GPSAZORES

GPS Azores – Geographical and Political Scenarios and Maritime Spatial Planning for the Azores and North Atlantic

MAP VIEWER
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WP 5 – Map Viewer
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1 – INTRODUCTION

Map viewers containing spatialized data are essential tools for visualizing possible scenarios in ocean management (Pınarbaşı et. al., 2017). Future MSP outcomes can be viewed, considering different economic driving forces, and support planners in the management plan development (Pınarbaşı et. al., 2017).

Map viewers for the three scenarios were developed with the guidance of Calado et al. (2021). Each map therefore has some evident activities. The BAU scenario was market-driven, affected by the development of tourism as a priority; the N@W scenario, as the name suggests, mainly protected nature and conservation activities; and the BD scenario had drivers that were mainly investments in emerging sectors, e.g., geological extraction.

All associate information (metadata) were transferred in layers to the Seasketch (https://www.seasketch.org/) online platform. Seasketch is a web-based solution tool that enables stakeholder interaction and engagement for enabling and improving participatory processes (Seijo et. al., 2021).

The program has been chosen as a special decision-making tool to help experts in the Strategic environmental assessment (SEA), because it is useful to measure the ecological impact of different scenarios (Pınarbaşı et. al., 2017). Seasketch allows a clear visualisation of different future economic contexts in spatial information, helping decision making within distinct stakeholders' sectors (Lombardi et. al., 2016). The tool allows easy interpretation of the data and the possibility for collaborators to choose which layers to visualise, and specific areas of approach, favouring a more detailed analysis of the local context (McClintock & Gordon, 2015).

2. SPATIAL DATA

Online databases were used to develop the maps by creating GIS vectors: PSOEM (GEOPORTAL), Project LabAqua (Potential Aquiculture), and Portal SIGMAR/ DRAM (GEOSERVER) according with table 01 below.

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Activity	Layer	Source
Grid	Oriente	Authors
	Azores	Authors
Geological Extraction	areas_extracao_areias_azores	Portal SIGMAR/ DRAM
	areas_potenciais_extracao_areias	Portal SIGMAR/ DRAM
Aquaculture	areas_producao_aquicola_azores	Portal SIGMAR/ DRAM
	potencial_aquicultura	Portal SIGMAR/ DRAM
	Potencial Locaqua	Projeto Locaqua
Fisheries	Regulamentos pesca áreas protegidas zona maritima santa maria: Pesca: Usos atividades	Portal SIGMAR/ DRAM
	Nucleos pesca ponto: Portos navegacao: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	Regulamentos pesca ribeira quente: Pesca: Usos atividades	Portal SIGMAR/ DRAM
	Área proteção portos categoria d pescas: Outras áreas condicionantes: Servidoes restricoes	Portal SIGMAR/ DRAM
	Área Núcleos Pesca	Portal SIGMAR/ DRAM
	Regulamentos pesca áreas reserva regime apanha portaria 57 2018: Pesca: Usos atividades	Portal SIGMAR/ DRAM
	Distancias referencia pesca: Pesca: Usos atividades	Portal SIGMAR/ DRAM
	Áreas Potencial Expansão Portos Classe D Pescas: Portos navegacao: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
Maritime Transport, ports and coastal infrastructure	Capitanias azores: Portos navegacao: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	Área proteção portos categoria e portinhos: Outras áreas condicionantes: Servidoes restricoes	Portal SIGMAR/ DRAM
	localizacao_portos_d_pescas: Portos navegacao: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	Área proteção portos abc: Outras áreas condicionantes: Servidoes restricoes	Portal SIGMAR/ DRAM
	Infraestruturas portuarias azores ponto: Portos navegacao: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	Infraestruturas portuarias azores area: Portos navegacao: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	Marinas nucleos recreio ponto: Portos navegacao: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	Boias fundeadas sma: Portos navegacao: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	portos_abrigo_classificados	Portal SIGMAR/ DRAM
	Área proteção fundeadouros costeiros: Outras áreas condicionantes: Servidoes restricoes	Portal SIGMAR/ DRAM
	Áreas Pilotagem Obrigatória	Portal SIGMAR/ DRAM
	Fundeadouros costeiros portuarios: Portos navegacao: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	localizacao_boias_gestao_autoridade maritima	Portal SIGMAR/ DRAM
	Localização boias aeai: Portos navegacao: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	Áreas jurisdicao portuaria: Áreas jurisdicao portuaria: Servidoes restricoes	Portal SIGMAR/ DRAM

