

ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ



**ΤΜΗΜΑ ΝΑΥΤΙΛΙΑΚΩΝ ΣΠΟΥΔΩΝ
ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ
ΣΠΟΥΔΩΝ**

στην

ΝΑΥΤΙΛΙΑΚΗ ΔΙΟΙΚΗΤΙΚΗ

**“MARINE RESOURCES & WHY HUMANS
HAVE TO RESPECT THEM”**

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ΔΙΠΛΩΜΑΤΙΚΗ ΕΡΓΑΣΙΑ

που υποβλήθηκε στο Τμήμα Ναυτιλιακών Σπουδών του Πανεπιστημίου Πειραιώς ως μέρος των απαιτήσεων για την απόκτηση του Μεταπτυχιακού Διπλώματος Ειδίκευσης στην Ναυτιλιακή Διοικητική.

Πειραιάς

Νοέμβριος 2020

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Θα ήθελα να ευχαριστήσω τον Κύριο Τσελεπίδη Αναστάσιο θερμά για το σημαντικό ερευνητικό υλικό που μας έδωσε απλόχερα, για την καθοδήγηση του κατά την εκπόνηση της συγκεκριμένης Δ.Ε. και τέλος για την πολύ ενδιαφέρουσα κουβέντα που είχαμε στο αεροπλάνο επιστρέφοντας από το Λονδίνο, η οποία ήταν σήμα κατατεθέν ώστε να επιλέξω το συγκεκριμένο θέμα Δ.Ε. Επίσης, θα ήθελα να ευχαριστήσω και τα υπόλοιπα μέλη της τριμελούς επιτροπής για την συνεισφορά τους στην ολοκλήρωση της εργασίας.

ΠΕΡΙΛΗΨΗ

Η Δ.Ε. αυτή εξετάζει το ζήτημα της ανάγκης για προστασία των θαλάσσιων πόρων από την ανθρωπότητα στο σύνολό της. Παρέχει μια κριτική βιβλιογραφική ανασκόπηση, που συνδυάζει πηγές και αναφορές από τη διεθνή βιβλιογραφία και εξετάζει τις κύριες επιπτώσεις της ρύπανσης των υδάτων, την έλλειψη πολιτικών για την προστασία της θαλάσσιας ζωής και, κατά συνέπεια, την κλιματική αλλαγή στον πλανήτη και την ανθρωπότητα. Το κύριο συμπέρασμα που προκύπτει είναι ότι το φαινόμενο της υπεραλίευσης, της έντονης εκβιομηχάνισης καθώς και της απόρριψης πλαστικών και χημικών σε όγκους νερού προκαλεί προβλήματα υγείας, κοινωνικά προβλήματα και περιβαλλοντικά προβλήματα, όχι μόνο σε παράκτιες περιοχές αλλά και σε όλη την ανθρωπότητα. Ωστόσο, διαπιστώνεται επίσης ότι οι διεθνείς οργανισμοί, καθώς και ο

ιδιωτικός τομέας, μαζί με τις τοπικές κοινότητες, επενδύουν στην αντιμετώπιση των προβλημάτων που σχετίζονται με την κλιματική αλλαγή και τη βιωσιμότητα της οικονομίας των ωκεανών. Στην πραγματικότητα, υπογραμμίζεται ότι η συνεργασία μεταξύ των μικρότερων τοπικών ομάδων και των μεγαλύτερων θεσμών είναι ζωτικής σημασίας για την επιτυχία των παγκόσμιων προσπαθειών για τη μείωση της κλιματικής αλλαγής και την αύξηση της θαλάσσιας προστασίας.

Abstract

This study addresses the issue of the need for the protection of marine resources by humanity as a whole. The report, therefore, provides a critical bibliographic review, combining sources and reports from the international literature and examining the main implications of water pollution, lack of policies to protect marine life and, consequently, climate change on the planet and humanity. Also, one of the main questions addressed in this essay is what the comparison between the literature review findings and the quantitative data can reveal about the severity of the problem. The main conclusion that emerges is that the phenomenon of overfishing, intense industrialization as well as the rejection of plastics and chemicals in water volumes causes health problems, social problems and environmental problems, not only in coastal areas but also in all of humanity. However, it is also found that the international organizations as well as the private sector along with the local communities invest at tackling the problems related to climate change and ocean economy sustainability. In fact, it is underlined that the cooperation between the smaller local groups and the larger institutions is vital for the success of the global efforts to reduce climate change and increase marine protection.

Keywords

Waste, pollution, water resources, marine resources, ocean economy, sustainability, local communities, fishery, marine debris.

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Chapter 1- Introduction

The management of marine resources is an important issue for both the business world and the academic community and well as the political leadership. In particular, issues related to the management of water and submarine resources are the subject of international law (maritime law), particularly due to the fact that maritime disputes can lead to potential conflicts among the states competing for them (Dolven, Kan, & Manyin, 2013).

In addition to the economic and legal nature of maritime resources, there are both legal and political as well as practical / humanitarian issues and issues related to environmental protection, and issues related to public health that arise (Anton & Shelton, 2011). More specifically, it is proven that the overexploitation of marine resources can lead to depletion of available resources, disruption of the balance of the marine ecosystem and deprivation of the ability to survive in coastal populations (Sherbinin, Carr, Cassels, & Jiang, 2007).

In general, the main problems that arise with regard to maritime activities and the management of marine and submarine resources include dilemmas such as the protection of marine and coastal zones that are at risk of contamination or pollution (for example due to their proximity to industrial units), chemical contamination of water, shoreline cleaning, exploitation and / or control of fishery products and the human-sea relationship (European Marine Board, 2013).

This study analyzes these issues using the method of critical bibliographic review, theoretically approaching and using secondary data (statistics, research findings) the question of "why we should respect marine resources". Also, in the context of conducting the bibliographic review of the available academic literature in relation to the exploitation of marine resources in Greece, Europe and internationally, a research takes place in the form of systematic bibliographic review.

Therefore, the structure of the work is as follows:

- Chapter 2 is focused the systematic bibliographic review

- Chapter 3 is dedicated on the analysis of statistics and data on the reasons for the protection and conservation of marine resources

- Chapter 4 is the conclusions' chapter.

This project aims, therefore, not only to list these causes but to combine the available data to draw original conclusions and to suggest possible solutions, thus contributing to the available academic literature.

Chapter 2- Systematic Literature Review

This chapter of the study is the chapter of the systematic literature review. More specifically, twenty (20) articles are studied that focus precisely on the specific subject of this study and are both up-to-date and published in credible academic sources. The research and collection of this material was done through the Google Scholar platform as well as Elsevier.

2.1. Methodology of the analysis

Thus, in a separate chapter of the study, twenty articles are selected which meet the following criteria for their selection:

- A. emphasis on marine resources, management of marine resources and protection / respect of the sea / sea floors
- B. have been published since 2010
- C. have at least 20 citations in the Google Scholar database from which these articles are selected.

The collection of data started with an elaborate search of material (articles, books and reports) from Google Scholar. Although the total number of available resources exceeded 2,6 million documents and papers, after setting the data of publication to 2010-2020 the results were limited to 84.400 papers and reports. Afterwards, an additional criterion was set, that of the total number of citations (over 20 per reference) as well as that of relevance. This means that material that did include the keywords in the title and / or abstract but is not directly related to the purpose and the subject of the study was excluded. Then, an additional criterion was set – that of credibility. To

determine which of the sources was most appropriate, students' papers as well as newspaper articles were excluded from the systematic literature review.

The total material used is included in the table below:

<i>Citation</i>	<i>Number of references (as of Sept. 2020)</i>	<i>Methodology of the paper / book / report</i>
1. (Coll & Libralato, 2012)	136	Systematic literature review per topic
2. (Beyerl, Putz, & Breckwoldt, 2016)	35	EwE (Ecopath with Ecosim) Critical literature review
3. (Gooch & Hobday, 2013)	124	Survey – based
4. (Ferse, Costa, Manez, Adhuri, & Glaser, 2010)	155	Literature review
5. (Fleming, et al., 2006)	256	Literature review
6. (Wegge, 2015)	31	Literature review
7. (Avila, Kaschner, & Dormann, 2018)	58	Literature review
8. (Srinivasan, Cheung, Watson, & Sumaila, 2010)	178	Literature review
9. (Planque, et al., 2010)	352	Literature review
10. (McIlgorm, Campbell, & Rule, 2011)	130	Quantitative analysis (financial and pollution data)
11. (Forster, Lake, Watkinson, & Gill, 2014)	43	Mixed methods research – study of quantitative data and qualitative (interviews)
12. (Thornton & Scheer, 2012)	185	Literature review
13. (Arrieta, Arnaud-Haond, & Duarte, 2010)	185	Quantitative analysis
14. (Lorenzen, Leber, & Blankenship, 2010)	199	Systematic literature review
15. (Srinivasan, Cheung, Watson, & Sumaila, 2010)	180	Literature review and secondary sources analysis and synthesis
16. (Möllmann & Diekmann, 2012)	106	Critical literature review
17. (Purcell, et al., 2013)	347	Critical literature review

18.	(Loh, McMurray, Henkel, Vicente, & Pawlik, 2015)	79	Critical literature review
19.	(Burgess, Polasky, & Tilman, 2013)	100	Modeling (linear model)
20.	(Methot Jr, Tromble, Lambert, & Greene, 2014)	35	Modeling (mathematical model)

2.2. Literature review – Marine Resource Management

2.2.1. The need to respect the marine resources

Starting the literature review from the article by Coll & Libralato (2012) this paper refers to the management of marine resources in the Mediterranean, comparing a variety of available sources theoretically and by sector. In particular, researchers are focusing on different axes to assess the impact of human activity on the Mediterranean marine ecosystem. More specifically, they use the EwE methodology to model their research and highlight a) the impact of pollution on the marine ecosystem, b) the importance of ecosystem conservation in tackling climate change. The methodology they use concerns the use of Ecopath for the analysis of the structure of this ecosystem. Based on the data and results of the research of Coll & Libralato (2012) one concludes that there are significant differences in the findings in relation to the quality of marine resources along the Mediterranean. This means that environmental protection is important and valuable in maintaining their quality and that the measures implemented work when there is appropriate environmental design. It also appears that policy uncertainty has a negative effect on the effort to protect the environment and additional measures are needed to protect and respect marine resources.

Further analyzing these issues, Ferse et al. (2010) refer to marine protected areas and examine which of the marine resource management strategies seems to be the most effective. Like Beyerl, Putz, & Breckwoldt (2016) and Gooch & Hobday (2013), they

also emphasize the role of local communities and smaller groups of citizens who depend on the sea. More specifically, Ferse et al. (2010) showed that the combination of management methods related to classical management is more efficient than simply recognizing certain areas as protected. As, respectively, Gooch & Hobday (2013) recognized the lack of initiatives and the existence of effective methods to address the problems of mismanagement and lack of planning.

Indeed, as Fleming et al. (2006), suggest, the mismanagement of waste leads to a rapid increase of the concentration of bacteria and harmful substances in the water and in the marine resources.

In particular, the findings of the researchers, regard that (Fleming et al., 2006):

- Climate change directly impacts human health
- Climate change and ocean / water pollution impact the regions that are dependent on tourism and tourist activity to a larger extent
- The main health hazard associated with the mismanagement of waste and the lack of measures to tackle water pollution regard the increase of toxic substances in the water sources and marine resources as well as the increase of Harmful Algal Blooms (HAB)
- The increase of pollution leads to a decrease of diversity of marine resources and, as a consequence, to a reduction of available resources
- Many sea – animals and plants are close to extinction due to waste and pollution
- Climate change leads to an overall increase of the global temperature, meaning that many regions are at risk of desertification
- As the weather patterns change due to climate change and pollution, more extreme phenomena are expected to take place, including cyclones and tsumamis in the Asia – Pacific and the Atlantic regions

Next, Wegge (2015) attempts to analyze the reasons why addressing the problems of mismanagement of marine resources is imperative. More specifically, the researcher examines the example of the Arctic Ocean, in which problems related to both pollution, climate change and landscape change, as well as politics, occur. In general, the Arctic region has been one of the geopolitical zones that are systematically studied by both geologists and environmentalists as well as political scientists and sociologists, due to

the importance of maintaining low temperatures, protecting its biodiversity and achieving cooperation in the exploitation of its marine and submarine resources. This is because melting ice will change the geography of the Arctic and therefore raise new international issues regarding the exploitation rights of the Arctic soils and resources by the various states competing for this right.

