ecomarine

ecomarine-project.eu
facebook.com/Ecomarine.project
twitter.com/ecomarine_

D 1.3. National and EU Legislation for the Protection of the Marine Environment

Co-funded by the Erasmus+ Programme of the European Union

619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

PROJECT INFORMATION

Project Acronym	EcoMarine
Project title	Building a Comprehensive Mechanism for Preserving Marine Ecosystems and Life from the negative consequences of Climate Change and the disposal of Plastic Debris
Agreement number	619158-EPP-1-2020-1-CY-EPPKA2-CBHE-JP
EU programme	Capacity Building for Higher Education (EAC/A02-2019-CBHE)
Project website	www.ecomarine-project.eu

PREPARED BY

Organization	Universiti Malaysia Terengganu (Malaysia) Universiti Kebangsaan Malaysia (Malaysia) Andhra University (India) Adarsh Foundation (India) Universidad De Oviedo (Spain)
Authors	Kesaven Bhubalan (UMT) Fredolin Tanggang (UKM) Simple Doshi (SAL) Janakiram Pasupuleti (AU) José Luis Acuña (Uniovi) Yaisel J. Borrell (Uniovi)
Date	13 May 2021
Version	V 2.0
Dissemination Level	Restricted to other E+ Programme participants (including EACEA, Commission services and project reviewers)

Reviewed by	**Dr Georgios Georgiou**
Date of Review	
Acceptance level	Accepted ☐ To be reviewed ☐ Rejected ☐

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Table of Contents

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

1. Executive Summary

This report provides detailed information about the existing legislation for the protection of marine ecosystems in the EU and the Partner countries (Malaysia and India). It focus on various aspects of marine ecosystems protection (protected species, protected habitats, management measures and conservation schemes), fisheries and fish stock management, as well as measures that relate to the management and prevention of plastic debris at sea. The legislation analysis reveals that conservation bodies and laws are similar in the EU countries, in India and in Malaysia. All of them are aligned with international conventions such as UNCLOS, ISA, IMO, MARPOL, UNEP, IOC, RAMSAR, CITES and others. In this regard, many of the conservation targets and approaches are shared by all countries, especially the need to reconcile conservation, ecology, economy and society, following the Agenda 21.

In the EU, the main instrument to manage Marine Ecosystems is the Marine Strategy Framework Directive (MSFD), which aligns the objectives and approaches of other Directives and policies such as the Water Framework Directive (WFD), the Environmental Quality Standards Directive in the field of water policy (EQS), the Bird Directive (BD), the Habitats Directive (HD) or the Common Fisheries Policy (CFP) among others. The MSFD is a supranational Ecosystem Management framework based on objectives-monitoring-assessment-objectives cycles. It is aimed at achieving "Good Environmental Status", an objective, operational definition of a sustainable, resilient and productive ocean based on 11 main descriptors. It is suggested that countries like Malaysia and India can adopt a framework similar to MSFD in order to strive for a better, quantitative definition of the "good environmental status" and thresholds, a more effective, less complex management, more connected with models and monitoring programs. These would ensure a framework which is more integrated across national and regional scales and more transparent and accessible.

According to the 2020 Assessment of its first implementation cycle in the EU, the MSFD has achieved a holistic framework for the management of European marine ecosystems, has expanded research and management to address poorly known stressors (i.e. marine litter and underwater noise), has increased ocean literacy, awareness and public involvement and has fostered regional and international cooperation. Despite this, the MSFD will need to reach a more coherent and ambitious determination of 'good environmental status', a simplified, streamlined and effective implementation of measures, a greater policy integration, a more effective regional cooperation and will have to ensure better data availability and comparability. The ECOMARINE initiative could contribute 1) to develop a common monitoring framework that will help to test, and to implement in partner countries, the "Good Environmental Status" strategy and 2) to prepare an action plan that

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

helps to achieve a more effective Ocean Literacy strategy, not only for partner countries, but also for EU participants.

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

2. Policies, laws and regulations governing the marine ecosystem in the European Union

2.1. Introduction.

The European Union (EU) is a political and social union of Member States with a population of 447 million (Table 1). There are 106 cm of coastline per inhabitant in the EU, which is similar to that of Malaysia, but some 27 times that of India. The difference increases when looking at the Exclusive Economic Zone surface per capita, which is five times that of Malaysia and 29 times that of India. This difference is largely due to overseas territories inherited from a colonial past. On top of that, EU vessels operate in international waters worldwide, and in national waters trough agreements (for example, in Africa). The benefit of those agreements for non-EU nations is debatable (Kaczynski et al., 2002). These rough figures point to a milder human impact on the ocean in EU and Malaysia than in India, although this also depends on the economic and social structure of each country.

Table 1. Population of the European Union, as compared to that of Malaysia and India (Exclusive Economic Zone Areas and coast lengths are approximate).

	population	population density	coast length	coast length per capita	EEZ surface	EEZ surface per capita
	millions	population/Km2	Km	cm	Km^2	m^2
India	1353	411	7516	0,6	2305143	17
Malaysia	33	92	4675	14,3	334671	102
European Union	448	106	68000	15,2	22000000	491

The WISE data portal (https://water.europa.eu/marine) offers updated information on the current situation of EU marine ecosystems. According to the Marine Strategy Framework Directive, there is good status in 25 % of the EU seabed, 7 % of coastal fish stocks, 5 % of pelagic fish stocks, 3 % of cephalopod stocks, 10% of coastal ecosystems, 22 % of shelf ecosystems, 3 % of small-toothed cetacean populations, 8% of deep-diving toothed cetaceans, 15 % of baleen whales, 18% seals, 7% of pelagic ecosystems, 43 % of grazing birds, 8 % of wading birds, 18 % of surface-feeding birds, 29 % of pelagic-feeding birds, 7 % of benthic-feeding birds and 12 % turtle populations. The rest is either in recovery with different estimations for the time to reach Good Environmental Status, or unassessed. The EU Blue Economy had a turnover of €750 billion and supported 5 million jobs in 2018 (European

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-I-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Commission, 2020), with an ambitious "EU Blue Growth Strategy" to sustainably harness the potential of the oceans. As in any other country in the world, EU marine ecosystems are threatened by climate change, unsustainable fish and shellfish exploitation, contamination, eutrophication, adverse hydrographical conditions, marine litter, non-indigenous species physical loss and disturbance of the seabed underwater noise and other forms of energy input. Each of those pressure sources vary in their effects and magnitude depending on the region or sub-region.

Each Member State in the EU has national and regional legislations for the protection and sustainable use of marine ecosystems. The description of those internal policies case by case is impractical in this report. At the EU level, protection of Marine Ecosystems is mainly addressed by the Marine Strategy Framework Directive (**MSFD**), which overlaps and envelopes other legislation also affecting marine ecosystems (Table 2). EU Directives are legislative acts that set out goals that all EU countries must achieve. However, it is up to the individual countries to devise their own laws on how to reach these goals. Implementation is done through recursive management cycles that require monitoring progress towards those goals. In this context, marine monitoring is the systematic, spatially and temporally planned measurement of parameters of the marine environment to assess whether it evolves towards a desired state and to guide management towards achieving such state (Zampoukas et al., 2013). EU reglaments are based on and inspired by International Regional Conventions, such as the Commission for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), the Baltic Marine Environment Protection Commission (HELCOM), the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (the Barcelona Convention) or the Convention on the Protection of the Black Sea against Pollution (the Bucharest Convention). They are also based on international bodies and treaties like the United Nations Convention on the Law of the Sea (UNCLOS), the International Seabed Authority (ISA), the International Maritime Organization (IMO), the North East Atlantic Fisheries Convention (NEAFC), the International Convention for the Prevention of Pollution from Ships (MARPOL) or the United Nations Environmental Program (UNEP), among others.

2.2.The Marine Strategy Framework Directive (MSFD, 2008/56/EC)

The MSFD is the most comprehensive and ambitious legislation addressing the health of marine ecosystems in the EU. It aims to achieve Good Environmental Status (**GES**) of EU marine waters, defined as:

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

The environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive

Operationally, reaching the GES means that

- biodiversity is maintained (Descriptor 1),
- non-indigenous species do not adversely alter the ecosystem (Descriptor 2),
- the population of commercial fish species is healthy (Descriptor 3),
- elements of food webs ensure long-term abundance and reproduction (Descriptor 4)
- eutrophication is minimized (Descriptor 5)
- the sea floor integrity ensures the functioning of the ecosystem (Descriptor 6)
- permanent alteration of hydrographical conditions does not adversely affect the ecosystem (Descriptor 7)
- concentrations of contaminants give no effects (Descriptor 8)
- contaminants in seafood are below safe levels (Descriptor 9)
- marine litter does not cause harm (Descriptor 10)
- introduction of energy (including underwater noise) does not adversely affect the ecosystem (Descriptor 11).

The Commission Decision (EU) 2017/848 of 17 May 2017 establishes the criteria and methodological standards on GES of marine waters and specifications and standardized methods for monitoring and assessment. This decision replaced Decision 2010/477/EU, to allow more flexibility of member states to address their particular environmental challenges, to achieve comparable and consistent outcomes across Member States, to set threshold values and clarify environmental objectives, to foster cooperation among countries within regions and to avoid redundancy and promote synergy with requirements of other EU legislation. The MSFD is an adaptive management scheme, operating in cycles of which the first one was completed in 2018, with the publication of the Report from the

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Commission to the European Parliament and the Council on the implementation of the Marine Strategy Framework Directive (Directive 2008/56/EC). The cycle lasted 6 years and was implemented in three steps:

- First step: Member States reported on the status of their marine waters and set targets to achieve GES based on the 11 descriptors (see above), covering ecosystem health and human pressures and impacts.

- Second step: Member States set up monitoring programmes to collect data to assess progress in achieving GES and reaching targets.

- Third step: Member States set up programmes of measures to deliver their objectives, and in 2018 they had to report on their progress.

Spatially, the MSFD operates in 4 regions and 8 subregions, within which the Member States shall cooperate to ensure coherent and coordinated implementation of the Directive (Figure 1).