	Infraestruturas investigacao monitorizacao ambiental: Outros equipamentos infraestruturas: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	Cabos_submarinos_EMODnet	PSOEM_GEOPORTAL
	locais_descarga_aguas_residuais	Portal SIGMAR/ DRAM
	Emissarios submarinos: Outros equipamentos infraestruturas: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	Área salvaguarda locais descarga águas residuais: Outras áreas condicionantes: Servidoes restricoes	Portal SIGMAR/ DRAM
	areas_protecao_emissarios_smg	Portal SIGMAR/ DRAM
	Área Proteção Cabos Submarinos Cartas Naúticas Edital Capitania: Outros equipamentos infraestruturas: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	Cabos submarinos azores: Outros equipamentos infraestruturas: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	Sinalizacao maritima: Portos navegacao: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	localizacao_farois_farolins	Portal SIGMAR/ DRAM
	Rotas maritimas preferenciais mercadorias: Portos navegacao: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	Rotas maritimas preferenciais passageiros: Portos navegacao: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	Áreas Potencial Expansão Portos Classe D Pescas: Portos navegacao: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	areas_potencial_expansao_portos_e_portinhos: Portos navegacao: Infraestruturas equipamentos	Portal SIGMAR/ DRAM
	sp.situacao_potencial:boias_amarracao_potencial	Portal SIGMAR/ DRAM
Tourism, Underwater Cultural Heritage (UCH)	Guia patrimonio cultural subaquatico: Património cultural subaquatico: Património cultural	Portal SIGMAR/ DRAM
	Parques arqueologicos subaquaticos: Património cultural subaquatico: Património cultural	Portal SIGMAR/ DRAM
	Paleoparque santa maria: Outras áreas condicionantes: Servidoes restricoes	Portal SIGMAR/ DRAM
	Geossitios marinhos: Outras áreas condicionantes: Servidoes restricoes	Portal SIGMAR/ DRAM
	Área proteção paleoparque santa maria: Outras áreas condicionantes: Servidoes restricoes	Portal SIGMAR/ DRAM
	Área proteção patrimonio cultural subaquatico 200m: Outras áreas condicionantes: Servidoes restricoes	Portal SIGMAR/ DRAM
	Área proteção patrimonio cultural subaquatico 50m: Outras áreas condicionantes: Servidoes restricoes	Portal SIGMAR/ DRAM
	Áreas potencial surf: Desporto lazer: Usos atividades	Portal SIGMAR/ DRAM
	Zonas mergulho: Desporto lazer: Usos atividades	Portal SIGMAR/ DRAM
	locais_mergulho_classificados	Portal SIGMAR/ DRAM
	Pontos canyoning: Desporto lazer: Usos atividades	Portal SIGMAR/ DRAM
	Desportos nauticos: Desporto lazer: Usos atividades	Portal SIGMAR/ DRAM
	Áreas Marinas Núcleos Recreio	Portal SIGMAR/ DRAM
	vigias_baleias_azores	Portal SIGMAR/ DRAM
	localizacao_interesse_regatas_arva_pontos	Portal SIGMAR/ DRAM
	areas_interesse_regata_locaqua	Portal SIGMAR/ DRAM
	Zonas balneares POOC sao miguel norte: Desporto lazer: Usos atividades	Portal SIGMAR/ DRAM

