated by the current IUCN system.²⁰

Notwithstanding, all these new regulations cannot function properly if the distinction between terrestrial and marine areas is not defined. The current classification was intended to fit both landscapes and seascapes, but there is an inherited difference between conservation methods for marine and terrestrial protected areas. Terrestrial protected areas are totally or partially protected areas that are established by States as reserves with limited public access, national parks, natural monuments, nature reserves or wildlife sanctuaries, protected landscapes, and areas governed primarily for sustainable use. Marine biodiversity requires different commitments, since the sea is hard to monitor and there are many more factors to consider. When referring to terrestrial protected areas we can identify clear boundaries, while a marine setting is characterized by the openness and fluidity of the environment. The international community is prone to promote a more conventional management, such as a species-by-species approach, which is not plentiful anymore. Therefore, a general classification which represents both environments is not suffice to effectively differentiate the particular conservation measures for marine areas. This paper analysis potential avenues for accelerating progress towards representative MPA networks as part of an international large-scale effort towards improving the conservation and sustainable use of marine biodiversity.

Scientists have concluded that the benthic habitat together with the communities of species that they sustain are being depleted by the fishing practices used and other human activities present on the water column.²¹ In response, the international community had to adopt a precautionary management and an ecosystem approach to the issues of marine conservation.²² Additionally, sedentary and nonmigratory marine species have a broad dispersal range due to the external factor, such as eddies. Thus, they do not experience genetic isolation over the course of time.²³ While other species may become vulnerable to anthropogenic stress factors as a consequence

²⁰ Al-Abdulrazzak, Dalal, and Stephen C. Trombulak. "Classifying levels of protection in Marine Protected Areas." *Marine policy* 36, no. 3 (2012): 576-582.

²¹ Watling, Les, and Elliott A. Norse. "Special section: Effects of mobile fishing gear on marine benthos." *Conservation Biology* 12, no. 6 (1998): 1178-1179.

²² Ecosystem approach is considered a strategy for the integrated management of sea and living resources that promotes conservation and sustainable use in an equitable way.

²³ Palumbi, STEPHEN R. "Macrosatial genetic structure and speciation in marine taxa with high dispersal abilities." *Molecular zoology: advances, strategies and protocols*. Wiley, New York (1996): 101-117.

of their endemism²⁴. All these characteristics should make a difference when selecting and designing a MPA.

The evaluation of the development of marine conservation targets necessitate an improvement when it comes to reporting on the existent MPAs and their regulation. Horta e Costa et al.²⁵ suggested that a new classification should be used when designating an MPA, a regulation-based system focused on the potential impacts of uses. This alternative is not intended to abolish the IUCN classification system, but rather to compliment it.²⁶ Biodiversity hotspots should be placed under effective protection, all presented issues show why policy and institutional coherence is necessary to properly operating a MPA governance system. In the next subchapter a short story will be presented of how marine protected areas first started.

2.2 Historical background

The world's first protected area was made by the United State in 1935 when it established the Fort Jefferson National Monument in Florida, which included 18.850 ha of sea and 35 ha of coastal land. At an international level, the World Congress on National Parks gathered in 1962 for the first global convention to concentrate efforts and resources on protecting wildlife and habitats. The Torrey Canyon environmental disaster with its subsequent oil pollution in 1967 drew public attention to the threat which marine life faced as a result of human activities. These oil spills have greatly contributed to larger public and political interest in the conservation of marine wildlife. The idea of marine protected areas became a discussed and interesting subject in one of the follow-up meetings in 1982 of the World Congress on National Parks, which resulted in the incorporation of marine, coastal and freshwater sites into the worldwide network of protected areas.

In order to develop a response to threats to coastal and marine waters, the international community had to determine issues of governance of marine areas. The Law of the Sea Convention of 1958 (UNCLOS I) provided a legal framework to address sovereignty and jurisdictional rights of nations to the continental shelf beyond the customary 3-mile territorial

²⁴ Represents species being unique to a defined geographic location

²⁵ e Costa, Bárbara Horta, Joachim Claudet, Gustavo Franco, Karim Erzini, Anthony Caro, and Emanuel J. Gonçalves. "A regulation-based classification system for Marine Protected Areas (MPAs)." *Marine Policy* 72 (2016): 192-198.

²⁶ e Costa, Barbara Horta, Joachim Claudet, Gustavo Franco, Karim Erzini, Anthony Caro, and Emanuel J. Gonçalves. "A regulation-based classification system for marine protected areas: A response to Dudley et al.[9]." *Marine Policy* 77 (2017): 193-195.

sea. Four conventions were adopted in 1958, the Convention on the Continental Shelf, the Convention on the High Seas, the Convention on the Territorial Sea and the Contiguous Zone, and the Convention on Conservation of the Living Resources of the High Seas, establishing an international regulation for protection of living marine resources.²⁷

The first conference on marine protected areas was held by the International Union for the Conservation of Nature and Natural Resources (IUCN) in Tokyo in 1975. The conference drew international attention and accentuated the significance of marine environments and ecosystems in the long-term objective of adopting conservation measures. It was at that point the international community developed a well-controlled MPA system that was exemplary of the world's marine ecosystems. Not long after this, in 1982 UNCLOS III was adopted, including Part XII on the protection and preservation of the marine environment making it the first all-encompassing set of regulations directed at the protection and preservation of the marine environment. The Convention on Biological Diversity (CBD) was signed in 1992 during the Earth Summit in Rio de Janeiro with the objectives to conserve biological diversity, to sustainably use its components and the fair and equitable sharing of benefits arising from handling of genetic resources. The CBD was a significant improvement for it introduced the concept of sustainability.

Over the past decades there have been significant improvement in the number of created MPA, nevertheless the fact remains that these MPAs cover only an insignificant percent of the oceans. At present, there have been some substantial achievement which should be celebrated because it is due to the historical evolution of MPAs that this area was created. On 28 October 2016 in Australia, the Convention for the Conservation of Antarctic Marine Living Resources agreed to establish the first Antarctic and largest marine park in the world encompassing 1.55 million km² in the Ross Sea.²⁸

2.3 The role of legal principles in MPAs

The legal principles are recognized as one of the three main legal sources on which the ICJ refer to when they deliver their judgement on case law. Principles can hint decision-makers, for instance MPA managers, to follow a particular conduct, when rules and regulations are not clear

²⁷ Board, Ocean Studies, and National Research Council. *Marine Protected Areas: Tools for Sustaining Ocean Ecosystem*. National Academies Press, 2001.

²⁸ <https://www.ccamlr.org/en/news/2016/ccamlr-create-worlds-largest-marine-protected-area>

or may require a certain policy mindset. These environmental legal principles can effectively contribute to environmental conservation management, if used properly.

Before presenting the legal principles, which have a significant impact on MPA management, there is an issue which has been heavily debated in the international academic environment, the distinction between legal principles and customary law. According to Cheng:

*“while conventions can be easily distinguished from the two other sources of international law, the line of demarcation between custom and general principles of law recognized by civilized nations is often not very clear, since international custom or customary law, understood in a broad sense, may include all that is unwritten in international law. In Article 38, however, custom is used in a strict sense, being confined to what is a general practice among States accepted by them as law. General practice among nations, as well as the recognition of its legal character, is therefore required.”*²⁹

And so, it is to say that a distinction is made by the presence or absence of the requirement of a general practice. The legal principle is view as a conduct, while the customary law is a practice initiated by the State.

2.3.1 Prevention of environmental harm

According to Principle 21 of the Stockholm Declaration encompasses the prevention of environmental harm principle. Under art. 194(2) UNCLOS states are obligated not to cause environmental damage by polluting, and are guided to:

“...take all measures necessary to ensure that activities under their jurisdiction or control are so conducted as not to cause damage by pollution to other States and their environment, and that pollution arising from incidents or activities under their jurisdiction or control does not spread beyond the areas where they exercise sovereign rights.”

²⁹ Cheng, Bin, and Georg Schwarzenberger. *General principles of law as applied by international courts and tribunals*. No. 21. London: Stevens, 1953.

Although, before the principle became sanctioned in law, the idea of prevention of environmental harm was introduced by the Trail Smelter Case in 1938, in which the arbitrators discussed on the obligation of the State to not cause harm to the environment of another State.³⁰

2.3.2 Environmental impact assessment

Assessments should be available to the State, so that they are aware if an activity undertaken inside their national jurisdiction has the potential to harm or pollute the State's marine environment or that of the neighboring states. This practice has been widely spread in the last decade and it is encompassed in both CBD Article 14 (impact assessment and minimizing adverse impacts) and UNCLOS Articles 206 (assessment of activities' potential effects) and 207 (pollution from land-based sources). In the MOX Plant case (arbitration) inadequacies were found in the environmental impact assessment procedure. Even though the focus was on the inadequacies the State had taken, and not on whether a valid EIA was made beforehand, still it gives insight into what countries should do in order to control the activities sustained on the seas.³¹

2.3.3 Precautionary principle

In Principle 15 of Rio Declaration is stated that in the face of scientific uncertainty to whether damage might occur to the environment, should not be used as an excuse for not taking the appropriate measures to prevent such effects from happening.

2.3.4 The polluter pays principle

Generally, there is no binding regulations that incorporated this principle. Perhaps, in this context of marine environment, the damage cannot be definitively traced back to the polluter or maybe States do not wish a legally binding enforcement measure for their alleged harmful activities? The principle is incorporated in the Rio Declaration as Principle 16:

“National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the

³⁰ Case, Trail Smelter. "Reports of International Arbitral Awards." *United States vs Canada* 16 (1938): 1905-1982.

³¹ Shany, Yuval. "The first MOX Plant award: the need to harmonize competing environmental regimes and dispute settlement procedures." *Leiden Journal of International Law* 17, no. 4 (2004): 815-827.

polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment."³²

2.3.5 Sustainable development

The World Commission of Environment and Development (WCED) report 1987 (also known as "The Brundtland Report"), put sustainable development in the center of the environment and development conversation. When the Brundtland report was published, regrettably the UNCLOS was already in force, so no direct reference to this principle is mentioned in the provisions. Although there might be some similarities between the principle and articles 61(3) and 119(1)(a) UNCLOS. The principle of sustainable development represents a "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*".³³ The principle has been integrated into many "hard laws", such the CBD, EU treaty and UNFCCC, as well as policy of international organizations.

2.3.6 The ecosystem approach

This approach entails a holistic management strategy rather than focusing on individual components specific approach, isolating species or habitats from one another. This perspective was introduced in the CBD and FAO regulations, therefore there is no trace of the concept in UNCLOS. Nevertheless, there might be an indirect reference to it in art. 145. ISA has the obligation to adopt regulations in order to protect the marine environment specifically any "interference with the ecological balance of marine environment".