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

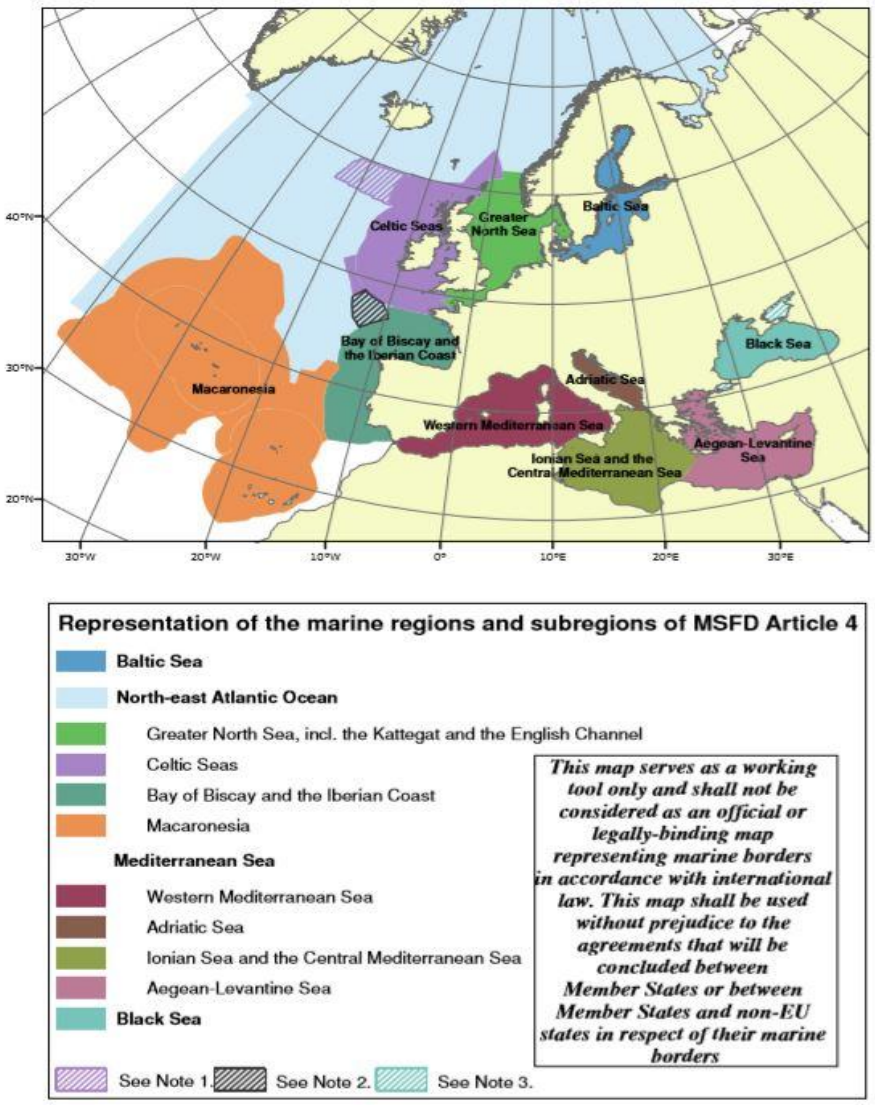

Figure 1. For implementation of the European Marine Strategy Framework Directive, the EU seas are divided into regions and subregions, within which the different countries are bound to cooperate (Source of the figure: European Commission, 2021).

The existence of previous regional conventions was instrumental for the adoption of this spatial configuration. The principles of Ecosystem-Based Management and the DPSIR framework (Driving

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

forces, Pressures, States, Impacts and Responses) are embed in the MSFD. It is an overarching, marine legislation related to a series of other EU directives and frameworks. Each has its own implementation protocol, largely in common with the MSFD. Thus, potential for overlap, but also for synergy, is large (Table 2).

Table 2. List of the most relevant directives related to the marine environment in the EU, and their relationship with monitoring elements considered in the Marine Strategy Framework Directive. **MSFD**, Marine Strategy Framework Directive; **WFD**, Water Framework Directive; **EQS**, Environmental Quality Standards Directive in the field of water policy; **BD**, Bird Directive; **HD**, The Habitats Directive; **CFP**, Common Fisheries Policy; **UWWTD**, Urban Wastewater Treatment Directive; **ND**, nitrates Directive; **BWD**, Bathing Water Directive; **MSPD**, Maritime Spatial Planning Directive; **WaFD**, Waste Framework Directive; **SUPD**, Single-Use Plastics Directive. Based on Zampoukas et al. (2013).

	Directives										
monitoring elements	MSFD	WFD	EQS	BD	HD	CFP	ND	BWD	MSPD	SUPD	WaFD
Phytoplankton, zooplankton	+	+									
Angiosperms, macroalgae, zoobenthos	+	+									
Fish	+				+	+					
Reptiles, marine mammals and other protected species	+				+						
Seabirds	+			+					+		
Habitats (predominant, special, protected, endangered	+				+				+		
Currents, depth, salinity ice cover	+	+									
Waves	+	+									
Mixing, residence time	+										
Seabed	+	+							+		
Temperature, turbidity	+	+									
Upwelling, abrasion, extraction, sealing, siltation	+	+	+								
Contaminants	+							+			
Oxygen	+	+									
pH	+										
Marine litter	+									+	+
Underwater noise	+										
Microbial pathogens	+							+			
Non-indigenous species	+										
Selective extraction of species	+					+					

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

2.3. Additional regulations governing the marine ecosystem in the European Union.

2.3.1. The Water Framework Directive (WFD, 2000/60/EC, amended in 2013/39/EU)

It establishes the basic principles of sustainable water policy in the European Union. It started in December 2000 and has gone through two management cycles so far. Member States have transposed the Directive to their respective legislations, identified baseline conditions at their water bodies and have conducted hydromorphological river restoration to achieve predefined targets by 2027. Although an important component of the Directive relates to continental water bodies, transitional and coastal waters up to one nautical mile from shore are also included. The directive addresses the biological, hydromorphological, physic-chemical and chemical quality of the water bodies, including water pollutants, with a set of standards or thresholds setting the boundary for a "good ecological status". A recent analysis identifies poor intersectoral communication, insufficient staff capabilities and inadequate funding as main bottlenecks for application of the WFD. A database with results from the monitoring program can be consulted in the WISE viewer.

2.3.2. The Environmental Quality Standards Directive in the field of water policy (EQS, Directive 2008/105/EC)

It sets out environmental quality standards (EQSs) concerning the presence in surface water of certain substances or groups of substances identified as priority pollutants because of the significant risk they pose to or via the aquatic environment. These standards are in line with the strategy and objectives of the EU Water Framework Directive. These substances include the metals cadmium, lead, mercury, nickel and their compounds, benzene, polyaromatic hydrocarbons (PAH) and several pesticides. The standards include thresholds for the average concentration and maximum allowable concentrations. Mixing zones near points of discharge where the EQSs may be exceeded must be clearly identified

2.3.3. The Bird Directive (BD, DIRECTIVE 2009/147/EC)

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Implemented in 1979, this is the oldest environmental protection Directive in the EU, and alongside the Habitats Directive forms the backbone of biodiversity conservation in the UE. It aims to protect all of the 500 wild bird species naturally occurring in the European Union, including seabirds, by protecting their best territories through a network of Special Protection Areas (SPAs) (Figure 2). It also bans the disturbance, killing, capture or trade of wild birds and the destruction of their nests. Since 1994, all SPAs are included in Natura 2000, an EU ecological network of protected areas (Figure 2). There is evidence that this supranational conservation tool has delivered benefits to the bird fauna in the EU, although further efforts should be devoted to set quantitative conservation goals and improve data availability (Donald et al., 2007).

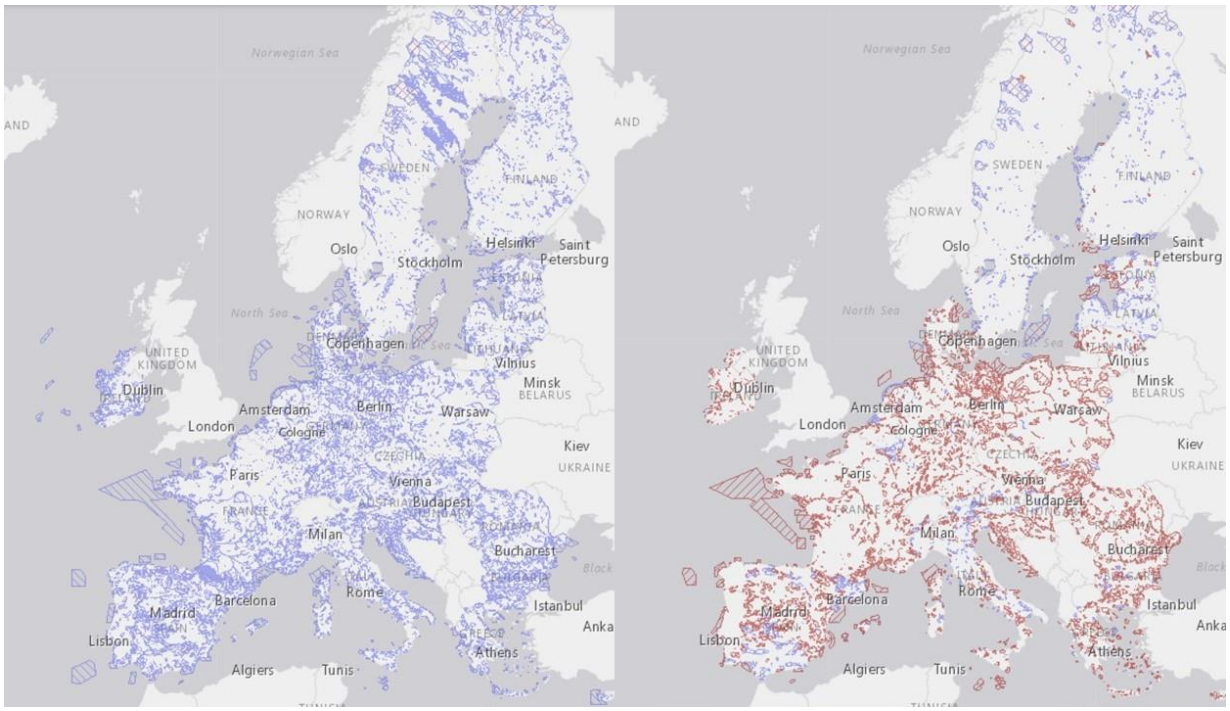

Figure 2. The Natura 2000 network of protected areas. Left: Special Areas of Conservation, Habitats Directive; Right: Special Protection Areas, Birds Directive. Consulted the 28 April 2021 in the Natura 2000 Viewer.