At the same time, Avila, Kaschner & Dormann (2018) focus on the protection of marine life mainly through an analysis of the challenges identified due to human activity in different parts of the world. Researchers are examining, in particular, the impact of both tourism, overfishing and non-compliance with existing legal frameworks on living things around the oceans and seas, as well as marine life. They also point out that human communities are equally affected by the exploitation of marine resources without controls and limits, which, in any case, becomes apparent from all the sources being studied (Beyerl, Putz, & Breckwoldt, 2016; Dulal, Shah, & Ahmad, 2009; Ferse, Costa, Manez, Adhuri, & Glaser, 2010; Fleming, et al., 2006).

Moreover, Planque et al. (2010) approach the problem of insufficient enforcement of the international law and the environmental regulations in relation to the protection of marine resources by emphasizing fisheries and less on the political dimension or industrial production. Thus, they explain that scientists dealing with climate change and marine biology tend to focus on two questions:

- Whether climate is naturally variable, so the climate change is a fact but cannot be limited
- That the fishery exploitation is the main cause of the decline of marine wildlife and its population.

The researchers are also looking at the role of individual and organized fishing activities separately, and note that overfishing cannot be attributed to a single actor as a phenomenon. At the same time, they believe that the climate is changing, but excessive activity is accelerating climate change and has countless negative consequences for the quality of life and marine biodiversity. In particular, the researchers believe that the planet is in danger because the areas that are richer in resources are exploited without limits (Planque, et al., 2010).

Furthermore, McIlgorm, Campbell & Rule (2011) analyze the importance of maintaining seabed and seawater quality for the planet as a whole. More specifically, they attribute to a large extent the pollution of the waters and the degradation of the quality of the marine resources to the accumulation of a large volume of plastics and garbage at the bottom. More specifically, they estimate that, for the twenty-one (21) areas of the Indian-Pacific that they studied, the costs from the disposal of plastic and toxic substances at the bottom reach \$ 1.3 billion. This amount puts even more strain on the economies of these countries, and industry does not seem to be taking action to support the goal of reducing pollution. On the contrary, to a large extent, the responsibility for climate change and widespread pollution is attributed to large industrial units which, through their activity, invest mainly in reducing their operating costs and not in reducing climate change.

Then, in relation to the conservation of marine species and the conservation of biodiversity worldwide, Arrieta, Arnaud-Haond, & Duarte (2010) explain that the importance of conservation and protection of marine resources begins with the finding that 70% of life on earth concerns marine biodiversity. Also, human activity, however, is constantly evolving, estimating that, for example, the production of genetically modified food increases by 12% on an annual basis (2010 data).

Additionally, Arrieta, Arnaud-Haond & Duarte (2010) showed that although the improvement of biotechnology has positive effects on the economy and production, more than 18,000 species of marine life are affected by developments in genetics. The problem is, however, that laws and the law are not always enforced, and it is therefore doubtful whether or not these developments will affect human and animal health in the long run. As a matter of fact, the researchers are proposing to intensify efforts to protect biodiversity, research into the long-term impact of implementing policies with a focus on profitability by changing the genetic profile of these species (fish, shellfish) and the impact on local communities and beyond.

Next, Lorenzen, Leber, & Blankenship (2010) discuss the need to support or to restore the marine resources, particularly with regard to fisheries. In their study, they approach the question of why one needs to respect and to enhance the marine resources by explaining the different approaches of various researchers and organizations. Through their study, they reach the following conclusions:

- The public and the stakeholders must be informed, aware and updated on the matters related to marine protection
- The fisheries need to apply more contemporary and innovative management strategies and approaches
- The strategies need to be based on sustainable and practical goals and priorities
- Restocking is key.

2.2.2. The importance of local communities

Then, Beyerl et al. (2016) in their study examine the importance of marine resource management by local communities. More specifically, they explain that the proper management and respect of these resources starts from the realization of the need to maintain appropriate methods to reduce pollution and the implementation of practical solutions to reduce their abuse and mismanagement. Researchers also argue that it is empirically proven that the implementation of appropriate practices leads to a reduction in the problems that start with a lack of awareness. Thus, they propose raising public awareness and citizen participation in actions at local and national level. Moreover, with regard to defining the factors that are mostly relevant to studying the need to protect and respect marine resources, the researchers underline the need to avoid oversimplification and, also, consider (Beyerl, Putz, & Breckwoldt, 2016):

- Social and demographic factors and characteristics of the communities under study as well as their personal ambitions
- Knowledge and information among the members of the communities
- The impact of the communication strategies
- Bias and perceptions of the people with regard to management and use of marine resources
- Norms, values and ethics as well as attitudes
- The cultural factor

Next, the research of Gooch & Hobday (2013) examines the vulnerability of populations living in coastal settlements and / or dependent on the exploitation of marine resources for their survival and livelihood. This research used the method of quantitative research which was addressed to a sample of one hundred and forty five (145) fishermen and sixty two (62) travel agents regarding their estimates of the impact of natural disasters on vulnerable and non-vulnerable communities in tropical areas. Specifically, this research focused on the effects of tropical cyclones and floods on these populations.

The researchers explain that these extreme phenomena are due to climate change as well as the fact that small businesses that depend on tourism and fisheries are greatly affected. They also believe that these people should be involved in the decision-making process and that efforts should be made to tackle and reduce climate change as a whole so that there can be a substantial result. This clearly requires respect for and protection of the environment and marine resources, as well as research and information on the needs and challenges of populations affected by disrespect for marine resources (Gooch & Hobday, 2013). Therefore, the conclusions of Beyerl, Putz, & Breckwoldt (2016) and Gooch & Hobday (2013) are essentially consistent.

Further analyzing these issues, Ferse et al. (2010) refer to marine protected areas and examine which of the marine resource management strategies seems to be the most effective. Like Beyerl, Putz, & Breckwoldt (2016) and Gooch & Hobday (2013), they also emphasize the role of local communities and smaller groups of citizens who depend on the sea. More specifically, Ferse et al. (2010) showed that the combination of management methods related to classical management is more efficient than simply recognizing certain areas as protected. As, respectively, Gooch & Hobday (2013) recognized the lack of initiatives and the existence of effective methods to address the problems of mismanagement and lack of planning.

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Respectively, Srinivasan et al. (2010) explain that disrespect for marine resources leads to multifaceted problems of coastal and not only populations. The most important of the problems identified are food insecurity. Indeed, as widely explained in the present study, the lack of protection of these resources can directly affect human health and safety and cause food problems. This problem is more pronounced in areas that are dependent on fisheries and agriculture, although it is not limited to them, as is obvious, given that international trade is highly developed, as well as that the problems in a region of the planet cannot be limited solely to it.

The article by Forster, Lake, Watkinson & Gill (2014), which focuses on the example of Anguilla (Caribbean), is also more focused on coastal communities. Based on their research, it appears that these areas are very vulnerable due to pollution and due to the general problems related to the particular nature of the phenomena that occur in the region (earthquakes, cyclones etc) that are identified and which are related to climate change. Indeed, these areas are both very popular tourist destinations, so pollution is increased, and vulnerable due to the intense climatic phenomena that are observed. Also, their economy is developing and there are phenomena of poverty and inequality among their populations.

On the other hand, it is found that there is diversity both geological and geographical and social (cultural, cultural) between the different regions of the Caribbean. Thus, despite being at risk, the Caribbean as a whole is resilient, and its population appears to be in favor of measures to curb climate change and environmental disaster. The activism of the locals, the empowerment of the local communities and the information, seem to be possible solutions to the problems that are located in this area (Forster, Lake, Watkinson, & Gill, 2014).

The role of local communities is also focused on Thornton & Scheer, (2012) who consider it particularly important to take into account the views, opinions and information provided by locals (both experts and ordinary citizens) in relation to conservation. of marine resources. More specifically, in addition to the need for

empowerment and support highlighted above (Beyerl, Putz, & Breckwoldt, 2016; Dulal, Shah, & Ahmad, 2009; Ferse, Costa, Manez, Adhuri, & Glaser, 2010; Forster, Lake, Watkinson, & Gill, 2014; Gooch & Hobday, 2013), Thornton & Scheer (2012) note that local knowledge and tradition in relation to environmental phenomena, should be a source of knowledge for the scientific community.

2.2.3. Overfishing and disruption of the marine environment

Next, in an attempt to highlight the role and impact of overfishing on water quality and marine resources, one can study the article by Srinivasan et al. (2010) which examines the relationship between overfishing and the reduction of the quality of life of citizens living in coastal and island areas. The aforementioned researchers explain that, worldwide, there is a rapid increase in demand for raw materials and food. In fact, in developing regions, this need is linked to the goal of mass production of cheap raw materials and the exploitation of resources by both large companies and micro-producers (Srinivasan, Cheung, Watson, & Sumaila, 2010).

The researchers are also examining the role of large fishing units in the exclusive economic zones from 1950 to 2010, when this article was published. In particular, they find that not only is there overfishing in these areas at a rate of 36-66% over time, but, in fact, in many parts of the world, the catches are not even used and are discarded. The discharge of these derivatives is estimated at 77-93% for the year 2000. More specifically, this study shows that 77% of catches in North America, 81% in Europe and Africa, 86% in Asia, 87 % in Oceania, 89% in the High Seas and 93% in South America are discarded as "waste". Consequently, there is a waste of marine resources and problems are caused without even securing a profit for the citizens or without the fishing activities leading to any economic and social benefit (Srinivasan, Cheung, Watson, & Sumaila, 2010).

Following a similar argument, Möllmann & Diekmann (2012) explain that climate change, lack of respect for marine resources and overfishing combined lead to serious

problems. However, the reasons for such phenomena are complex. In particular, researchers attribute this situation, on the one hand, to the rapid increase in the birth rate in developing areas, especially in the 1980s and beyond, to pollution as well as the natural change of ecosystems. The main problem they identify, however, is the fact that, due to the lack of respect for marine resources and overfishing, not only indigenous peoples are affected but also the environment and human societies in general. This means that dealing with these problems becomes more difficult due to the fact that the problems are multiplying (Möllmann & Diekmann, 2012).

In addition, Möllmann & Diekmann (2012) find that these problems are persistent because no coordinated efforts are made to address them. As reported by many international organizations such as the World Bank (WB), the United Nations (UN) and the Organization for Economic Co-operation and Development (OECD), efforts are limited either nationally or regionally while private companies and large production units to break the law without consequences. This situation contributes to increasing environmental and climate problems (Lorenzen, Leber, & Blankenship, 2010; NOAA, 2020; OECD, 2020; UNESCO, 2020; WB, 2020).

In addition, as the researchers point out, climate change, combined with the natural occurrence of currents in the ocean, is actively affecting the environmental balance in other parts of the world. In particular, currents transport waste and toxic substances to various parts of the world and lead to the accumulation of plastics on the ocean floor even in areas that are significantly away from areas of intense industrial activity. In combination with overfishing, these phenomena can lead to significant losses in terms of biodiversity and protection of marine life (Möllmann & Diekmann, 2012).

Further analyzing the problems caused by overfishing, Purcell et al. (2013) explain how this phenomenon is related to mismanagement of resources and lack of planning. At the same time, it can be attributed to the inadequate efforts of international organizations and the governments of many countries to meet the challenge of maintaining sustainable development and environmental protection. More specifically, the researchers focus on a specific example, that of catching sea cucumbers, to explain the problems they find. Specifically, they emphasize that the main problems that are identified concern the following (Purcell, et al., 2013):

- In most cases, tropical fish and sea – creatures are not a popular food item so they tend to be less a “victim” of overfishing. However, when it comes to particular types of fish, there is over-exploitation, particularly for big companies that trade a specific type of fish.
- The species harvested are not always monitored and there is not always a respect of international guidelines as to when and to what extent they can be fished.
- Overfishing leads to long-term negative impact in marine mammals and fish as the decrease of biodiversity is high and there is a disruption in the food chain.

