PLASMAR

Bases para la planificación sostenible de áreas marinas en la Macaronesia

Identification of areas for Blue Growth

THE DEVELOPMENT AND APPLICATION OF A MULTICRITERIA ANALYSIS TO SUPPORT MARITIME SPATIAL ZONING

UNIVERSIDADE DOS AÇORES – FUNDAÇÃO GASPAR FRUTUOSO

Governo dos Açores
Secretaria Regional do Mar, Ciência e Tecnologia

PROYECTO COFINANCIADO POR LA UNIÓN EUROPEA
Investigación e Innovación

MAC 2014-2020
Cooperación Territorial

Interreg

www.plasmar.eu

To cite this report:

Shinoda, Deborah; Calado, Helena; Vergílio, Marta. 2019. 'Identification of Areas for Blue Growth: The development and application of a multicriteria analysis to support maritime spatial zoning'. *University of Azores*. Report prepared as part of PLASMAR Project (co-financed by ERDF as part of POMAC 2014-2020). 27 pp.

LEGAL NOTICE

TABLE OF CONTENTS

I. Introduction

1 The PLASMAR project

Aiming the development of methodologies to support Maritime Spatial Planning (MSP) and Blue Growth, the project PLASMAR "Setting the basis for sustainable maritime spatial planning in Macaronesia" has the goal to potentialize the development of marine activities in balance with the biogeographical specific characteristics of Macaronesia region (including in Portugal the Azores and Madeira archipelagos, and in Spain the Canary Islands). It also aims to support the achievement of the Good Environmental Status (GES) launched at the Marine Strategy Framework Directive (MSFD) (Directive 2008/56/EC).

The PLASMAR activity 2.1.2 "Pilot Zoning – identification of areas for Blue Growth development within ecosystem approach" intends to identify potential areas for the "blue growth" in Macaronesia. This task consists on developing a general methodology of zoning activities/sectors over the maritime space and implementing a pilot zoning for Macaronesia, which will be developed on INDIMAR platform.

The elaboration of a zoning proposal demands basis information. Hence, this data will be gathered, organized and produced in the following activities:

i. Activity 2.1.1 "Finding the balance of Blue Growth Sustainable Development within Ecosystem Approach";
ii. Activity 2.2.1 "Analyses of data & information availability, current and potential data holders/providers, in the scope of Maritime Spatial Planning";
iii. Activity 2.3.1. "Marine monitoring methods needed to apply MSP ecosystem approach".

From the results obtained in the project, a zoning methodology will be stablished considering the following marine sectors:

i. Aquaculture;
ii. Fisheries;
iii. Marine transportation;
iv. Offshore renewable energy;
v. Aggregate extraction;
vi. Marine tourism.

The pilot zoning will identify the best suitable areas for specific maritime activities, in line with the maintenance of the GES, according to the information available in the Marine Distributed Data Infrastructure. This is a result of the Activity 2.2.1 of PLASMAR "Analyses of data & information availability, current and potential data holders/providers, in the scope of Maritime Spatial Planning".

In this sense, the different methodologies currently applied for Multi-Criteria Decision Making (MCDM) will be further developed in order to subsidize the methodology currently being developed in this project.

II. Multicriteria-decision making draft methodology

2 PLASMAR multicriteria analysis

In order to apply the methodology of weight calculation under the PLASMAR project, further detailed at the previous reports (Shinoda *et al.*, 2018; Shinoda *et al.*, 2019), an expert based survey was applied for each sector. The final methodology of this survey will be briefly developed in this section.

2.1 Methodological framework

Aiming the achievement of the Action 2.1.2. of PLASMAR, "Pilot Zoning – Identification of areas for Blue Growth development within ecosystem approach", a detailed methodology of weight calculation was proposed based on the Analytical Hierarchy Process (AHP).

The PLASMAR action 2.2.1, "Identification of areas for Blue Growth", was the basis for the goal definition in this analysis. Furthermore, in order to comprehend the different maritime sectors addressed during the project as the blue growth sectors, the overall goal was subdivided into objectives. This subdivision aimed the identification of specific criteria and weights for each sector individually and the hierarchical structure proposed for this analysis can be observed in Figure 1 (Shinoda et al., 2019).

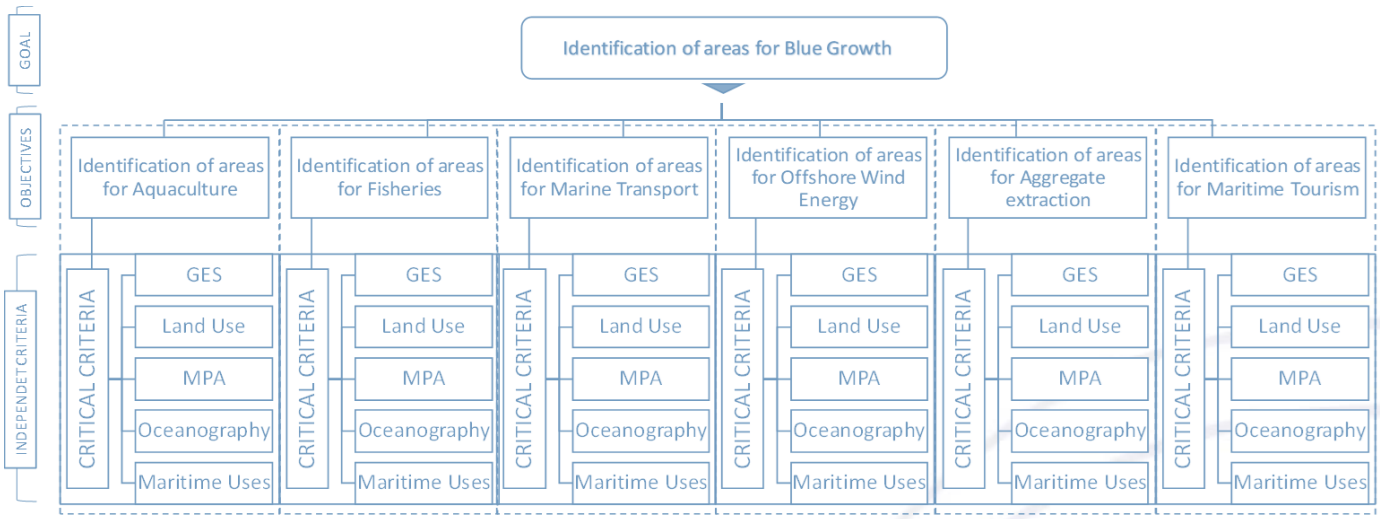


Figure 1: Final proposition of hierarchical structure for the PLASMAR analysis.

Furthermore, the logic of analysis within each cluster varied between impact and contribution. This classification was given after several discussions taken within PLASMAR group on the revision of the methodology. The logic of analysis can be observed in Figure 2.

