PLASMAR

Bases para la planificación sostenible de áreas marinas en la Macaronesia

Task report: workshop and meetings on "Good Environmental Status & Aquaculture"

19-23 March 2018, IU-ECOAQUA, Canary Is. (Spain).

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1 SUMMARY

As part of the PLASMAR project, two members of the partner Regional Agency for the Development of Research, Technology and Innovation (ARDITI) from Madeira (Portugal) visited the University Institute ECOAQUA (IU-ECOAQUA) between 19-23 March 2018 at Gran Canaria (Canary Islands, Spain) for the progress of the coordinated action on the assessment of GES & Aquaculture (defined as project task 211c&d. This task had been initiated during MaPSIS 2017 Conference PLASMAR Open workshop on "Blue Growth & GES".

The Expert's Workshop had been programmed in accordance with the Coordinator of the PLASMAR project as an optimal opportunity to add to that project task the support, expertise and inputs from scientists belonging to the Aquaculture Research Group and to the Biodiversity and Conservation Research Group, both part of the IU-ECOAQUA.

A dynamic and participatory workshop session entitled "Good Environmental Status & Aquaculture", was developed on Wednesday of 21st March at the IU-ECOAQUA facilities in the Marine Technological Science Park, Taliarte (Gran Canaria).

In addition to the workshop session, time was allocated to the project task review, mainly between the two visitors (ARDITI members) and the staff assigned to the PLASMAR project in the IU-ECOAQUA. The main discussion included identification of key issues to be solved (identifying significant quality descriptors and criteria for aquaculture), major clarifications to be obtained from experts, preparation of materials, analyses of main workshop outcomes, and also to further expert consultations if required.

As a result, experts from ARDITI and IU-ECOAQUA delivered a detailed review of the Aquaculture interaction with marine environment, based on Good Environmental Status (GES) quality descriptors defined by the Marine Strategy Framework Directive 2008/56/EC and Commission Decision 2017/848/EU.

2 GENERAL BACKGROUND

Blue growth is the maritime contribution to achieving the goals of the **Europe 2020 strategy for smart, sustainable and inclusive growth**. Its development must go hand in hand with the implementation of the **Marine Strategy Framework Directive** (MSFD) (Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy), which is the environmental pillar of the **EU Integrated Maritime Policy**.

The main goal of the MSFD is to achieve **Good Environmental Status** of EU marine waters by 2020. The Directive defines Good Environmental Status (GES) as:

> *"The environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive" Article 3*

The Commission Decision (EU) 2017/848 on good environmental status of marine waters, adopted on 17 May 2017, contains a number of criteria and methodological standards for determining good environmental status, in relation to the 11 descriptors of good environmental status laid down in Annex I of the Marine Directive. The criteria build on existing obligations and developments within the EU legislation, covering further relevant elements of the marine environment, not yet addressed in the acting policies. The Decision also contains specifications and standardised methods for monitoring and assessing marine waters. The Decision is a major stepping stone to establish precise objectives for the achievement of GES within the implementation of the MSFD, thereby providing a picture of the extent to which good environmental status is achieved in the EU's seas and oceans.

3 ANALYSES OF BLUE GROWTH & GES BY PLASMAR PROJECT

PLASMAR Project, within project task 2.1.1 c&d, has developed a methodology (Abramic *et al*., 2018) aimed at finding the balance of Blue Growth sustainable development within Ecosystem approach. The review of state of art of each considered MA is undertaken for the identification of possible impacts, related pressures solutions, mitigation and monitoring methods, making a proposal to integrate this information in the Environmental Impact Assessment process, based on the EU environmental legislation and making special reference to the Macaronesian Region. Furthermore, these analyses will serve as base information for the Marine Spatial Planning tasks (following project action).

The proposed methodology, mainly based on literature review and expert consultation, is being applied by project partners to the main maritime activities and sectors identified within the European Macaronesian archipelagos, i.e.: Aquaculture, Fisheries, Maritime Tourism, Maritime transport, Mineral extraction, and Renewable energy (Offshore wind).