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	Zonas balneares POOC sao miguel sul: Desporto lazer: Usos atividade	Portal SIGMAR/ DRAM
	Zonas balneares POOC santa maria: Desporto lazer: Usos atividades	Portal SIGMAR/ DRAM
	Zonas balneares fora do POOC: Desporto lazer: Usos atividades	Portal SIGMAR/ DRAM
	Zonas aptidao balnear azores: Desporto lazer: Usos atividades	Portal SIGMAR/ DRAM
	areas_salvaguarda_marinas	Portal SIGMAR/ DRAM
	situacao_potencial:afundamento_navios	Portal SIGMAR/ DRAM
	Áreas proteção fontes hidrotermais: Outras áreas condicionantes: Servidoes restricoes	Portal SIGMAR/ DRAM
	Áreas ramsar: Convencoes: Zonas maritimas convencoes	Portal SIGMAR/ DRAM
	Áreas restricao pesca: Pesca: Usos atividades	Portal SIGMAR/ DRAM
	Área NAMMCO: Convencoes: Zonas maritimas convencoes	Portal SIGMAR/ DRAM
	Área nasco: Convencoes: Zonas maritimas convencoes	Portal SIGMAR/ DRAM
Nature Protection	Zonas proteção especial azores: Rede natura 2000: Zonas maritimas convencoes	Portal SIGMAR/ DRAM
	Zonas especiais conservação azores: Rede natura 2000: Zonas maritimas convencoes	Portal SIGMAR/ DRAM
	Parques naturais ilha: Parques naturais ilha: Servidoes restricoes	Portal SIGMAR/ DRAM
	Parque marinho azores: Parque marinho azores: Servidoes restricoes	Portal SIGMAR/ DRAM
	Ibas marinhas (aves): Zonas maritimas convencoes Zonas de Proteção Especial	Portal SIGMAR/ DRAM
	reserva_ecologica_faixa_maritima	Portal SIGMAR/ DRAM

Table 01: Activities and layers with respective sources.

3 – SCENARIOS VIEWER

All maritime activity able to be spatialized, with available shapefiles, were added in a QGis design, and then exported to ArcGIS project. The data was introduced in the participatory program Seasketch (Figure 01). Indicators of strategic assessment, developed by the team of experts on the GPS Project, were considered references for measuring the impacts of activities. Three GIS databases were also created for understanding the scenario outcomes and as sources for further research.

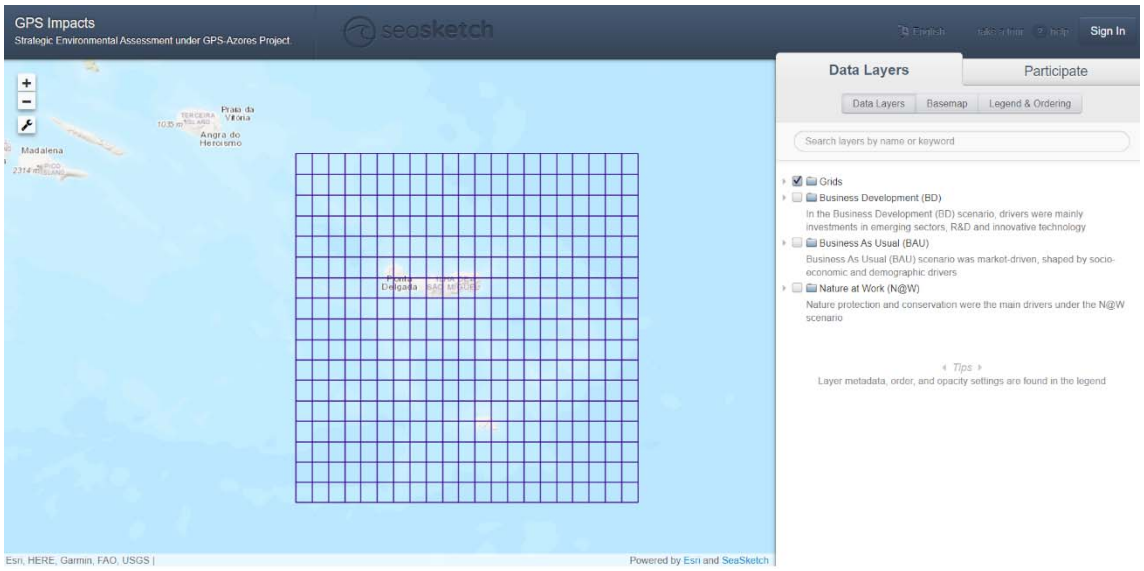

Figure 01: Seasketch view

Some of the icons were already pre-stated in the GIS source, and some small patterns and colours were added to help with visualizing the scenarios. These followed intuitive criteria (Figure 02): Yellow was assigned as a representative colour for geological extraction, with some variations for BD. Purple defined marine and nature protection, with some extra areas for N@W. Aquaculture had different potential references depending on the scenario and was represented by orange. Fisheries were basically represented by pink, with some red variations in prohibited areas. Maritime transport, ports, and coastal infrastructure received some variation of green for each

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scenario. Blue was assigned to tourism UCH, with the same pattern in all scenarios but differentiated by potential activities and importance.