By further specifying specific examples, one can also study the article by Loh et al. (2015) relating to overfishing in the coral reefs of the Caribbean. In detail, the researchers say that, indeed, the risk to biodiversity is greater and less for human populations living in areas that are affected by overfishing and overexploitation of the natural environment. This is because protected areas, both on land and at sea, are typically sparsely populated and there is little contact between humans and fauna that is endemic to an area. However, the impact is, fundamentally, indirect, both when it comes to local populations as well as the global communities.

Having mentioned the above, it can also be noted that Loh et al. (2015) observe that overfishing may be related to the increase or decrease, on the one hand, of species in specific areas and, on the other hand, of the size of species in these areas. Indeed, if one considers the example of sponge farming in the Caribbean, one finds that a significant number of fish feed on sponges. In areas where fishing of sponge – eating fish was intense, the number of sponges on coral reefs increased by 25.6%, which, on the one hand, allows the exploitation of this species but, on the other hand, alters the character and chemical balance of coral reefs. This means that, even if the effects of a phenomenon are not immediately apparent in one case, they are likely to affect the biodiversity and composition of water in certain areas of the planet in the long run.

Coming, then, to potential solutions and management of the fisheries and the prevention of overfishing in general, Burgess, Polasky & Tilman, (2013), attempt to predict the impact of the phenomenon on the economic and environmental sector using a mathematical model. In their model, they assess, the impact of overfishing on particular species of fish by measuring their “vulnerability”. Therefore, they create an elaborate

formula that can be used by researchers to measure the various consequences of the lack of respect of marine resources in the long-term.

The main conclusions of Burgess, Polasky & Tilman (2013) include that one can predict the number of fish that will be under threat over time using early indicators. These indicators include, amongst others, their stock, the activities in a region and the demand of the species in the market. Therefore, it can be concluded that, fish that are, in general, numerous and are not widely used for production will not be in immediate risk or threat of either extinction or overfishing.

By the same token, Methot ,Jr., Tromble, Lambert & Greene (2014) discuss the possibility of predicting the course of fisheries economies and the possibility of implementing a management system that is, at the same time, sustainable, efficient and secure. More specifically, they begin their study by finding that, in the United States, there is a high degree of uncertainty about the future of large fishing units due to the fact that the state invests in the implementation of laws aimed at limiting overfishing.

The researchers also point out that while the Magnuson-Stevens Fishery Conservation and Management Act has been in force since 1976, no particular solution has been found to produce species that give maximize efficiency and ensure the profitability of businesses without compromising biodiversity or environmental safety. At the same time, the researchers point out that there are a variety of law enforcement strategies, but this should be the goal of all fisheries because otherwise, individual efforts can not lead to change (Methot Jr, Tromble, Lambert, & Greene, 2014).

Having discussed the above issues which are of great interest because they do not concern only one aspect of the analysis but its multiple dimensions, it is important, at this point, to make a presentation, analysis and synthesis of quantitative data in relation to the phenomena studied as and the reasons why one should respect marine resources. The next chapter deals with these issues and extracts quantitative data from a variety of sources.

Chapter 3- Research and study findings on the impact of ocean pollution at a global level

As mentioned in the introduction of this study, the main issue that this study attempts to approach concerns the importance of marine resource management in order to protect the environment and human life. In many parts of the world, environmental pollution and climate change are leading to desertification, extinction and economic damage. Water pollution, in fact, begins in the coastal zones, but is not limited to it, as it can come, among other things, from commercial activity, maritime transport and even from the extraction of mineral resources (European Marine Board, 2013).

A report on the reasons why all humans must take action to protect marine resources and minimize ocean / sea floor pollution and accumulation of debris, typically starts from a needs assessment. In order to discuss, then, at a larger extend, the main problems that arise due to the fact that the human health and wellbeing is impacted, the findings of the studies investigated are presented in the following section of the report.

3.1. Data on ocean pollution and management of marine resources

Examining these factors that impact the quality of water, fish and the air in coastal and island regions, and based on the available data and research, it turns out that, in fact, the problems that arise are particularly important. The following studies illustrate, then, the extend of the problem:

(1) Sea and ocean pollution – comparison between the 1990s and the 2000s

After the beginning of the new millennium, it has become increasingly more apparent that climate change is not a myth- instead is one of the most pressing issues that the planet is facing. The United Nations as well as other international and regional organizations, funding research and activities to tackle global pollution and reduce

global warming. However, the impact was not uniform across the various regions of the planet, particularly after the expansion of Asian markets (United Nations, 2020).

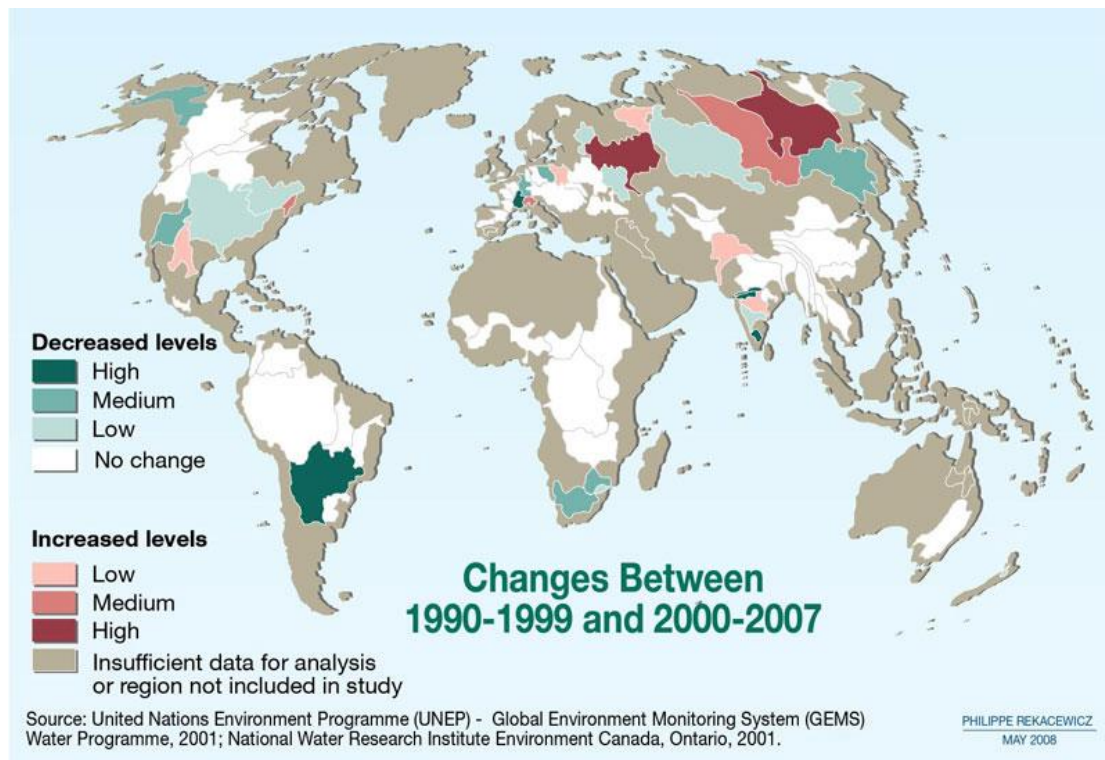


Figure 1, United Nations Map – Changes in Sea and Ocean pollution (1990-2007), (United Nations, 2020)

Based on the findings of the United Nations' report on Water Quality, it appears that the level of pollution on seabeds and the ocean / sea water in general is, at a global level and on average, increased. This increase can be translated to an increase of risk for the health of the global population. Indeed, the UN representatives argue that the main health problems associated with the increase of pollution, mainly in Asia, lead to (United Nations, 2020):

- decrease of water quality
- hormonal imbalances
- physical pain caused by diseases and illnesses
- increased levels of bacteria in the water

- lower quality of food and soil
- infectious diseases

Simultaneously, the UN (2020) pinpoint the need to take immediate action to reduce the amount of mismanaged waste, particularly in regions that are, already, most affected. However, it is also proven that in regions such as the Americas and Europe, the environmental programs applied as well as the measures to reduce climate change have a positive impact on the quality of water.

(2) The impact of plastic production and disposal to the marine resources and their quality

Richie and Roser (2018) showed in their research that various human activities lead to indirect and direct and indirect environmental burden as follows:

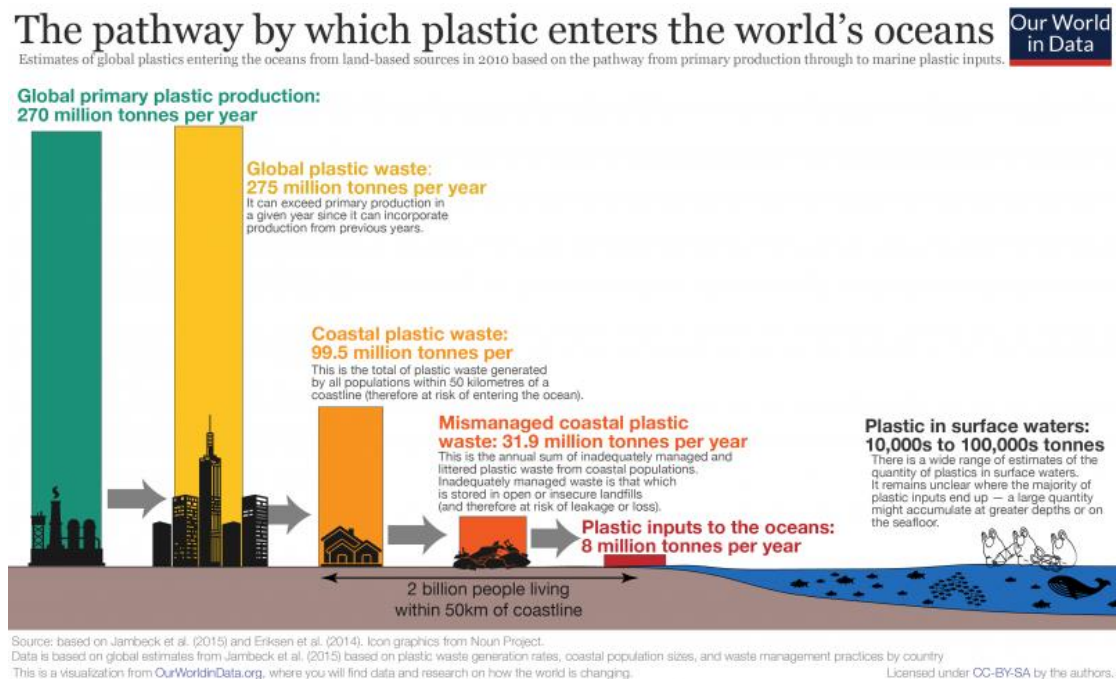


Figure 2, Explaining ocean pollution, (Ricchie & Roser, 2018)

As it is explained above, out of the 270 million tons of plastic produced at an annual basis, at least 10.000 tons and up to 100.000 tons will end up polluting the surface of the oceans, 31.9 tons will be mismanaged and led to the coastal regions and 8 million tons will end up in water sources (Ricchie & Roser, 2018).

This means that more than 2 billion people annually, those leaving in close proximity to the sea and the oceans, will be impacted by pollution caused by a singular material – plastic. It is also added that this plastic waste will directly impact the sea life and the quality of the sea water. As a result, both humans who consume the marine products as well as the fishermen and other professionals who depend on the sea and the marine – submarine products, will be impacted to a large extend as well (Fleming, et al., 2006; Ricchie & Roser, 2018).