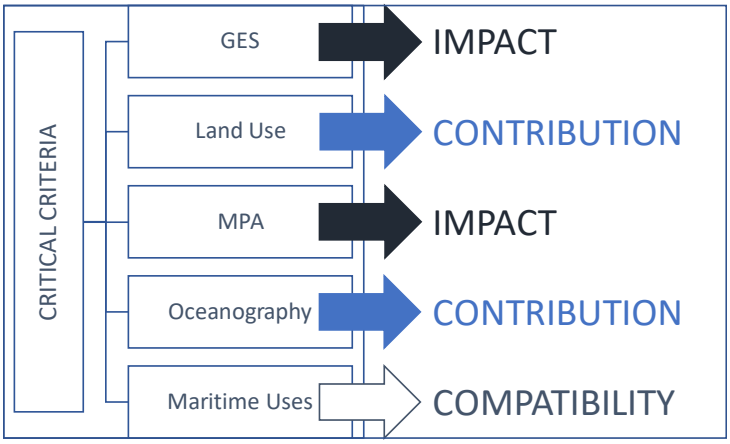


Figure 2: Logic taken for each cluster within the analysis.

The criteria adopted for the multicriteria analysis in this study were the PLASMAR data framework, in order to associate the aforementioned analysis with the spatial data developed in the scope of the project. During the development of the methodology updates were made in the PLASMAR data framework list and the latest version is presented in Table 1. Details on the selection of the parameters will be available soon at plasmar.eu.

Table 1: PLASMAR data framework adopted for the identification of areas for Blue Growth. In red the removed parameters, in green the ones added.

Group of parameters	Parameter	Sub-parameter
MSFD Good Environmental Status criteria elements	Descriptor 1: Biodiversity – Habitats and Species	Marine Habitats
		Coastal habitats
		Benthic habitats
		Sensitive species distribution/migrations
		Mammals
		Birds
		Turtles
		Cephalopod
	Descriptor 2	Non-indigenous species
	Descriptor 3	The population of commercial fish species
	Descriptor 4	Elements of food webs
	Descriptor 5: Human-induced eutrophication	Chlorophyll a
		Dissolved oxygen
		Nutrients
		Water transparency

	Descriptor 6	The sea floor integrity (physical loss & disturbance)
	Descriptor 7	Permanent alteration of hydrographical conditions
	Descriptor 8	Concentrations of contaminants – heavy metals and other contaminates
	Descriptor 9	Contaminants in seafood - assessed data, not time series
	Descriptor 10	Marine litter
	Descriptor 11	Energy, including underwater noise data
MPA	Nationally designated areas (CDDA by EEA) *	
	Natura 2000 *	
	No take zone*	
Land use/cover	CORINE data set on land cover	Urban areas
		Industrial areas
		Port areas
		Agriculture
		Forest
		Beaches, dunes, sands
		Airports
	Distance to the coast	
	Point and lineal coastal pressures	
Oceanography	Overall ocean temperature	
	Sea surface/sea bottom temperature	
	Sea salinity	
	Mixed layer thickness	
	Currents	
	Waves	
	Depth/bathymetry	
	Wind	
Maritime activities/pressures	Aquaculture facilities	
	Maritime traffic lanes	
	Fishery areas	
	Submarine outfalls	
	Aggregate extraction: Dredging/sand extraction	
	Whale watching	
	Cables	
	Research area	
	Military area	

	Artificial reefs
	Seaweed cultivation
	Diving
	Nautical sports: Windsurfing and surf
	Wreck
	Dumping

** these parameters were considered as the group "Maritime Protected Areas" in the AHP analysis.*

Furthermore, it is important to highlight that the parameters for each maritime sector were classified based on its significance by PLASMAR experts. The importance of each parameter was classified as "low", "medium" and "high", and only the classifications "medium" and "high" were included in the AHP analysis as the critical criteria for analysis (Figure 3). The pairwise comparison models for each sector can be found in Annex 1.

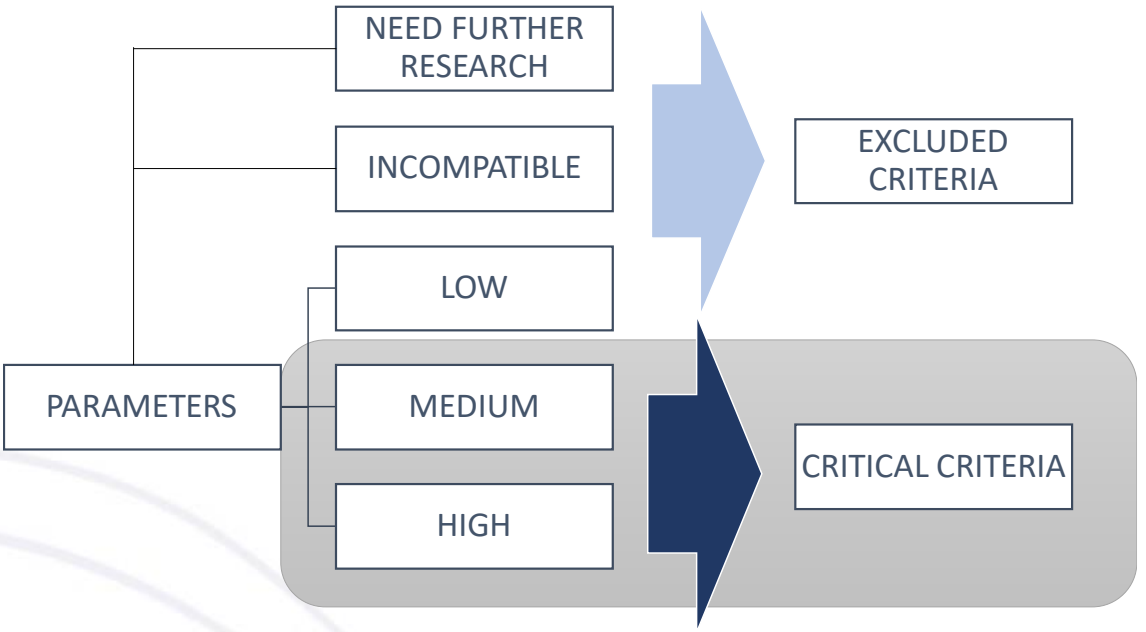


Figure 3: Significance analysis on PLASMAR parameters.

Regarding the expert's consultation, it was initially applied on experts internal to PLASMAR project, mostly on a group-based consensus decision. This approach aimed not only the achievement of weights, but also the test and adaptations, if necessary, of the analysis for each specific sector.

Furthermore, this consultation aimed to be complemented by experts external to the PLASMAR project. This consultation took place at the Azores and the selection was based on the governmental experts' database. Nonetheless, it is important to highlight the need to expand this survey in the future to the entire Macaronesia and to a wide range of stakeholder's for further representativity in the results.

Regarding the methodology employed for the final weight definition, Escobar and Moreno-Jiménez (2007), citing Aczel and Saaty (1983) and Saaty (1980), observes that several aggregation procedures are proposed on literature, nonetheless the most commonly adopted is the geometric mean once it satisfies the unanimity condition (Pareto principle) and homogeneity condition.