4 GOOD ENVIRONMENTAL STATUS & AQUACULTURE: DEVELOPMENT OF WORKSHOP AND FURTHER SUPPORT ACTIONS

For the aquaculture sector (agreed as a coordinated action between ARDITI and IU-ECOAQUA both for present and subsequent related tasks), the literature review was shared according to broader taxonomic groups. Thus, ARDITI staff was in charge of the review for finfish and algae, and ULPGC staff of the review for molluscs and crustaceans.

The relevance and opportunity to develop a workshop on aquaculture was also agreed, in order to take benefit of the expertise accumulated by local scientists on aquaculture and on environmental conservation belonging to Aquaculture Research Group and to Biodiversity and Conservation Research Group, both at IU-ECOAQUA.

The workshop "GOOD ENVIRONMENTAL STATUS & AQUACULTURE" was developed on Wednesday of 21st March at the IU-ECOAQUA facilities in the Marine Technological Science Park, Taliarte (Gran Canaria). It supported PLASMAR project activity 2.1.1 c&d, serving to clarify and validate the literature review for the analyse of the relationship between the 11 qualitative descriptors (that determine GES according to the MSFD) and their specific criteria to the activity of marine aquaculture.

Due to the state of project action, main focus was given to finfish aquaculture, as ARDITI had reached greater progress in the development of the literature review, although guidance for the progress on algae and molluscs groups was also gained. At present state, crustacean aquaculture was not considered as there are not possibilities of its culture production in the Macaronesian marine environment.

During the week, staff from ARDITI and from IU-ECOAQUA developed collaborative work. Work developed prior to the workshop included the review of the project 2.1.1 c&d task progress, identification of priorities to be discussed at the workshop (main quality descriptors and specific criteria were impacts needed to be clarified and/or identifying specific solutions and monitoring methods), including key clarifications to be obtained from discussions with aquaculture experts. These work sessions counted with the participation of Ricardo Haroun and Sachi Kaushik. The preparation and printing of workshop materials was also undertaken. After the workshop sessions, analyses of main workshop outcomes, and more detailed expert consultations were done.

5 DESCRIPTION OF THE WORKSHOP SESSION "GOOD ENVIRONMENTAL STATUS & AQUACULTURE": 21st March 2018.

The **general aim of the workshop** was the analyses of marine aquaculture, as one of the main maritime sectors key to Blue growth, the implementation of MSFD and practical application of the 11 Quality descriptors with regards to specific maritime activities for the achievement of GES, and the identification of barriers and synergies between marine and coastal activities.

Regarding the **detailed learning objectives**, it was assessed as very interesting to review with the experts all 11 Quality descriptors. Nevertheless, due to time restrictions during the morning session (initially planned for 9-12am) and given the detailed structure of criteria contained in Commission Decision (EU) 2017/848, it would be more fruitful to focus on the primary criteria (a total of 28 criteria). Posters showing each Quality descriptor and its primary criteria, with space for each of the considered species considered groups (finfish, algae, molluscs) were designed and printed (see results tables at the end of the document). All considered species groups were incorporated to the working materials although being fully aware that limited time would not make possible the detailed discussion on each criteria and group. Some copies of Commission Decision (EU) 2017/848 of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU, were also prepared, in order to serve for a more detailed reference of the structure and content Quality Descriptors, criteria and indicators, whenever necessary.

The **methodology** was designed in order to have a dynamic workshop that would facilitate active involvement of all participants. The room was arranged to locate on the walls the posters for each Quality descriptor, providing coloured post-its and felt tipped pens to include notes (on impacts, pressures, mitigation, monitoring methods, …) for the different species groups. A large table served to locate laptops for specific literature and online consultations, and a coffee corner was arranged with refreshments in order make the most of the scheduled time, while creating a more welcoming work space.