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

2.3.4. The Habitats Directive (HD, Directive 92/43/EEC)

This Directive, adopted in 1992, pursues the conservation of rare, characteristic or threatened species and habitats through the declaration of Special Areas of Conservation. Each country elaborates a National List of Sites of Community Importance (SCIs) based on ecological criteria. Once the definitive list of SCIs is approved by the European Commission, the member nations have 6 years to produce a management plan for each SCI. If approved by the European Commission, they become Special Areas of Conservation (SACs), and are definitively integrated in the Nature 2000 network (Figure 2; see the Natura 2000 viewer for consultation). Nearly 1000 species and 200 habitat types are listed in the HD. Member States have to report on the conservation status of SACs and establish compensation measures for projects with negative impacts on Natura 2000 sites. A recent (2016) "Fitness Check" of the HD and the BD identified an excessively slow recovery of habitats and species, a deviation of efforts from non-Natura 2000 areas, difficulty in harmonizing conservation and use of spaces, insufficient data dissemination, very limited funding, limited stakeholder awareness and involvement, gaps in knowledge and a need for ensuring better coherence with other EU policies among other shortfalls. The LIFE program, which co-finances environmental and climate change projects with a European added value, has been instrumental in the implementation of environmental directives, including the HD and the BD.

2.3.5. The Common Fisheries Policy (CFP)

It is a set of rules for the sustainable management of European fishing fleets and the preservation of fish stocks. More specifically, the CFP aims at setting fish stock management at maximum sustainable yields, limit discards (the "landing obligation"), set fleet capacity ceilings and harmonize national fisheries. It is one of the few exclusive competences of the EU, and all of its decisions are adopted by qualified majority. This is in marked and problematic contrast with the environmental directives, which depend on the national governments, which leads to important difficulties to align ocean conservation with fisheries. The top-down nature of the CFP has also been identified as not being able to address the complexities of the fishing sector (Sissenwine and Symes, 2007), causing a recent shift towards the promotion of bottom-up measures, small scale fisheries, co-management and participation.

2.3.6. The Urban Wastewater Treatment Directive (UWWTD; Directive 91/271/EEC)

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

It started in 1991, and is intended to "protect the environment from adverse effects of wastewater discharges from cities and "certain industrial sectors". Particular attention is paid to estuaries and coastal waters which are eutrophic or may become eutrophic in the future. A recent evaluation pointed to circular economy and climate change as the main challenges for the UWWTD.

2.3.7. The nitrates Directive (ND, Directive 91/676/EEC).

Aims at preventing nitrates from agricultural sources from polluting ground and surface waters. This is achieved through the promotion of good farming practices.

2.3.8. Bathing Water Directive (BWD, Directive 2006/7/EC)

Intended to maintain clean and healthy bathing waters, it tracks the water quality at more than 22 200 bathing sites in the EU. Monitoring of fecal bacteria and other important parameters, as well as a beach quality index can be consulted in a viewer.

2.3.9. Maritime Spatial Planning Directive (MSPD, 2014/89/EU)

Initiated in 2014, it is intended to promote the spatial coexistence and sustainability of relevant activities and uses. Adopting an ecosystem-based approach, first reporting is expected in 2021.

2.3.10. The Strategic Environmental Assessment and Environmental Impact Assessment Directives (SEA and EIA)

To ensures that the environmental implications of decisions are taken into account before the decisions are made in both projects and plans or programmes.

2.3.11. Waste Framework Directive, the EU strategy for plastics and the Single-Use Plastics Directive

These three directives provide mechanisms for the removal of litter and the improvement of water quality. They seek halting the generation of marine litter.

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

2.4.Assessment of the Marine Strategy Framework Directive

According to a recent Report from the Commission to the European Parliament and the Council on the implementation of the Marine Strategy Framework Directive, the Directive has achieved:

- **A holistic framework for the management of EU marine ecosystems.** The ecosystem-based approach, which pursuits healthy oceans to sustain essential services, has become a legally-binding and operational principle in the EU.

- **A research effort in poorly known aspects of ocean protection**, that are now included in the management framework, like marine litter and underwater noise. It has also permitted to identify important knowledge gaps which are now at the forefront of research.

- **A joint effort** of more than 280 experts from Member States, 70 participants from EU institutions and more than 100 registered observers or stakeholders. It was steered by the EU Marine Directors and organised by the Marine Strategy Coordination Group, with three working groups focused on: i) good environmental status; ii) programmes of measures and socio-economic analysis; and iii) data, information and knowledge exchange.

- **Public involvement and ocean literacy.** The MSFD has a transparent mechanism to design and implement national marine strategies and to follow the process at European level, which can be followed through open web pages. Every implementation stage has a public consultation process organized by each of the 23 coastal Member States and many of the MSFD programmes of measures also feature awareness-raising campaigns (i.e., plastics).

- **Regional cooperation, which addresses** transboundary pressures through coordination with regional conventions. In turn, the concept of 'good environmental status' and the environmental target-setting of the MSFD have been incorporated into some sea conventions.

- **Global commitments.**

As challenges/shortcomings, the report identified the need of

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

- **Achieving a more coherent and ambitious determination of 'good environmental status'**. Definition of GES is regionally heterogeneous, only qualitative, and the use of short deadlines precludes the nations to set ambitious GES and thresholds.

- **Ensuring the effectiveness of measures.** Management responses to key regional pressures are not adequate, frequently not reported or evaluated with reference to the GES, and need to be better connected to modelling and monitoring programmes and consistent at EU, regional and national levels. Spatial protection measures occupy a preeminent place in this context. In particular, the Natura 2000 network of Marine Protected Areas is unevenly distributed across regions and across depth zones. The areas are still not properly managed (many of them thus becoming "paper parks"), frequently cannot be assessed in terms of coherence and effectiveness, and contain few no-take reserves. These aspects are targets for the new Biodiversity Strategy for 2030.

- **Streamlining implementation:** The MSFD requires simplification of procedures, increasing resources (especially human resources), reducing and clarifying reporting, involving industry in the monitoring of their impacts, thus ensuring the harmonization of blue economy and sustainability, and improving and consolidating observation systems through research projects. An underutilized potential financial source is the European Maritime and Fisheries Fund. Misalignment of targets with management measures and monitoring programs was common, implantation of thresholds has been slow and the thresholds are too conservative and shy due to the short deadlines to achieve targets. Those deadlines are not consistently strict for reporting, consultation, publication or assessment, generating. In addition, reporting is strenuous and impractical. Information is not readily accessible, although the efficient and transparent publication of information in the WISE Marine web portal is a step forward in this direction.

- **Greater policy integration**. About 75% of the MSFD measures stem from other legislative frameworks, including the Directives mentioned above. In addition, the Blue Growth Strategy and the Green Deal both interact and affect the MSFD (for example, through the expansion of offshore energy and aquaculture). Policy integration is not yet operative at the level of data integration, monitoring or assessment. In particular, the integration of the MSFD with climate policy is essential.

- **Boosting regional cooperation.** Member States should use common regional indicators to assess their marine waters, and more coherent monitoring programmes and management measures, with stronger coordination to reduce the main pressures affecting each region.

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

- **Ensuring data availability and comparability.** Important data gaps need to be filled (i.e. underwater noise levels, plastic debris) and existing but publicly unavailable databases must be mobilized. Inputs from research projects is essential and innovative, cost-effective monitoring systems will allow broader spatial and temporal coverage. In the context of this project, the adequacy of EU monitoring programs to address Good Environmental Status has been reviewed by Painting et al. (2020), Bean et al. (2017), Borja et al. (2019), García-García et al. (2019) and Zampokas et al. (2013). The data generated by those programs must be made comparable through use of unified lists of contaminants, nutrients and species and threshold values to assess the environmental status and proximity to the GES. Current electronic reporting tools have improved comparability but there is room for improvement.

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

3. Policies, laws and regulations governing the marine ecosystem in Malaysia

3.1. Introduction

Malaysia is made of two parts namely West Malaysia, a.k.a. Peninsula Malaysia and East Malaysia with a total coastline of 4800 km (Mustafa & Ariffin, 2011). Malaysia is blessed with one of the largest continental shelves and extremely rich in biodiversity. On another note, Malaysia is included in the Coral Triangle. The total coral cover of the countries of the Coral Triangle is approximately 1.6% of the total area of the Earth's oceans but it is home to 76% of all known coral species, 37% of all known coral-reef fish species, 53% of the world's coral reefs, and the most extensive mangrove forests in the world, which are spawning and juvenile growth areas for tuna and other commercial fish species of global importance (Asian Development Bank, 2014). The nation can take the opportunity to generate revenue via the fisheries sector. However, from year 2000 to 2008 fish stocks had been overfished due to unsustainable fishing management (Jamaluddin et al., 2019). Not only that, destructive fishing practices such as fish bombing, bottom trawling and muro-ami not only destroys the seabed dwellers also kills fishes with no regards to species.

Increasing in human populations will also increase the dependence of human towards the marine environment in order to meet with the demands. As reported by Clark & Clausen (2019) 75% of major fisheries are fully exploited during the 21st century, and more than 90% of large predatory fish in the world had been overexploited. This then further interrupted the food web relationship in the marine species that are closely related to each other (Montoya et al., 2006). The best example to describe the benefits gained from fisheries is where more than 90 million tons a year of fishes were caught for human consumption, and 40 million of people employed directly to fishing industry (Gascon et al., 2015). The truth is, there are no areas in the ocean that did not receive influences from human activities (Santos et al., 2019).

The marine environment need to be conserved since it's provide many monetary and non-monetary benefits to humans (Selig et al., 2019), which include supplies of marine resources for human livelihood, economic benefits from fisheries, and coastal protection to prevent erosion. Sustainable management is therefore needed to ensure long-term socio-economic developments

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

while conserving the marine ecosystems (Aziz at al., 2019). Policies, laws and acts are therefore used to regulate the developments to manage human activities in the ocean areas to conserve and ensure sustainable use of resources.

3.2. Domestic legislations to protect and conserve marine ecosystem in Malaysia.

To protect and sustainably utilize our own marine resources the federal government enacted some necessary legislatives. Table 3 shows the major legislatives enacted by Malaysia that is responsible for protecting the marine ecosystem. One of the two listed national environmental policies is National Policy on the Biodiversity 2016-2025. This policy is adopted from the Convention of Biological Diversity's Strategic Plan for Biodiversity 2011-2020. The main purpose of this policy is to guide and act as a framework for the nation to conserve its biodiversity. The six targets out of the 17 listed are believed to be related to protecting the marine ecosystem. Next, the National Policy on the Environment 2002 aims at *"continued economic, social, and cultural progress of Malaysia and enhancement of the quality of life of its people through environmentally sound and sustainable development"*. The Environmental Quality Act 1974 (Section 25, 27 & 29) was enacted to restrict/prohibit the discharge of the any forms of waste into water bodies of Malaysia.