Furthermore Ossadnik et al. (2016) highlights the need to consider the group structure in the aggregation technique. The author observes that in the case the group structure is homogeneous and decision makers are willing to act like a single individual, the aggregation of individual judgments (AIJ) is recommended. Considering that the stakeholders' selection was taken on a sectoral basis and that it only considers experts on the specific field, the AIJ will be considered in this analysis.

3 Results

The weight definition of each maritime sector will be further discussed in this section.

3.1 Aquaculture

PLASMAR expert consultation was taken to one individual, added to two experts consulted individually at the Azores. The geometric mean was taken for each entrance of the comparison matrices. The final weights can be observed in Table 2.

The parameters that present the highest values for this sector are on the Good Environmental Status and Oceanography clusters, they are: Biodiversity (Benthic habitats), Overall ocean temperature, Biodiversity (birds), and currents. The parameters that presented the lowest values are: Marine Protected Areas and several CORINE-based coastal land uses, they are: agriculture, port areas and industrial areas.

Table 2: Aquaculture sector final weight.

Cluster	Criteira	PLASMAR	EXTERNAL 1	EXTERNAL 2	Final weight
Good Environmental Status					
	Biodiversity (Benthic habitats)	10.62877	3.9152	19.6484	13.25018
	Biodiversity (Mammals)	4.226503	1.420777	9.969633	5.365483
	Biodiversity (Birds)	4.238919	3.943961	7.575267	6.944937
	Non-indigenous species	4.764705	6.265497	4.470628	6.377168
	Eutrophication (Dissolved oxygen)	1.81068	8.10125	1.463114	3.668818
	Eutrophication (Nutrients)	2.562569	12.83415	1.463114	4.917574
	The sea floor integrity	0.834	2.537105	5.333005	2.824793
	Marine litter	0.761368	19.31566	6.451492	6.43137
Maritime Protected Areas		2.127927	0.718787	1.371442	1.27996
Coastal Land Use					
	CORINE (Urban areas)	1.772627	0.828369	3.05608	2.098576
	CORINE (Industrial areas)	0.734281	0.555149	4.858634	1.571685
	CORINE (Port areas)	0.308705	2.570147	2.22978	1.508314
	CORINE (Agriculture)	0.433225	1.906039	1.040984	1.129357
	Distance to the coast	2.42539	4.223543	0.460646	2.184135
	Point and lineal coastal presures	1.232889	4.223543	1.292051	2.413014
Oceanography					
	Overal ocean temperature	15.69744	8.71511	0.97591	6.946318
	Currents	9.541356	3.548124	3.899662	6.937667
	Waves	5.957021	1.427845	4.065677	4.256015
	Depth/bathymetry	2.522382	1.427845	9.275698	4.134907
	Wind	1.37642	1.427845	2.866862	2.362732
Current Maritime Uses					
	Maritime traffic lanes	1.01848	4.82989	3.591831	3.545116
	Aquaculture facilities	2.844428	2.49131	0.420369	1.847995
	Submarine outfalls	4.822617	1.328047	2.267353	3.090946
	Artificial reefs	8.886995	0.545758	0.976185	2.305397
	Seaweed cultivation	8.47031	0.89905	0.976185	2.607541

3.2 Fisheries

In the fisheries sector the survey was taken within the PLASMAR experts' group only, through a consensus-based decision. It is highly advisable to consult external experts in the future. The PLAMSAR weights can be observed in Table 3.

The parameters that present the highest values for this sector are on the Good Environmental Status cluster, they are: The population of commercial fish species, elements of food web, biodiversity (Marine and coastal habitats). The parameters that presented the lowest values are: Fisheries/Area efforts, the CORINE port-areas, and several oceanographic parameters.

Table 3: Fisheries sector final weight.

Cluster	Criteira	PLASMAR
Good Environmental Status		
	Biodiversity (Marine and coastal habitats)	13.50171
	Biodiversity (Mammals)	1.405155
	Biodiversity (Birds)	1.429261
	Biodiversity (Turtles)	3.105014
	The population of commercial fish specie	17.06702
	Elements of food webs	17.06702
	The sea floor integrity	9.39556
	Marine litter	4.722678
Maritime Protected Areas		4.053757
Coastal Land Use (CORINE: port areas)		0.499363
Oceanography (depth/bathymetry)		
	Overal ocean temperature	0.430414
	Sea surface/sea bottom temperature	0.409481
	Sea salinity	0.409481
	Mixed layer thickness	0.409481
	Currents	2.871043
	Waves	2.983245
	Depth/bathymetry	0.723811
	Wind	2.983245
Current Maritime Uses		
	Aquaculture facilities	3.823518
	Fishery areas/efforts	0.335123
	Submarine outfalls	0.934775
	Research area	3.541501
	Artificial reefs	3.541501
	Diving	3.541501
	Dumping	0.815354

3.3 Maritime Transport

In the maritime transport sector, the survey was taken within the PLASMAR experts' group, through a consensus-based decision. Furthermore, one external expert at the Azores was consulted. The geometric mean was taken for each entrance of the comparison matrices. The final weights can be observed in Table 4.

The parameters that present the highest values for this sector are: Aquaculture facilities and Depth/bathymetry. The parameters that presented the lowest values are on the Good Environmental Status and Coastal land use cluster, they are: Eutrophication (nutrients), eutrophication (dissolved oxygen), the seafloor integrity, CORINE (airports).

Table 4: Maritime transport sector final weight.

Cluster	Criteira	PLASMAR	EXTERNAL 1	Final weight
Good Environmental Status				
	Biodiversity (Mammals)	6.333007	0.895937	2.982789
	Biodiversity (Turtles)	1.863281	0.895937	1.594165
	Non-indigenous species	3.09592	1.764463	2.836669
	Eutrophication (Dissolve	1.58434	0.198701	0.662946
	Eutrophication (Nutrien	1.162654	0.211979	0.625236
	Eutrophication (Water t	1.264903	0.534122	1.014704
	The sea floor integrity	0.827222	0.46896	0.757921
	Concentrations of conta	4.811293	0.946389	2.564851
	Marine litter	2.934205	2.97864	3.674495
	Energy, including under	12.27897	1.886289	6.155986
Maritime Protected Areas		2.436491	2.306233	2.552231
Coastal Land Use				
	CORINE (Industrial area	0.48936	14.82421	3.381703
	CORINE (Port areas)	1.982018	21.59208	8.244512
	CORINE (Airports)	0.158439	3.176459	0.890233
	Distance to the coast	0.519643	5.439121	2.093203
Oceanography				
	Waves	3.512245	4.67562	4.964289
	Depth/bathymetry	17.60892	11.36778	17.38863
	Wind	1.553442	1.905376	2.109995
Current Maritime Uses				
	Aquaculture facilities	18.61091	12.75476	19.82464
	Aggregate extraction (dr	11.14581	3.71745	8.030307
	Nautical sports (Windsu	2.913463	1.066287	2.234476
	Fishery areas/efforts	2.913463	6.393203	5.416014

3.4 Offshore Wind Energy

The offshore wind energy sector survey was taken to one individual within PLASMAR experts, added to two experts consulted individually at the Azores. The geometric mean was taken for each entrance of the comparison matrices. The final weights can be observed in Table 5.