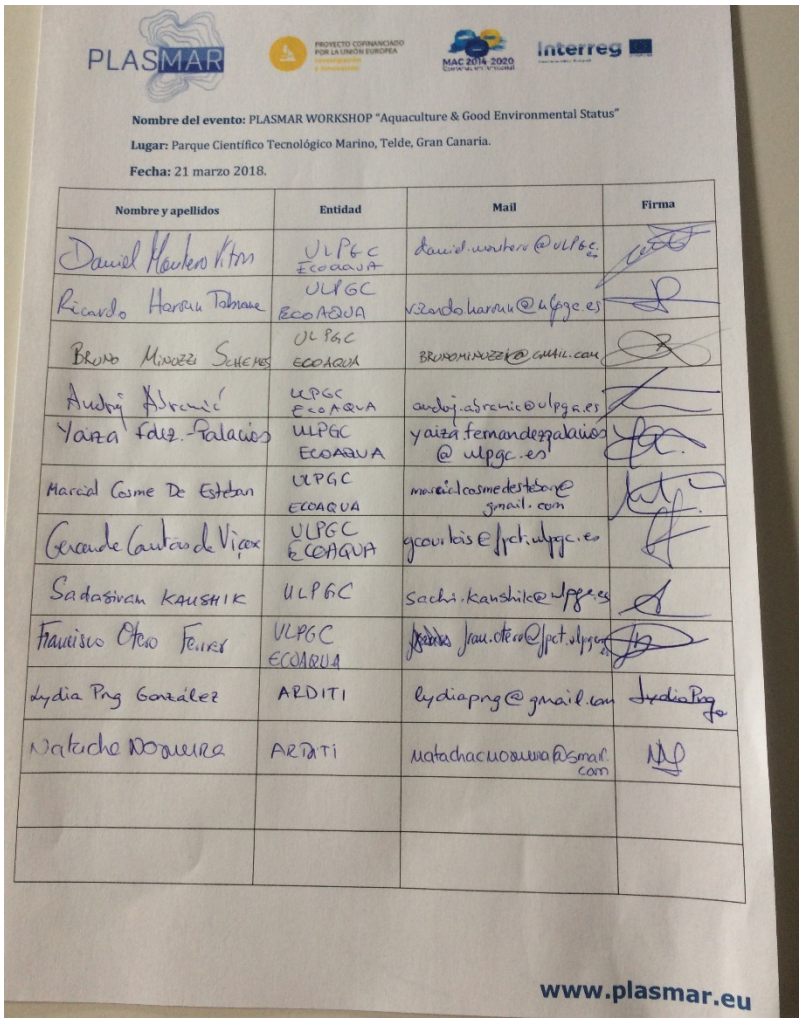
The **Workshop "GOOD ENVIRONMENTAL STATUS & AQUACULTURE"** was conducted **on the 21st March at the IU-ECOAQUA venue** (Gran Canaria, Spain). It was developed as an internal workshop were invited experts belonged to Aquaculture Research Group (GIA) and Biodiversity and Conservation Research Group (BIOCON), provided their working time and shared their high level of expertise in aquaculture and marine environment, and the high interest of the contributions to be provided by the different participants.

The **workshop development** proceeded as planned and after the introductory presentations, the expert review was initiated: each Quality descriptor was briefly presented before primary criteria were discussed one by one. All participants contributed providing their experience and knowledge, which they backed with robust scientific references. Discussions were maintained and notes on agreed results or further research needed were taken. Participants had free movement from posters to computers (to review documents or take notes), and to refreshment area when necessary, creating a comfortable work environment. Although the workshop finalisation was expected for 12h, the review of Quality descriptors had not been completed and participants continued working until 14 hours.