2.4 Types of MPAs

In 1996 the World Conservation Congress in Montreal recommended World Commission on Protected Areas (WCPA) should create guidelines on the application of the IUCN Guidelines for Protected Area Management Categories in order to manage the marine environment.³⁴ In 2008 the IUCN-WCPA published the ***Guidelines for Applying Protected Area Management Categories***, however there was still a need for the supplementary guidelines which dealt with issues where more guidance was required. That is how the new guidelines of 2012 were

³² Declaration, Rio. Principle 16. "Rio declaration on environment and development." (1992).

³³ Brundtland, Gro Harlem. *Report of the World Commission on environment and development: "our common future."*. United Nations, 1987.

³⁴ Day, Jon, Nigel Dudley, Marc Hockings, G. Holmes, Dan d'A. Laffoley, Sue Stolton, and Susan M. Wells. *Guidelines for applying the IUCN protected area management categories to marine protected areas*. IUCN, 2012.

developed, with the ambition to upsurge the efficiency and coherence of appointment and reporting of the IUCN categories when applied to marine and coastal protected areas.³⁵

This subchapter will present the different types of MPAs and the different level of protection which a protected area can have. The term MPA is used by most conversation practitioners to designate a marine area which is under a certain amount of regulation, this may differ from area to area.³⁶ The IUCN developed this classification of six types of protected areas. Under this umbrella term several types of marine sites fit the definition. IUCN offered seven categories of protected area, based on management objectives³⁷:

IUCN Protected Areas Categories		System ³⁸
IUCN cat.	Definition	Primary Objective
Ia	<i>Strict Nature Reserve - is strictly protected area set aside to protect biodiversity and also possibly geological/geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring.</i>	<i>To conserve regionally, nationally or globally outstanding ecosystems, species (occurrences or aggregations) and/ or geodiversity features: these attributes will have been formed mostly or entirely by non-human forces and will be degraded or destroyed when subjected to all but very light human impact.</i>
Ib	<i>Wilderness Area - protected area is usually a large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and</i>	<i>To protect the long-term ecological integrity of natural areas that are undisturbed by significant human activity, free of modern infrastructure and where natural forces and</i>

³⁵ Dudley, Nigel, ed. *Guidelines for applying protected area management categories*. IUCN, 2008.

³⁶ Geijer, Christina KA, and Peter JS Jones. "A network approach to migratory whale conservation: Are MPAs the way forward or do all roads lead to the IMO?." *Marine Policy* 51 (2015): 1-12.

³⁷ Dudley, N. (Editor) *Guidelines for Applying Protected Area Management Categories*. (2008). Gland, Switzerland.

³⁸ Day, Jon, Nigel Dudley, Marc Hockings, G. Holmes, Dan d'A. Laffoley, Sue Stolton, and Susan M. Wells. *Guidelines for applying the IUCN protected area management categories to marine protected areas*. IUCN, 2012.

	<i>managed so as to preserve their natural condition.</i>	<i>processes predominate, so that current and future generations have the opportunity to experience such areas.</i>
II	<i>National Park - protected area is a large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities.</i>	<i>To protect natural biodiversity along with its underlying ecological structure and supporting environmental processes, and to promote education and recreation.</i>
III	<i>Natural Monument - protected areas are set aside to protect a specific natural monument, which can be a landform, sea mount, submarine caverns, geological feature such as caves or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value.</i>	<i>To protect specific outstanding natural features and their associated biodiversity and habitats.</i>
IV	<i>Habitat/Species Management Area - protected areas aim to protect particular species or habitats and management reflects this priority. Many category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.</i>	<i>To maintain, conserve and restore species and habitats.</i>
V	<i>Protected Seascape - protected areas are where the interaction of people and nature over time has produced an area of distinct character with significant ecological,</i>	<i>To protect and sustain important landscapes/seascapes and the associated nature conservation and</i>

	<i>biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.</i>	<i>other values created by interactions with humans through traditional management practices.</i>
VI	Managed Resource Protected Area - <i>protected areas conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.</i>	<i>To protect natural ecosystems and use natural resources sustainably, when conservation and sustainable use can be mutually beneficial.</i>

This classification has been intensely criticized by many authors, such as Horta e Costa et. al.³⁹ and Fitzsimons⁴⁰ who believe that these categories need to be modified in order to accommodate the management needs by avoiding significant mismatch in regulations. Horta e Costa et. al. proposes an alternative global classification for MPAs based on regulations of use. This new system will solve the issues regarding inconsistencies in regulations, vaguely mentioned objective in management plans and multi-purpose MPAs comprised of different zones (with different rules which are not clearly outlined). While Fitzsimons believes that most management plans for MPAs have been mislabeled hence not taking the appropriate actions needed for the conservation and protection of the area. Given these examples, it is the objective

³⁹ e Costa, Bárbara Horta, Joachim Claudet, Gustavo Franco, Karim Erzini, Anthony Caro, and Emanuel J. Gonçalves. "A regulation-based classification system for Marine Protected Areas (MPAs)." *Marine Policy* 72 (2016): 192-198.

⁴⁰ Fitzsimons, James A. "Mislabeled marine protected areas and why it matters—a case study of Australia." *Conservation Letters* 4, no. 5 (2011): 340-345.

if the present paper to explore an alternative to this classification and give a different perspective of what MPAs management tools should take into consideration.

Owing to the subject of this paper, a cutting-edge classification of protected areas by their geographical location is considered – pelagic (PMPA) and benthic protected areas (BMPA). Pelagic marine protected areas (PMPA) refer to marine protected areas created in the water column of the sea. As seen in the picture below there are several layers of the pelagic zone according to the depth of the water column. This type of protected area is the most difficult to define since the ecosystem is extremely dynamic due to water currents and other unstable

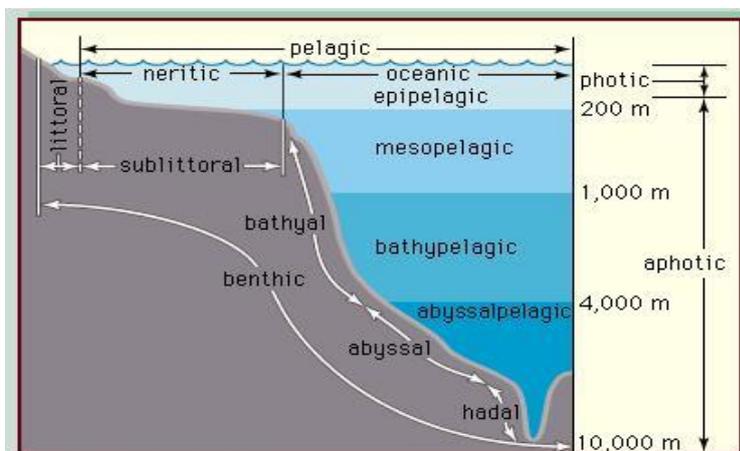


Figure 1 Marine zoning

factors. For this specific type of conservation, the amount of data analyzed to design a protected area should identify key sites of interests (such as spawning grounds). Benthic marine protected areas (BMPA) represent areas engaged in the conservation of bottom-dweller species which

live on, in or near the seabed. The benthic community is complex and is categorized according to size, location and type of species. Once more, there are challenges to be faced in benthic protected areas regarding which species fit into this category since there are also external factors, such as water currents, specie distribution and son on which are crucial to be the planning and establishment. Still, there is also the probability of infringement of rights belonging to other marine zones. This might be the case of marine protected areas created in the outer continental shelf which belongs to the jurisdiction of the coastal State, but might infringe the rights and freedoms of the High-Seas, the water column on top of the OCS. According to article 76 UNCLOS which states that a coastal state can extend its continental shelf if the outer edge permits it by “350 nautical miles from the baselines from which the breadth of the territorial sea is measured or shall not exceed 100 nautical miles from the 2,500 meters isobaths, which is a line connecting the depth of 2,500 meters.” The coastal State has the right to exercises over the continental shelf “sovereign rights for the purpose of exploring it and exploiting its natural resources” as presented in art. 77(1). Thus, in an area two marine zone meet and both have different principles and regulation, this makes both zones limited in their rights.

The assessment of progress towards ocean conservation targets needs a consistent and an appropriate action plan to further the understanding of MPAs and yield results for the marine environment. This is intended to compliment the existent IUCN system for a simplified management plan for users.

Admittedly, the reason why pelagic and benthic protected areas should be governed separately stems from their respective ecosystem characteristics. A pelagic ecosystem is clearly a dynamic environment with highly migratory species, while as the benthos is characterized by a static environment, which includes sedentary or sessile organism. Good management tools considers the indicators of the environment by applying an intelligent ecosystem approach, moving away from rigid and traditional standardized approaches.

2.5 Conservation objectives

The main objectives of MPAs are to preserve biodiversity, secure fish stocks and to protect the habitat.⁴¹ However, there is still the need to address the issues surrounding piecemeal governance and categorization of the MPA system. This can lead to countries mislabeling⁴² a MPA which by the IUCN guidelines clearly prohibits, for example, commercial or recreational fishing, but nonetheless it is still happening and the government is fully aware of it.

Bearing in mind, an effective MPA management plan requires a clear determination of the objectives in order to establish the regulation. It is essential that managers have a clear idea of key values of the MPA (such as ecosystems), but also to understand what the major areas of management activities are (here, includes tourism, research, etc.). As a principle, MPAs have ecological goals, meaning that the objective is to maintain the diversity of the marine ecosystem, preserve the habitats and protect from any damaging activities.⁴³ Jones⁴⁴ developed an evaluative management plan with seven key steps in order to achieve the objectives proposed for the MPA.

⁴¹ Al-Abdulrazzak, Dalal, and Stephen C. Trombulak. "Classifying levels of protection in Marine Protected Areas." *Marine policy* 36, no. 3 (2012): 576-582.

⁴² Fitzsimons, James A. "Mislabeling marine protected areas and why it matters—a case study of Australia." *Conservation Letters* 4, no. 5 (2011): 340-345.

⁴³ Pomeroy, Robert S., John E. Parks, and Lani M. Watson. *How is your MPA doing?: a guidebook of natural and social indicators for evaluating marine protected area management effectiveness*. IUCN, 2004.

⁴⁴ Jones, Glenys. "Outcomes-based evaluation of management for protected areas—a methodology for incorporating evaluation into management plans." In *WWF International Conference, "Beyond the Trees"*, Bangkok. 2000.