The parameters that present the highest values for this sector are: Biodiversity (birds) and Marine Protected Areas. The parameters that presented the lowest values are: Marine Protected Areas and several CORINE-based coastal land uses, they are: Fishery area/efforts, seaweed cultivation, aquaculture facilities and biodiversity (cephalopods).

Table 5: Offshore wind energy sector final weight.

Cluster	Criteira	PLASMAR	EXTERNAL 1	EXTERNAL 2	Final weight
Good Environmental Status					
	Biodiversity (Benthic habitats)	21.22567	2.51293	1.209612	5.176694
	Biodiversity (Mammals)	7.018654	3.597172	3.605939	5.556526
	Biodiversity (Birds)	12.20373	15.30534	4.682695	12.70951
	Biodiversity (Cephalopods)	1.535602	2.969774	0.665879	1.820437
	Non-indigenous species	3.141943	5.442448	3.605939	4.699876
	Population of commercial fish species	6.818524	5.522201	2.36893	5.545243
	Energy,including underwater noise data	9.994481	2.366771	3.332337	5.62561
Maritime Protected Areas		8.303117	11.52389	13.64338	12.7029
Coastal Land Use					
	CORINE	1.264053	7.379031	2.197259	3.332543
	Distance to the coast	1.264053	7.379031	10.98629	5.698569
Oceanography					
	Depth/bathymetry	8.848371	0.576312	6.535914	3.933975
	Wind	8.848371	2.881559	13.07183	8.475491
Current Maritime Uses					
	Aquaculture facilities	0.531953	1.042477	4.87057	1.668405
	Fishery areas/efforts	0.25144	1.179214	4.87057	1.344143
	Maritime traffic lanes/intesivity maps	2.416032	5.058539	4.87057	4.756717
	Aggregate extraction (Dredging / Sand e	0.71665	2.862885	4.87057	2.589169
	Cables	1.95386	6.466882	4.87057	4.904431
	Military area	3.219411	15.2062	4.87057	8.042388
	Seaweed cultivation	0.444087	0.727347	4.87057	1.417376

3.5 Aggregate Extraction

In the aggregate extraction sector, the survey was taken within the PLASMAR experts' group, through a consensus-based decision. Furthermore, external experts at the Azores were consulted individually. The geometric mean was taken for each entrance of the comparison matrices. The final weights can be observed in Table 6.

The parameters that present the highest values for this sector are: Marine Protected Areas and CORINE (beaches, dunes and sand). The parameters that presented the lowest values are: Biodiversity (mammals) and energy.

Table 6: Aggregate extraction sector final weight.

Cluster	Criteira	PLASMAR	EXTERNAL 1	EXTERNAL 2	Final weight
Good Environmental Status					
	Biodiversity (Benthic Habitats)	7.652249	11.96397	23.32034	14.97
	Biodiversity (Mammals)	0.774352	7.2265	2.723949	2.59
	The population of commercial fish species	1.660048	8.129251	5.916462	4.62
	The sea floor integrity	11.62513	1.707446	6.188571	5.63
	Permanent alteration of hydrographical conditions	3.945016	31.78874	2.741798	7.92
	Energy, including underwater noise data	2.153626	3.40834	2.228733	2.66
Maritime Protected Areas		38.07021	8.219503	30.47012	30.10
Coastal Land Use (CORINE: beaches, dune and sand)		22.25836	21.31769	11.47088	21.68
Oceanography (depth/bathymetry)		11.861	6.238563	14.93914	9.84

3.6 Maritime Tourism

The maritime tourism sector did not present until the date of this report any expert consultation. It is recommended to apply the consultation to PLASMAR experts' group and to external experts', as recommended in this methodology.

4 INDIMAR

The weights developed through this methodology intend to feed the INDIMAR platform (http://www.geoportal.ulpgc.es/indimar/). The final weights given by the multicriteria analysis will be adopted in the platform in order to spatially analyse each sector in Macaronesia.

It is important to notice that each cluster of parameters presented specific negative and positive classifications given in the significance analysis taken in the previous phase. This classification might be translated in INDIMAR through the colour classification existent for each parameter.

Furthermore, it is important to observe that each sector might present specific spatial data demands that might be considered in the spatialization.

5 References

Escobar, M. T. and Moreno-Jiménez, J. M. (2007) 'Aggregation of Individual Preference Structures in Ahp-Group Decision Making', *Group Decision and Negotiation*, 16, pp. 287–301. doi: 10.1007/s10726-006-9050-x.

Ossadnik, W., Schinke, S. and Kaspar, R. H. (2016) 'Group Aggregation Techniques for Analytic Hierarchy Process and Analytic Network Process : A Comparative Analysis'. Springer Netherlands, pp. 421–457. doi: 10.1007/s10726-015-9448-4.

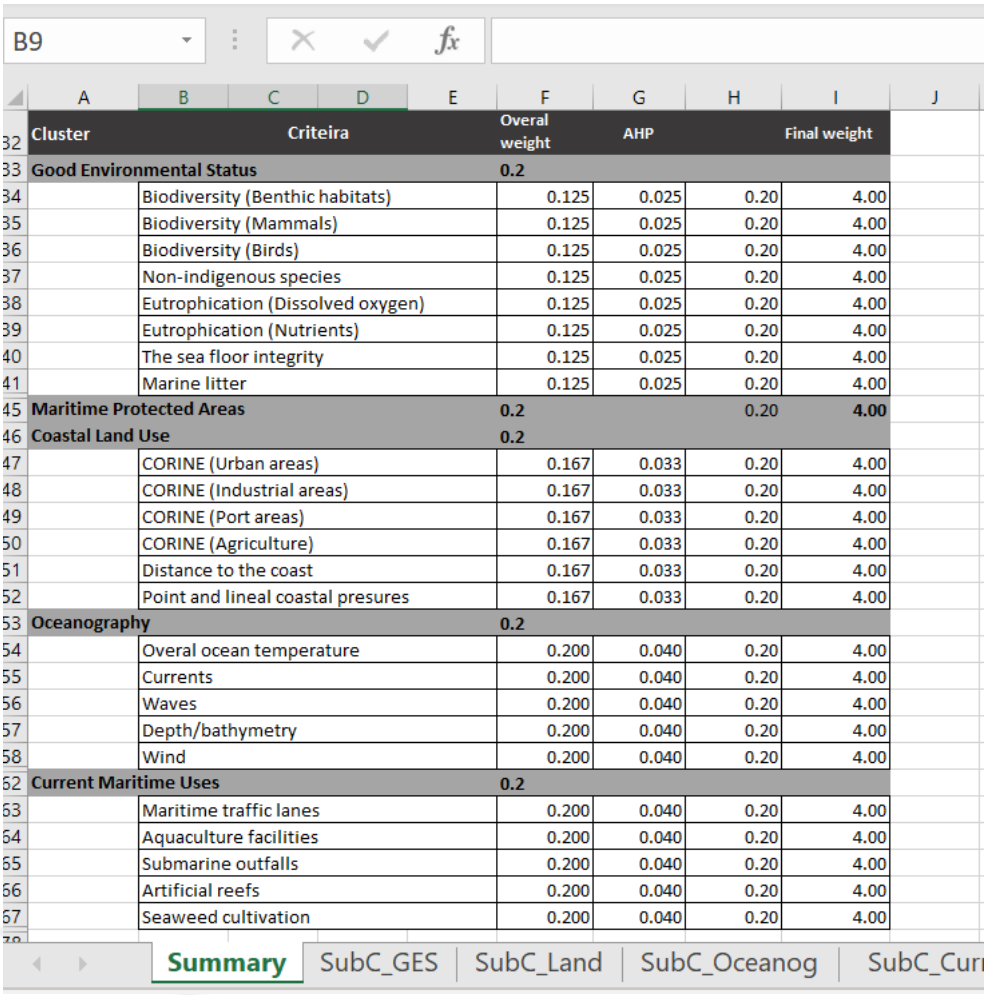
Shinoda, Deborah; Calado, Helena; Vergílio, Marta; Kramel, Diogo; Caña Varona, Mario. (2018) 'Identification of Areas for Blue Growth: Detailed MCDA Draft Methodology'. *University of Azores*. Report prepared as part of PLASMAR Project (co-financed by ERDF as part of POMAC 2014-2020). 30 pp.