Invited **participants** at the Aquaculture workshop were:

- Natacha Nogueira (ARDITI)
- Lydia Png González (ARDITI)
- Daniel Montero Vitores (IU-ECOAQUA)
- Gercende Courtois de Vicose (IU-ECOAQUA)
- Francisco José Otero Ferrer (IU-ECOAQUA)

- Marcial Cosme de Esteban (IU-ECOAQUA)
- Bruno Minuzzi (IU-ECOAQUA)
- Yaiza Fernández-Palacios Vallejo (IU-ECOAQUA)
- Andrej Abramic (IU-ECOAQUA)
- Juan Manuel Afonso López (IU-ECOAQUA); absence excused.
- Lidia Esther Robaina Robaina (IU-ECOAQUA; absence excused.
- Ricardo Haroun Tabraue (IU-ECOAQUA)
- Sachi Kaushik (ECOAQUA ERA Chair)



PLASMAR

Nombre del evento: PLASMAR WORKSHOP "Aquaculture & Good Environmental Status"

Lugar: Parque Científico Tecnológico Marino, Telde, Gran Canaria.

Fecha: 21 marzo 2018.

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Fig. 1. List of attendees to the Workshop "GOOD ENVIRONMENTAL STATUS & AQUACULTURE".

The role of workshop **moderators** was developed by Lydia Png-Gonzalez (ARDITI) and Yaiza Fernández-Palacios Vallejo (IU-ECOAQUA).

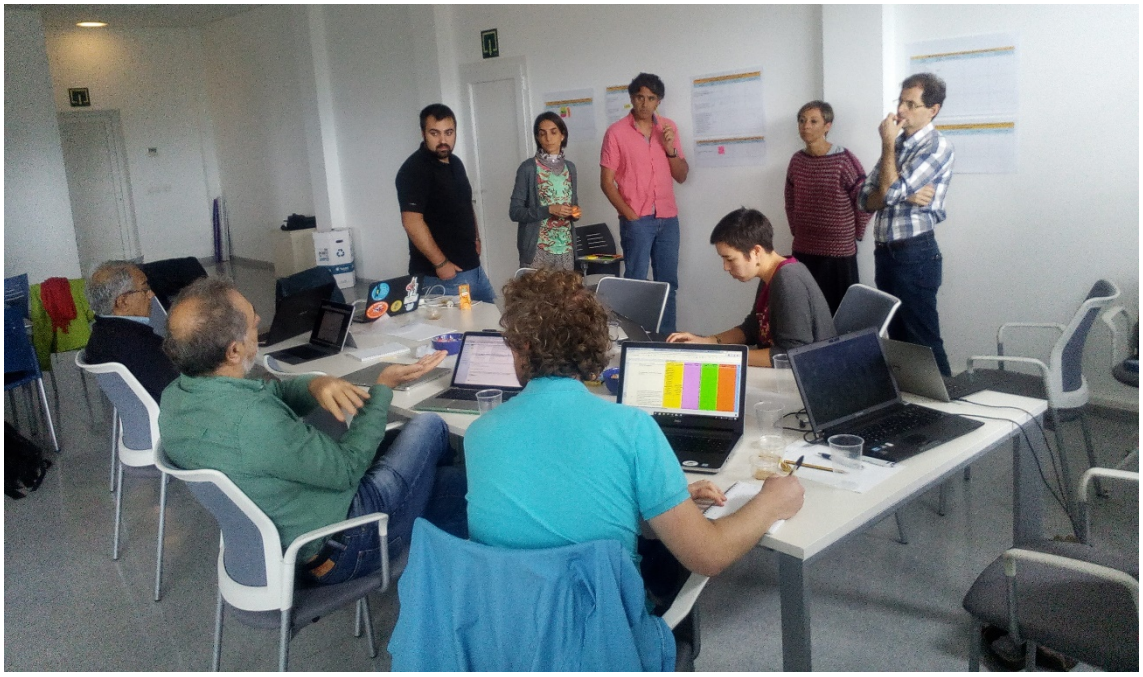
In conclusion, the Workshop **"GOOD ENVIRONMENTAL STATUS & AQUACULTURE"** served to jointly clarify doubts and validate the literature review previously developed by ARDITI on finfish, and to point some issues to be tackled through the review for the species groups of algae and molluscs.