The Wildlife Conservation Act 2010 perhaps the most important legislation for wildlife conservation in Malaysia protects and conserves all animals with a threatened status. Next, the Fisheries Act 1985 regulated by the Department of Fisheries (DOF). Under this act, fishing without license is an offence and can be prosecuted. One of the most important part of the Act is the zoning. The DOF had implemented in 1982 the four-zone marine protected areas (MPAs) denoted as zone A (0-5 nm), zone B (5-12 nm), zone C (12-30 nm), zone C2 and zone C3 (beyond 30 nm) (Figure 3). Section 61 of the Fisheries Act 1985 give the Minister the power to formulate regulations with the intention of implementing the provisions of this Act. Fisheries (Control of Endangered Species of Fish) Regulations 1999 were enacted to protect the marine animals from disturbance. The Schedule has 25 species of marine animals listed as 'endangered species of fish'.

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

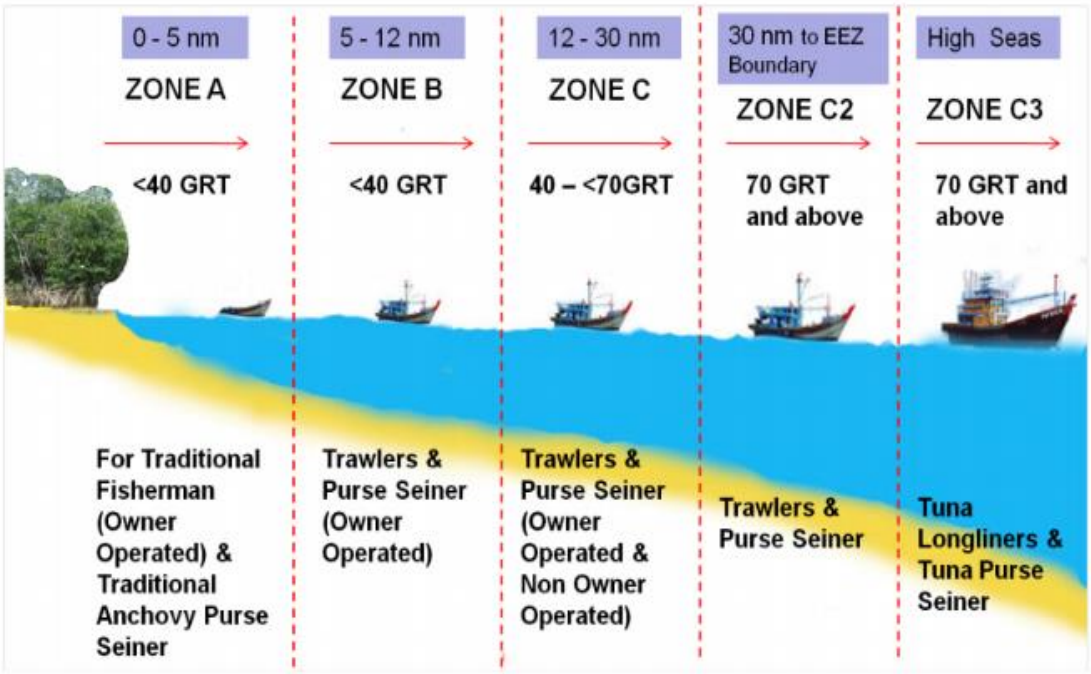

Figure 3. The zoning of marine protected areas (MPA) and the allowed type of vessel to fish in specific zones in Malaysia (Department of Fisheries, 2015).

The Exclusive Economic Zone (EEZ) Act 1984 sets out the exclusive economic zone as the area beyond and adjacent to the territorial sea extending to 200 nautical miles (nm) measured from the baselines (Figure 4) where Malaysia has sole exploitation rights over all natural resources. In this EEZ area Malaysia exercises sovereign rights for exploring and exploiting, conserving and managing natural resources, whether living or non-living, of the sea bed and the subsoil and the superjacent waters. Also, Malaysian jurisdiction is asserted over the establishment of artificial islands and installations, marine research and protection and preservation of the environment.

Malaysia strategic located at the conjunction of Malacca straits and the South China Sea which is a major commercial shipping route between the Indian Ocean and the Pacific Ocean (Mustafa & Ariffin, 2011). The Malacca Straits is by far the most susceptible to vessel-based marine pollution which includes oil and grease. In this regard, only the law can be considered the plausible mean of controlling the pollution. Hence, the Merchant Shipping (Amendment and Extension) Act 2011

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP
This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

(Section 306CA) and Merchant Shipping (Oil Pollution) Act 1994. The Merchant Shipping (Amendment and Extension) Act 2011 (Section 306CA) is an updated version of the Merchant Shipping Ordinance 1952 where the Act covers the area of EEZ.

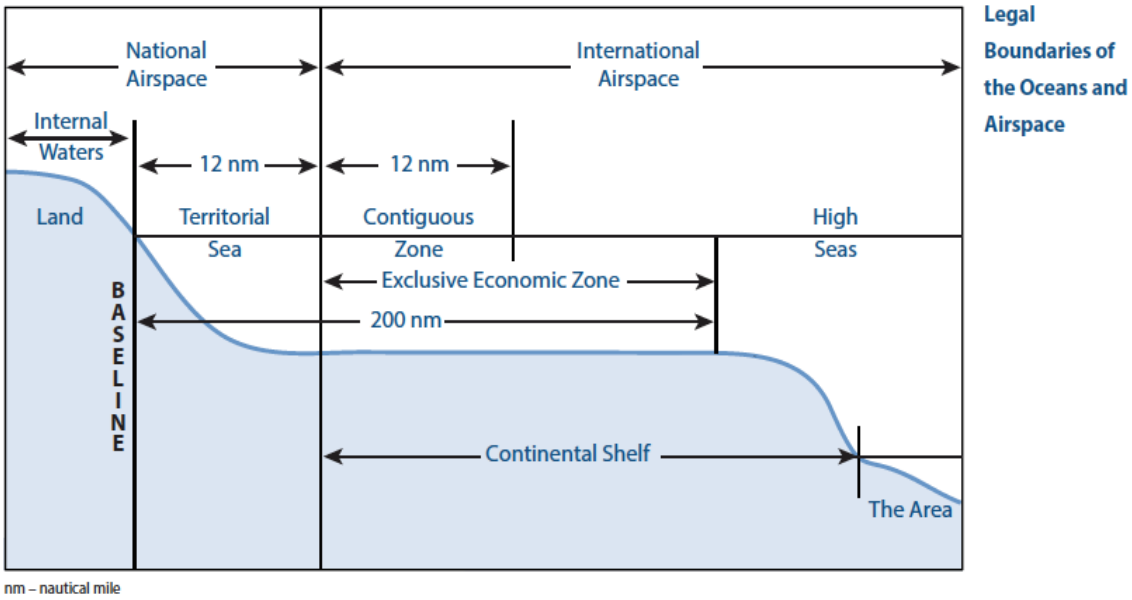

Figure 4. The EEZ as detailed in UNCLOS

Malaysian Maritime Enforcement Agency (MMEA) Act 2004 is an Act to establish the Malaysian Maritime Enforcement Agency to perform enforcement functions for ensuring the safety and security of the Malaysia Maritime Zone with a view to the protection of maritime and other national interests in such zone and for matters necessary thereto or connected therewith. The MMEA has the right to stop any vessel deemed suspicious and demand for paperwork to clarify its identity and intention. The Customs Act 1967 Section 31(1) allows the Minister by order namely Customs (Prohibition of Exports) Order 1998 and Customs (Prohibition of Imports) Order 1998 to requires permit prior to the exports and imports of coral (dead or alive).

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-I-2020-1-CY-EPPKA2-CBHE-JP
This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Table 3. The major domestic legislations responsible for protecting the marine ecosystem in Malaysia.

Policies/Acts/Laws/Regulations	Aim/Targets/Goals	Enacted/Launched by
National Policy on the Biodiversity 2016-2025	Target 6: By 2025, at least 20% of terrestrial areas and inland waters, and 10% of coastal and marine areas, are conserved through a representative system of protected areas and other effective area-based conservation measures. Target 7: By 2025, vulnerable ecosystems and habitats, particularly limestone hills, wetlands, coral reefs and seagrass beds, are adequately protected and restored. Target 8: By 2025, important terrestrial and marine ecological corridors have been identified, restored and protected. Target 9: By 2025, the extinction of known threatened species has been prevented and their conservation status has been improved and sustained. Target 10: By 2025, poaching, illegal harvesting and illegal trade of wildlife, fish and plants are under control and significantly reduced. Target 11: By 2025, invasive alien species and pathways are identified, priority species controlled and measures are in place to prevent their introduction and establishment.	Ministry of Natural Resources and Environment
National Policy on the	Strategy 2.2: Biologically rich habitats and ecosystems will be established and	Department of

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Environment 2002	maintained as zones for the conservation (marine protected area (MPA)) Strategy 2.8: Seas, coastal zones, lakes, rivers, mangroves, wetlands, islands, seagrass and coral reefs shall be managed soundly, preventing ecologically unsustainable harvesting.	Environment
Eleventh Malaysia Plan 2016-2020	Strategy C1: Conserving terrestrial and marine areas – enforcing relevant measures to help improve the marine parks	Prime Minister's Department, Malaysia
Environmental Quality Act 1974 (Act No. 127) (Section 25, 27 & 29)	The aim of the respective Sections is to restrict/prohibit the discharge of any forms of pollution (eg. wastes & oil) into water bodies of Malaysia.	Duli Yang Maha Mulia Seri Paduka Baginda Yang di-Pertuan Agong
Exclusive Economic Zone Act 1984 (Act No. 311)	An Act pertaining to the exclusive economic zone and certain aspects of the continental shelf of Malaysia and to provide for the regulations of activities in the zone and on the continental shelf and for matters connected therewith.	Seri Paduka Baginda Yang di-Pertuan Agong
Fisheries Act 1985 (Act No. 317)	An Act relating to fisheries, including the conservation, management and development of maritime and estuarine fishing and fisheries, in Malaysian fisheries waters, to turtles and riverine fishing in Malaysia and to matters connected therewith or incidental thereto.	Seri Paduka Baginda Yang di-Pertuan Agong
Fisheries (Control of Endangered Species of Fish) Regulations 1999	A regulation pertaining to protect to endangered species of fish listed in its schedule.	Minister of the Federal Government who is for the time being charged with the responsibility