Figure 02: Patterns and colours used to describe each scenario

The placement of the various layers depended on the importance of the activity in a specific scenario or on overlapping visual aspects (Figures 03 to 05). These pattern of colours and level of layer placement enables the impact visualization related to each activity. In the final map of each scenario is possible to identify which sector has more importance by the predominant colours. In the case of N@W is it possible to observe purple in the top layers, giving the viewer a feeling that protected areas have a prominent place in this scenario.

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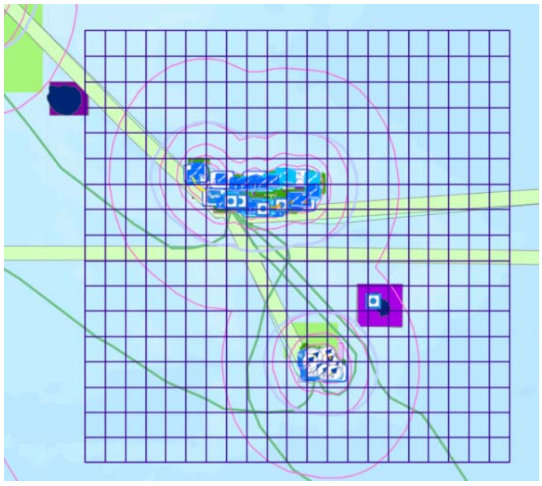
Business as Usual (BaU)



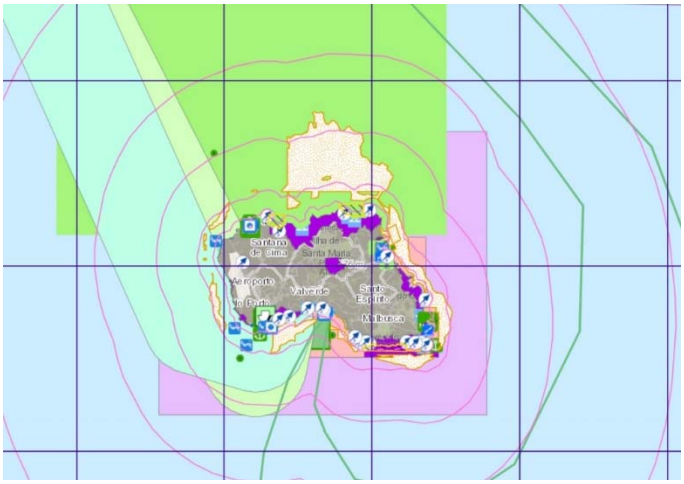


Figure 03: BAU represented how it appears with the grid 'oriente' zoom and an approach to Santa Maria Island.

Calado et. al., 2021 defines *'Business as usual (BAU): A future largely resembling the current state of the marine environment and status of key maritime sectors and activities. The future is largely market driven, and thus key drivers are demographic and short-term economic gain'*.

Geological Extraction

In this scenario the blue growth sectors are not fully reached, including geological extractions that remains mainly on sand extraction. This activity is represented in yellow the actual sand extraction sites.

Aquaculture

Aquaculture remains in its infancy, with negligible investment and few commercial applications. The fulfilled polygons are the actual sites where the activity is already in

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place. And the crackled oranges are those potential areas of exploration, divulgated by Azorean Government.

Tourism, Underwater Cultural Heritage (UCH)

This is the sector with most investment and growth, clearly stimulated by cruise ships and low-coast flights. The mass tourism overlaps UCH and MPAs, conflicting directly with environmental preservation. The entire Azorean ZEE is a cetacean watching zone and it is represented in a light blue. The medium blue, with some icon's variation, represents the different sports and maritime activities and some projections/ potential. Inside these areas it is represented: surf zones and points, dive areas and spot, canyoning, marine sports, whale watching spots, recreational marina areas, areas of interest for regattas, potential sites to do shipwreck. Bathing sites are divided in two different labels of light blue, first with a medium blue inside, representing those areas inside the Coastal Zone Management Plan (POOC in Portuguese), and those with the medium blue in the border, representing areas outside of the POOC. Darker blues are representing UCH areas: marine geosites, underwater archaeological parks, palaeoparks and underwater cultural heritage.

Fisheries

In immediate timing will happen an increase in fishing effort, major commercial target species come to the edge of collapse. All the main fisheries activities, infrastructures and potential areas were represented by pink colour. Potential fishery ports are represented by light pink colour.