(3) Accumulation of waste and debris

According to the study of Touali (2016), the world’s oceans are, to a large extend, polluted, with this pollution being caused, as the European Marine Board (2013) suggested, not only by industrial waste and human activity in the coastal regions only, but also, by the overall human activity at all levels. Indeed, the study illustrates that:

- (a) The European coasts are polluted, as there is debris accumulated in the sea floor of all the main European seas. In fact the debris accumulation is estimated as follows:

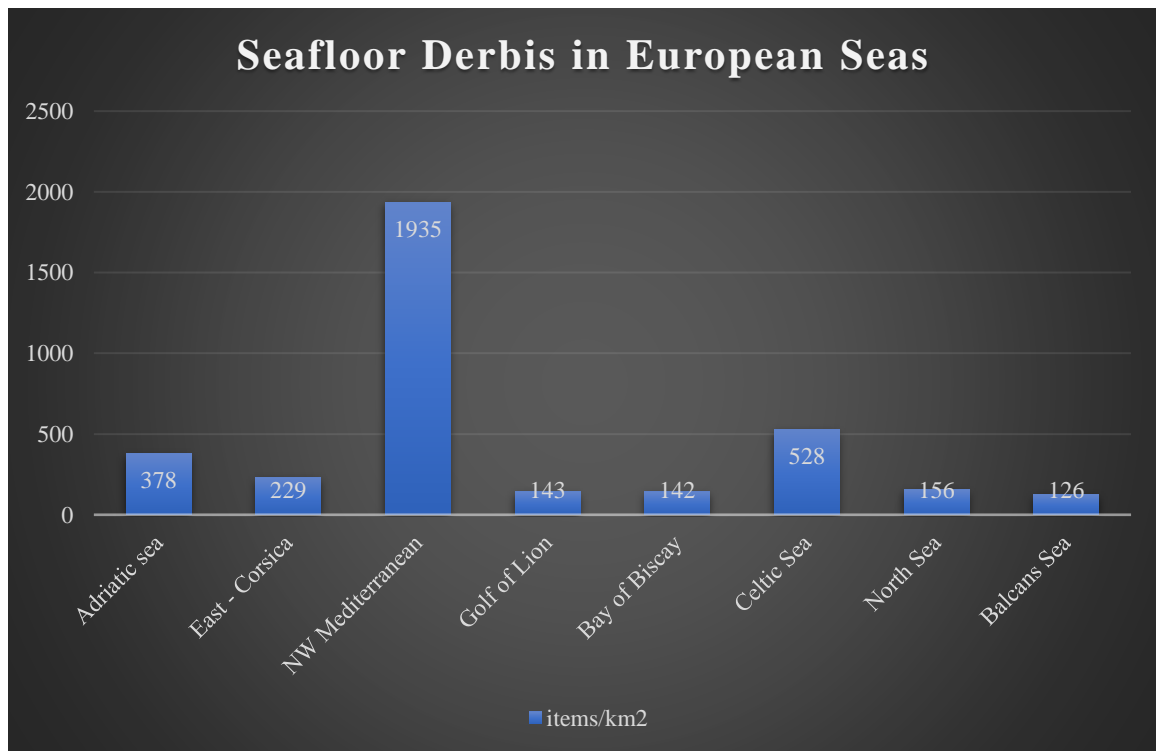


Figure 3, Seafloor Derbis in European Seas, (Greenpeace cited by Touali, 2016).

As it is seen above, the North – Western Mediterranean region is the most impacted by sea and seafloor pollution, with the density of objects per square kilometer being much higher (almost tenfold) in the North-Western Mediterranean than in seas such as the Balkan Sea, the North Sea, the Gulf of Lion and the Bay of Biscay. Therefore, it is found found that the populations of these areas are at a higher risk of pollution and adverse health effects due to the contamination of their food sources (Touali, 2016).

(4) Sources and reasons of pollution

Based on the findings of the aforementioned research and using data derived from the reports of the United Nations, Touali (2016) showed that the main source of ocean / sea pollution is the land runoff (44%) and airborne emissions (33%), while shipping spills (12%) and ocean dumping (12%) are less significant statistically. However, one needs to underline the fact that all the aforementioned sources of pollution cause long – term effects, as the waste accumulated in sea beds and the sea level are close to impossible to collect, recycle or dispose (European Marine Board, 2013; Fleming, et al., 2006; Ricchie & Roser, 2018; Touali, 2016).

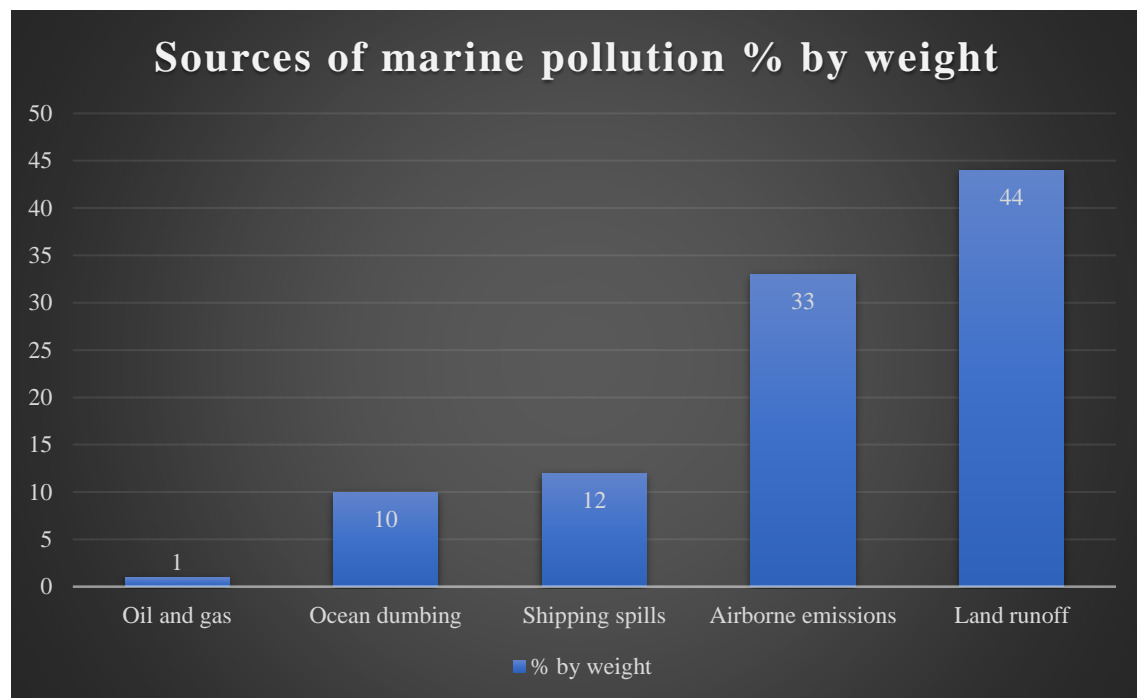


Figure 4. Sources of marine pollution (global level) (United Nations, cited by Touali, 2016).

(5) The countries that are responsible for the increased level of ocean / sea pollution are Asian countries (McCarthy, 2020). As McCarthy explained, regions that are a) closer to the main oceans (Atlantic, Pacific), b) producing using chemicals and plastic, c) densely populated and, d) mismanaging waste, are contributing to the increased accumulation of waste and debris on the sea floor (McCarthy, 2020):

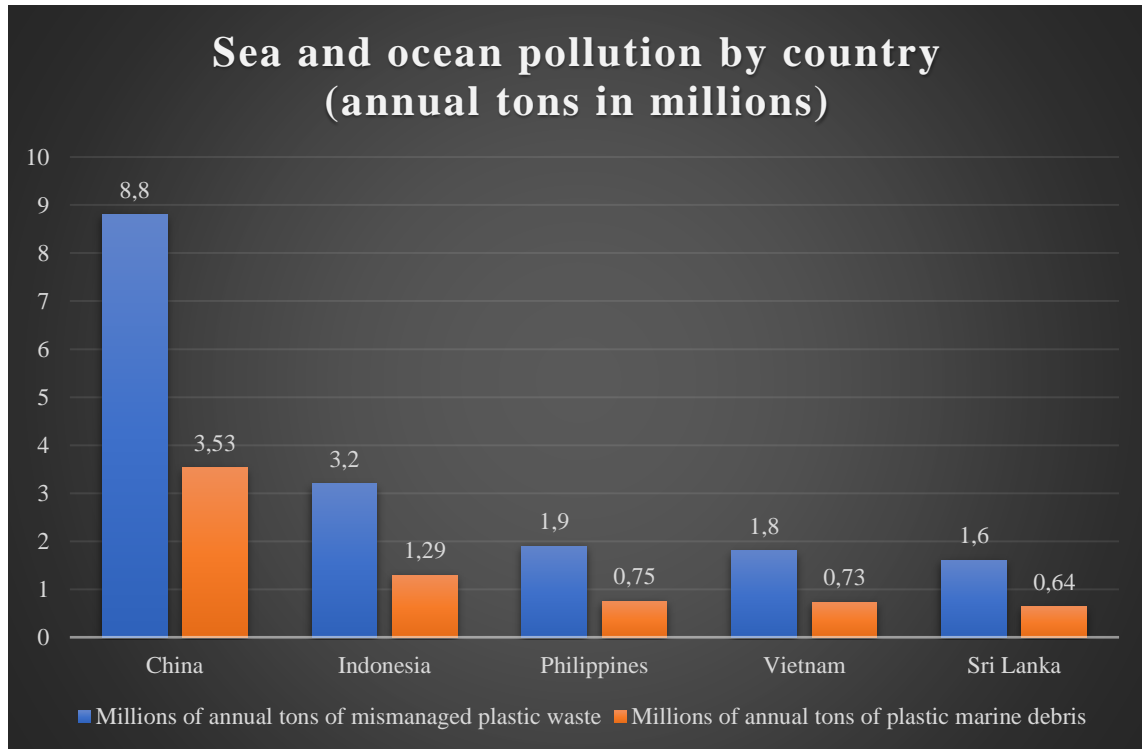


Figure 5, Annual waste by country (most polluting countries globally), (The Wall Street Journal cited in McCarthy, 2020).

As it is shown above, China is responsible for more the accumulation of an additional 3,53 million tons of waste at an annual level, followed by Indonesia (1,29 mil. Tons per year).