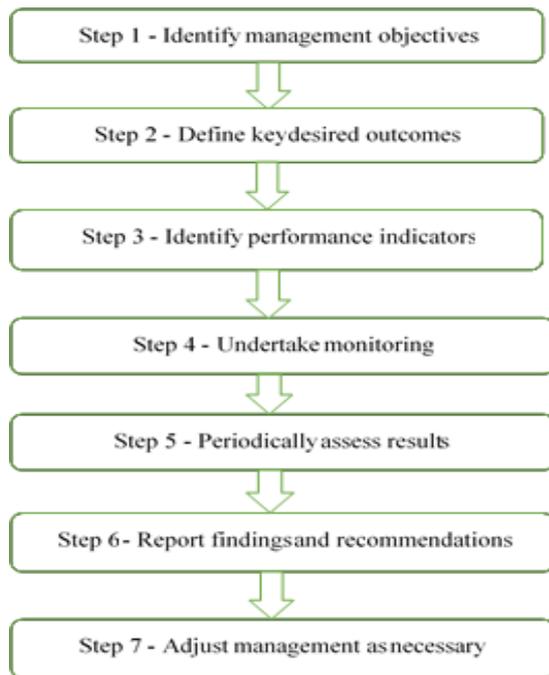


Figure 2 The seven-step evaluative management framework proposed by Jones

Additionally, MPAs aim to provide for the continued welfare of people by ensuring an important food source, to preserve cultural heritage and improve fishing management. However, each type of MPA can have a specific objective due to different types of fishing and environmental regulations. 94% of MPAs allow some sort of level of fishing, to this extent effective regulations should be put in place to control or reduce exploitation rates.⁴⁵ With regards to pelagic protected areas, it is essential to protect key breeding sites which cetaceans, birds or other species rely on for most of their lives. In this dissertation, I argue that the conservation plan should reduce secondary fishing impact by regulating fishing gear in order to avoid other nontargeted species which may be taken as bycatch. The protection of benthic habitats from destruction not only will maintain biodiversity, but also may enhance the fishery.

Beyond the presented objectives there are both benefits and threats to the marine ecosystem to be discussed. There are various contributions of MPAs when it comes to fisheries management and socio-economic benefits, however they are sometimes outweighed by illegal fishing, misinterpretation of regulations or mislabeling of protected areas. This aspect should play into

⁴⁵ Costello, Mark J., and Bill Ballantine. "Biodiversity conservation should focus on no-take Marine Reserves: 94% of Marine Protected Areas allow fishing." *Trends in ecology & evolution* 30, no. 9 (2015): 507-509.

the management plan as to avoid issues such as those mentioned previously. An outline of the action plan should be considered when developing a MPA (see Annex 1).

2.6 Legal framework

As mentioned at the beginning of the thesis, a well-known phenomenon in international law is fragmentation, more specifically vertical fragmentation. Therefore, as exemplified below there are a number of international, regional and national regulations with the scope of governing the marine environment. Some of these regulations may be divergent due to the its implementing scope, some may regulate MPAs from an ecosystem perspective, while other may have a fishing management approach. One can debate on whether or not these instruments are complementary, as oppose to fragmentation. However, since most do not apply the ecosystem approach which as will be seen in the following chapter it is required to achieve good management, it is safe to say that it is a fragmented governance system, where rules change according to the region or country.

United Nations Convention on the Law of the Sea

The United Nations Convention on the Law of the Sea (UNCLOS) is the main legal framework which governs any operations undergone in the oceans. This includes, of course, the conservation and sustainable use of marine biodiversity within and beyond areas of national jurisdiction. There are two implementing agreements, one for Part XI, which focus on issues of conservation related to the Area and the conservation and management of straddling fish stocks and highly migratory fish stocks. Part XII with article 192 to article 237, labeled “Protection and Preservation of the Marine Environment”, deals with marine conservation. A number of provisions call for the States to protect and preserve the marine environment (art. 192 UNCLOS), and to prevent pollution from any origin (art. 196 UNCLOS). Meantime UNCLOS reinforces the possibility of countries to create MPAs, no specific reference is made to protected areas. This aspect will be discussed in detail in chapter 3 and 4.

Agenda 21 (1992)

Agenda 21 is the Program of Action resulting from Rio Declaration and 1992 UN Conference on Environment and Development. Even though, Agenda 21 is a non-legally binding instrument as seen from art. 6 of the UN Constitution, the State members should take into account this as guidelines. In chapter 17 contains prerequisites for the protection of marine living resources

and the marine environment, including the establishment of limitations on the utilization of marine ecosystems through the selection of protected areas and through alternative way.⁴⁶

Convention on Biological Diversity (1992)

The Convention on Biological Diversity came into force in 1993 with three fundamental objectives: the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the use of genetic resources. One of the key recommendations under article 8 CBD was for the establishment of national systems of protected areas or areas where special measures are needed to be taken to protect biological diversity.

World Summit on Sustainable Development (2002)

The World Summit on Sustainable Development (WSSD) in 2002 resulted in an international commitment to maintain the productivity and biodiversity of important and vulnerable marine and coastal areas, the development and facilitation of new approaches and tools, *inter alia*, establish marine protected areas consistent with international law and based on scientific information.⁴⁷

In addition to UNCLOS, CBD and other implementing agreements, a number of international instruments at the global and regional levels are relevant to the conservation and sustainable use of marine biodiversity beyond areas of national jurisdiction. Supplemental to the regulations adopted by the International Seabed Authority for the protection and preservation of the marine environment in the Area, are instruments adopted by the Food and Agriculture Organization of the United Nations (FAO) for fishery management, by the International Maritime Organization (IMO) for pollution from vessels, and by World Trade Organization and the World Intellectual Property Organization for marine resources.

Regionally, there are relevant measures include those ratified by regional fisheries management organizations (also known as RFMOs) and other regional seas organizations having competence beyond areas of national jurisdiction. Only a few regional conventions are relevant for this thesis and will be given a short presentation.

⁴⁶ Birnie, Patricia W., and Alan E. Boyle. *International law and the environment*. 1994. p.680

⁴⁷ WSSD Plan of Action §31.

Barcelona Protocol

Under the UNEP Regional Seas Program, the Barcelona Convention from 1976 was signed by the riparian states of the Mediterranean Sea as one of the first multilateral instruments. The convention aimed at designing a MPA to improve the state of the natural and cultural heritage of the Mediterranean Sea, resulting in the Specially Protected Area of Mediterranean Importance (SPAMI). The objective is to conserve and sustainably use the Mediterranean biodiversity by cooperating without bringing prejudice to the sovereignty or jurisdiction of other States. As stated in article 4 of the Convention, States “*shall individually or jointly take all appropriate measures in accordance with the provisions of this Convention and those Protocols in force to which they are party to prevent, abate, combat and to the fullest possible extent eliminate pollution of the Mediterranean Sea Area and to protect and enhance the marine environment in that Area so as to contribute towards its sustainable development*”.

OSPAR Convention

Another regional treaty of great significance is the 1992 Convention for the Protection of the Marine Environment of the North-East Atlantic. This came into existence after the merge of the two treaties, the Oslo Convention of 1972 and the Paris Convention of 1972, referred to as the OSPAR Convention. According to art. 2 States must “*take all possible steps to prevent and eliminate pollution and shall take the necessary measures to protect the maritime area against the adverse effects of human activities so as to safeguard human health and to conserve marine ecosystems and, when practicable, restore marine areas which have been adversely affected.*”

2.7 Conclusion

The classification system proposed here is intended to complement the existing MPA classification system established by IUCN and is based on a marine geographical approach (ecosystem). Management effectiveness, including governance, implementation, monitoring and applicability of regulations, is a key factor towards a successful MPA. It might be that PMPAs and BMPAs will become the future of area based management tools. Adapting management actions to more specific areas will increase their efficiency.

It is clear that one size does not fit all the requirements of an ever-changing, extremely dynamic environment. Since much of the theories related to the classification of MPAs stem from

developing management strategies to protect terrestrial wildlife, we have seen that these models may affect the conservation measures of marine species.

PART II

3. PELAGIC MARINE PROTECTED AREAS

3.1 Introduction

Protection of the marine biodiversity is one of the most important objectives of environmental conservation. There is a need for a shift from the traditional example of terrestrial approach onto the marine ecosystem, to a new approach that moves away from the static management strategy and employs new methods of conservation to a 3-dimensional pelagic area. With a general consensus that the planet is facing a substantial decline in diversity and marine species biomass, which is due to increasing human stress factors (such as fishing, transportation etc.)⁴⁸, this new approach is needed in this context.

The marine pelagic environment has been defined as the largest system on the face of the planet, constituting around 99% of the biosphere volume.⁴⁹ Moreover the pelagic ecosystem provides for more than 80% of the fish consumed by humans⁵⁰, it also makes up for roughly half of the photosynthesis produced on Earth⁵¹, through direct or indirect means it support approximately the entire marine life and it has a great impact on climate change by storing almost 93% of the total CO₂ volume.⁵² Pelagic ecosystems are defined as “the physical, chemical and biological features of the marine water column, now face a multitude of threats including overfishing, pollution, climate change, eutrophication, mining and species introductions”.⁵³ Thus, a pelagic marine protected areas (PMPA) should be seen as merely a subcategory of MPAs, whose specific ambition is to protect the three-dimensional marine water column and the biodiversity it accommodates.

This section seeks to analyze the effectiveness of the PMPA network initiative for the conservation of the threatened and geographically dynamic pelagic species, although the intent isn't to exclude the pelagic environment in itself. There is a cost to pay for poor management

⁴⁸ McCauley, Douglas J., Malin L. Pinsky, Stephen R. Palumbi, James A. Estes, Francis H. Joyce, and Robert R. Warner. "Marine defaunation: Animal loss in the global ocean." *Science* 347, no. 6219 (2015): 1255-641.

⁴⁹ Angel, Martin V. "Biodiversity of the pelagic ocean." *Conservation Biology* 7, no. 4 (1993): 760-772.

⁵⁰ Pauly, Daniel, Villy Christensen, Sylvie Gu nette, Tony J. Pitcher, U. Rashid Sumaila, Carl J. Walters, Reg Watson, and Dirk Zeller. "Towards sustainability in world fisheries." *Nature* 418, no. 6898 (2002): 689-695.

⁵¹ Field, Christopher B., Michael J. Behrenfeld, James T. Randerson, and Paul Falkowski. "Primary production of the biosphere: integrating terrestrial and oceanic components." *Science* 281, no. 5374 (1998): 237-240.

⁵² Hays, Graeme C., Anthony J. Richardson, and Carol Robinson. "Climate change and marine plankton." *Trends in ecology & evolution* 20, no. 6 (2005): 337-344. Harvard

⁵³ Game, Edward T., Hedley S. Grantham, Alistair J. Hobday, Robert L. Pressey, Amanda T. Lombard, Lynnath E. Beckley, Kristina Gjerde, Rodrigo Bustamante, Hugh P. Possingham, and Anthony J. Richardson. "Pelagic protected areas: the missing dimension in ocean conservation." *Trends in ecology & evolution* 24, no. 7 (2009): 360-369.

and this can result in undermining of the resilience of the ecosystem, on which we depend on, for food and other economic benefits. It is to say that the conventional management strategy and piecemeal governance is becoming less and less appropriate when thriving for a sustainable usage of the marine environment, especially for the pelagic ecosystem.