V. Overview of the maritime sectors in the Canary Islands.

The **workshop agenda** was as follows:

9:00	Welcome coffee.
9:15	Presentation of PLASMAR Project. Andrej Abramic (IU-ECOAQUA)
9:20	Introduction to workshop objectives and methodology. Lydia Png (ARDITI) and Yaiza Fernández-Palacios (IU-ECOAQUA).
9:30	Detailed analyses of interaction of GES Quality descriptors (primary criteria) with marine aquaculture, with special reference to the Macaronesia. All participants.
11:45	Wrap up and conclusions of workshop. Final programmed at 12:00; Work was extended until 14:00.

The following pictures show different moments of the working session and discussions:



Results of the outputs for finfish aquaculture are shown in the following tables:

QD1 Species groups of birds, mammals, reptiles, fish and cephalopods (relating to Descriptor 1)				
Criteria (element)	**Criteria (code)**	**Environmental Impact**	**Possible solutions**	**Monitoring method**
The mortality rate of birds, mammals, reptiles and non-commercially-exploited species of fish and cephalopods from incidental by-catch is below levels which threaten the species, such that its long-term viability is ensured.	D1C1	NO		
The population abundance of the species is not adversely affected due to anthropogenic pressures, such that its long-term viability is ensured. MS shall establish a set of species representative of each species group, selected according to the criteria laid down under 'specifications for the selection of species and habitats', through regional or subregional cooperation. These shall include the mammals and reptiles listed in Annex II to Dir. 92/43/EEC and may include any other species, such as those listed under Union legislation (other Annexes to Dir. 92/43/EEC, Dir. 2009/147/EC or through Reg. (EU) No 1380/2013) and international agreements such as Regional Sea Conventions.	D1C2	NO		
The population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity, and survival rates) of the species are indicative of a healthy population which is not adversely affected due to anthropogenic pressures. Primary for commercially-exploited fish and cephalopods and secondary for other species	D1C3	Species related to aquaculture facilities are known to have a bigger body size than their wild counterparts.	Improvement of feeding management to reduce feed wastes.	
The species distributional range and, where relevant, pattern is in line with prevailing physiographic, geographic and climatic conditions. Primary for species covered by Annexes II, IV or V to Directive 92/43/EEC and secondary for other species.	D1C4	Effect of FAD and consequent changes in the migratory route ('oportunistic migration') of seabirds, pelagic fish species, etc. 'Feeding station' function.	Dissuasive methods.	Visual census.
The habitat for the species has the necessary extent and condition to support the different stages in the life history of the species. Primary for species covered by Annexes II, IV and V to Directive 92/43/EEC and secondary for other species	D1C5	NO		

QD1 Pelagic habitats (relating to Descriptor 1)				
Criteria (element)	**Criteria (code)**	**Environmental Impact**	**Possible solutions**	**Monitoring method**
The condition of the habitat type, including its biotic and abiotic structure and its functions (e.g. its typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), is not adversely affected due to anthropogenic pressures.	D1C6	There is an effect of the aquaculture activity on this criterion, which it is not necessarily considered as a negative impact. Presence of FADs: physical effects (darkening, hydrodynamic conditions), eutrophization and distribution of the pelagic community.	Site selection: avoidance of areas considered as possible 'migratory/pelagic corridors'	Further research needed.

QD2 Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems				
Criteria (element)	**Criteria (code)**	**Environmental Impact**	**Possible solutions**	**Monitoring method**
Newly-introduced non-indigenous species	D2C1	Introduction of NIS associated to farmed molluscs. *Species present over 20 yr are not considered as introduced anymore.	Thermal shock to sterilise associated organisms during the translocation of farmed mollusc individuals. Use of triploid finfish individuals to avoid reproduction in the wild.	Sampling surveys in the farm proximities whenever escape events occur and recapture.