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

		for fisheries
Wildlife Conservation Act 2010	**Section 9(1)** Bans any act of endangering the animals listed in the Annexes without any license. **Section 5** Provides for wildlife sanctuaries and reserves as well as the inclusion of any wildlife that needs protection into the Annexes	Parliament of Malaysia
Merchant Shipping (Amendment and Extension) Act 2011 (Section 306CA)	Prohibits the discharge of oil or harmful substances into the sea with the following exceptions: 1) Securing the safety of the ship or saving a life at sea 2) Failure to stop the discharge resulting from accidental damage with all necessary precaution taken; discovery of the discharge for the purpose of preventing, or if it could not be prevented, stopped or minimized 3) For the purpose of combating a specific discharge by another country other than Malaysia to minimize the damage of the pollution and is approved by the Director of Marine.	Parliament of Malaysia
Merchant Shipping (Oil Pollution) Act 1994	An Act to make provisions with respect to civil liability for oil pollution by merchant ships and for matters connected therewith.	Seri Paduka Baginda Yang di-Pertuan Agong
Malaysian Maritime Enforcement Agency Act 2004 (Act No. 633) (Section 7)	-To detain and inspect any fisheries vessel suspected of committing an offence against the Fisheries Act 1985.	Parliament of Malaysia

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

	-To demand, inspect, copy or take extracts from license, permit, record, certificate, or other document of the suspected party. -To expel any vessel deemed unsafe or threatens the safety and order of the Malaysian Maritime Zone	
Customs (Prohibition of Exports) Order 1998 Customs (Prohibition of Imports) Order 1998	According to the First Schedule of both Orders, the export/import of corals (dead or alive) requires export/import permit from relevant authorities.	Parliament of Malaysia
Environment Protection Enactment 2002	**Section 29** No person shall, in or along any coastal area: 1) reclaim or drain any foreshore or seabed in a manner which has, or is likely to have, a significant adverse effect on the environment; 2) alter, erect, demolish, place, reconstruct, or remove any structure, or any part of a structure, that is fixed in, on, under, or over any foreshore or seabed in a manner which has, or is likely to have, a significant adverse effect on the environment; 3) damage, destroy, or disturb any foreshore or seabed by excavating, drilling or tunnelling in a manner that has, or is likely to have, a significant adverse effect on the foreshore or seabed, other than for the purpose of lawfully harvesting any plant or animal pursuant to any written law; or 4) deposit in, on, or under any foreshore or seabed any pollutant in	Legislature of the State of Sabah

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

	a manner that has, or is likely to have, a significant adverse effect on the foreshore or seabed. **Section 32** No person shall discharge any, in a manner which has or is likely to have a significant adverse effect on the environment 1) pollutant into water; 2) pollutant onto or into any land in circumstances which may result in pollutant (or any other pollutant emanating as a result of natural processes from that pollutant) entering water; 3) pollutant from any agricultural premise, industrial premise or any other premises into air; or 4) pollutant from any agricultural premise, industrial premise or any other premises into land **Section 34** No person shall introduce any genetically modified organism or plant or animal which has or is likely to have a significant adverse effect on the environment.	
Parks Enactment 1984 (Part VIII: Section 48)	Part VIII of the enactment provides control of parks or nature reserves. Section 48 details the acts prohibited within the parks or nature reserves without the written permission from the authority.	Legislature of the State of Sabah
Sabah Biodiversity Enactment 2000	**Section 15** Any collector with the intention to collect biological resources to apply in writing to the	Legislature of the State of Sabah

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

	council for an access license. Given the circumstances, the Council may exempt the party (intending to conduct any pure academic and non-profit oriented research) from the application of access license. **Section 16** An application for an access license shall be in respect of access to biological resources found on: 1) State lands; 2) any reserves, natives' customary lands, or any other sites over which indigenous and local communities exercise community-based or customary rights; or 3) any other areas, including rivers, tributaries, waterways, or areas covered by water, marine parks or territorial waters of the state, and shall also include any ex-situ collections maintained by the state.	
Sarawak State Fisheries Ordinance 2003	An Ordinance to regulate fishing and promote aquaculture and to provide for the proper and sustainable management of fisheries in the State of Sarawak, and for other connected and incidental matters.	Legislature of Sarawak

As detailed in Part VI of the Federal Constitution, the Legislature of a State may make laws for the whole or part of the State with respect to any of the matters enumerated in the State List or the Concurrent List. The Legislature of Sabah enacted the Environment Protection Enactment 2002, Parks Enactment 1984 and Sabah Biodiversity Enactment 2000 to establish and protect the wildlife and environment which includes the marine ecosystem. The Legislature of Sarawak enacted the Sarawak State Fisheries Ordinance 2003 with the similar intention as Fisheries Act 1985 but more geared towards the needs of that State.

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP
This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

3.3. Marine environmental protection in Malaysia in the framework of national and international regulations.

Wetlands are widely considered to be the most, or at least among the most, valuable of our ecosystems in terms of contributions of ecosystem services and their biodiversity provides an essential foundation for the sustained production and delivery of ecosystem services (Sutton-Grier & Sandifer, 2019). However, natural wetlands all around the world are facing degradation at accelerated rate (Bai et al., 2013; Davidson et al., 2018), due to pollutions and developments such as reclamation. According to Haron et al. (2020), wetlands are often undervalued and are not put as priority in decision-making process. Therefore, Malaysia adopted the Ramsar Convention to utilize its framework to sustainably manage the wetlands with the intention to harvest its ecological services. Wetlands are also home to many marine creatures where the biodiversity comes second after coral reefs. Table 4 summarizes the international treaties adopted by Malaysia intended to protect the marine ecosystem.

The Convention on Biological Diversity (CBD) is an international convention that gave rise to the Aichi Biodiversity Targets 2011-2020 and Malaysian National Policy on the Biological Diversity 2016-2025. The Convention on Migratory Species of Wild Animals (CMS) provides a framework to determine the policy and provide guidance on specific issues through Strategic Plans, Action Plans, resolutions, decisions and guidelines.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is the best tool to fight for the illegal wildlife trade that are threatening many endangered species all around the world (WWF, 2016). It is an agreement made between governments to ensure the international trade of specimen is in accordance with the CITES agreement ensuring the survival of the species of wild animals and plants.

United Nations Convention on the Law of the Sea (UNCLOS) is also well known as the “Constitution of the Seas”. It allows the members of the United Nations to enjoy their fair share of raw resources under their sovereignty. The nation is allowed to do anything they wish in the zones of their jurisdiction.

Table 4. International treaties adopted by Malaysia intended to protect the marine ecosystem.

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Agreements/Treaty	Aims/Targets/Goals
Convention on Wetlands of International Importance (Ramsar Convention)	The conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world. Ramsar sites in Malaysia: 1) Tasek Bera, Pahang 2) Tanjung Piai, Johor 3) Pulau Kukup, Johor 4) Sungai Pulai, Johor 5) Kuching Wetland National Park, Sarawak 6) Lower Kinabatangan-Segama Wetlands, Sabah 7) Kota Kinabalu Wetlands, Sabah
United Nations Convention on the Law of the Sea (UNCLOS)	UNCLOS lays down a comprehensive regime of law and order in the world's oceans and seas. The 1982 convention was signed by 117 states and it establishes rules governing all uses of the ocean and its resources. The convention also provides the framework for the development of a specific area of law of the sea. The convention is a lengthy document having 446 articles group in 7 parts in 9 annexes. UNCLOS came into force internationally on 16th Nov 1994. Aims: 1) To promote the peaceful use of the seas and oceans; 2) To facilitate International Communications; 3) To enable equitable and efficient utilisation of ocean resources; 4) To protect and preserve the marine environment; 5) To promote Maritime safety.
Convention on Biological Diversity (CBD)	The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives: 1) The conservation of biological diversity. 2) The sustainable use of the components of biological diversity. 3) The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.
Aichi Biodiversity	Target 6: By 2020, all fish, invertebrates and aquatic plants are managed

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-I-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Targets 2011-2020	and harvested sustainably, legally and applying ecosystem-based approaches. Recovery plans and measures are in place for all depleted species. Target 9: By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment. Target 10: By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning. Target 11: By 2020, at least 10 % of coastal and marine areas especially areas possess particularly important ecological services and biodiversity are effectively and equitably managed.
Convention on Migratory Species of Wild Animals (CMS)	Aims to conserve terrestrial, marine and avian migratory species throughout their range. A total of 87 species found in Malaysia are listed in the CMS (CMS, 2021).
Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES)	An international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species. Appendix I – Most endangered among CITES-listed animals and plants Appendix II – List of species not threatened with extinction but will come to be if trade is not controlled Appendix III - List of species included at the request of a Party that already regulates trade in the species and that needs the cooperation of other countries to prevent unsustainable or illegal exploitation

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-I-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

In conclusion, Malaysia has numerous international treaties and domestic policies, laws and regulations safeguarding the marine ecosystem. Although the legislation and regulations are important to protect the marine ecosystem and to evolve to a sustainable use of resources, the new focus is now moving onto the ocean literacy. According to the Global Ocean Science Report 2020, it is of great relevance to create awareness. Conservation of marine environment is a shared-responsibility of all humankind around the world, and the oceans are interdependent and must be managed as a whole for it to continue serve the benefits.

3.4.Permissions required for installation of Marine Monitoring Equipment

In general, there are no specific permission process in place for installation of marine monitoring equipment in Malaysia. However, approval from federal or state authorities is needed if the monitoring activities are being conducted in protected areas such as Marine Parks. Besides that, installation of equipment at public area should be reported to the local law enforcement agency for security purposes.

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

4. Policies, laws and regulations governing the marine ecosystem in India

4.1. Introduction

The marine environment, which includes the adjacent coastal areas, supports productive and protective habitats such as mangroves, coral reefs and sand dunes. The marine environment is facing several pressures, arising out of the needs of people, and the multiple uses that coastal and marine areas can be put to. These pressures contribute to the depletion of marine resources and degradation of the marine environment. In the absence of good management, these pressures may result in severe stress.

India has a long coastline of more than 7500 km. Its marine resources are spread over in the Indian Ocean, Arabian Sea, and Bay of Bengal. The exclusive economic zone (EEZ) of the country has an area of 2.02 million sq km comprising 0.86 million sq km on the west coast, 0.56 million sq km on the east coast and 0.6 million sq km around the Andaman and Nicobar islands. The east coast supports activities such as agriculture and aquaculture while a number of industries are supported on the west coast. Tourism has emerged as a major economic activity in coastal states such as Goa, Kerala and Orissa.