Shinoda, Deborah; Calado, Helena; Vergílio, Marta. (2019) 'Identification of Areas for Blue Growth: Advances on the MCDA Methodology'. *University of Azores*. Report prepared as part of PLASMAR Project (co-financed by ERDF as part of POMAC 2014-2020). 19 pp.

Annex 1

1. PLASMAR pairwise comparison model for Aquaculture Finfish

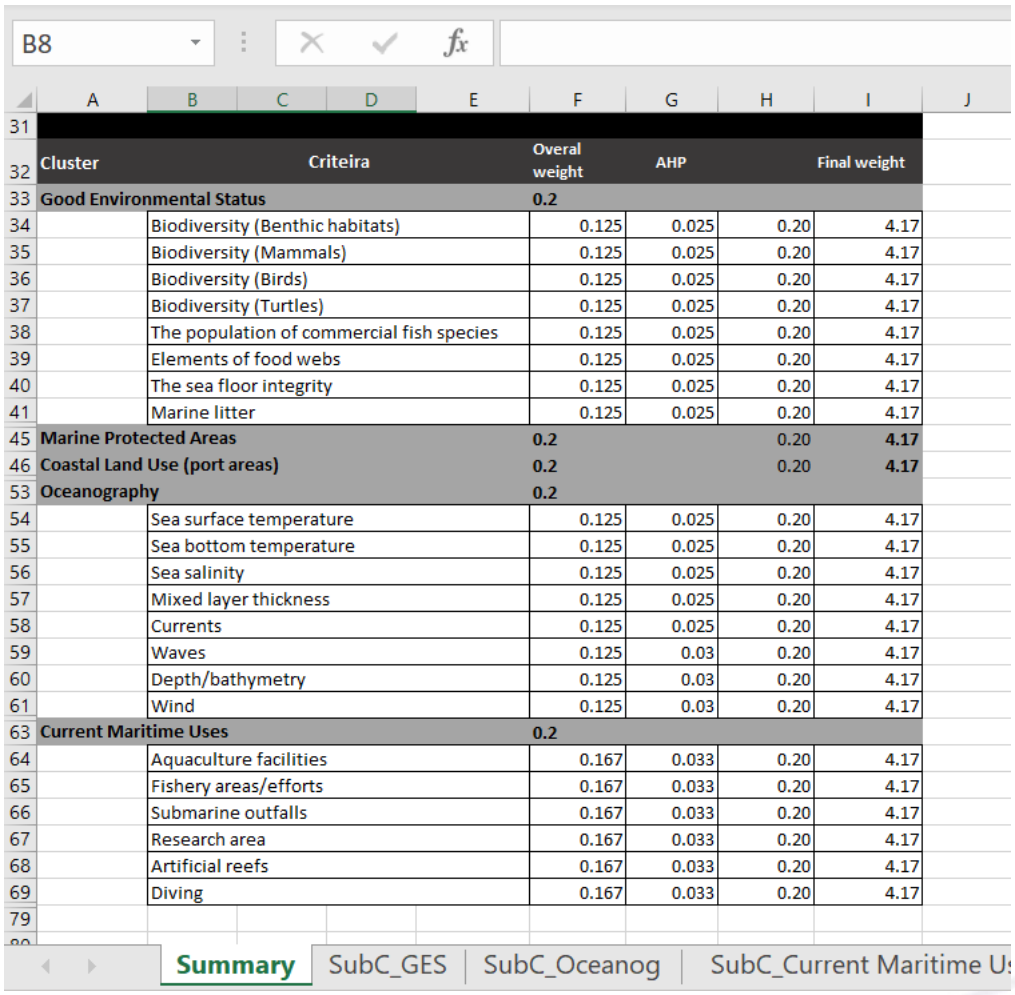
Excel table name: PLASMAR pairwise comparison model_ FINAQUAC



Cluster	Criteira	Overal weight	AHP		Final weight
Good Environmental Status		**0.2**			
	Biodiversity (Benthic habitats)	0.125	0.025	0.20	4.00
	Biodiversity (Mammals)	0.125	0.025	0.20	4.00
	Biodiversity (Birds)	0.125	0.025	0.20	4.00
	Non-indigenous species	0.125	0.025	0.20	4.00
	Eutrophication (Dissolved oxygen)	0.125	0.025	0.20	4.00
	Eutrophication (Nutrients)	0.125	0.025	0.20	4.00
	The sea floor integrity	0.125	0.025	0.20	4.00
	Marine litter	0.125	0.025	0.20	4.00
Maritime Protected Areas		**0.2**		0.20	**4.00**
Coastal Land Use		**0.2**			
	CORINE (Urban areas)	0.167	0.033	0.20	4.00
	CORINE (Industrial areas)	0.167	0.033	0.20	4.00
	CORINE (Port areas)	0.167	0.033	0.20	4.00
	CORINE (Agriculture)	0.167	0.033	0.20	4.00
	Distance to the coast	0.167	0.033	0.20	4.00
	Point and lineal coastal presures	0.167	0.033	0.20	4.00
Oceanography		**0.2**			
	Overal ocean temperature	0.200	0.040	0.20	4.00
	Currents	0.200	0.040	0.20	4.00
	Waves	0.200	0.040	0.20	4.00
	Depth/bathymetry	0.200	0.040	0.20	4.00
	Wind	0.200	0.040	0.20	4.00
Current Maritime Uses		**0.2**			
	Maritime traffic lanes	0.200	0.040	0.20	4.00
	Aquaculture facilities	0.200	0.040	0.20	4.00
	Submarine outfalls	0.200	0.040	0.20	4.00
	Artificial reefs	0.200	0.040	0.20	4.00
	Seaweed cultivation	0.200	0.040	0.20	4.00