The problem begins with fishing methods in the pelagic systems, because both desired (target) and undesired (nontarget) species end up captured. Strategic ecosystem based marine spatial protection may offer considerable benefits to pelagic systems for both target and non-target species.⁵⁴ It has been suggested that this concept of ecosystem based management (EBM) has gathering growing conceptual support in both regional and international conventions, as well as governments.⁵⁵ That is why PMPAs are a desired method of conservation for such areas, for the can protect a large range of species.

An ecosystem-based management, as referred to by E. Hoyt, is a regime which accomplishes to manage the uses and values of ecosystems with all stakeholders in order for them to maintain ecological integrity in the face of the incertitude and the ever-changing nature of ecosystems.⁵⁶

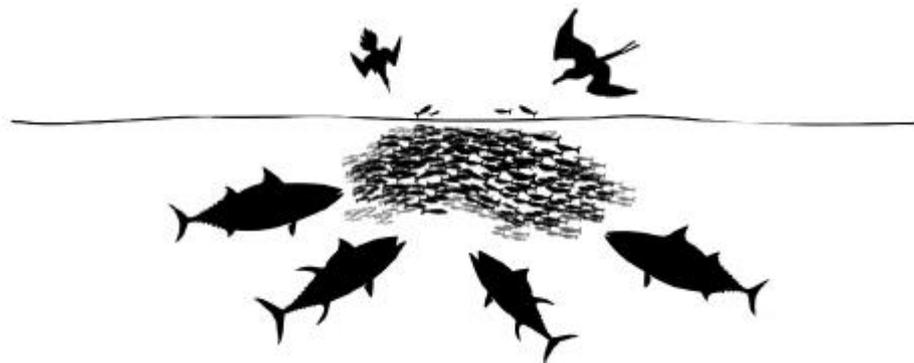


Figure 3 Schematic of subsurface predator facilitated foraging. Image credit Drew Briscoe

Take for example the case of many species of tropical seabird who depend on subsurface predators to bring prey closer to the ocean's surface in order for them to be able to forage. All these elements of the ecosystem create a necessary balance for all species to thrive in. By adding or removing a specie from a habitat the immediate result can illustrate how ecological

⁵⁴ Katsanevakis, Stelios, Vanessa Stelzenmüller, Andy South, Thomas Kirk Sørensen, Peter JS Jones, Sandy Kerr, Fabio Badalamenti et al. "Ecosystem-based marine spatial management: review of concepts, policies, tools, and critical issues." *Ocean & Coastal Management* 54, no. 11 (2011): 807-820.

⁵⁵ Baker, Elaine K., and Peter T. Harris. "Habitat mapping and marine management." *Seafloor geomorphology as benthic habitat-GeoHAB atlas of seafloor geomorphic features and benthic habitats* (2011): 23-38.

⁵⁶ Hoyt, Erich. *Marine Protected Areas for Whales, Dolphins and Porpoises: A world handbook for cetacean habitat conservation and planning*. Routledge, 2012.

relationships work and the importance of maintaining them for the safety of the ecosystem services provided.⁵⁷

Areas that are used for feeding or breeding are considered critical habitat.⁵⁸ These areas present themselves with many challenges for PMPAs because the pelagic species are highly migratory due to the changing oceanographic conditions. Identifying the critical habitat of pelagic species, as their crucial core areas, is the first step toward obtaining a sound marine management of PMPAs for marine organisms.

3.2 Historical background

Historically there have been many PMPAs, although not officially declared as being this specific subcategory of MPA. The reason is quite simply, for the marine conservation goal at the time was mainly based on a specie-by-specie approach and didn't include a holistic approach to the MPA by protecting all pelagic species. One of the oldest PMPA is Glacier Bay, located in Alaska, established in 1925 and had the main conservation goal the protection of the cetacean habitat. This National Monument was created before the territory of Alaska ever became the 49th state of the USA.

The International Whaling Commission (hereafter IWC) established two MPAs, both of which prohibit commercial whaling. The first one was the Indian Ocean Sanctuary, established in 1979, and the second MPA was adopted in 1994 and covers the waters of the Southern Ocean around Antarctica.⁵⁹

In recent years, countries have created PMPAs by prohibiting or limiting pelagic fishing around fixed areas, as is the case of these areas in the Gulf of California⁶⁰. While other MPAs accounted for the dynamic dispersal rate of southern bluefin tuna habitat off the east coast of Australia⁶¹. None of these areas, however, prevent all pelagic fishing from occurring because either they were mislabeled or because of failures from the monitoring process. More often,

⁵⁷ Myers, Ransom A., Julia K. Baum, Travis D. Shepherd, Sean P. Powers, and Charles H. Peterson. "Cascading effects of the loss of apex predatory sharks from a coastal ocean." *Science* 315, no. 5820 (2007): 1846-1850.

⁵⁸ Ibidem ref. 56.

⁵⁹ <https://iwc.int/sanctuaries>

⁶⁰ NOAA. (2000) Regulatory Amendment 1 to the Atlantic Tunas, Swordfish, and Sharks Fishery Management Plan: Reduction of Bycatch, Bycatch Mortality, and Incidental Catch in the Atlantic Pelagic Longline Fishery, Highly Migratory Species Division, National Marine Fisheries Service, National Oceanic and Atmospheric Administration

⁶¹ Hobday, A. J., and K. Hartmann. "Near real-time spatial management based on habitat predictions for a longline bycatch species." *Fisheries Management and Ecology* 13, no. 6 (2006): 365-380.

PMPAs have the scope of only protecting marine mammals within national jurisdiction and high seas waters. Nowadays, PMPAs are more focused on key habitats for marine mammals, as is the Pelagos Marine Sanctuary⁶² example, or calving areas, such as the Great Australian Bight Marine Park.

3.3 Types of PMPAs (key geographical zones)

Pelagic marine protected areas are regarded as merely a subcategory of MPAs, as Game et al. calls it a three-dimensional marine water column, which helps protect the environment and biodiversity it consists of. And because these pelagic systems are not sedentary as benthic marine species are, it requires a dynamic management strategy which will help improve and lessen threats to pelagic biodiversity. This new approach goes beyond the conventional way of thinking. The present thesis aims at providing a different perspective, a different game plan for MPAs and to do so it necessitates a better understanding of pelagic protected areas and the environment it intends to safeguard.

During the 9th meeting of the COP CBD a Decision was adopted addressing issues relating to the conservation and sustainable use of biodiversity in marine areas beyond national jurisdiction. At this meeting, they considered four initial steps to develop representative networks of marine protected areas, and one of the steps was to develop a biogeographic classification system. Through this system they desired to address the key ecological features within the area, by creating a separation of at least two realms—pelagic and benthic.

Biogeography is the natural science that studies the distribution of species and ecosystems in a determined time and space. The study is interested in habitat patterns and factors responsible for variations in distribution. More accurately, biogeography is a division of biology combined with the important contributions made by physical geographers, especially in the study of flora. This study is a result of Darwin's theory of evolution and the geographic distribution of plants and animals.⁶³

As seen in the following figure, there are different degree of depth of the water column and respectively there are also distinct habitats which come in contact with these areas. Lets take the example of foraging birds, as seen in Fig. 3, the birds come in contact with the epipelagic

⁶² Notarbartolo-di-Sciara, Giuseppe, Tundi Agardy, David Hyrenbach, Tullio Scovazzi, and Patrick Van Klaveren. "The Pelagos sanctuary for Mediterranean marine mammals." *Aquatic Conservation: Marine and Freshwater Ecosystems* 18, no. 4 (2008): 367-391.

⁶³ <https://www.britannica.com/science/biogeography>

zone on account of the small prey that come close to the surface trying to escape the predator fish. This interaction and exchange is a clear example of how the ecosystem works and the conclusion drawn here is that a classification based on the depth of the water column can be a feasible distribution, looking at a specific habitat.

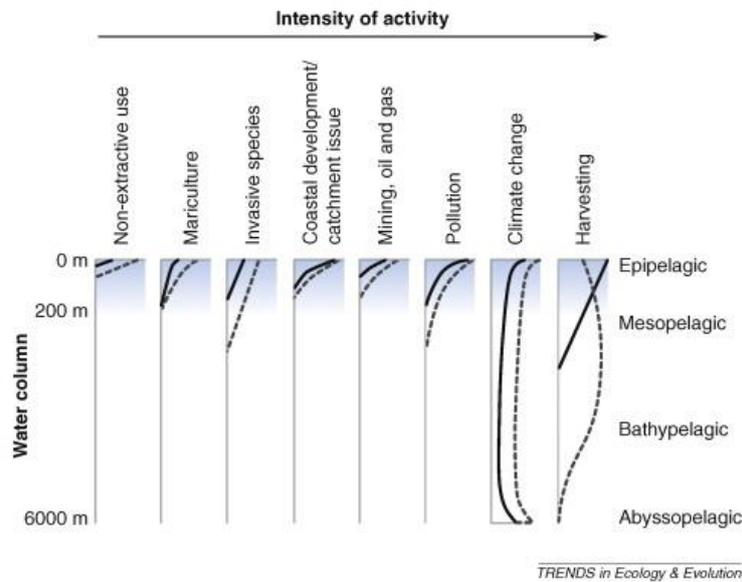


Figure 4 Schematic of the intensity of the eight largest threats in the pelagic ocean as a function of depth. Blue color shows the level where light reaches into the water column. The straight line is current intensity of threats and the interrupted line is potential change in intensity for the next 50 years. Ref. <https://doi.org/10.1016/j.tree.2009.01.011>

Besides representing a distribution of pelagic water depth, the above figure created by Game et al.⁶⁴ further indicates the most common eight threats to the pelagic environment. Through the establishment of a pelagic protected area these menacing effects on marine ecosystems can be impaired.

Another manner of classifying is by the kind of species the PMPA wants to protect or it can also focus on the activity of said species. There are MPAs focused on the conservation and protection of birds which come to forage⁶⁵ or breeding grounds⁶⁶ in a particular marine area. In

⁶⁴ Game, Edward T., Hedley S. Grantham, Alistair J. Hobday, Robert L. Pressey, Amanda T. Lombard, Lynnath E. Beckley, Kristina Gjerde, Rodrigo Bustamante, Hugh P. Possingham, and Anthony J. Richardson. "Pelagic protected areas: the missing dimension in ocean conservation." *Trends in ecology & evolution* 24, no. 7 (2009): 360-369.