QD3 Populations of all commercially-exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock				
Criteria (element)	**Criteria (code)**	**Environmental Impact**	**Possible solutions**	**Monitoring method**
The *Fishing mortality* rate of populations of commercially-exploited species	D3C1	NO		
The *Spawning Stock Biomass* of populations of commercially-exploited species	D3C2	This criterion is applied whenever farmed species are native or viable in the wild. In this case, hybridization may occur by escapees.	Avoid the introduction of non-indigenous species, which is currently regulated by the law. Replacement of the breeding stock to improve the genetic diversity.	Genetic analysis/stable isotopes? For native and viable species.
The age and size distribution of individuals in the populations of commercially-exploited species is indicative of a healthy population. This shall include a high proportion of old/large individuals and limited adverse effects of exploitation on genetic diversity.	D3C3	NO		

QD1&QD4 Ecosystems, including food webs (relating to Descriptors 1 and 4)				
Criteria (element)	**Criteria (code)**	**Environmental Impact**	**Possible solutions**	**Monitoring method**
The diversity (species composition and their relative abundance) of the trophic guild is not adversely affected due to anthropogenic pressures.	D4C1	Modification of the fatty acid composition ('footprint') on species associated to finfish aquaculture facilities.	Site selection and inclusion of filter feed species under sea-cages.	Use of Biodiversity index according to depth, age of farm and annual production.
The balance of total abundance between the trophic guilds is not adversely affected due to anthropogenic pressures.	D4C2	NO DATA		

QD5 Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters				
Criteria (element)	**Criteria (code)**	**Environmental Impact**	**Possible solutions**	**Monitoring method**
Nutrient concentrations (Dissolved Inorganic Nitrogen (DIN), Total Nitrogen (TN), Dissolved Inorganic Phosphorus (DIP), Total Phosphorus (TP)) are not at levels that indicate adverse eutrophication effects.	D5C1	This criterion might apply depending on the production magnitude, management practices, oceanographic conditions and carrying capacity of the local environment.	Improvement on feed quality and investment on technology (e.g. sensors). Good management relating feed wastes and facilities maintenance.	Proposal of monitorization with sensors for feed wastes and forecast by modelling tools.
Chlorophyll a concentrations are not at levels that indicate adverse effects of nutrient enrichment.	D5C2	It is not considered as feasible under curent conditions in the Macaronesia.		
The concentration of dissolved oxygen is not reduced, due to nutrient enrichment, to levels that indicate adverse effects on benthic habitats (including on associated biota and mobile species) or other eutrophication effects.	D5C5	It would only apply whenever a critical management occur or by chance, and water renewal were scarce.	Site selection, fallowing, good management practices.	Biochemical/Chemical Oxygen Demand sensors.

QD6 Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected				
Criteria (element)	**Criteria (code)**	**Environmental Impact**	**Possible solutions**	**Monitoring method**
Spatial extent and distribution of physical loss (permanent change) of the natural seabed	D6C1	NO		
Spatial extent and distribution of physical disturbance (including intertidal areas) pressures on the seabed.	D6C2	Mooring system, darkening.	Site selection, investment in technology improvement.	Sediment and infaunal community analysis.
Spatial extent of each habitat type which is adversely affected, through change in its biotic and abiotic structure and its functions (e.g. through changes in species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), by physical disturbance.	D6C3	Waste input (uneaten feed, faeces).	Site selection with preference for offshore facilities.	Periodic monitoring programmes on sediment and benthic communities. Biological markers (e.g. DNA, stable isotopes). *Need to define indicators for Macaronesia.