Based on data from the World Bank, as included also in the appendix of this paper, it appears that, in 2018, at a global level, dozens of fish species are under threat. In detail, the data has as such per country (WB, 2020):

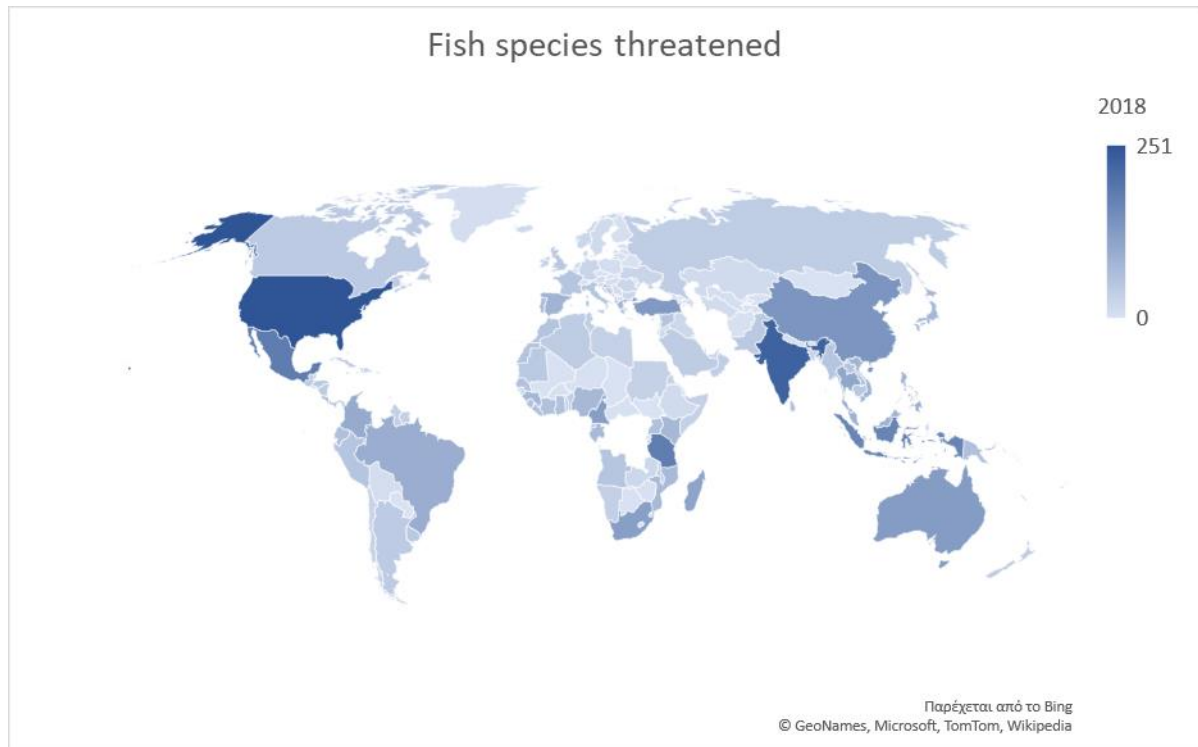


Figure 6, world bank data, endangered/threatened fish species, (WB, 2020)

As it is shown above, the USA and India are among the countries with the most intense problem with regard to the number of threatened fish species. Also, based on the aforementioned data, as they have been processed by the researcher, it is shown that, on average 38 fish species per country are threatened annually. This development is attributed to climate change, water pollution and increase of water debris level and density (WB, 2020).

Then, according to the Organization for Economic Co-operation and Development (OECD), pollution of the oceans and marine ecosystems is indeed a major challenge facing governments around the world. More specifically, based on the statistics provided by the OECD, it appears that the member countries primarily invest in the sustainability of the ocean economy (OECD, 2020).

The OECD data can be presented as follows (OECD, 2020):

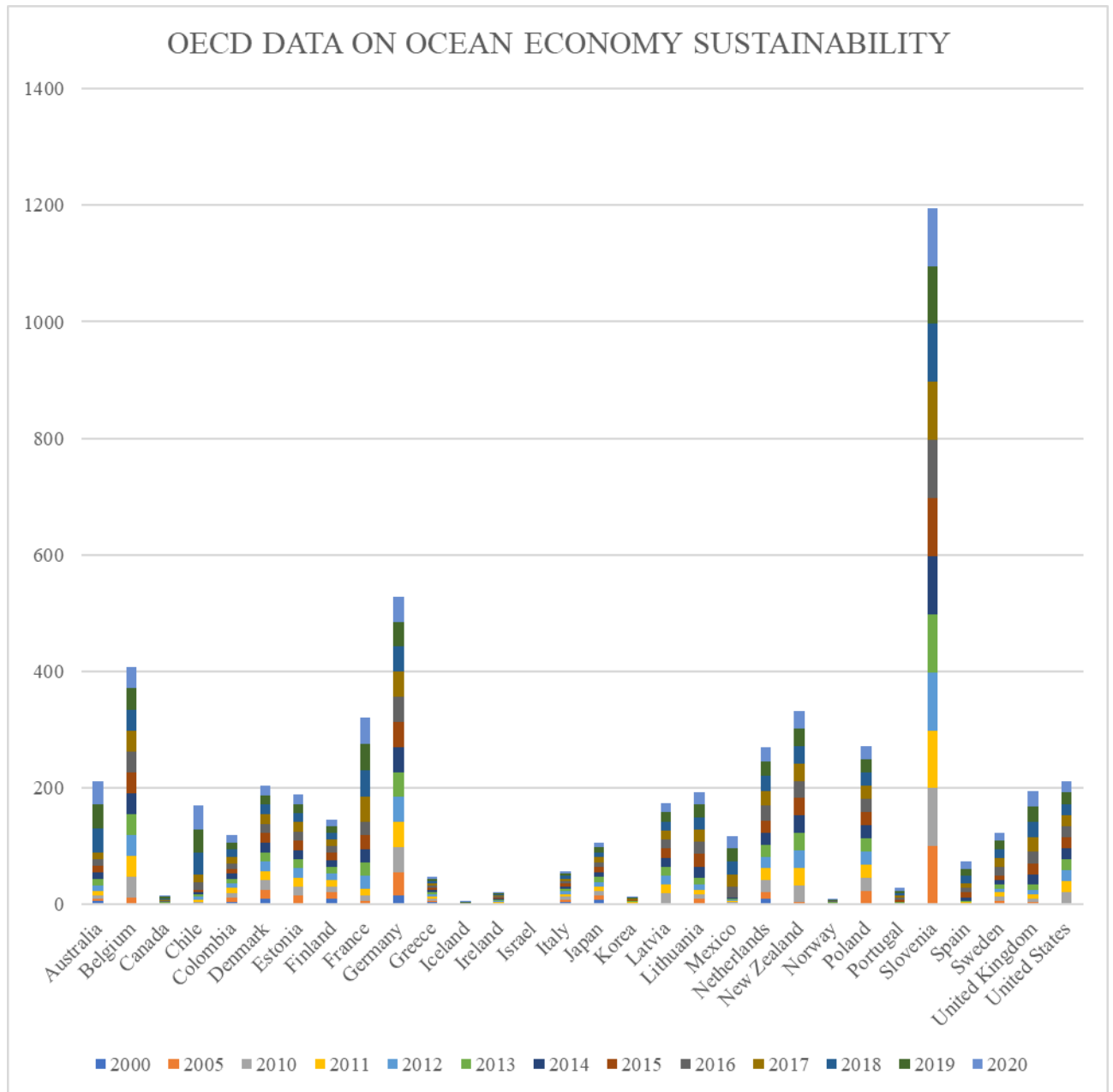


Figure 7, total number of protected marine areas per country, OECD, 2020.

More elaborately, one can compare the progress of the development of sustainable marine areas and protected marine areas amongst the regions. This way, the conclusions drawn can be more representative of the findings and provide the readers with a more clear image with regard to the actual process of the efforts to protect marine resources amongst the different countries of the world. .

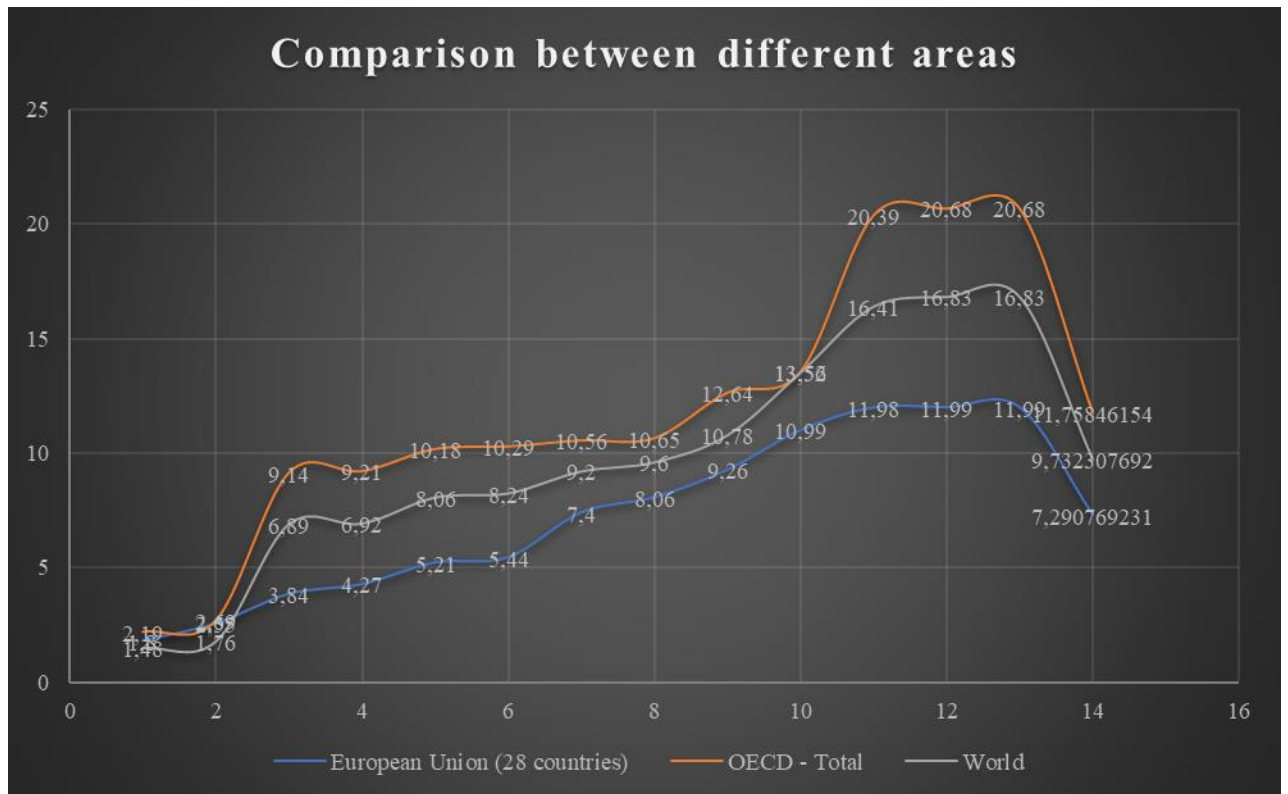


Figure 8, comparison between different areas of the world, OECD, 2020.

In detail, the findings have as such:

Table 1, presentation of OECD Data in tables with regard to marine protected areas.

Year	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average
European Union (28 countries)	1.48	1.76	3.84	4.27	5.21	5.44	7.4	8.06	9.26	10.99	11.99	11.99	11.99	7.29
OECD - Total	2.19	2.99	9.14	9.21	10.18	10.29	10.56	10.65	12.64	13.58	20.39	20.68	20.68	11.75
World	1.48	1.76	6.69	6.92	8.06	8.24	9.2	9.6	10.78	13.52	16.41	16.83	16.83	8.46

Indeed, one can conclude that, while during the 2000s the efforts of the countries have been actually limited to invest in sustainable marine areas, it was after 2016-2017 that they were intensified. Also, the following general conclusions can be drawn after processing the available data extracted from the official OECD website (OECD, 2020):

- On average, the various regions of the planet have 15 ocean protected zones.

- Compared to the year 2000 where only four (4) OECD member countries had more than ten (10) protected areas, in the year 2020, twenty two (22) of the thirty eight (38) countries surveyed had more than ten (10) protected areas.

Then, Greenpeace data on overfishing are recorded which can be directly combined with what is mentioned in the critical literature review. Starting with issues related to fishing and overfishing, Greenpeace studies show that the problem concerns the largest producing countries such as China. Over time, the problem of species exploitation and non-protection of marine resources has led the world to major problems with China sharing responsibility for the situation with other major Asian producers even though no country follows an excellent production model. In particular, Greenpeace reports note the following (Baxter, 2017):

- China is, to a very large degree, producing uncontrollably while the demand from the countries around the world, both the European Union as well as other regions, being equally relentless.
- China is the largest producer and exporter of fish and seafood in the last decade (2010-2020).
- Greenpeace studied fish “trash – samples” in twenty - two (22) ports in China. Out of the total sample, 44% of the fish were, in fact, edible. This means that the Chinese fish trade is, probably, contributing to overfishing and food-waste.