⁶⁵ Maxwell, Sara M., and Lance E. Morgan. "Foraging of seabirds on pelagic fishes: implications for management of pelagic marine protected areas." *Marine Ecology Progress Series* 481 (2013): 289-303.

⁶⁶ Costa, Daniel P., Greg A. Breed, and Patrick W. Robinson. "New insights into pelagic migrations: implications for ecology and conservation." *Annual review of ecology, evolution, and systematics* 43 (2012): 73-96.

other circumstances, regional marine conservation organizations focus on particular species, such as mammals, cetaceans, certain tuna species, etc.⁶⁷

3.4 Environmental challenges

Understanding the connectivity between species population mobility and dynamic habitats is key in developing a good sustainable management plan. This provides data which will be used in making an informed decision regarding the conservation of the ecosystem.

There are many scientific challenges to take into consideration when creating a PMPA. A statistical framework needs to be put in place to correctly estimate the mobility range of species in a designated area. Moreover, the dispersal of larva is also a factor to be taken into account, since some species have different reproductive behaviors.

Seascape connectivity includes both structural connectivity, meaning the physical relationships between different areas, which is considered dynamic and is influenced by currents, water stratification or other factors, and functional connectivity, which means the response of an organism to the marine framework and dynamics from a biological and behavioral point of view.⁶⁸

3.4.1. The biological challenges

The majority of pelagic species are highly mobile, some having the ability to cover thousands of kilometers each year⁶⁹. Only by protecting the entire pelagic marine area, can it be possible to preserve the distribution of particular species found within an MPA. A MPA covering a limited group of a species and their distribution pattern may not have a big impact, because of the likelihood that the species will remain exposed to perils just outside the protected area. This can be regarded as one of meaningful shortage of pelagic MPAs, since among these mobile

⁶⁷ Hoyt, Erich. *Marine Protected Areas for Whales, Dolphins and Porpoises: A world handbook for cetacean habitat conservation and planning*. Routledge, 2012. Also the main tuna fishery management bodies are the Western and Central Pacific Fisheries Commission, the Inter-American Tropical Tuna Commission, the Indian Ocean Tuna Commission, the International Commission for the Conservation of Atlantic Tunas, and the Commission for the Conservation of Southern Bluefin Tuna.

⁶⁸ Gerber, Leah R., Maria Del Mar Mancha-Cisneros, Mary I. O'connor, and Elizabeth R. Selig. "Climate change impacts on connectivity in the ocean: Implications for conservation." *Ecosphere* 5, no. 3 (2014): 1-18.

⁶⁹ Block, Barbara A., Steven LH Teo, Andreas Walli, Andre Boustany, Michael JW Stokesbury, Charles J. Farwell, Kevin C. Weng, Heidi Dewar, and Thomas D. Williams. "Electronic tagging and population structure of Atlantic bluefin tuna." *Nature* 434, no. 7037 (2005): 1121-1127.

organisms there are species with high commercial value like tunas, cetaceans, sea turtles and seabirds, which are acknowledged as the objects for conservation action.⁷⁰

Admitting, this is quite a challenge for PMPAs, but this doesn't necessarily mean that highly migratory species cannot be a part of protected area. For instance, from the seascape that migratory species take only determined areas are where these species can be regarded as truly vulnerable. The routes, foraging and breeding areas are the most vulnerable part, and as such these critical habitats should be the focus of PMPA managers.⁷¹

3.4.2. The physical challenges

The pelagic environment is defined by ever-changing environment, influenced by ocean currents, oceanic thermal fronts, wind driven surface currents and eddies. Factors such as these have great influence over the living organisms' sequence and diversity in the pelagic seascape⁷². In a traditional management plan, a closed area with boundaries set in stone doesn't correctly assess the dynamic aspect of the seascape and ends up failing. Supported by an ecosystem approach the indicators of the environment are weighed and this will give rise to a progressive management technique.

Even though, this ecosystem is continuously changing and may seem random to the unknowing eye, scientific claims say otherwise. It seems that there is a pattern in the spatial and temporal distribution of these living organism which can be correlated to biological and physical reactions that can be easily manipulated in the architecture of a PMPA.⁷³ The solution is to track through biological monitoring programs the pattern of the biological diversity along with the external factors, which can also alter because of environmentally induced forced migration.

3.5 Management challenges

Our limited knowledge of the world's biodiversity coupled with the narrow scientific information and understanding of MPAs, it is not surprising that there are many management

⁷⁰ Ibidem ref. 64.

⁷¹ Louzao, Maite, K. David Hyrenbach, José Manuel Arcos, Pere Abelló, Luis Gil Sola, and Daniel Oro. "Oceanographic habitat of an endangered Mediterranean procellariiform: implications for marine protected areas." *Ecological Applications* 16, no. 5 (2006): 1683-1695.

⁷² Palacios, Daniel M., Steven J. Bograd, David G. Foley, and Franklin B. Schwing. "Oceanographic characteristics of biological hot spots in the North Pacific: a remote sensing perspective." *Deep Sea Research Part II: Topical Studies in Oceanography* 53, no. 3 (2006): 250-269.

⁷³ Etnoyer, Peter, David Canny, Bruce Mate, and Lance Morgan. "Persistent pelagic habitats in the Baja California to Bering Sea (B2B) ecoregion." *Oceanography* (2004): 90-101.

challenges. Indicators of “healthy ecosystem” aren’t fully understood, which makes it difficult to restore habitats or even the effects which some invasive species have on the ecosystem.⁷⁴

Governance is an important element when discussing about management, because it is crucial to have a framework to work with. Moreover, the usage of marine resources governed by different laws and regulations or circumstance when MPAs overlap multiple jurisdictions and involve multiple management partners with different responsibilities may cause new obstacles.

Managing PMPA requires to effectively coordinate multiple jurisdictions, establish a more coordinated program of management, assistance, and information-sharing, as well as engaging the public in MPA planning. All these aspects are vital towards achieving the proposed conservation goals. Furthermore, the transboundary effects of management decisions on neighboring ecosystems should be considered by those managing the ecosystem. The ecosystem approach must be applied at the appropriate spatial and temporal scales. Simultaneously ecosystems should be managed in an economic context, that is, taking account of externalities either that impact on the ecosystem or that are created by its management, and incentives should be created to promote its conservation. Finally, an appropriate balance between conservation and use of biodiversity should be struck.

3.6.1. External factors

Despite having reached a well-conceived MPA with a compatible location and knowing this constitutes an invaluable tool for pelagic management, there would still be concerns over the shortage of data, methods and tools to enable proper selection of the correct areas for protection.

3.6.2. Gathering data

From the pelagic area, generally, fewer data is gathered in comparison to terrestrial systems. Furthermore, the design of terrestrial protected areas has traditionally been based on finding biodiversity surrogates, in a pelagic environment it is extremely difficult to measure these indicators.⁷⁵ The assumption is that pelagic ecosystem complexities are not well defined, and therefore making the process of decision making difficult for an appropriate design and location

⁷⁴ Hudson, Peter J., Andrew P. Dobson, and Kevin D. Lafferty. "Is a healthy ecosystem one that is rich in parasites?" *Trends in ecology & evolution* 21, no. 7 (2006): 381-385.

⁷⁵ *Ibidem* 64.

for MPAs⁷⁶. Nonetheless, the limitations imposed by the availability of data shouldn't be a reason for halting PMPAs projects.

Recent technological advancements have significantly improved data selection and analysis. A number of programs can be used in order to determine patterns of pelagic species by looking into the sea-surface temperature, chlorophyll or other similar factors. The underlying issues is the proper integration into the management plan, so that later on a right monitoring program can be set in place.

3.6 The Pelagos Sanctuary

In 1991, a critical movement originated in Italy which later on stimulated the motion for establishing a large MPA in the north-western Mediterranean Sea to protect cetacean populations within the territorial waters. This idea eventually led to the signing of the agreement by Italy, France and Monaco that created the "International Sanctuary for the Protection of Mediterranean Marine Mammals", also known as the "Pelagos Sanctuary". The Pelagos Sanctuary is a special marine protected area extending about 90.000 km² in the north-western Mediterranean Sea between Italy, France and the Island of Sardinia, encompassing Corsica and the Archipelago Toscano

The catalyst for the Sanctuary proposal was threefold: (i) recently acquired knowledge of the presence of important populations of cetaceans in the area; (ii) awareness of the existence of serious threats to these populations; and (iii) a lack of legal instruments to protect the Mediterranean high seas beyond the 12-nautical mile (22.3 km) buffer provided by the national territorial seas, where most of the habitats of these cetacean populations lie.⁷⁷

⁷⁶ Sale, Peter F., Robert K. Cowen, Bret S. Danilowicz, Geoffrey P. Jones, Jacob P. Kritzer, Kenyon C. Lindeman, Serge Planes et al. "Critical science gaps impede use of no-take fishery reserves." *Trends in ecology & evolution* 20, no. 2 (2005): 74-80.

⁷⁷ Notarbartolo-di-Sciara, Giuseppe, Tundi Agardy, David Hyrenbach, Tullio Scovazzi, and Patrick Van Klaveren. "The Pelagos sanctuary for Mediterranean marine mammals." *Aquatic Conservation: Marine and Freshwater Ecosystems* 18, no. 4 (2008): 367-391.



Figure 5 The map of the Pelagos Sanctuary

The Pelagos Sanctuary covers an area over 87 500 km² in the north-western Mediterranean Sea, between south-eastern France, Monaco, north-western Italy and northern Sardinia, and surrounding Corsica and the Tuscan Archipelago. The protected area consists of the Ligurian Sea and parts of the Corsican and Tyrrhenian Seas, and is formed of 15% EEZ, 32% territorial waters (France, Monaco and Italy), and a 53% high seas.⁷⁸

The sanctuary contains deep-water and shelf-slope habitats appropriate for the breeding and foraging use of cetacean species native to Western Mediterranean Sea.⁷⁹ Due to the fact that the coastal area has many notable touristic destinations, this add a lot human pressures and can pose as possible threats to the marine species.

What is unique about this MPA and why it is relevant to this thesis is mainly because it provides insight into a well-built management plan. Besides having set high standards for granting protection to the species and their habitats, it uses an ecosystem-level management plan which has to include an understanding of the ecosystem of the endemic pelagic species. Here, the

⁷⁸ Notarbartolo-di-Sciara, Giuseppe, Tundi Agardy, David Hyrenbach, Tullio Scovazzi, and Patrick Van Klaveren. "The Pelagos sanctuary for Mediterranean marine mammals." *Aquatic Conservation: Marine and Freshwater Ecosystems* 18, no. 4 (2008): 367-391.

⁷⁹ Beaubrun, P. C., and Musee Oceanographique. "Atlas préliminaire de distribution des cétacés de Méditerranée." (1995).

managers are fully aware of the potential threats posed by outside the protected area, but also take into account the highly migratory species. In other words, they use a dynamic ecosystem based approach to manage the marine area.