Mangrove cover in India has been estimated at approximately 4,975 sq. km confined mainly along the east (Orissa and West Bengal) coast and Andaman and Nicobar Islands. The Sunderbans in West Bengal have one of the largest mangrove forests in the world. The mangrove flora of India is comprised of 50 exclusive species belonging to 20 genera. Some of the common and economically important species include *Mugil cephalus*, *Hilsa ilisha*, *Lates calcarifer*, *Scylla seratta*, *Meretrix casta* and *Crassostrea grephoides*. According to the latest evaluation (Rao, Molur and Walker, 1999), 67 % of the mangroves and associated plant species are endangered, while 97% of the plant species are threatened. Indiscriminate cutting, reclamation for agriculture and urbanization, fuel and overgrazing by domestic cattle have severely degraded mangroves in India. The threat to mangroves in recent years comes mainly from aquaculture and urban settlements. Sand dunes which support diverse flora are categorized as ecologically sensitive areas under the Coastal Regulation Zone notification of 1991. Coral reefs are found in the Palk Bay, Gulf of Mannar, Gulf of Kutch, central west-coast of India, Lakshadweep and Andaman and Nicobar islands. A few species of corals have

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP
This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

recently been reported from the Maharashtra coast. A total of 50 genera and 13 sub-genera of reef-building corals are known to occur in Indian reefs representing more than half of those recorded from all over the world. Fisheries in the Indian marine environment comprise 15 pelagic and the same number of demersal fisheries. India is a major seafood exporting country. The annual export of fisheries is 0.4 million tonnes (MT) worth Rs 47,000 million (Pandian, 1999). Marine fishery exports in 2000 were 421,075 MT valued at Rs 63,965 million. The Indian marine production increased from 0.534 MT in 1950-51 to 2.576 MT in 1992-93. However, the growth of Indian marine fisheries has become sluggish in recent years (Acharya & Thakur, 1999) and reached a plateau at around 2.8 MT by 1995-96 (MoA, 1996). While the inland sector contributed increasingly (6.2% annually since 1980-81) to the growth of fish production in India (5.21% annually since 1980-81), the growth in marine food production decreased to 2.5 % during 1990-99 from 3.73 % during 1980-90 (Krishnan et al., 2000). The potential harvestable yield of marine fish stock in the Indian EEZ is estimated to be 3.9 MT (Devaraj & Vivekanandan, 1999; Somvanshi, 1999). About 1 million people in 3651 villages of India situated along the coast are employed in marine capture fisheries. Indian fishery also supports several ancillary activities such as boat building, processing plants etc. All these features make this an important sector from the economic and social viewpoint.

The coastal and offshore environment of India supports rich biodiversity. Bacteria, fungi, and zooplankton species are abundant. Benthic fauna consists of polychaeta (62%), crustaceans (20%), and molluscs (18%). Over 630 species of marine algae have been reported. The annual production of seaweed is estimated at 70,000 tonnes. Sea grass flora is dominated by *Thalassia hemprichii* and *Cymodocea* species. The total standing crop is estimated at 7000–8000 tonnes. The few economically important species of algae such as *Gracilaria edulia* can be cultivated on a large scale. A sea grass called *Enhalus acroides* is now a threatened species. *Dugong dugon*, a mammal dependent on sea grass for its food is also threatened. Economic activities such as offshore drilling, aquaculture, port activities all impact the coastal ecosystem. India's external is almost entirely dependent on surface transport through its ports, except for a small quantity of high-value international cargo in volume terms, which is carried by air.

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

4.2. Domestic legislation to protect and conserve marine ecosystem in India.

For the protection, preservation and management of coastal waters and maritime zones the Central Government has formulated exclusive jurisdiction. The state governments too, have jurisdiction over the development of fishery and other living resources in the territorial waters adjoining the states. The institutions responsible for decision-making in the area of oceans and seas (Table 5) and highlights of major policies and programmes adopted by India (Table 6) are shown below.

Table 5. Institutions responsible for decision-making in the area of oceans and seas in India.

Organization	**Responsibilities**
Ministry of Environment and Forests	Management of resources in the coastal water, nodal ministry with major responsibility for protecting marine environment, includes implementation of legislative measures.
Department of Ocean Development	Scientific monitoring of the marine environment, Management of resources in the high seas
Ministry of Agriculture	Development of fisheries, aquaculture, fish processing
Ministry of Water Resources	Erosion
Ministry of Defence (Indian Coast Guard)	Pollution response measures, including oil pollution
Ministry of Surface Transport	Ports, shipping etc.
Ministry of Petroleum and Natural Gas	Offshore installations, coastal refineries, pipelines etc.

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Ministry of Tourism	Tourism activities in coastal regions
Ministry of mines	Mining activities in coastal regions

Table 6. Highlights of major policies and programmes to conserve marine ecosystems adopted by India.

Year	**Relevant Acts, programmes and policies**	**Salient features and Amendments**
1897	Indian Fisheries Act	Offers protection to fisheries against explosives or dynamites
1908	Indian Ports Act	Enactment relating to ports and port charges. Provides for rules for the safety of shipping and conservation of ports
1950	Coast Guard Act	Provides levying of heavy penalties for the pollution of port waters. In 1993, Coast Guard under Ministry of Defence, was made directly responsible for combating marine pollution. National Oil Spill Disaster Contingency Plan, formulated in 1996, under Coast Guard Act lays down action to be taken in the event of oil spills
1958	Merchant Shipping Act	Control of pollution from ships and off-shore platforms
1972	Wildlife Protection Act	Offers protection to marine biota Creates conditions favourable for in situ conservation of fauna and flora.Amended in 1991 to prohibit fishing within the

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP
This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

		sanctuary area Gahirmatha, annual mass nesting place for Olive Ridley turtle, an endangered species, accorded the status of marine sanctuary in 1997. Amended in 2001 to include several species of fish, corals, sea cucumbers and sea shells in Schedule I and III Whale shark placed in schedule I
1974	Water (Prevention and Control of Pollution) Act	Control of pollution from land-based sources includes tidal waters, unlike many other countries and has jurisdiction up to 5 km in the sea
1976	Maritime Zones Act	Describes various zones such as territorial waters, EEZ, Continental shelf etc.
1978	Marine fishing Regulation Act	A model act, which provides guidelines to the maritime states to enact laws for protection to marine fisheries by regulating fishing in the territorial waters. The measures include: regulation of mesh size and gear, reservation of zones for various fishing sectors and also declaration of closed seasons. Laws framed and amended from time to time by different maritime states Coastal states ban fishing during closed season Different closure period for different states
1980	Forest Conservation Act	Protection to marine biodiversity
1982	Coastal Pollution Control Series (COPOCS programme)	Started in 1982 by CPCB Aims at assessing the pollution status of coastal waters
1986	Environment Protection Act	Under this, the Coastal Regulation Zone 1991 has been

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP
This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

	(EPA)	notified. Standards for discharging effluents are listed
1991	Coastal Regulation Zone Notification	Regulations on various activities in coastal zone. Classifies coastal zone into four categories specifying activities permitted and prohibited in each category Offers protection to backwaters and estuaries Aquaculture was allowed as foreshore activity. The Supreme Court in 1996 banned all the aquaculture activities, except traditional and modified traditional, in the coastal zone up to 500m in most places. Aquaculture Authority was formed
1991	Deep Sea Fishing Policy	Allows foreign fishing vessels into Indian waters beyond 12 nautical miles. Protests from local fishermen Charter and leasing operations of foreign trawlers suspended in 1997 No granting of new licenses to joint venture companies operating in the EEZ Deep Sea Fishing Policy, 1991 practically scrapped in 1997
1991	Coastal Ocean Monitoring and Prediction systems (COMAPS Project)	Being implemented from 1991 onwards, it assesses the health of coastal waters and facilitates management of pollution-related issues. The programme was restructured and modified in 2000-01 to include pollution monitoring; liaison, regulation and legislation; and consultancy services
1995	National Environmental Tribunal Act	This has been created to award compensation for damages to persons, property and the environment arising from any activity involving hazardous substances

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

1995	UNCLOS	A new international order established for oceans Provides a comprehensive legal framework for integrated treatment of issues relating to oceans and seas.
1995	Land Ocean Interaction in the Coastal Zone (LOICZ Project)	Aims to develop, on a scientific basis, the integrated management of coastal environments
1996	Coastal Zone Management Plans (CZMPs)	Supreme Court Intervention that all the Coastal states prepare their CZMPs by 1996
1997	National Environment Appellate Authority Act	Addresses appeals with respect to restrictions of areas in which classes of industries etc. are carried out or prescribed subject to certain safeguards under the EPA. The objective is to bring in transparency and accountability and to ensure the smooth and expeditious implementation of developmental schemes and projects
1998	Turtle Exclusion Device (TED) mandatory in Orissa	Orissa High Court passed judgment in 1998 that all fishing trawlers be equipped with TED
1997-1998	Ocean Observation and Information Services (OOIS)	Generate reliable oceanographic data. Various projects of DOD were restructured under this regulation
1998	Integrated Coastal and Marine Area Management (ICMAM Project)	Aims at integrated management of coastal and marine areas. Model plans for Chennai, Goa and Gulf of Kutch being prepared
2000	The Biodiversity Bill	With an aim to protect and conserve biodiversity and

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

		sustainable use of its components the Biodiversity Bill is being placed in Parliament

4.3. Marine environmental protection in India in the framework of national and international regulations.

India's rapid population, economic and industrial growth has created pressures on the coastal resources. Some coastal stretches in India are highly polluted with municipal waste deriving from urbanization and tourism, waste generated from industry, chemical agents from fertilizers and pesticides and silt from degraded catchments. Untreated sewage and other non-industrial waste account more pollution than industrial effluents. Mining of sand from the sea-bed results in an increase in turbidity in the ambient water, which affects benthic organisms and primary productivity by limiting the availability of light. Aquaculture activity in some parts of India has also placed considerable pressure on coastal resources. Construction of breakwaters, which forms part of the port development, alters the sediment transport mechanisms in the coastal areas, thereby causing erosion or accretion.