2. PLASMAR pairwise comparison model for Fisheries

Excel table name: PLASMAR pairwise comparison model_ FISH



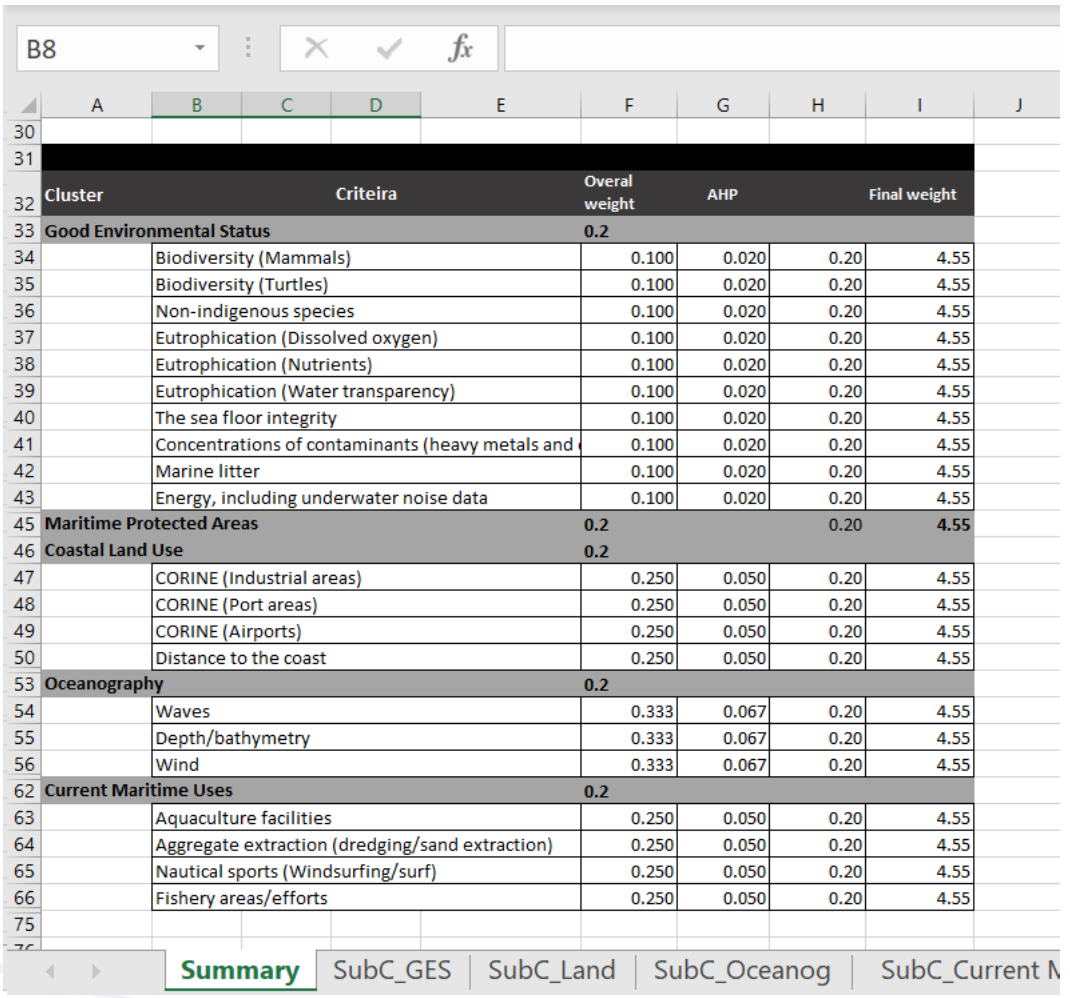
B8

	Cluster	Criteira	Overal weight	AHP		Final weight
33	**Good Environmental Status**		**0.2**			
34		Biodiversity (Benthic habitats)	0.125	0.025	0.20	4.17
35		Biodiversity (Mammals)	0.125	0.025	0.20	4.17
36		Biodiversity (Birds)	0.125	0.025	0.20	4.17
37		Biodiversity (Turtles)	0.125	0.025	0.20	4.17
38		The population of commercial fish species	0.125	0.025	0.20	4.17
39		Elements of food webs	0.125	0.025	0.20	4.17
40		The sea floor integrity	0.125	0.025	0.20	4.17
41		Marine litter	0.125	0.025	0.20	4.17
45	**Marine Protected Areas**		**0.2**		0.20	**4.17**
46	**Coastal Land Use (port areas)**		**0.2**		0.20	**4.17**
53	**Oceanography**		**0.2**			
54		Sea surface temperature	0.125	0.025	0.20	4.17
55		Sea bottom temperature	0.125	0.025	0.20	4.17
56		Sea salinity	0.125	0.025	0.20	4.17
57		Mixed layer thickness	0.125	0.025	0.20	4.17
58		Currents	0.125	0.025	0.20	4.17
59		Waves	0.125	0.03	0.20	4.17
60		Depth/bathymetry	0.125	0.03	0.20	4.17
61		Wind	0.125	0.03	0.20	4.17
63	**Current Maritime Uses**		**0.2**			
64		Aquaculture facilities	0.167	0.033	0.20	4.17
65		Fishery areas/efforts	0.167	0.033	0.20	4.17
66		Submarine outfalls	0.167	0.033	0.20	4.17
67		Research area	0.167	0.033	0.20	4.17
68		Artificial reefs	0.167	0.033	0.20	4.17
69		Diving	0.167	0.033	0.20	4.17