QD1& QD6 Benthic habitats (relating to Descriptors 1 and 6)				
Criteria (element)	**Criteria (code)**	**Environmental Impact**	**Possible solutions**	**Monitoring method**
The extent of loss of the habitat type, resulting from anthropogenic pressures, does not exceed a specified proportion of the natural extent of the habitat type in the assessment area.	D6C4	NO		
The extent of adverse effects from anthropogenic pressures on the condition of the habitat type, incl. alteration to its biotic and abiotic structure and its functions (e.g. its typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), doesnt exceed a specified proportion of the natural extent of the habitat type in the assessment area.	D6C5	Effect of FAD and consequent attraction of benthic species. Contribution to ecosystem services: feed availability, shelter, new niches.	Feed management to mitigate the attraction efect.	NO DATA Suggested visual census

DC8 Concentrations of contaminants are at levels not giving rise to pollution effects				
Criteria (element)	**Criteria (code)**	**Environmental Impact**	**Possible solutions**	**Monitoring method**
Concentrations of contaminants (ubiquitous persistent, bioaccumulative and toxic substances - Article 8a(1)(a) of Directive 2008/105/EC) do not exceed the established (WFD) threshold values in water, sediment or biota.	D8C1	NO *It is considered a relevant criterion which should be monitored.		
The spatial extent and duration of significant acute pollution events (Dicharging oil and noxious liquid substances - MARPOL 73/78Article 2(2) of Directive 2005/35/EC) are minimised.	D8C3	NO		
The adverse effects of significant acute pollution events on the health of species and on the condition of habitats (such as their species composition and relative abundance)	D8C4	NO		

QD9 Contaminants in fish and other seafood for human consumption do not exceed levels established by Union legislation or other relevant standards				
Criteria (element)	**Criteria (code)**	**Environmental Impact**	**Possible solutions**	**Monitoring method**
The level of contaminants in edible tissues (muscle, liver, roe, flesh or other soft parts, as appropriate) of seafood (including fish, crustaceans, molluscs, echinoderms, seaweed and other marine plants) caught or harvested in the wild (excluding fin-fish from mariculture) does not exceed Regulation (EC) No 1881/2006	D9C1	This criterion does not apply to finfish aquaculture. In the case of other types of aquaculture (molluscs, seaweeds, echinoderms), it is not feasible to occur, since the presence of contaminants in edible tissue would not be due to the aquaculture activity itself.		

QD10 Properties and quantities of marine litter do not cause harm to the coastal and marine environment				
Criteria (element)	**Criteria (code)**	**Environmental Impact**	**Possible solutions**	**Monitoring method**
The composition, amount and spatial distribution of litter (excluding micro-litter, classified in the following categories : artificial polymer materials, rubber, cloth/textile, paper/cardboard, processed/worked wood, metal, glass/ceramics, chemicals, undefined, and food waste) on the coastline, in the surface layer of the water column, and on the seabed, are at levels that do not cause harm to the coastal and marine environment.	D10C1	Accumulation of marine litter due to aquaculture activities by wear and tear of structures. Also by severe weather conditions.	Good management practices to combat sea-based sources.	Visual surveys (underwater and at the surface) to remove marine litter.
The composition, amount and spatial distribution of micro-litter (particles < 5mm) on the coastline, in the surface layer of the water column, and in seabed sediment, are at levels that do not cause harm to the coastal and marine environment.	D10C2	Accumulation of microplastics due to the degradation and fragmentation of plastic debris. Additionally, boring fauna in aquaculture structures may release microplastics into the marine environment.	Best practices and working protocols through maintenance and gear recovery.	Clean-up methods based on oceanographic models.

QD11 Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment				
Criteria (element)	**Criteria (code)**	**Environmental Impact**	**Possible solutions**	**Monitoring method**
The spatial distribution, temporal extent, and levels of anthropogenic impulsive sound sources do not exceed levels that adversely affect populations of marine animals.	D11C1	NO		
The spatial distribution, temporal extent and levels of anthropogenic continuous low-frequency sound do not exceed levels that adversely affect populations of marine animals.	D11C2	NO		

6 References

Abramic *et al.*, 2018. Finding the balance of Blue Growth within Ecosystem Approach: a standardised methodology for the analyses of maritime sectors. *(In preparation)*. Soon available at: www.plasmar.eu