Then, one can emphasize on the impact of environmental policies of the EU. In particular, Transparency International has published a report on overfishing in the European Union, based on which it is shown that the member states of the Union have, in fact, taken important steps in reducing overfishing. In detail, the data has as such (EU & Bendel, 2016):

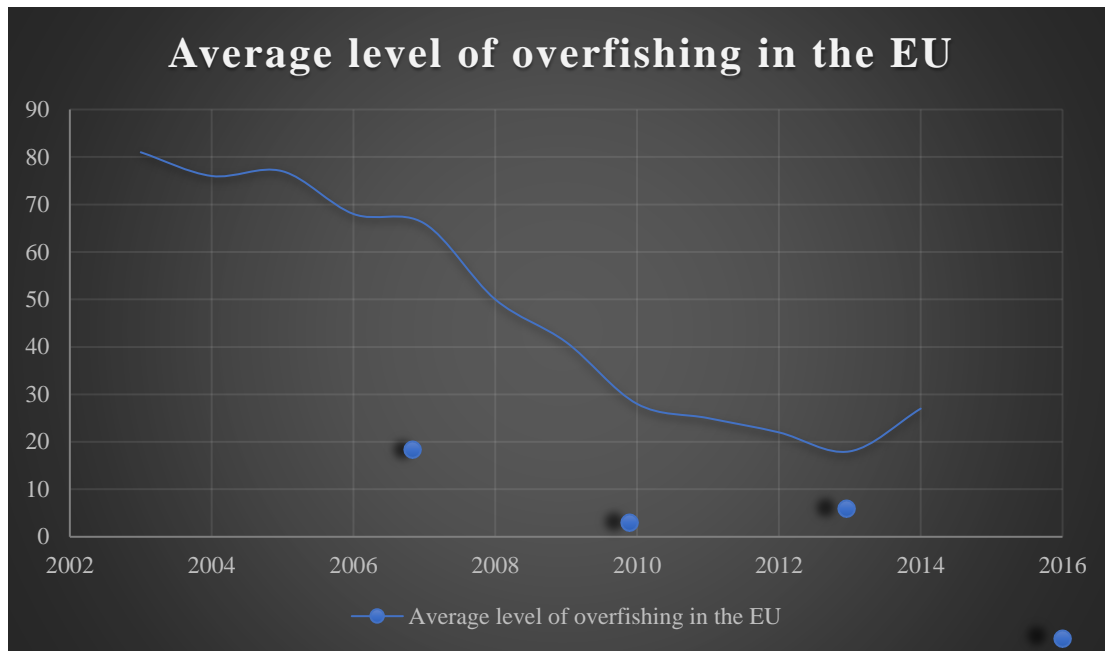


Figure 9, average level of overfishing in the EU, (EU & Bendel, 2016).

In detail, based on the aforementioned data, it appears that, from 2002-2007 the policies of the EU were not as targeted to reducing overfishing. However, after 2010, it appears that there was a measurable response of the European Countries with regard to reducing overfishing. On the other hand, it is also clear that, after 2013, there was a minor change in the level of overfishing (EU & Bendel, 2016).

Next, in the paper of Carpenter & Kleinjans (2016) one can discuss the extent to which countries overproduce and over-fish both in the EU and the United Kingdom (UK). In detail, in their paper, the researchers concluded on the following (Carpenter & Kleinjans, 2016):

- Ireland is the country in the EU that is more prone to overfishing and wasting seafood and fish (26%).
- The UK is, perhaps, the country that produces the most fish – seafood waste, as the country produces 18% excess waste, but their production is at least 2,3 times larger than that of Ireland.

In detail (Carpenter & Kleinjans, 2016):

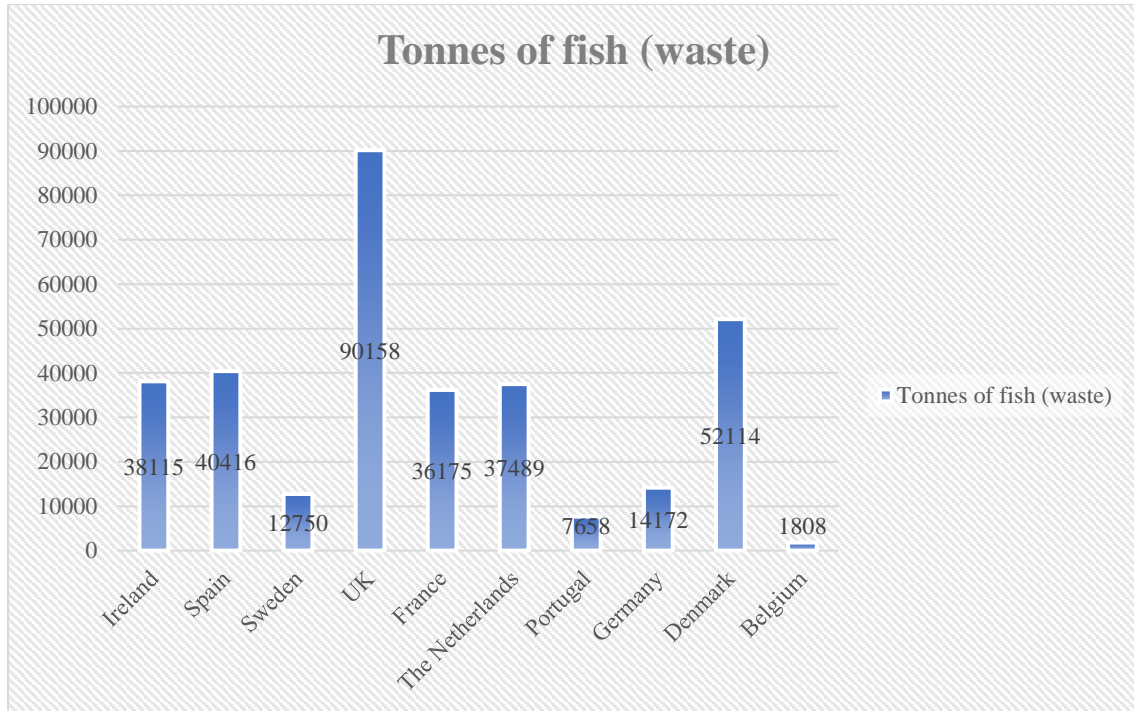


Figure 10, overfishing in tonnes in the EU, (Carpenter & Kleinjans, 2016)

And when it comes to the overall percentage of overfishing compared to the total sales of fish and seafood the image has as such (Carpenter & Kleinjans, 2016):

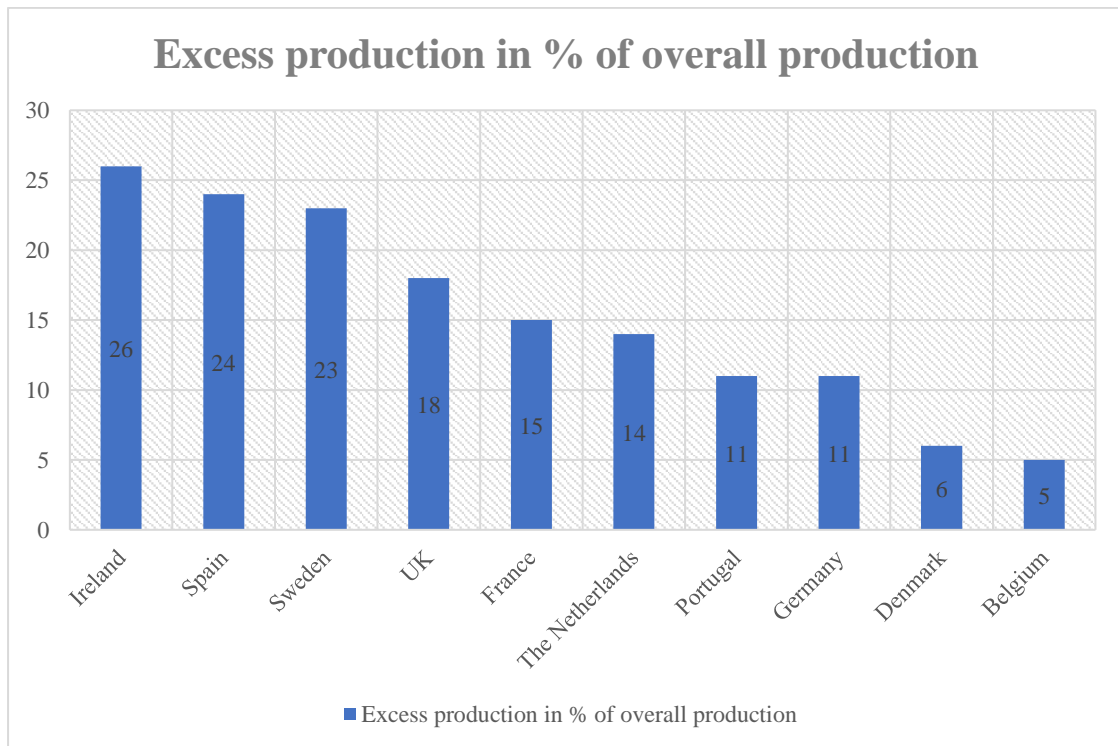


Figure 11, wastefulness of fish production in the EU, (Carpenter & Kleinjans, 2016)

Based on the findings of Caprenter & Kleinjans (2016), therefore, one can conclude that the main problem is not overfishing per se, but overfishing compared to the overall production of fish as well as the types of fish that are being fished. This can be discussed also with regard to the findings of the Systematic Literature review, where similar conclusions were drawn regarding how rare the species are and the degree to which they can be considered to be under threat (Avila, Kaschner, & Dormann, 2018; Burgess, Polasky, & Tilman, 2013; Coll & Libralato, 2012; Loh, McMurray, Henkel, Vicente, & Pawlik, 2015; Möllmann & Diekmann, 2012; WB, 2020).

3.2. Discussion of findings and synthesis of facts and data

The data presented above, illustrate that, as it has been hypothesized and suggested in the introduction of the present report, the increased levels of ocean and sea pollution have a severe impact on the health and quality of life of the population. Since the founding of the United Nations, a large number of issues and disputes among states with regard to the law of the sea have been resolved through negotiations and compromise. Among them, the international law addresses issues related to the protection of marine resources through the United Nations Convention on the Law of the Sea (UNCLOS) as well as bilateral and transnational conditions and agreements that define the framework for their management (United Nations, 2020). The formal issues concerning these agreements and acts relate to (Dolven, Kan, & Manyin, 2013; European Marine Board, 2013; Gürel, Mullen, & Tzimitras, 2013; United Nations, 2020; Young, 2009):

- Protecting the freedom of trade and free shipping
- Maintaining interstate peace and international security
- The application of international law in international waters
- The protection of marine resources and marine life
- Respect for borders and the right of peoples to self-determination
- The protection of the right to conduct submarine surveys and studies
- Crew protection
- The protection of coastal populations.

In addition, based on the study of Price (2001) the effects are more visible and are related to the exploitation of the sea, per se, and marine products. These are direct and indirect, especially for residents of coastal and island populations. Indeed, due to the fact that many coastal populations are housed near the coast, they are fed by fishing and survive through marine activity, marine environment disruption and infection, leading to serious losses for these individuals (Price, 2001). The most immediate are health problems due to infection and environmental changes, such as respiratory problems, skin infections and cancer (Fleming, et al., 2006)

However, up to this day, there are numerous agreements on the protection of the sea signed, and, yet, it is proven that the bilateral and multilateral agreements do not always lead to a full solution. Characteristically, Greece and Turkey are in open dispute about the Exclusive Economic Zone, whilst a vast number of countries compete about the exploitation of resources in areas such as the Northern Sea, the South China Sea or the Libyan Sea, and / or the North Sea, (Gürel, Mullen, & Tzimitras, 2013; Subba, 2019; Young, 2009).

At the same time, the protection of the international maritime activity and commerce, are amongst the most pressing issues of the agendas of organizations such as the United Nations (UN), the European Union (EU), the World Trade Organization (WTO) and the World Health Organization (WHO) (European Marine Board, 2013; Samonte-Tan, et al., 2007; Subba, 2019; United Nations, 2020; Young, 2009).