3.7 Conclusion

As scientific research advances, countries are facing increasing pressure to establish MPAs at both regional and national levels. The 10% target set out the CBD member States at COP 10, also known as Aichi target, promises to create a “well-connected system of marine protected areas” by 2020. Meanwhile the current percentage of the ocean covered by MPAs becoming considerable at a relatively slow rate⁸⁰, but we realize that a clarification must be made regarding their future design, such as location, size, spatial organization, and flexible zoning. However, this term *well-connected* hints that we need a satisfactory understanding of connectivity patterns and dimensions.

On this note, PMPA may be a better solution for specific conservation needs, although the effectiveness of this instruments hasn't been proven yet. Principally, PMPAs are still in the development faze as an experimental adaptive management tool. For this conservation strategy to be brought to light a framework is needed, which should redefine conservation methods and governance policies.

⁸⁰ Marinesque, Sophie, David M. Kaplan, and Lynda D. Rodwell. "Global implementation of marine protected areas: Is the developing world being left behind?" *Marine Policy* 36, no. 3 (2012): 727-737.

4. BENTHIC MARINE PROTECTED AREAS

4.1 Introduction

The oceans are still unconquered territory in terms of scientific knowledge. Today we know more about the habitats and faunas of the territorial lands than we do about the seas. For a very long time there was the idea that the seabed is a desert, except for the presence of non-living mineral resources seen as the most valuable. Technological advancement today has helped us discover and extract information from remote environments of the seabed with life forms which have unique genetic and morphological characteristics.

Just a short while ago, all life on Earth was believed to be dependent on the sun. Recent scientific discoveries have found that the deep-sea ecosystems actually use an alternative source of energy, for light barely reaches a 30m depth near the shore and about 100m in the high seas. One way energy is produced in the abyssal is from the carcasses of the living creatures from the pelagic layers of the sea. The benthic species are scavengers or detritivores and they feed on the remains of pelagic species. Another source of energy is chemosynthesis to produce biomass. This way of producing energy is different from the one made from remains of the upper layers of the water, this type of energy is derived from an inorganic chemical reaction..

Statistically, there are more benthic species in deeper waters, than closer to the shoreline,

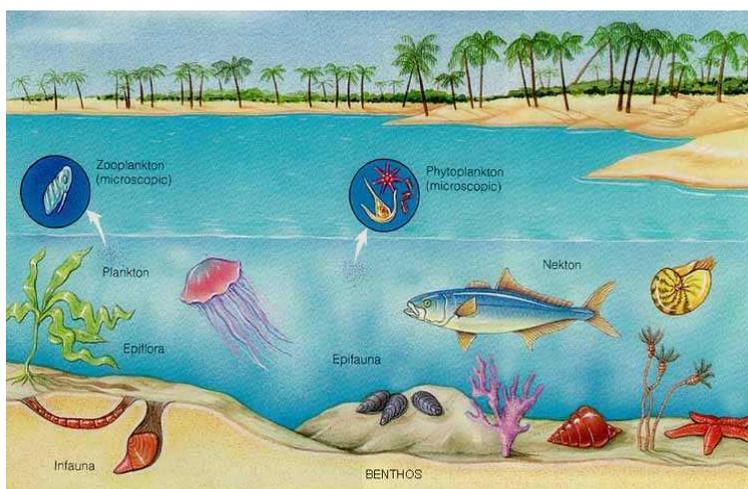


Figure 6 Image of benthic species

because there is many more carcasses where the pelagic population is a higher. Sediments from rivers dead organisms will reach the seabed and from there currents and eddies will carry the food all around so that the organisms don't have to use their own energy to go and get food. For the organisms that are not bound by the sea floor and are able to

move, come up and feed on higher level species. It is common for big organisms to feast on smaller organisms in order to survive.⁸¹

The term benthos comes from the Greek *bénthos*⁸² meaning depth (of the sea) and it is a term used to describe the bottom most layer of oceanic division known as the benthic zone. It also includes the sand, sediments and organisms found on the ocean floor. In the benthos community you can expect to find organisms from each realm. These organisms are divided, thus some of them live above the sediment, hyperbenthos, some live just on top of the sediment, epibenthos, while others live actually in the sediment, endobenthos.⁸³

The benthos can also be classified into another three separate categories on the criteria of size. Macrobenthos are organisms big enough to see with the naked eye. Starfish, oysters, clams, sea cucumbers, brittle-stars and anemone can be included into this category. Meiobenthos are between one tenth and one millimeter in size. Organisms in this group include diatoms and sea worms. Microbenthos are very tiny organisms like diatoms, ciliates and bacteria. They are smaller than one tenth of a millimeter.

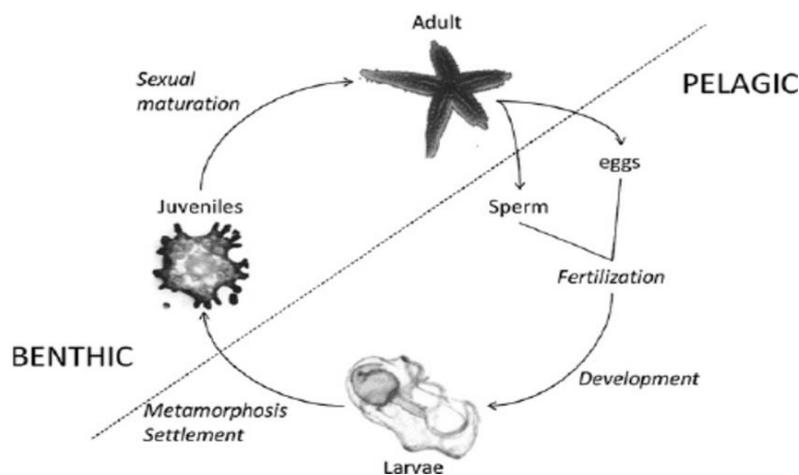


Figure 7 Larval dispersal

One of the main features of both pelagic and benthic is the interconnectivity of these quite distinct environments. This connectivity becomes evident from the dispersal of larvae. Larval dispersal represents the spread of larvae from the spawning source, the adult species, to a

⁸¹ de Broyer, Claude, J. K. Lowry, K. Jazdzewski, and H. Robert. *Census of Antarctic Marine Life. Synopsis of the Amphipoda of the Southern Ocean. Vol. 1. Part 1: Catalogue of the Gammaridean and Corophiidean Amphipoda of the Southern Ocean with Distribution and Ecological Data*, by C. de Broyer, JK Lowry, K Jazdzewski and H. Robert. Institut Royal des Sciences Naturelles de Belgique, 2007.

⁸² Liddell, Henry George. *A greek-english lexicon*. Harper & brothers, 1894.

⁸³ Encyclopaedia Britannica Inc. *2008 Britannica Book of the Year*. Vol. 33. Encyclopaedia britannica, 2008.

settlement site, as seen in the above figure the larvae goes into the pelagic sea.⁸⁴ Population connectivity is defined as the exchange of species among geographically separated areas. From this explanation it is understood that, if the interchange is measured at the time of spawning or settlement, the connectivity is virtually the larval dispersal from one realm to another.⁸⁵

BMPAs are a good solution to protect benthic habitats from alteration by fishing activities while granting access for fishing activities that do not contribute to the degradation of benthic habitats and communities within a delimited area. In the most simplified version, BMPAs only exclude dangerous mobile fishing gear which can impact the seabed such as bottom trawls and dredges from a determined area. Furthermore, BMPAs can be used to safeguard the seabed from impacts of non-fishing activities, like for instance mining or extraction of petroleum. Although there has not been any BMPAs which specifically excluded energy and mineral exploration and exploitation, such activities are banned as a consequence of the BMPA becoming a fully protected area (no-take zone). Trawling activities bans have been ratified to conserve certain nursery grounds. For instance, Thailand has prohibited trawling within 3 kilometers of shore in order to protect both benthic habitats and juvenile fish. BMPA is expected to allow protection to vulnerable marine ecosystems, or areas where the benthic habitats and communities have a significant conservation worth. Just as the industry group Southern Indian Ocean Deepsea Fishers Association (SIODFA) has willingly enforced BMPAs since 2006 and advocates for RFMOs to assess their biodiversity data to diminish negative impacts on benthic ecosystems and vulnerable marine areas.⁸⁶

4.2 Historical background

Many coastal States have developed throughout history fisheries management projects including closed areas or marine protected areas. Such an example is the Fiji temporary fishing bans from June to September each year for the purpose of replenishing fish stocks as well as protecting the benthic communities. However, even though the proposed closed areas or MPAs were

⁸⁴ Begon, Michael, Colin R. Harper Townsend, L. John, R. Townsend Colin, and L. Harper John. *Ecology: from individuals to ecosystems*. No. Sirsi) i9781405111171. 2006.

⁸⁵ PiNeDa, Jesús, Jonathan A. Hare, and S. U. Sponaugle. "Larval transport and dispersal in the coastal ocean and consequences for population connectivity." *Oceanography* 20, no. 3 (2007): 22-39.

⁸⁶ See FAO 2008 workshop on Deep-Sea Fisheries In The High Seas A trawl industry perspective on the International Guidelines for the Management of Deep-sea Fisheries in the High Seas, <http://www.fao.org/3/a-i0477e>

established solely on the idea of protecting and recovering benthic ecosystems, they were not labelled as such (BMPAs).

In 2005, the North Pacific Fishery Management Council adopted several new closed areas to conserve essential fish habitats. In order to minimize the effects of fishing on important habitats, but also more importantly to address concerns about the impacts of bottom trawling on benthic habitat. An estimated 1.5 million km² of benthic habitat is protected⁸⁷ within about 3.5 million km² of Alaska's state marine area. The Council forbids all bottom trawling in the Aleutian Islands area and also in ten determined zones along the continental shelf of the Gulf of Alaska. In June 2007, they approved precautionary measures to preserve benthic species and habitats in the Bering Sea by limiting trawling activities.⁸⁸

In 1990, Florida Keys National Marine Sanctuary was created in response to the predominant threats to the reef ecosystem and the decline in biodiversity. In 2000 NOAA adjoined a 520 km² area to nearly 10,000 km² of the current protected area of the Florida Keys National Marine Sanctuary network.

In Chile, since 1991 the government has used Management and Exploitation Areas for Benthic Resources (MEABR) as the main way of protecting the coastal marine area and for managing inshore benthic resources. Although these protected areas have been used for such a long time, the current knowledge of the biological diversity in MEABRs aren't studied sufficiently and the only solution is to obtain insight into this framework in order to reach the sustainability goal.⁸⁹

Last but not least, Norway was one of the first country in Europe to put in place a protection system for cold-water corals and still it continues to improve the network as technology and information advances. The Marine Resources Act in Norway gives fisheries management organizations the power to close areas and restrict some gear types which can have a devastating

⁸⁷ Witherell, David, and Doug Woodby. "Application of marine protected areas for sustainable production and marine biodiversity off Alaska." *Marine Fisheries Review* 67, no. 1 (2005): 1-28.