Maritime transport, ports and coastal infrastructure

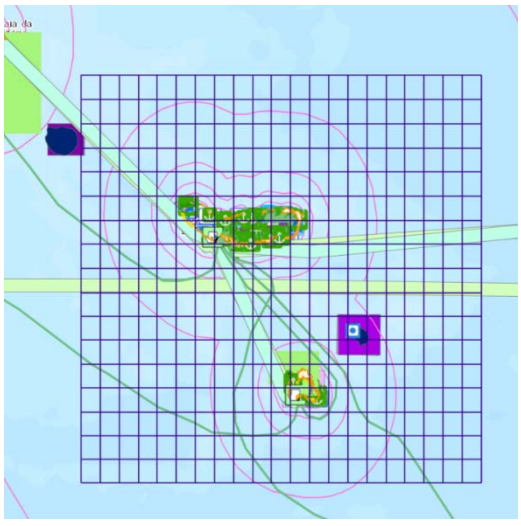
Increase of cruise ships, and massive tourism in general requires infrastructure, and will increase shipping lanes and maritime traffic. With no environmental approach, can increase intensity of coastal hazards (storms, flooding, and erosion), and for that more defences will be needed a medium time. Anchorage continues taking place within UCH and natural heritage sites and remains largely unregulated within MPAs. Green colour and its variations were selected to define these activities. Ports, shelters and

anchor buoys have a patter a bit darker in green scale. In contrast, lighter green was used to symbolize all kind of maritime signalling, routes and shipping lanes. Alternatively, emissaries, submarines cables and its areas of protection received a middle green pattern. A soft green was added to represent coastal defence works and areas of port expansion and buoys.

Nature Protection

In this Business as Usual (BaU) scenario MPAs and environmental protection are secondary compared with economic drives forces. In other words, in an overlapping area, all other activity take place first of MPA, for example. The actual MPAs are represented in different categories of purple, related to your status: RAMSAR sites, Rede Natura 2000, Azores Marine Park, Nature parks. Moreover, the polygons in red represent restriction to fisheries, known as no-take areas.

Blue Development (BD)



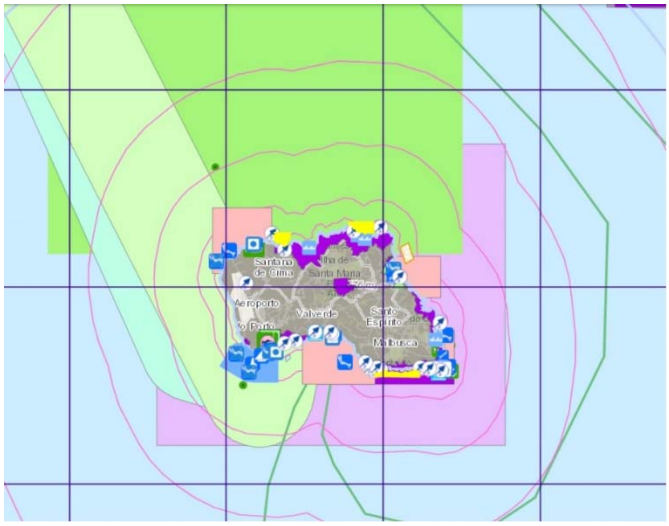


Figure 04: BD represented how it appears with the grid 'oriente' zoom and an approach to Santa Maria Island.

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Calado et. al., 2021 states '*Blue Development (BD): A future where substantial Research and Development (R&D) funds are allocated for research in the development of emerging maritime activities and sectors ('blue growth') with the overarching aim of the technical and ultimately commercial development of sectors*'.

Geological Extraction

In this scenario geological extraction is considering a blue growth activity and will explored in you fully potential, including for example exploration of hydrothermal vents and seamounts. Keeping the same patter of colours, yellow was used as a pattern of this maritime activity. The yellow checkered polygons represent the actual sand extraction in development. And the plain yellow polygons, dots, icons are different potential exploration, represented by sand extractions, seamounts, low depth hydrothermal, and dipping dredging areas.

Aquaculture

Aquaculture is also a blue growth activity and will be explored in your fully industrial potential. The fulfilled polygons are the actual sites where the activity is already in place. And the crackled oranges are those potential areas of exploration, divulgated by Azorean Government and developed by LOQAQUA.