These organizations aim to create and implement a common framework for the protection of human and market rights, while at the same time not jeopardizing transnational relations. The great emphasis on these issues highlights the importance of good resource management and the need for immediate management of these problems together (Young, 2009). Additionally, due to the fact that the marine resources are of great importance for the survival of coastal populations, as mentioned above, and local restrictions on fishing, pollution and illegal mining are not sufficient, international efforts and actions are needed (Dolven, Kan, & Manyin, 2013). This means that, whilst specific regions take measures and action to tackle the problems and the impact of climate change and waste / pollution in the oceans, there is no consensus as to how and why the main challenges will be faced (United Nations, 2020).

Also, due to commercial exploitation with limited or no control in some areas, populations are deprived of access to species necessary for their livelihood, such as fish and seafood. Especially because many families in coastal and island areas are dependent on their fishing activity, these problems can lead to poverty, underemployment and unemployment (Price, 2001; Samonte-Tan, et al., 2007; Sherbinin, Carr, Cassels, & Jiang, 2007).

Thus, among the indirect problems, one can mention that the recession and limited access to resources also lead to social problems. In particular, both within the state itself and regionally and internationally, the affected population groups are likely to be groups at particular risk due to a lack of resources such as lack of access to health and education services. Such phenomena are apparent in the Caribbean and in South East Asia, among other coastal and island regions (Dulal, Shah, & Ahmad, 2009).

As the report of the European Marine Board (2013) suggests, also, the impact is even more apparent when one focuses on the effect of toxins and hazardous chemicals in the quality of seafood, fish and marine production in general. In detail, the waste and plastic accumulated in the oceans, alters the environment and the composition of the algae and the marine production.

Moreover, the report of EMB (2013) notes that the impact of radioactive and toxic waste is even more apparent in areas that are industrially active. In particular, Russia, Japan and China are among the regions that have suffered nuclear and chemical accidents and, therefore, the marine resources from these regions are amongst the most dangerous to consume. This finding confirms the suggestions and conclusions of McCarthy (2020) and Fleming et. al. (2006) who have raised similar questions and discussed the need for immediate action to limit the impact of the uncontrolled disposal of chemicals and toxic waste in water bodies (rivers and the sea).

On the other hand, whilst individuals, organizations and specific countries aim at leading the actions and programs to tackle climate change and manage waste, the lack of common action does not lead to enduring solutions. The debris accumulation is increasing and the activity of international companies transferring goods and products from one region to another means that the risk of pollution and disruption of the marine environment is apparent in all regions (Dulal, Shah, & Ahmad, 2009; Fleming, et al.,

2006; United Nations, 2020). Therefore, the risk is not localized and the fact that it does not directly affect the most advanced regions does not translate to a lack of motivation for people in the Americas or Europe to respect marine resources.

Further investigating data on the need to respect ocean and marine resources, one can discuss the findings of the National Oceanic and Atmospheric Administration (NOAA) of the US Department of Commerce, one can conclude that pollution and marine debris is a global problem. The impact of marine pollution seems to include the following (NOAA, 2020):

- Heavy metals and toxic materials disposed (often illegally) in the sea can cause severe impact on human and animal health, as they are consumed by fish and other sea animals and plants.
- Coastal pollution can cause further health problems to the populations residing at close proximity to the coastline.
- Pollution can lead to ocean acidification.
- Oil spills cause long-term impact on the quality of water and food.
- Ocean and coastal pollution worsen the situation with regard to climate change, often causing extreme weather phenomena.

Then, according to UNESCO, the impact of oceanic pollution is major and it is doubtful whether it could be limited or not. In detail, UNESCO in its “Blueprint for Ocean and Coastal Sustainability” mentions that the use of land-based resources and land-based production are responsible for over 80% of the ocean / marine pollution at a global level. At the same time, due to the increase of marine pollution, to this day, up to 500 dead zones have been created globally. The UN, then, estimate that, per square mile, one can locate over 46.000 pieces of plastic floating on the surface of the oceans. Simultaneously, UNESCO pinpoints the fact that, annually, around 10.000 sea animals and marine creatures die due to pollution, existence of plastic on the ocean floor and sea debris. The data appear to be concerning and underline the suggestion that marine resources and the oceans should be protected (UNESCO, 2020).

Above, the conclusions from the processing of primary OECD data were also reported and presented in the form of notes as well as tables. From this analysis, it can be underlined that the OECD Member States have significantly increased their efforts to

restore the balance of the ocean environment. The increase in protected areas around the world is, indeed, dramatic, as it reaches 5.5 times (OECD, 2020).

However, additional critical remarks can be drawn from these findings. Indeed, composing the data obtained throughout the research, one can point out that, probably, the reason why there are indeed significant efforts in the field of marine resource protection, is the recognition of the need to tackle climate change (Avila, Kaschner, & Dormann, 2018; Beyerl, Putz, & Breckwoldt, 2016; Dulal, Shah, & Ahmad, 2009; Ferse, Costa, Manez, Adhuri, & Glaser, 2010; Forster, Lake, Watkinson, & Gill, 2014; NOAA, 2020; OECD, 2020).

On the other hand, it is possible that there is such a strong need to reduce the impact of climate change because pollution is at such a high level that one should take immediate action to reduce the phenomenon. It is also possible that there will be a large increase in these efforts due to the activities and initiatives of the European Union in this area (European Marine Board, 2013). Whilst this could be the case based on the overall literature review, though, the data of OECD prove that the EU is close to the average globally and, in fact, is less active than the majority of the Latin American countries and the United States of America in the area (OECD, 2020).

However, in the opposite, a similar trend is observed in Latin America and the Caribbean, although the development is mainly located from 2016 onwards (OECD, 2020). In conclusion, it is noted that the reasons for which efforts are being made to widen the protection of marine resources are probably political, economic and social at the same time (Arrieta, Arnaud-Haond, & Duarte, 2010; Beyerl, Putz, & Breckwoldt, 2016; Dulal, Shah, & Ahmad, 2009; European Marine Board, 2013; Lorenzen, Leber, & Blankenship, 2010; McIlgorm, Campbell, & Rule, 2011; OECD, 2020; Planque, et al., 2010; Ricchie & Roser, 2018; United Nations, 2020).

Chapter 4- Conclusions

The importance of the protection of marine resources with the aim of a) environmental protection and b) human health has already been mentioned above. In reality, however, these two goals seem to be inextricably linked as climate change, environmental pollution, overfishing and over-exploitation directly affect the standard of living and development of these areas.

Indeed, areas where international maritime law is at stake and which are at risk from non-compliance with the law and legal provisions tend to be more exposed to environmental risks. In the Pacific and Atlantic Oceans, in particular, the lack of respect for marine ecosystems, overfishing, water pollution and ocean pollution, among other things, have caused significant problems for the local population (Samonte-Tan, et al., 2007).

The study also found that the effects of human resource abuse and activity, especially in areas with high industrial activity, put two billion people at immediate risk and indirectly the whole of humanity. The most serious of these effects are serious health problems, the immediate risk of poverty, the exacerbation of social inequalities and climate change (European Marine Board, 2013; Fleming, και συν., 2006; McCarthy, 2020; Price, 2001; Young, 2009).

On the other hand, this research shows that, although, indeed, humans are primarily responsible for the accumulation of debris on the surface, waters and bottom of the oceans, they are also the ones who can invest in finding solutions. From the whole literature review, in fact, it is concluded that local communities and ordinary citizens can make a decisive contribution to solving a variety of problems related to environmental pollution and lack of respect for marine resources (Arrieta, Arnaud-Haond, & Duarte, 2010; Coll & Libralato, 2012; Dulal, Shah, & Ahmad, 2009; Ferse, Costa, Manez, Adhuri, & Glaser, 2010; Forster, Lake, Watkinson, & Gill, 2014; Planque, και συν., 2010).

At the same time, it is established both theoretically and quantitatively that the concentration of plastic and toxic substances at the bottom of the oceans and seas is less related to the individual actions of citizens and more to the activities and actions of large industrial plants. Indeed, the intense industrialization of Asian countries, the use of cheap alternative raw materials and the disposal of industrial derivatives and waste are the main reasons for the deterioration of the quality of both drinking and seawater (European Marine Board, 2013; McCarthy, 2020; UNESCO, 2020).

Another important factor that contributes, though, to the loss of livelihood and can lead to important health risks for people is overfishing. As the data of the international organizations (EU, WB and OECD) show, overfishing can be related to (Avila, Kaschner, & Dormann, 2018; Dulal, Shah, & Ahmad, 2009; Forster, Lake, Watkinson, & Gill, 2014; Lorenzen, Leber, & Blankenship, 2010; Srinivasan, Cheung, Watson, & Sumaila, 2010):

- Disruption of the marine environment
- Poverty and social inequality
- Human health risks
- Local and regional disputes

Climate change is not expected to bring about a broader change in the way citizens live. Already, natural disasters caused by extreme weather are more common, especially in the Pacific and Atlantic. These changes will cause even more problems for the local population, and will affect global shipping (European Marine Board, 2013). Suggestions for reducing these problems, based on all that has been said and based on the personal critique and reflections that can be made at this point, are as follows:

- Immediate measures to control waste management methods by large industrial plants
- Control of the activity of ships and maritime transport for the immediate reduction of the pollution from the leakage of fuel and the disposal of waste at sea
- Taking specific actions to resolve issues related to international law and affect the situation worldwide

- Strengthening the existing programs and increasing the controls with an emphasis on water quality and chemical composition in areas where intense fishing activity occurs
- Training and information of the inhabitants of the coastal areas.

Finally, in this study, it was found that the need for decision-making and immediate measures to reduce water pollution and the lack of initiatives for immediate waste management is pressing. In just one decade, according to the United Nations, the levels of infection have seriously deteriorated in the already burdened areas, namely Southeast Asia, and have decreased in the areas where measures are being taken. This finding leads to the conclusion that change and improvement of the situation is possible.

References and bibliographic sources

1. Anton, D., & Shelton, D. (2011). Law and the Environment. In *Environmental protection and human rights* (pp. 1-16). Cambridge University Press. Retrieved from https://scholarship.law.gwu.edu/cgi/viewcontent.cgi?article=1297&context=faculty_publications
2. Arrieta, J. M., Arnaud-Haond, S., & Duarte, C. M. (2010). What lies underneath: conserving the oceans' genetic resources. *Proceedings of the National Academy of Sciences*, *107*(43), pp. 18318-18324.
3. Avila, I. C., Kaschner, K., & Dormann, C. F. (2018). Current global risks to marine mammals: Taking stock of the threats. *Biological Conservation*, *221*, pp. 44-58.
4. Baxter, T. (2017, November 6). China has a big overfishing problem. <https://www.greenpeace.org/eastasia/blog/1370/china-has-a-big-overfishing-problem/>.
5. Beyerl, K., Putz, O., & Breckwoldt, A. (2016). The role of perceptions for community-based marine resource management. *Frontiers in Marine Science*, *3*.
6. Burgess, M. G., Polasky, S., & Tilman, D. (2013). Predicting overfishing and extinction threats in multispecies fisheries. *Proceedings of the National Academy of Sciences*, *110*(40), pp. 15943-15948.
7. Carpenter, G., & Kleinjans, R. (2016). Landing the blame: Overfishing in the Northeast Atlantic 2016 . https://www.researchgate.net/publication/297001324_Landing_the_blame_Overfishing_in_the_Northeast_Atlantic_2016.
8. Coll, M., & Libralato, S. (2012). Contributions of food web modelling to the ecosystem approach to marine resource management in the Mediterranean Sea. *Fish and fisheries*, *13*(1), pp. 60-88.