⁸⁸ See North Pacific Fishery Management Council's website <https://www.npfmc.org/habitat-protections/>

⁸⁹ Giacaman-Smith, José, Sergio Neira, and Hugo Arancibia. "Community structure and trophic interactions in a coastal management and exploitation area for benthic resources in central Chile." *Ocean & Coastal Management* 119 (2016): 155-163.

impact benthic habitat. The country has a seabed mapping program, MAREANO, which is still under development and will be beneficial for determining the needs of the benthic ecosystem.⁹⁰

4.3 Types of BMPAs

As seen in the previous chapter, the determination of subcategories of a MPA can be given by the conservation goal that it has. Most of the BMPAs are a reaction of the unsustainable practice of bottom trawling or long-line fishing. This represents a great issue, because the balance between pelagic and benthic is maintained through very intricate connections of interdependence. In order for the higher trophic species to survive they need the food source provided by the benthos. The deep-sea is defined by geographical features of the seafloor, along with its associated habitats. The scope of the present thesis is to present all these geographical locations as potential objective of BMPAs applying an ecosystem based management approach. The seabed organisms are of importance due to their resilience to high salinity, high pressure, low temperature and special lighting conditions. Their genetic information can bring contributions to marine enzyme technology, by developing valuable products. The enzymes obtained can be used as pharmaceuticals, nutritional additives and chemical industry.

4.3.1 Cold seeps

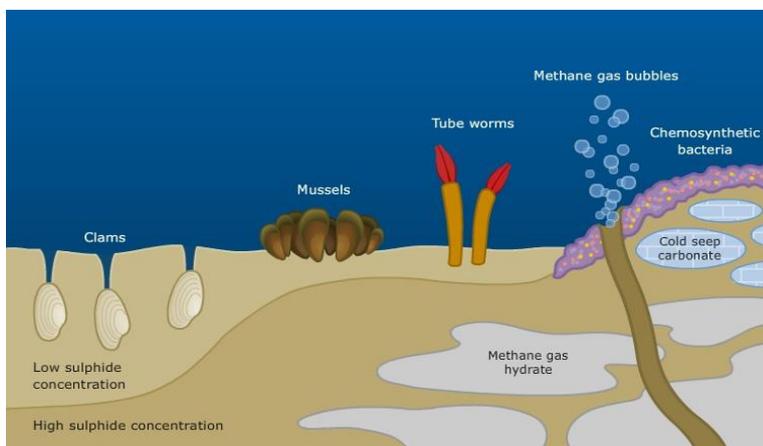


Figure 8 Cold seeps. Ref: <https://www.sciencelearn.org.nz/resources/475-cold-seep-communities>

Cold seeps materialize in sites along the outer continental shelves between 300 and 600 m isobath. Methane gas, hydrogen sulphide and other compounds flows through fissures or holes from the sea floor in a stream of globules of air at an equal temperature as the surrounding water. Organisms use these

compounds for energy through a process called chemosynthesis. The ecosystem is defined by crustaceans and tubeworms formed by the chemosynthesis organisms.⁹¹

⁹⁰ Fosså, Jan Helge, P. B. Mortensen, and Dag M. Furevik. "The deep-water coral *Lophelia pertusa* in Norwegian waters: distribution and fishery impacts." *Hydrobiologia* 471, no. 1 (2002): 1-12.

⁹¹ Paddy Ryan, 'Deep-sea creatures - Sea-floor life', Te Ara - the Encyclopedia of New Zealand, <http://www.TeAra.govt.nz/en/deep-sea-creatures/page-4> (accessed 21 November 2017)

4.3.2 Hydrothermal vents

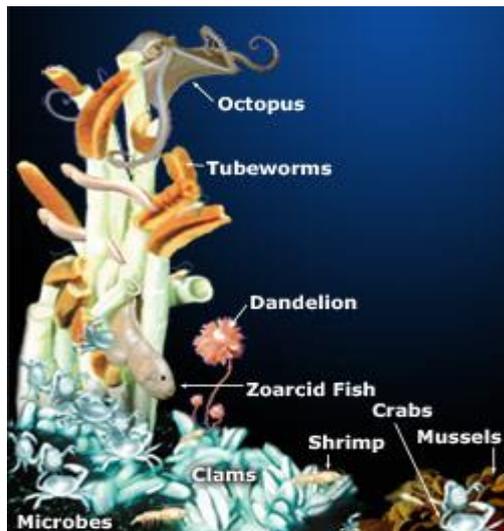


Figure 9 Hydrothermal vent

Hydrothermal vents (black smokers) are similar to geysers, producing superheated, mineral-laden water. They are found along zones of tectonic or volcanic activity such as mid-ocean ridges where hot magma is near the sea floor. The minerals are used by chemosynthesis organisms, forming the basis of a unique community that does not depend on sunlight. The giant tubeworm *Riftia pachyptila*, found all over vents, can grow up to 1.5 metres long, yet has no mouth or anus and only a vestigial gut.⁹² Very fascinating is the high levels of species abundance and

bacterial diversity found on hydrothermal vents. It has been called by scholars and scientists “the oases of abyss”⁹³, the “Oceanic Gardens of Eden”⁹⁴ and “biological islands”⁹⁵.

4.3.3 Coral reefs



Figure 10 Coral reef. Ref: <https://dodobirdz2.deviantart.com/art/Deep-Sea-Coral-Reef-347295839>

Coral reefs are like the rainforests of the sea. Corals aren't just colorful rocks, they actually the skeletons of polyps, which constantly secrete calcium to build these protective skeletons. Corals are species related to jelly fish and sea enamines and are immobile organisms since they live their entire lives in just one place. Coral reefs are formed from giant accumulations of corals which grow and die on top of each other over millions of

⁹² Ibidem 91

⁹³ Beurier, Jean-Pierre, Alexandre Kiss, and Said Mahmoudi. "New technologies and Law of the marine environment: Nouvelles technologies et droit de l'environnement marin." In *Conference, Lisbon, 1988 organised by the European Council on Environmental Law*. Kluwer Law International, 2000.

⁹⁴ Allen, Craig H. "Protecting the oceanic gardens of Eden: international law issues in deep-sea vent resource conservation and management." *Geo. Int'l Eenvtl. L. Rev.* 13 (2000): 563.

⁹⁵ Baker, C. M., B. J. Bett, D. S. M. Billett, and A. D. Rogers. "An environmental perspective." *The status of natural resources on the high seas* (2001): 1-67.

years. This creates the basis of about 25% of all ocean life and form some of the most diverse ecosystem on Earth. The amount of species living around and feeding off the corals reefs surpass 1 million, that is why it is essential to protect them. A very unique type of coral is the deep-water coral, an enigmatic organism because it creates reefs in the dark cold depths of waters at high latitudes.

4.3.4 Seamounts

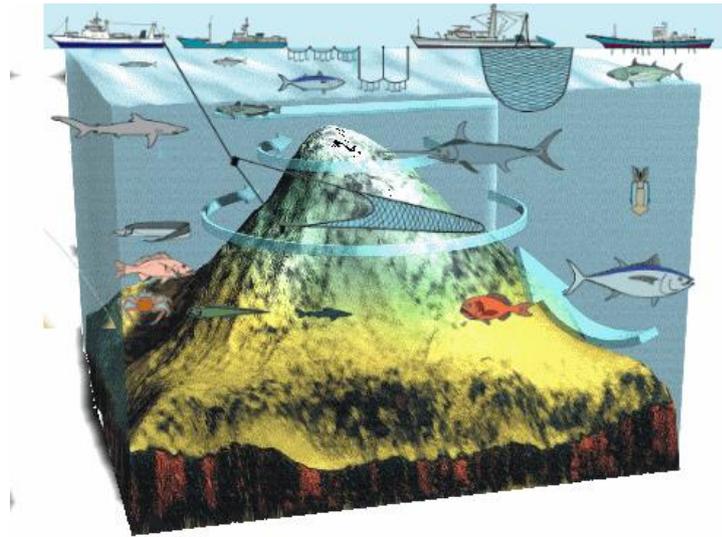


Figure 11 Seamount

Seamounts rise up high in the water column, creating complex current patterns influencing what lives on and above them, by providing organisms a site where they can settle and grow. Seamounts are usually vestiges of defunct volcanoes. A seamount is a geographical form higher than 1,000 m above the surrounding seafloor. Since the seamounts never go above surface water level they

cannot be considered islands. Seamounts are densely populated on account of the currents of nutrient-rich water forced up the sides from the ocean floor. There is an estimated 31,000 seamounts in the ocean which have yet to be explored.

4.4 Environmental challenges

In contrast to pelagic ecosystems, the benthic ecosystem is defined by sedentary and sessile species within a slowly changing or static habitat. This type of environment doesn't create too many challenges in the design stage of the BMPAs. But clearly one of the most noticeable challenge is that of mapping an area, especially the very deep part of the seabed. The deepest point reached was obtained by James Cameron in 2012 at a record level of 10,898 meters isobath.

Even though there is still much of the oceans man has not yet conquered, a new multibeam sonar sounding systems may be the solution towards mapping the seabed. Compared to other sonar systems, multibeam systems shoots sound waves in a pyramid shape from underneath the

ship. The water depth is determined by the time it takes the sound to reach the seabed and bounce back to the receiver.

Data collection prior to the creation of the BMPA is essential to determine the functions of the benthic habitats so as to put in place the most compatible methods of protection. Designer must also take into account the impact of activities which will take or have taken place in the areas outside or near the protected area. In the next part, a set of recommendation of what best practices should be considered and which specific action may give rise to challenges in managing BMPAs.

4.5 Management challenges

To all appearances, the protected area needs a variety of management structures in order to succeed. Deficiencies in enforcement and compliance are the leading factor in declining rate of MPAs. Additionally, fishermen and other stakeholders have to get involved in the creation and management process of BMPAs, in this way perhaps they can take on voluntary compliances.

The benthic marine environment is at risk due to increasing extraction of resources and deep-sea areas, such as seamounts, cold water corals and hydrothermal vents, are becoming vulnerable. The problem is that there is lack of effective enforcement and monitoring measures. Illegal, unregulated and unreported (IUU) fishing is still one of the main causes of biodiversity decline, along with climate change effects and land based pollution. There is a need for further analysis and identification of best practices to improve success rates, but that is quite hard to achieve when there are not detailed guidelines put into place for specific ecosystems.