Several rules and laws regulate activities on the Indian coast. India has regulatory agencies such as the Central Pollution Control Board (CPCB) at the central level and State Pollution Control Boards (SPCB) at the state levels, constituted under Water (Prevention and Control of Pollution) Act, 1974. The Aquaculture Authority of India has been constituted and guidelines on sustainable aquaculture development for regulating coastal aquaculture have also been developed. A National Contingency Plan has been formulated to combat oil spills in the EEZ of India with the Coastal Guard as the nodal agency. The disposal of ship-based wastes is regulated by the Merchant Shipping Act, 1958 and by the adoption of MARPOL 73/78. Standards for discharging effluents are listed in the Environmental Protection Act, 1986. This serves as an umbrella act providing for the protection and improvement of the environment including coastal and marine areas. The effluents/discharges from various resources have to meet these standards before being discharged into marine waters.

The Coastal Zone Regulation Notification was issued in 1991 in India, under the EPA, 1986. The Notification aims at protecting and improving the quality of the coastal environment. The Notification declares the limits of the Coastal Zone and classifies it into four categories for purpose of regulation. CRZ I includes areas which are ecologically sensitive, areas of outstanding natural

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP
This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

beauty, historical heritage or rich genetic diversity. CRZ II includes the areas that have already been developed up to or close to the shoreline. Areas that are relatively undisturbed are classified under CRZ III. CRZ IV includes the coastal stretches in the Andaman and Nicobar, Lakshadweep and other small islands except those designated as CRZ I, II and III. The notification lays down certain prohibitions and also exceptions to prohibitions. Prohibited activities include setting up of new industries (except those which are directly related to the waterfront or which directly need foreshore facilities) and expansion of existing industries including fish processing units, manufacture, handling, storage or disposal of hazardous wastes and substances, discharge of untreated wastes and effluents and dumping of municipal wastes as landfills or otherwise. Withdrawal of groundwater within 200 metres of the High Tide Line (HTL) is prohibited with some exceptions. In most of these areas, an area of 200 metres from the high tide line (HTL) has been declared a no development zone. Several restrictions have been imposed for carrying out development in the area between 200 to 500 metres from the HTL. These measures have been adopted to protect fragile ecosystems which exist in the area and are vital for sustaining the ecological balance. Mangroves and coral reefs have been declared ecologically sensitive areas (CRZ I) under this notification and regular monitoring using satellite imagery is in progress.

A state-wise Mangrove Committee has been formed for effective management of the mangrove ecosystem. Mining of corals and coral sands has been banned. The CRZ notification also offers protection to coastal communities such as traditional fishermen. The Recycled Plastics Manufacture and Usage Rules, 1999; Municipal Soild Wastes (Management and Handling) Rules, 2000; Ozone Depleting Substances (Regulation) Rules, 2000; The Prevention and Control of Pollution (Uniform Consent Procedure) Rules, 1999, are some of the rules framed under EPA, 1986, with an aim to providing environmental protection and are relevant to the coastal environment. Since 1982, the CPCB has been carrying out a rapid inventory annually to assess the pollution status of coastal waters of India. This programme known as the Coastal Pollution Control Series (COPOCS), comprises among other things, a) Identification of the uses of coastal water at different stretches and the best use among them; class designation of the sector or a portion thereof, and b) Identification of land-based pollutants and polluting activities and those that require immediate control. The Coastal Ocean Monitoring and Prediction systems (COMAPS) programme was launched in 1991, by the Department of Ocean Development (DOD) for monitoring the health of India's coastal waters. The programme monitors the effect of anthropogenic activities on the marine environment periodically and assesses the impact on the marine flora and fauna in the coastal waters of India.

Studies related to the waste assimilation capacity of coastal waters have been undertaken from 1997-98 onwards. Efforts have been made to set up sewage treatment plants in all coastal states. Treated effluents are being discharged into deeper waters through pipelines. The Government is also preparing an action plan for treatment of domestic wastes. Legislation has helped in the

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP
This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

treatment of industrial wastes. In India, the Water (Prevention and Control of Pollution) Act includes tidal waters, unlike some other countries. The Act is applicable up to 5 km into the sea. Though the discharge of effluents from small-scale industries is still a problem, efforts are being made to set up common treatment plants. This will help in minimizing the load that is discharged to the sea.

To prevent overexploitation of fish stocks and protect the interests of coastal communities, the following legislation/rules/acts are in force in the country.

- The Maritime Zones of India (Regulation of fishing by Foreign Vessels) Act, 1981 provides regulations for foreign fishing vessels operating in Indian waters. The Coast Guard and the State/UT Police has been authorized under the Act to apprehend and prosecute unauthorized foreign fishing vessels/crew for fishing/poaching in Indian waters.
- The Marine Fishing Regulation Act (MFRA), 1978. Consistent with the guidelines contained in the MFRA, 1978, which is a model act, providing guidelines to the maritime states, legislations have been enacted and enforced for regulating fishing and conservative measures in territorial waters. Such state enactments provide for regulation of mesh size to avoid catching juvenile fish, regulation of gear to avoid over-exploitation of certain species, reservation of zones for various fishing sectors to provide exclusive rights to traditional fishermen to fish unhindered in near-shore areas and also for declaration of closed seasons during the fish-breeding period to avoid catching of young juvenile fish.

4.3.1. The sustainable development of small islands in India

The Andaman and Nicobar Islands and Lakshadweep archipelago are the major islands in India. Special emphasis on island development was given in the Ninth Five-Year Plan programme proposed by the DOD. This includes a programme on lobster resource enhancement, which has been implemented from 1998 onwards. The GoI has initiated several actions for the sustainable development of these small islands:

- Under the CRZ Notification, 1991 of EPA (1986), these islands are classified as a separate category (CRZ IV). Prohibitive activities include mining of corals in the coral reef area along with other restricted and regulated activities.
- An Island Development Authority (IDA) has been constituted. It was directly under the chairmanship of the Prime Minister earlier but the deputy chairman of the Planning Commission

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP
This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

is the current Chairman of the IDA. It takes up measures for ensuring sustainable development of the islands on scientific lines.

- The Andaman and Nicobar Integrated Development Corporation has been set up to undertake sustainable development in an integrated manner.
- An Island Development Programme is being implemented at the National Institute of Ocean Technology, Chennai. This programme aims at the transfer of technology in the area of marine living resources so that the island community can avail of socio-economic benefits.

In conclusion, India has a fairly comprehensive list of Acts, policies and programmes related to protecting the marine ecosystem. It comprises of a board of ministries that collectively protects the marine environment. The increasing population leads to increased stresses (pollution, food demand and space). Therefore, the existence of the set regulations, policies and programmes play an important role in sustainably managing the marine resources. The earliest regulatory framework was enacted in 1897 which implies that India has already begun managing the marine resources since then. It goes to show that the services and benefits provided by the marine resources were very important. As time goes on, more regulatory frameworks were made to solve the current problems at that time. It requires a collective effort from the community itself to assist the government to effectively yet efficiently protect the marine environment.

4.4. Permissions required for installation of Marine Monitoring Equipment

There is no specific permission required to set up a private testing lab in university. If the lab is going to do third party consultancy work, then National Accreditation Board for Testing and Calibration Laboratories (NABL) certification is required. Which is an autonomous body under the aegis of Department of Science & Technology, Govt. of India and is registered under the Societies Act.

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

5. Conclusions

The EU Marine Strategy Framework Directive is one of the largest and most innovative of the existing supranational initiatives to achieve a good environmental status of marine ecosystems, improve their resiliency against multiple stressors, and allow their sustainable use. It consists of an Ecosystem Management framework with the capacity to evolve in a changing stressor landscape while informing and raising awareness, involving stakeholders and fostering regional and international cooperation. Malaysia has numerous international treaties and domestic policies, laws and regulations safeguarding the marine ecosystem. The ones listed in this context are just a handful of major legislatives deemed important for the conservation of the marine ecosystem. On the other hand, India's list of Acts, policies and programmes related to protecting the marine ecosystem also comprises of a board of ministries that collectively protects the marine environment. However, in general, the increasing population leads to increased stresses (pollution, food demand and space).

The legislation analysis reveals that conservation bodies and laws are similar in the EU countries, in India and in Malaysia. They were all developed historically as an ad hoc response to environmental problems as they were appearing, or as a response to growing awareness about the health of the ocean among the population. All of them are aligned with international conventions such as UNCLOS, ISA, IMO, MARPOL, UNEP, IOC, RAMSAR, CITES and others. In this regard, many of the conservation targets and approaches are shared by all countries, especially the need to reconcile conservation, ecology, economy and society, following the Agenda 21. There are some salient initiatives, like India´s Five Year Plans by the Department of Ocean Development, now in their ninth cycle, with strong emphasis on the spatial allocation of ocean uses and conservation areas, with an ambitious plan to develop research infrastructures, and an important monitoring program, the Coastal Ocean Monitoring and Prediction System (COMAPS).

One main difference of India and Malaysia with the EU is driven by geography. They are partly or entirely tropical countries, with highly productive shallow coral reefs and mangrove systems that sustain a unique biodiversity. Protection of these systems and their associated biota is an important component of their legislation, an aspect which is simply missing in the EU. This includes regulations for the trade of exotic species, or laws against the alteration of biogenic structures. Tourism is another great player, particularly in Malaysia, with a growing number of visitors alongside numerous active ocean conservation NGOs focused on conservation and restoration of habitats and populations (i.e. turtles). An added player in Malaysia is its key policing role in the Malacca Strait, a

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-I-2020-1-CY-EPPKA2-CBHE-JP
This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

main route from the Pacific to the Indian Ocean. Control of invading species and ship pollution is a key aspect of Malaysian regulation. Lastly, India stands far from the EU and Malaysia in terms of population density, with a marked pressure on its coasts and fish stocks and an emergent aquaculture sector that represents a challenge and an opportunity. Both Malaysia and India seem to share a problem with enforcement, especially in regards to their fisheries. In particular, they both have a thriving artisanal fleet which is at the same time a problem and an opportunity. If co-management and community involvement make their way into fisheries legislation, the artisanal fleet may become real ocean caretakers.

Another large and key difference is the presence of an overarching, EU legislation which is not present in India and Malaysia. The foundation and growth of the EU as a political and economic union represented the opportunity to develop new legislation that incorporates many novel ingredients. The Marine Strategy Framework Directive is an adaptive, ecosystem-based management regulation that not only responds to problems, but seeks the recovery of the ocean towards a healthy and productive level that is objectively defined. This is all done in cycles, and informed by an ambitious monitoring system. Note also that the implementation of the MSFD and other EU Directives has provoked some degree of alignment of national initiatives. However, because of its top-down nature it may not be fully appreciated by EU citizens.