Maritime transport, ports and coastal infrastructure

Maritime transport and its infrastructure are key role in this scenario. To de development of blue economy, it is essential a support net to all trade activities related to maritime transportation, including the promotion of cruise tourism. Green colour and its variations were selected to define these activities. Ports, shelters and anchor buoys have a patter a bit darker in green scale. In contrast, lighter green was used to symbolize all kind of maritime signalling, routes and shipping lanes. Alternatively, emissaries, submarines cables and its areas of protection received a middle green pattern. A soft green was added to represent coastal defence works and areas of port expansion and buoys.

Fisheries

Industrial fisheries will increase as a growing blue activity, following the predictions of potential ports and structure on the coastal areas. All the main fisheries activities, infrastructures and potential areas were represented by pink colour. Potential fishery ports are represented by light pink colour.

Tourism, Underwater Cultural Heritage (UCH)

Tourism will reduce to emerging blue economy activities growth. In this scenario limited development in recreational fishing and Fishing-tourism occur. This category is represented by the blue colour. Darker blues are representing UCH areas: marine geosites, underwater archaeological parks, palaeoparks and underwater cultural heritage. The medium blue, with some icon's variation, represents the different sports and maritime activities. Inside these areas it is represented: surf zones and points, dive areas and spot, canyoning, marine sports, whale watching spots, recreational marina areas, and areas of interest for regattas. Bathing sites are divided in two different labels of light blue, first with a medium blue inside, representing those areas inside the Coastal Zone Management Plan (POOC in Portuguese), and those with the medium blue in the border, representing areas outside of the POOC.

Nature Protection

In Blue Development scenario (BD) it is promoted the research and development approach. Taking that in mind the MPA still have a role in BD, but other activities can overlap some areas, as fisheries or aquiculture, for example. The actual MPAs are represented in different categories of purple, related to your status: RAMSAR sites, Rede Natura 2000, Azores Marine Park, Nature parks, Special Protected Zones (IBAS birds). Moreover, the polygons in red represent restriction to fisheries, known as no-take areas.

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Nature at Work (N@W)

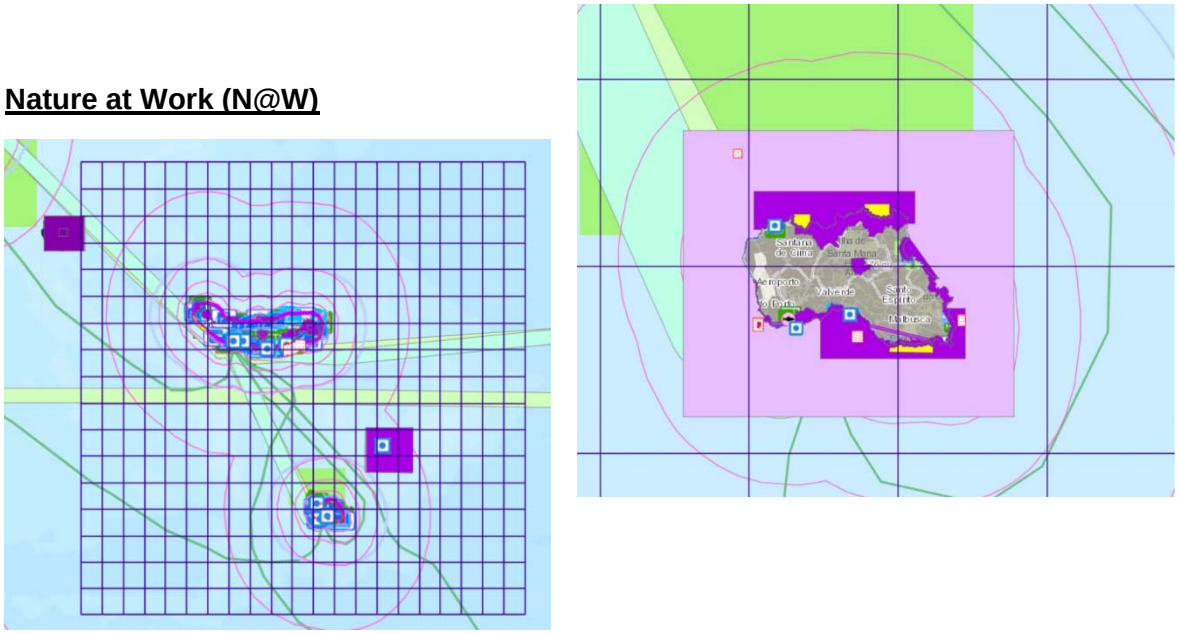

Figure 05: N@W represented how it appears with the grid 'oriente' zoom and an approach to Santa Maria Island.