Summary | SubC_GES | SubC_Oceanog | SubC_Current Maritime Us

3. PLASMAR pairwise comparison model for Marine Transport

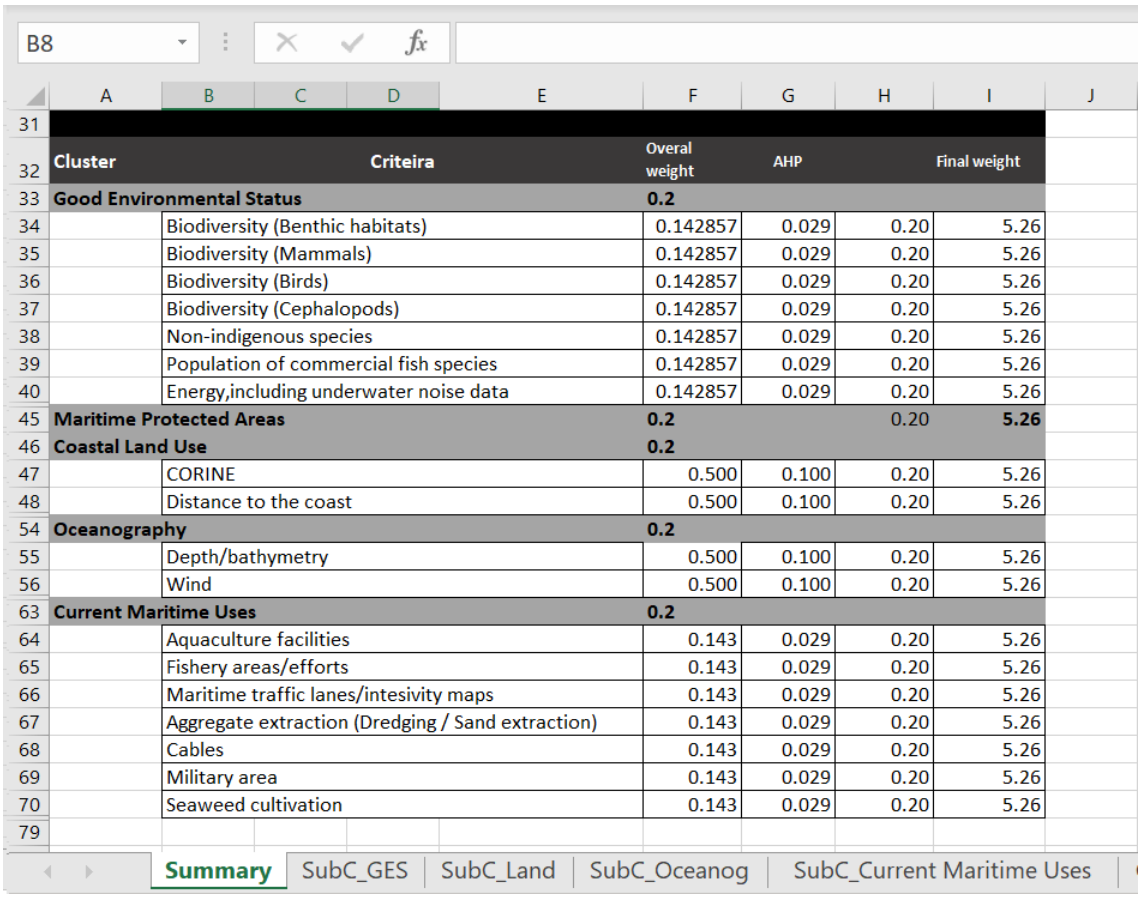
Excel table name: PLASMAR pairwise comparison model_ TRASNPORT



Cluster	Criteira	Overal weight	AHP		Final weight
Good Environmental Status		**0.2**			
	Biodiversity (Mammals)	0.100	0.020	0.20	4.55
	Biodiversity (Turtles)	0.100	0.020	0.20	4.55
	Non-indigenous species	0.100	0.020	0.20	4.55
	Eutrophication (Dissolved oxygen)	0.100	0.020	0.20	4.55
	Eutrophication (Nutrients)	0.100	0.020	0.20	4.55
	Eutrophication (Water transparency)	0.100	0.020	0.20	4.55
	The sea floor integrity	0.100	0.020	0.20	4.55
	Concentrations of contaminants (heavy metals and	0.100	0.020	0.20	4.55
	Marine litter	0.100	0.020	0.20	4.55
	Energy, including underwater noise data	0.100	0.020	0.20	4.55
Maritime Protected Areas		**0.2**		0.20	**4.55**
Coastal Land Use		**0.2**			
	CORINE (Industrial areas)	0.250	0.050	0.20	4.55
	CORINE (Port areas)	0.250	0.050	0.20	4.55
	CORINE (Airports)	0.250	0.050	0.20	4.55
	Distance to the coast	0.250	0.050	0.20	4.55
Oceanography		**0.2**			
	Waves	0.333	0.067	0.20	4.55
	Depth/bathymetry	0.333	0.067	0.20	4.55
	Wind	0.333	0.067	0.20	4.55
Current Maritime Uses		**0.2**			
	Aquaculture facilities	0.250	0.050	0.20	4.55
	Aggregate extraction (dredging/sand extraction)	0.250	0.050	0.20	4.55
	Nautical sports (Windsurfing/surf)	0.250	0.050	0.20	4.55
	Fishery areas/efforts	0.250	0.050	0.20	4.55