Ocean literacy is a main challenge in the coming decades for the EU, Malaysia and India. Although the legislation and regulations are important to protect the marine ecosystem and manage human activities ensuring sustainable use of resources, the new focus is now moving on to the relevant role of the citizens to protect the environment (the empowerment of citizens). According to the Global Ocean Science Report 2020, Ocean Literacy is the understanding on human influence on the oceans and vice versa. In conclusion, ocean literacy and harmonization of the MSFD with the Blue Growth Strategy or the Green Deal will surely represent major challenges in the coming years and help to create awareness, especially among a wide range of stakeholders such as governments, regulatory agencies, fishermen, communities, universities and research centers.

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

6. References

Acharya, P., & Thakur, N. K. (1999). Aquatic resources management policy to cater to the needs of 21st century In Vision on Indian fisheries of 21st century, Abidi S A H, Thakur N K, Biradar R S, Shenoy L (eds.) Mumbai: Proceedings of the national seminar CIFE, pp. 35-46.

Asian Development Bank. (2014). State of the Coral Triangle: Malaysia. In J. M. Saad (Ed.), Asian Security Handbook: Assessment of Political-security Issues in the Asia-Pacific Region. Asian Development Bank.

Aziz, N., Muhammad, Z., Farahdilah, G., Talaat, W. I. A. W., & Saputra, J. (2019). Marine Spatial Planning: The way forward for sustainable development of Central Terengganu, Malaysia. *Journal of Southwest Jiaotong University*, 54(4), 1–11.

Bai, J., Cui, B., Cao, H., Li, A., & Zhang, B. (2013). Wetland degradation and ecological restoration. *The Scientific World Journal*.

Bean, T. P., Greenwood, N., Beckett, R., Biermann, L., Bignell, J. P., Brant, J. L., ... & Righton, D. (2017). A review of the tools used for marine monitoring in the UK: combining historic and contemporary methods with modeling and socioeconomics to fulfill legislative needs and scientific ambitions. *Frontiers in Marine Science*, 4, 263.

Borja, A., Garmendia, J. M., Menchaca, I., Uriarte, A., & Sagarminaga, Y. (2019). Yes, we can! Large-scale integrative assessment of european regional seas, using open access databases. *Frontiers in Marine Science*, 6, 19.

Clark, B., & Clausen, R. (2019). The Oceanic Crisis: Capitalism and the Degradation of Marine Ecosystem. Monthly Review (New York, N.Y.:1949), July 2008.

CMS (2021). Convention on the Conservation of Migratory Species of Wild Animals: Malaysia. Retrieved from https://www.cms.int/en/country/malaysia. [Accessed on 14/4/2021]

Davidson, N. C., Fluet-Chouinard, E., & Finlayson, C. M. (2018). Global extent and distribution of wetlands: Trends and issues. *Marine and Freshwater Research*, 69(4), 620–627.

Department of Fisheries. (2015). National Plan of Action for the Management of Fishing Capacity in Malaysia (Plan 2). Department of Fisheries Malaysia.

Devaraj, M., & Vivekanandan, E. (1999). Marine capture fisheries of India: Challenges and opportunities. *Current Science*, 314-332.

Donald, P. F., Sanderson, F. J., Burfield, I. J., Bierman, S. M., Gregory, R. D., & Waliczky, Z. (2007). International conservation policy delivers benefits for birds in Europe. *Science*, 317(5839), 810-813.

Co-funded by the Erasmus+ Programme of the European Union

619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

European Commission (2020). The EU Blue Economy Report. 2020. https://blueindicators.ec.europa.eu/sites/default/files/2020_06_BlueEconomy-2020-LD_FINAL-corrected-web-acrobat-pro.pdf. [Accessed on 14/4/2021].

European Commission. (2021). Our Oceans, Seas and Coasts: Implementation of the Marine Strategy Framework Directive. Retrieved from https://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/index_en.htm

Gascon, C., Brooks, T. M., Contreras-Macbeath, T., Heard, N., Konstant, W., Lamoreux, J., … Vié, J. C. (2015). The importance and benefits of species. *Current Biology*, 25(10), 431–R438.

García-García, L., van der Molen, J., Sivyer, D., Devlin, M., Painting, S., and Collingridge, K. (2019). Optimizing monitoring programs: a case study based on the OSPAR Eutrophication assessment for UK waters, *Frontiers in Marine Science*. https://doi.org/10.3389/fmars.2018.00503.

Haron, N. F., Aziz, I., Ghani, H. A., & Amirah, N. A. (2020). Environmental Awareness : Do People Really Concern about the Setiu Wetlands in Terengganu , Malaysia? *International Journal of Academic Research in Business and Social Sciences*, 10(10), 1066–1079.

Jamaluddin, N. A., Hussin, S. A. S., Zahid, Z., & Khairi, S. S. M. (2019). Estimation of Maximum Sustainable Yield (MSY) for Sustainable Fish Catch. *Journal of Physics: Conference Series*, 1366(1).

Kaczynski, Vlad M., & David L. Fluharty. "European policies in West Africa: who benefits from fisheries agreements?." *Marine Policy* 26, no. 2 (2002): 75-93.

Krishnan, M., Birthal, P. S., Ponnusamy, K., Kumaran, M., & Singh, H. (2000). Aquaculture in India: retrospect and prospects In Krishnan, M., & Birthal, P. S. (eds.) Aquaculture development in India: problems and Prospects Workshop Proceedings organised by National Centre for Agricultural Economics and Policy Research (NCAP) with Central Institute of Brackishwater aquaculture (CIBA), New Delhi pp:11- 31.

MoA. 1996. A hand book on Fisheries Statistics 1996 Ministry of Agriculture. 217 pp. Ninth Five Year Plan: 1997-2002 Vol. 2: Thematic Issues and Sectoral Programmes New Delhi: Government of India, Planning Commission. 1059 pp.

Montoya, J. M., Pimm, S. L., & Solé, R. V. (2006). Ecological networks and their fragility. *Nature*, 442(7100), 259-264.

Mustafa, M., & Ariffin, M. (2011). The Application of Law on Pollution Control towards Marine Biodiversity Conservation in Malaysia. International Conference on Environment and BioScience, 21, 129–133.

Painting, S. J., Collingridge, K. A., Durand, D., Grémare, A., Créach, V., Arvanitidis, C., & Bernard, G. (2020). Marine monitoring in Europe: is it adequate to address environmental threats and pressures?. *Ocean Science*, 16(1), 235-252.

Pandian, T. J., & Koteeswaran, R. (1999). Lability of sex differentiation in fish. *Current Science*, 580-583.

Co-funded by the Erasmus+ Programme of the European Union

619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Rao, T. A., Molur, S., & Walker, S. (1999). Mangroves of India: Report Summary 1998. Publication of Zoo Outreach Organization, 12(2), 1-49.

Santos, C. F., Ehler, C. N., Agardy, T., Andrade, F., & Orbach, M. K. (2019). Marine Spatial Planning. In World Seas: An Environmental Evaluation. Volume III: Ecological Issues and Environmental Impacts (2nd ed.). Elsevier Ltd.

Selig, E. R., Mckinnon, M. C., Turner, W. R., Hole, D. G., Chu, J., Allison, E. H., … Holland, M. B. (2019). Mapping global human dependence on marine ecosystems. *Conservation Letter*, 1–10. 7

Sissenwine, M., and Symes, D. (2007). Reflections on the common fisheries policy. Report to the General Directorate for Fisheries and Maritime Affairs of the European Commission, 75. https://www.researchgate.net/profile/David-Symes/publication/255631911_Reflections_on_the_Common_Fisheries_Policy/links/55c12e7b08aec0e5f44906be/Reflections-on-the-Common-Fisheries-Policy.pdf. [Accessed on 15/4/2021].

Somvanshi, V. S. (1999). Indian fisheries in 21st Century: some thoughts on marine fisheries resources management In Vision on Indian fisheries of 21st century, Abidi, S. A. H., Thakur, N. K., Biradar, R. S., Shenoy, L. (eds.) Mumbai: Proceedings of the national seminar CIFE. pp. 54-64.

Sutton-Grier, A. E., & Sandifer, P. A. (2019). Conservation of Wetlands and Other Coastal Ecosystems: a Commentary on their Value to Protect Biodiversity, Reduce Disaster Impacts, and Promote Human Health and Well-Being. Wetlands, 39(6), 1295–1302.

WWF (2016). Why CITES matter. Retrieved from https://www.worldwildlife.org/stories/why-cites-matters. [Accessed on 15/4/2021].

Zampoukas, N., Piha, H., Bigagli, E., Hoepffner, N., Hanke, G., & Cardoso, A. C. (2013). Marine monitoring in the European Union: how to fulfill the requirements for the marine strategy framework directive in an efficient and integrated way. *Marine Policy*, 39, 349-351..

Co-funded by the Erasmus+ Programme of the European Union

619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

7. Appendix

7.1. Acronyms

BD: Bird Directive
BWD: Bathing Water Directive
CBD: Convention on Biological Diversity
CFP: Common Fisheries Policy
CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS: Convention on Migratory Species of Wild Animals
CPCB: Central Pollution Control Board, India
CRZ: Coastal Zone Regulation
DOF: Department of Fisheries, Malaysia
EEZ: Exclusive Economic Zone
EPA: Environment Protection Act (India)
EQS: Environmental Quality Standards Directive in the field of water policy
EU: European Union
GES: Good Environmental Status
HD: Habitats Directive
HELCOM: The Baltic Marine Environment Protection Comission
IMO: International Maritime Organization
IOC: Intergovernmental Oceanographic Commission
ISA: International Seabed Authority
MARPOL: International Convention for the Prevention of Pollution from Ships
MMEA: Malaysian Maritime Enforcement Agency
MSFD: Marine Strategy Framework Directive
MSPD: Maritime Spatial Planning Directive
ND: nitrates Directive
NEAFC: North East Atlantic Fisheries Convention
OSPAR: Commission for the Protection of the Marine Environment of the North-East Atlantic
RAMSAR: Convention on Wetlands of International Importance (Ramsar Convention)
SPCB: State Pollution Control Board, India
SUPD: Single-Use Plastics Directive
UNCLOS: United Nations Convention on the Law of the Sea
UNEP: United Nations Environmental Program
UWWTD: Urban Wastewater Treatment Directive
WaFD: Waste Framework Directive
WFD: Water Framework Directive
WISE: Marine Information System for Europe
WWF: Worldwide Fund for Nature

Co-funded by the Erasmus+ Programme of the European Union
619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

7.2. List of Tables.

7.3.List of Figures

Co-funded by the Erasmus+ Programme of the European Union

619158-EPP-l-2020-1-CY-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.