9. Dolven, B., Kan, S., & Manyin, M. (2013). Maritime Territorial Disputes in East Asia: Issues for Congress. *Congressional Research Service*. Retrieved from http://www.dragon-report.com/Dragon_Report/KR_files/R42930.pdf
10. Dulal, H., Shah, K., & Ahmad, N. (2009). Social equity considerations in the implementation of Caribbean climate change adaptation policies. *Sustainability*, *1*(3), pp. 363-383. Retrieved from <https://www.mdpi.com/2071-1050/1/3/363/pdf>
11. EU, T., & Bendel, Y. (2016, May 26). How can we make council negotiations on fishing quotas more transparent? <https://transparency.eu/catch-22-how-can-we-make-council-negotiations-on-fishing-quotas-more-transparent/>.
12. European Marine Board. (2013). Linking Oceans and Human Health - A strategic priority for Europe. *Position Paper 19*. Retrieved from <https://marineboard.eu/publication/linking-oceans-and-human-health-strategic-research-priority-europe>
13. Ferse, S. C., Costa, M. M., Manez, K. S., Adhuri, D. S., & Glaser, M. (2010). Allies, not aliens: increasing the role of local communities in marine protected area implementation. *Environmental Conservation*, pp. 23-34.
14. Fleming, L., Broad, K., Clement, A., Dewally, E., Elmir, S., Knap, A., . . . Walsh, P. (2006). Oceans and human health: Emerging public health risks in the marine environment. *Marine pollution bulletin*, *53*(10-12), pp. 545-560. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2573863/>
15. Forster, J., Lake, I. R., Watkinson, A. R., & Gill, J. A. (2014). Marine dependent livelihoods and resilience to environmental change: A case study of Anguilla. *Marine Policy*, *45*, pp. 204-212.
16. Gooch, M., & Hobday, A. (2013). Social vulnerability of marine resource users to extreme weather events. *Ecosystems*, *16*(5), pp. 797-809.
17. Gürel, A., Mullen, F., & Tzimitras, H. (2013). The Cyprus hydrocarbons issue: Context, positions and future scenarios. *Oslo: Peace Research Institute Oslo (PRIO)*. Retrieved from <https://www.files.ethz.ch/isn/172873/Report%202013-1%20Hydrocarbons.pdf>

18. Klepp, S. (2011). A double bind: Malta and the rescue of unwanted migrants at sea, a legal anthropological perspective on the humanitarian law of the sea. *International Journal of Refugee Law*, 23(3), pp. 538-557. Retrieved from shorturl.at/ixCE1
19. Loh, T. L., McMurray, S. E., Henkel, T. P., Vicente, J., & Pawlik, J. R. (2015). Indirect effects of overfishing on Caribbean reefs: sponges overgrow reef-building corals. *PeerJ*, 3.
20. Lorenzen, K., Leber, K. M., & Blankenship, H. L. (2010). Responsible approach to marine stock enhancement: an update. *Reviews in Fisheries Science*, 18(2), pp. 189-210.
21. McCarthy, N. (2020). The Countries Polluting The Oceans The Most . *Statista*, <https://www.statista.com/chart/12211/the-countries-polluting-the-oceans-the-most/>.
22. McIlgorm, A., Campbell, H. F., & Rule, M. J. (2011). The economic cost and control of marine debris damage in the Asia-Pacific region. *Ocean & Coastal Management*, 54(9), pp. 643-651.
23. Methot Jr, R. D., Tromble, G. R., Lambert, D. M., & Greene, K. E. (2014). Implementing a science-based system for preventing overfishing and guiding sustainable fisheries in the United States. *ICES Journal of Marine Science*, 71(2), pp. 183-194.
24. Möllmann, C., & Diekmann, R. (2012). Marine ecosystem regime shifts induced by climate and overfishing: a review for the Northern Hemisphere. In *Advances in ecological research (Vol. 47)* (pp. 303-347). Academic Press.
25. NOAA. (2020). Ocean Pollution. *National Oceanic and Atmospheric Administration (NOAA) of the US Department of Commerce*. Retrieved from <https://www.noaa.gov/education/resource-collections/ocean-coasts/ocean-pollution>
26. OECD. (2020). Sustainable Ocean Economy. *Organization for Economic Co-operation and Development*, <https://stats.oecd.org/index.aspx?datasetcode=OCEAN>.

27. Planque, B., Fromentin, J. M., Cury, P., Drinkwater, K. F., Jennings, S., Perry, R. I., & Kifani, S. (2010). How does fishing alter marine populations and ecosystems sensitivity to climate? *Journal of Marine Systems*, 79(3-4), pp. 403-417.
28. Price, A. (2001). The marine food chain in relation to biodiversity. *The Scientific World Journal*, 1, pp. 579-587. Retrieved from <http://downloads.hindawi.com/journals/tswj/2001/713693.pdf>
29. Purcell, S. W., Mercier, A., Conand, C., Hamel, J. F., Toral-Granda, M. V., Lovatelli, A., & Uthicke, S. (2013). Sea cucumber fisheries: global analysis of stocks, management measures and drivers of overfishing. *Fish and fisheries*, 14(1), pp. 34-59.
30. Ricchie, H., & Roser, M. (2018). Plastic Pollution . <https://ourworldindata.org/plastic-pollution>.
31. Samonte-Tan, G., White, A., Tercero, M., Diviva, J., Caballes, C., & Caballes, C. (2007). Economic valuation of coastal and marine resources: Bohol Marine Triangle, Philippines. *Coastal Management*, 35(2-3), pp. 319-338. Retrieved from shorturl.at/djps3
32. Sherbinin, A., Carr, D., Cassels, S., & Jiang, L. (2007). Population and environment. *Annual Review of Environmental Resources* (32), pp. 345-373. Retrieved from <https://www.annualreviews.org/doi/pdf/10.1146/annurev.energy.32.041306.100243>
33. Srinivasan, U. T., Cheung, W. W., Watson, R., & Sumaila, U. R. (2010). Food security implications of global marine catch losses due to overfishing. *Journal of Bioeconomics*, 12(3), pp. 183-200.
34. Subba, G. (2019). International Court of Justice Judgment Over the South China Sea Dispute (Doctoral dissertation). <http://14.139.206.50:8080/jspui/bitstream/1/6119/1/Ganesh%20Subba.pdf>.

35. Thornton, T. F., & Scheer, A. M. (2012). Collaborative engagement of local and traditional knowledge and science in marine environments: a review. *Ecology and Society*, 17(3).
36. Touali, Y. (2016). Marine Debris Dispersion by Tidal Flow in Orkney Waters: Hydrodynamic Model Using DELFT3D - PART. *ICIT*. Retrieved from shorturl.at/jxHIJ
37. UNESCO. (2020). Blueprint for the future we want - Focus area- Oceans. <http://www.unesco.org/new/en/natural-sciences/ioc-oceans/focus-areas/rio-20-ocean/blueprint-for-the-future-we-want/marine-pollution/facts-and-figures-on-marine-pollution/>.
38. United Nations. (2020). United Nations Convention on the Law of the Sea of 10 December 1982. https://www.un.org/depts/los/convention_agreements/convention_overview_convention.htm.
39. United Nations. (2020). Water quality. <https://www.un.org/waterforlifedecade/quality.shtml>.
40. WB. (2020). Fish Species, Threatened. [https://databank.worldbank.org/reports.aspx?source=2&series=EN.FSH.THRED.NO&country=.](https://databank.worldbank.org/reports.aspx?source=2&series=EN.FSH.THRED.NO&country=)
41. Wegge, N. (2015). The emerging politics of the Arctic Ocean. Future management of the living marine resources. *Marine Policy*, 51, pp. 331-338.
42. Young, M. (2009). Fragmentation or interaction: the WTO, fisheries subsidies, and international law. *World Trade Rev.*, 8, pp. 477-515. Retrieved from https://minerva-access.unimelb.edu.au/bitstream/handle/11343/33005/297147_Young_fragmentation.pdf

Appendix

Country Name	2018 [YR2018]
Afghanistan	4
Albania	44
Algeria	41
American Samoa	12
Andorra	0
Angola	53
Antigua and Barbuda	31
Argentina	42
Armenia	3
Aruba	24
Australia	125
Austria	11
Azerbaijan	14
Bahamas, The	43
Bahrain	14
Bangladesh	29
Barbados	29
Belarus	2
Belgium	13
Belize	45
Benin	40
Bermuda	27
Bhutan	3
Bolivia	8
Bosnia and Herzegovina	36
Botswana	2
Brazil	93
British Virgin Islands	31
Brunei Darussalam	14
Bulgaria	22
Burkina Faso	4
Burundi	17
Cabo Verde	35
Cambodia	48
Cameroon	122

Canada	44
Cayman Islands	31
Central African Republic	3
Chad	1
Channel Islands	..
Chile	27
China	136
Colombia	99
Comoros	11
Congo, Dem. Rep.	94
Congo, Rep.	57
Costa Rica	64
Cote d'Ivoire	59
Croatia	64
Cuba	44
Curacao	28
Cyprus	24
Czech Republic	2
Denmark	18
Djibouti	23
Dominica	31
Dominican Republic	29
Ecuador	61
Egypt, Arab Rep.	58
El Salvador	17
Equatorial Guinea	44
Eritrea	29
Estonia	5
Eswatini	5
Ethiopia	14
Faroe Islands	13
Fiji	20
Finland	6
France	53
French Polynesia	28
Gabon	72
Gambia, The	35
Georgia	11
Germany	24
Ghana	58

Gibraltar	18
Greece	80
Greenland	9
Grenada	29
Guam	14
Guatemala	41
Guinea	76
Guinea-Bissau	41
Guyana	33
Haiti	30
Honduras	45
Hong Kong SAR, China	15
Hungary	9
Iceland	16
India	227
Indonesia	166
Iran, Islamic Rep.	47
Iraq	19
Ireland	28
Isle of Man	2
Israel	50
Italy	52
Jamaica	30
Japan	77
Jordan	20
Kazakhstan	14
Kenya	74
Kiribati	14
Korea, Dem. People's Rep.	20
Korea, Rep.	28
Kosovo	..
Kuwait	18
Kyrgyz Republic	3
Lao PDR	55
Latvia	6
Lebanon	28
Lesotho	1
Liberia	64
Libya	32
Liechtenstein	0

Lithuania	6
Luxembourg	1
Macao SAR, China	9
Madagascar	111
Malawi	36
Malaysia	87
Maldives	24
Mali	2
Malta	22
Marshall Islands	18
Mauritania	45
Mauritius	21
Mexico	181
Micronesia, Fed. Sts.	25
Moldova	8
Monaco	15
Mongolia	2
Montenegro	32
Morocco	54
Mozambique	72
Myanmar	53
Namibia	33
Nauru	11
Nepal	7
Netherlands	15
New Caledonia	37
New Zealand	38
Nicaragua	40
Niger	4
Nigeria	74
North Macedonia	13
Northern Mariana Islands	14
Norway	23
Oman	36
Pakistan	46
Palau	21
Panama	57
Papua New Guinea	61
Paraguay	0
Peru	52

Philippines	91
Poland	8
Portugal	67
Puerto Rico	32
Qatar	17
Romania	22
Russian Federation	39
Rwanda	7
Samoa	16
San Marino	0
Sao Tome and Principe	25
Saudi Arabia	41
Senegal	58
Serbia	15
Seychelles	24
Sierra Leone	57
Singapore	29
Sint Maarten (Dutch part)	31
Slovak Republic	5
Slovenia	33
Solomon Islands	24
Somalia	31
South Africa	121
South Sudan	0
Spain	83
Sri Lanka	57
St. Kitts and Nevis	30
St. Lucia	30
St. Martin (French part)	31
St. Vincent and the Grenadines	29
Sudan	32
Suriname	32
Sweden	15
Switzerland	9
Syrian Arab Republic	51
Tajikistan	5
Tanzania	179
Thailand	106
Timor-Leste	13
Togo	38

Tonga	16
Trinidad and Tobago	37
Tunisia	39
Turkey	131
Turkmenistan	13
Turks and Caicos Islands	30
Tuvalu	13
Uganda	60
Ukraine	24
United Arab Emirates	20
United Kingdom	48
United States	251
Uruguay	45
Uzbekistan	7
Vanuatu	18
Venezuela, RB	45
Vietnam	83
Virgin Islands (U.S.)	29
West Bank and Gaza	2
Yemen, Rep.	40
Zambia	20
Zimbabwe	3

Table 21, World Bank Data on Fish Species, Threatened. (WB, 2020), year 2018.