4. PLASMAR pairwise comparison model for Offshore Wind Energy

Excel table name: PLASMAR pairwise comparison model_ ENERGY

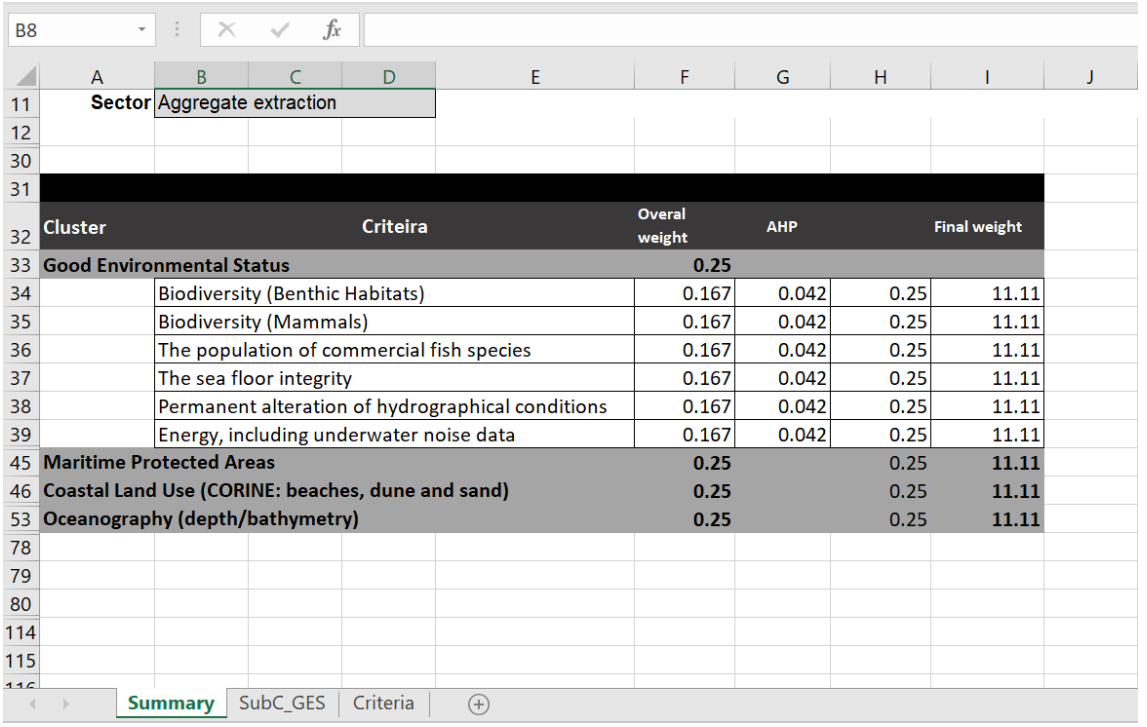


Cluster	Criteira	Overal weight	AHP		Final weight
Good Environmental Status		**0.2**			
	Biodiversity (Benthic habitats)	0.142857	0.029	0.20	5.26
	Biodiversity (Mammals)	0.142857	0.029	0.20	5.26
	Biodiversity (Birds)	0.142857	0.029	0.20	5.26
	Biodiversity (Cephalopods)	0.142857	0.029	0.20	5.26
	Non-indigenous species	0.142857	0.029	0.20	5.26
	Population of commercial fish species	0.142857	0.029	0.20	5.26
	Energy,including underwater noise data	0.142857	0.029	0.20	5.26
Maritime Protected Areas		**0.2**		0.20	**5.26**
Coastal Land Use		**0.2**			
	CORINE	0.500	0.100	0.20	5.26
	Distance to the coast	0.500	0.100	0.20	5.26
Oceanography		**0.2**			
	Depth/bathymetry	0.500	0.100	0.20	5.26
	Wind	0.500	0.100	0.20	5.26
Current Maritime Uses		**0.2**			
	Aquaculture facilities	0.143	0.029	0.20	5.26
	Fishery areas/efforts	0.143	0.029	0.20	5.26
	Maritime traffic lanes/intesivity maps	0.143	0.029	0.20	5.26
	Aggregate extraction (Dredging / Sand extraction)	0.143	0.029	0.20	5.26
	Cables	0.143	0.029	0.20	5.26
	Military area	0.143	0.029	0.20	5.26
	Seaweed cultivation	0.143	0.029	0.20	5.26

Summary | SubC_GES | SubC_Land | SubC_Oceanog | SubC_Current Maritime Uses

5. PLASMAR pairwise comparison model for Aggregate Extraction

Excel table name: PLASMAR pairwise comparison model_ MINERAL



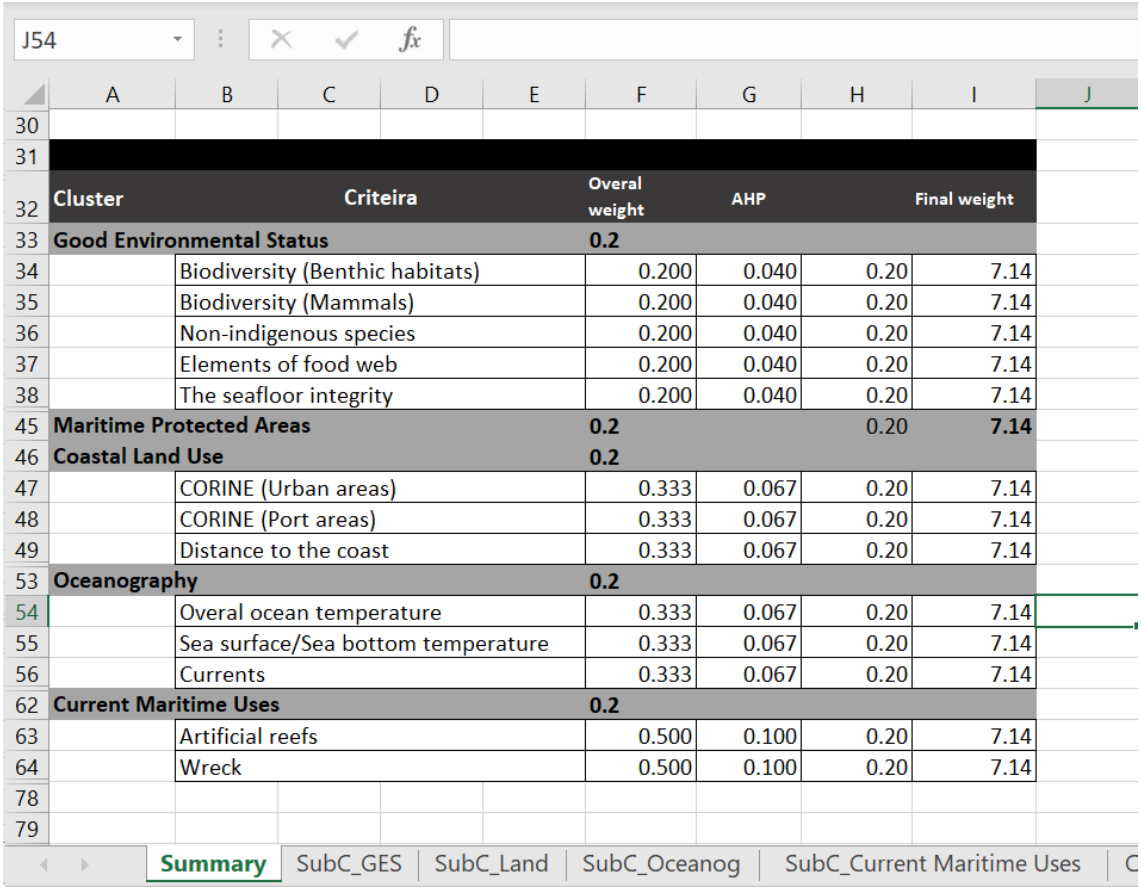
B8

	A	B	C	D	E	F	G	H	I	J
11	**Sector**	Aggregate extraction								
12										
30										
31										
32	**Cluster**	**Criteira**				**Overal weight**	**AHP**		**Final weight**	
33	**Good Environmental Status**					**0.25**				
34		Biodiversity (Benthic Habitats)				0.167	0.042	0.25	11.11	
35		Biodiversity (Mammals)				0.167	0.042	0.25	11.11	
36		The population of commercial fish species				0.167	0.042	0.25	11.11	
37		The sea floor integrity				0.167	0.042	0.25	11.11	
38		Permanent alteration of hydrographical conditions				0.167	0.042	0.25	11.11	
39		Energy, including underwater noise data				0.167	0.042	0.25	11.11	
45	**Maritime Protected Areas**					**0.25**		0.25	**11.11**	
46	**Coastal Land Use (CORINE: beaches, dune and sand)**					**0.25**		0.25	**11.11**	
53	**Oceanography (depth/bathymetry)**					**0.25**		0.25	**11.11**	
78										
79										
80										
114										
115										

Summary | SubC_GES | Criteria

6. PLASMAR pairwise comparison model for Diving in Maritime Tourism

Excel table name: PLASMAR pairwise comparison model_ TOURdive



Cluster	Criteira	Overal weight	AHP		Final weight
Good Environmental Status		**0.2**			
	Biodiversity (Benthic habitats)	0.200	0.040	0.20	7.14
	Biodiversity (Mammals)	0.200	0.040	0.20	7.14
	Non-indigenous species	0.200	0.040	0.20	7.14
	Elements of food web	0.200	0.040	0.20	7.14
	The seafloor integrity	0.200	0.040	0.20	7.14
Maritime Protected Areas		**0.2**		0.20	**7.14**
Coastal Land Use		**0.2**			
	CORINE (Urban areas)	0.333	0.067	0.20	7.14
	CORINE (Port areas)	0.333	0.067	0.20	7.14
	Distance to the coast	0.333	0.067	0.20	7.14
Oceanography		**0.2**			
	Overal ocean temperature	0.333	0.067	0.20	7.14
	Sea surface/Sea bottom temperature	0.333	0.067	0.20	7.14
	Currents	0.333	0.067	0.20	7.14
Current Maritime Uses		**0.2**			
	Artificial reefs	0.500	0.100	0.20	7.14
	Wreck	0.500	0.100	0.20	7.14