Once again, the result is the need for a uniform practice where countries which have been involved with benthic ecosystem approach collaborate on a framework to suit the needs of the species and habitats. Managers and stakeholders must work together to achieve the optimal design to assure the protection of benthic environment.

4.6 New Zealand's Benthic Protected Area

In 2007, New Zealand established BMPAs covering over 1.2 million km² of its EEZ. In other words, approximately 30 % of its off shore waters are closed to bottom trawling and dredging. This case study focuses on the process used to plan, design, and implement these BMPAs. They have been deliberately selected to set aside large areas that broadly represent the wide variety of benthic habitats and communities within the EEZ, based on the best available scientific

information at that time. Preference has been given to the closure of areas unmodified by human activity.

The Marine Reserves Act of 1971 is New Zealand's primary law for establishing marine protection. However, it applies only within the 12-nauticalmile territorial sea, not to EEZ waters and habitats that extend from 12 to 200 nautical miles offshore. Authority and guidance for marine protection beyond the territorial sea stem from other laws and policies. The Fisheries Act of 1996 is in place primarily to enable fisheries resources to be utilized sustainably but also permits the creation of BPAs to control fishing in the EEZ. In addition, adopted in 2000, the New Zealand Biodiversity Strategy calls for protection of 10 percent of the country's marine environment by 2010 and the establishment of a Marine Protected Areas Policy. Completed in 2008, the MPA Policy and Implementation Plan seek to conserve marine biodiversity by establishing a network of MPAs. The Marine Reserves Act and Fisheries Act are used to protect a range of representative marine habitats and ecosystems.

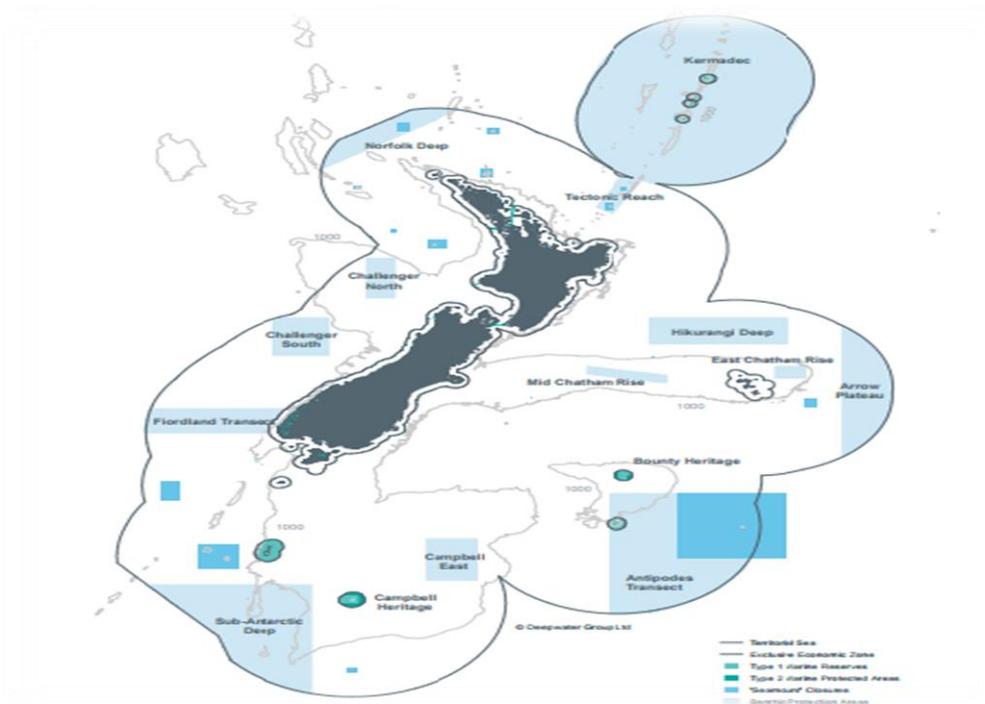


Figure 12 Map of New Zealand's BMPAs

As little is known about the nature and extent of benthic habitats and the size of areas needed to maintain “intact” and functioning ecosystems, the government and industry designed most

of the BPAs to cover large areas, the average size being nearly 67,000 km².⁹⁶ An independent analysis showed that around 8.5 percent of New Zealand's EEZ has been contacted once or more by bottom trawling.

In an analysis to assess the combined protection of specific benthic features, Helson et al. found that BPAs combined with existing seamount closures protect 52 percent of known seamounts and 88 percent of known active hydrothermal vents within the EEZ. The study also concluded that the BPAs cover nine of 15 biodiversity hotspots identified in *Shining the Spotlight on the Biodiversity of the New Zealand Marine Ecoregion*.

4.7 Conclusions

The case study analyzed for this thesis contain best practices that should be applied to future BMPA network development processes. The New Zealand case achieved clear benthic protection objectives, and so some essential aspects must be extracted and taken as exemplary features of a well-developed BMPA. Firstly, involving individuals from the commercial seafood industry and the conservation community during the proposal and design phases can create buy-in from the wider groups they represent. Secondly, objectives and targets must be agreed upon by the representative stakeholder group before the process is established. Once BPAs are implemented, the stakeholders must commit to continued data collection and analysis to measure effectiveness of protection and to determine if other protection is warranted. And lastly, it is strongly recommended that a continuing cooperative approach between industry, scientists, government, and NGOs be maintained.

⁹⁶ Helson, Jeremy, Stefan Leslie, George Clement, Richard Wells, and Ray Wood. "Private rights, public benefits: industry-driven seabed protection." *Marine Policy* 34, no. 3 (2010): 557-566.

5. CONCLUSIONS

5.1 Future Outlook

The world has had for many generations terrestrial protected areas, the total amount of them surpass by far that of marine protected areas. Ocean biodiversity is equally as important as the land based ones. In fact, there is more genetic diversity in the sea and it is crucial for the ecosystem to be protected. Today, the ocean area is being exploited at a phenomenal rate and it is left unnoticed. Protected areas need to be created so that all the living organism of the sea have a safe haven where they can reproduce and feed, in turn replenishing the depleting fish stocks for the entire oceans.

The negotiations held by the BBNJ PrepCom for the drafting of a new implementing agreement for the ABNJ had also focused on MPAs. They agreed that the protected areas should be founded on the ecosystem approach criteria with well-defined management objectives. The architectural design of a MPA should be created from the best scientific information available, governed by the ecosystem approach, and on top of that take into account the socioeconomic ramifications and the possible adaptability of the ecosystem to changing circumstances.

The idea that the international community has understood the urgency and will develop necessary management tools to apply the ecosystem approach is a huge break-through. Although, we must consider that the ABNJ is a marine area composed of two very distinct zones, the Area, govern by the principle of common heritage of mankind and the High-Sea, the water column beyond the 200-nm line where freedom of the seas is the applied principle.

Policy makers should focus more on the ecological factors and implement appropriate protected areas for both the pelagic and benthic communities for long-term sustainable use. A growing body of reports, literature and scientific works have recorded the effectiveness of these types of MPAs for conserving ecosystems, helping the recovery of over-exploited habitats or species and maintain a healthy ecosystem. A global agreement of this caliber could also promote better conservation efforts at the regional and international level by creating a mechanism for differentiated pelagic and benthic ecosystem approaches.

5.2 Conclusion

The marine environment is not as accessible as the terrestrial ecosystem and so the development of an effective legal system will take a long journey. The issue of marine conservation has been

identified in recent year as being of great significance from a social and economic perspective and States have been collaborating on this matter by implementing agreements.

It is past dues that the international community looks at methods and strategies to effectively save the species and their ecosystem that are under threat. If we are to preserve the oceans for future generations, nations must learn to correctly allocate and design MPAs. By identifying key areas and vital species, the design process becomes straightforward. MPAs are an insurance policy for the oceans it allows the communities to be more resilient against the future threats of climate change, still to come.

From a scientific point of view it is obvious the world needs these MPAs, but the important things is to correctly asses the requirements of each ecosystem. We need to influence the policy makers in a way that lets States move towards that 10% target imposed by the CBD. And hopefully move beyond to what should more than 20% as follows the terrestrial percentage.

As discussed throughout the thesis, pelagic and benthic protected areas provide a new perspective into marine conservation, which moves away from the original outdated classification system. Perhaps this matter of management can help the world achieve its targets, but to this effect a frame of reference is required. There is still hope in the international instrument for the BBNJ under UNCLOS, considering the fact that recommendations on the draft text have been allowed for and are yet to be finalized.

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Links:

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ANNEX

Outline Structure for an MPA Management Plan⁹⁷

The following provides guidance on the outline structure of a management plan for an MPA of the OSPAR Network. It is based on the IUCN model - see Salm, R. V., & Clark, J. R. 2000. IUCN Marine and Coastal Protected Areas. IUCN, Gland: 370pp. and Kellerher, G. 1999. Guidelines for Marine Protected Areas, IUCN, Gland: 107pp.

1. Executive summary
2. Introduction
 - 2.1 Purpose and scope of plan
 - 2.2 Legislative authority for the plan (national and international)
3. Description of the site and its features
 - 3.1 Regional setting: location and access
 - 3.2 Resources (facts pertinent to management; other data in an appendix or separate document)
 - 3.2.1 Physical: e.g., marine landscape features, currents, bathymetry, hydrology
 - 3.2.2 Biological: ecosystems (e.g., cold water coral reefs, seagrass beds); critical habitats (e.g., feeding, spawning); species (e.g., endangered, commercial, charismatic)
 - 3.2.3 Cultural: archaeological, historical, religious
 - 3.3 Existing uses (description, facilities, etc.)
 - 3.3.1 Recreational
 - 3.3.2 Commercial
 - 3.3.3 Research and education
 - 3.3.4 Traditional uses, rights, and management practices

⁹⁷ IUCN model outline for an MPA site management plan based on Salm et al. (2000) and Kelleher (1999) recommended for an MPA of the OSPAR network.

3.4 Existing legal and management framework

3.5 Existing and potential threats and implications for management (i.e. analysis of compatible or incompatible uses, solutions)

3.6 Existing gaps of knowledge

4. The plan

4.1 Goals and objectives (general and specific)

4.2 Management tactics

4.2.1 Advisory committees

4.2.2 Interagency agreements (or arrangements with private organizations, institutions or individuals)

4.2.3 Boundaries

4.2.4 Zoning plan

4.2.5 Regulations

4.2.6 Social, cultural, and resource studies plan

4.2.7 Resource management plan

4.2.8 Education and public awareness

4.3 Administration

4.3.1 Staffing

4.3.2 Training

4.3.3 Facilities and equipment

4.3.4 Budget and business plan, finance sources

4.4 Surveillance and enforcement

4.5 Monitoring and evaluation of plan effectiveness

4.6 Time table for implementation

5. Appendices

6. References