Calado et. al., 2021 declares that Nature at work is '*a future where environmental protection is key in future development, with conservation playing a leading role and maritime sectors developing in an environmentally-friendly, sustainable manner, at the community, local level*'.

Geological Extraction

This activity is represented in yellow the actual sand extraction sites. It is important to mention that some of these activities are occurring in areas designed as a MPA, in those cases the environmental approach must be respected, and it will be only possible to continue if the activities respect MPAs objectives.

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Nature Protection

Marine Protected Areas are in evidence in this scenario, as one of the main forces to drive. The purple colour was selected to all MPAs, and the differences between lines and fulfilment represents the main different categories that we have in this selected area. It is represented: hydrothermal vents, RAMSAR sites, NAMMCO Convention, NASCO Convention, Rede Natura 2000, Azores Marine Park, Nature parks, Special Protected Zones (IBAS birds), Maritime Ecological Reserve. Besides that, the polygons in red represent restriction to fisheries, known as no-take areas. Those area estimated projections of possible protected areas, but it is important to highlight that in in this scenario all international conventions and agreements will be respected. Therefore, the total area of Azores protected areas will be at least 15% of its waters as a no-take zone, by the government announcement in 2019.

Aquaculture

The aquaculture must be sustainable focusing on the maritime community development. To represent this maritime activity was selected the orange colour. The fulfilled polygons are the actual sites where the activity is already in place and will be adequate to MPAs objectives in this scenario. And the crackled oranges are those potential areas of exploration, out of existent MPAs.

Fisheries

All the main fisheries activities and infrastructures were represented by pink colour. In this scenario the fisheries activities are required to respects MPA objectives, when occur overlap of areas. The maritime activity must be sustainable and respecting fishing mortality and stock biomass are at levels that deliver Maximum Sustainable Yield (MSY) and meet GES policy objectives. This activity is based on small scale fisheries and for the maritime community development. The main bathymetric lines on fisheries area are represented. Combined with some polygons, also on pink colours, representing the core fishing areas. Besides it, it is represented the main fisheries port by the fish icon.

Tourism, Underwater Cultural Heritage (UCH)

This scenario favours the low impacts tourism in consonance with UCH preservation, sustainable forms are adopted. This category is represented by the blue colour. Darker blues are representing UCH areas: marine geosites, underwater archaeological parks, palaeoparks and underwater cultural heritage. The medium blue, with some icon's variation, represents the different sports and maritime activities. Inside these areas it is represented: surf zones and points, dive areas and spot, canyoning, marine sports, whale watching spots, recreational marina areas, and areas of interest for regattas. Bathing sites are divided in two different labels of light blue, first with a medium blue inside, representing those areas inside the Coastal Zone Management Plan (POOC in Portuguese), and those with the medium blue in the border, representing areas outside of the POOC.

Maritime transport, ports and coastal infrastructure

In this Nature at Work scenario (N@W) these activities are reduced at the minimum level, for example the number of docked cruise ships is limited to one at a time. Green colour and its variations were selected to define these activities. Ports, shelters and anchor buoys have a patter a bit darker in green scale. In contrast, lighter green was used to symbolize all kind of maritime signalling, routes and shipping lanes. Alternatively, emissaries, submarines cables and its areas of protection received a middle green pattern.

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4 – CONCLUSIONS

With the Seasketch project it is possible that all different stakeholder accesses the information of how the scenario in the future would be. This tool can offer a basis for more solid decision making, based on the strategy that one intends to adopt for the future.

However, it is worth including some limitations of Seasketch: not being able to assign a value in letters to the layers and the participation of stakeholders, difficulty in assigning colour to pre-defined layers. Considering the above limitations for the realization of this project it was decided to complement the questionnaire with an excel table to support the completion of the first two questions.

Nevertheless, it was possible to adapt and use the programme as a fundamental support tool for working with experts. In general, a dynamic, participative programme was observed which can be adapted to the reality and objective of SEA. We consider that Seasketch possesses all the qualifications to endorse a participative work of analysis and planning considering possible future scenarios.

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