Marine Spatial Planning Zoning Approach in the Red Sea

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Introduction

Red Sea Global (RSG) is committed to achieving net conservation benefit across its flagship destinations The Red Sea and AMAALA while actively enhancing the Kingdom's rich environmental and cultural heritage. In line with Saudi Vision 2030, RSG aims to explore the potential for developing a sustainable tourism destination within an archipelago located along the southwestern coast of the Kingdom of Saudi Arabia covering approximately 23,000 km^2.

One of the tools it used to explore this potential was the Marine Spatial Plan (MSP). MSP is a comprehensive and integrated process to manage human activities in the marine environment. It involves the systematic allocation of spatial and temporal uses/activities to ensure the sustainable management of marine resources including the conservation of marine ecosystems. MSP sets the rules for where different activities (like tourism and conservation) can co-exist while limiting impacts to the environment. The specific goals and objectives set for the MSP are presented in Table 1. The MSP was developed using a combination of desktop research, site walkover surveys, environmental and social assessments, and various secondary data sources. A site visit was also conducted to better understand the characteristics of the islands, their surrounding habitats, different location types, and their potential for development or conservation.

Table 1 MSP Goals and Objectives

Principles of Ecosystem-Based Marine Spatial Planning				
Healthy Ecosystems	Delivery of Ecosystem Services		Sustainable Uses	
Red Sea Southern Islands Project MSP Goals				
Environment	**Climate**	**Social**	**Economic**	**Governance**
Live within environmental limits and protect the area's rich biodiversity and ecosystems	Support net zero commitments and climate resilience	Protect cultural values and promote social heritage	Achieve a sustainable marine and coastal based economy and regenerative tourism sector	Promote good governance
Red Sea Southern Islands Project MSP Objectives				
Restore and enhance: Promote restoration of degraded habitats and enhance ecosystems for species of conservation interest **Promote connectivity:** Protect and enhance connectivity of habitats and species through ecological corridors **Net benefit:** Achieve a net nature conservation benefit e.g., net gain in features of conservation interest **Preserve the natural environment:** Ensure clean and healthy seas, air, and landscapes	**Net zero:** Facilitate delivery of renewable energy infrastructure **Climate mitigation:** Protect natural sea defences such as mangroves, seagrass beds and coral reefs **Climate adaptation and resilience:** Enhance habitats for carbon sequestration such as seagrass beds, mangroves and coral reefs	**Respect cultural values:** Protect cultural traditions and livelihoods such as artisanal fishing **Promote social heritage:** Preserve and promote social heritage for visitors and future generations	**Regenerative tourism:** Facilitate a thriving regenerative tourism sector that supports economic growth **Accessing nature:** Make nature accessible and enjoyable to visitors, for recreational, educational, spiritual and research purposes **Economic diversity:** Ensure continued diversity of marine uses to support economic diversity	**Sustainable management:** Ensure that identified multiple use areas operate sustainable management practices for the benefit of all users **Effective enforcement:** Provide mechanisms of effective enforcement of Saudi Environmental Law across the islands **Agile adaption:** Provide a plan that adapts management approach to future changes **Participatory and inclusive:** Seek support from stakeholders and considers trade-offs

Mott MacDonald was commissioned by RSG, to develop an MSP that sets out the zoning and sustainable management of resources. RSG's strategic development parameters were considered by the MSP as they were developed in parallel by the area's Strategic Development Plan (SDP). The SDP included detailed theme-based strategies and principles for development. The SDP provided a framework for tourism development in a way that benefits both the environment and the local economy. Both processes were supported by a Strategic Environmental Assessment (SEA) conducted to KSA SEA guidance[1] with additional aspects of the EU SEA Directive considered. Figure 1 shows the interfaces and interactions among MSP, SDP and SEA.

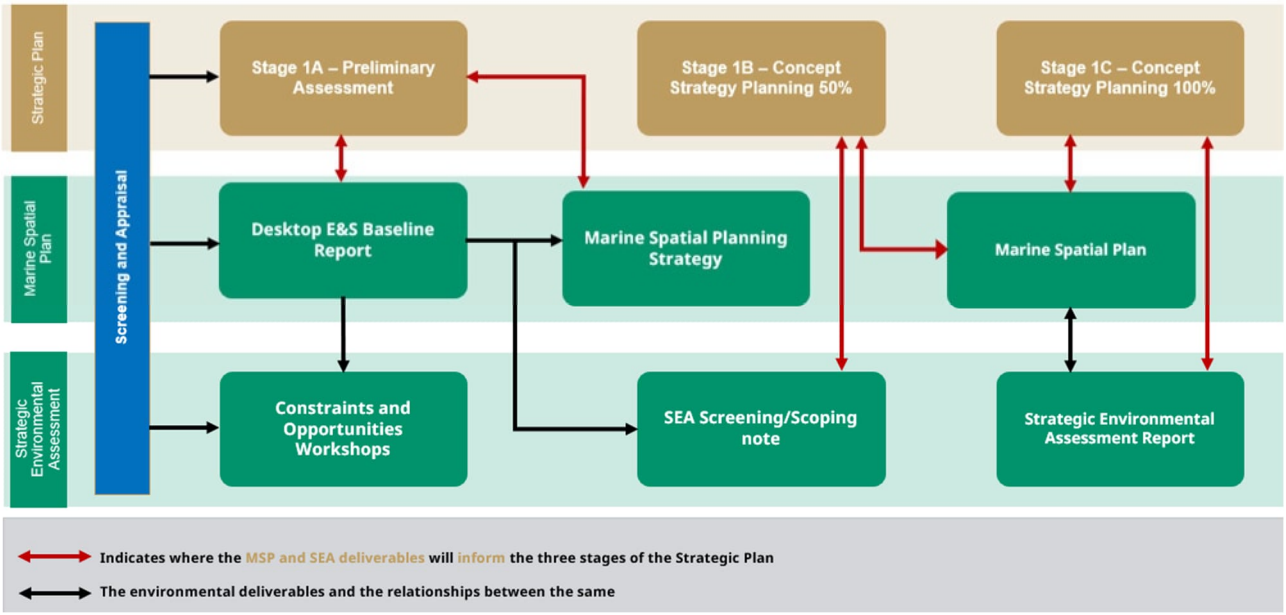


Figure 1 Process flows between MSP, SEA and SDP.

By adopting an ecosystem-based approach, aligned to UNESCO – IOC guidelines[2], MSP zones were defined using predictive modelling to balance human activities with the environment's capacity to provide and maintain ecosystem services (ES).

Management measures of these zones were designed to follow the UNESCO and the European Union Habitats Directive approach to manage protected areas. These provide a framework for how, where, and when human activities should occur to achieve the goals and objectives of the MSP. Such measures included but are not limited to biosecurity measures, noise limits, reducing vessel risks, preservation of heritage features, low impact fishing methods, and upskilling and employing impacted communities.

Methodology and analysis

To identify interactions between development and ecosystems, three scenarios were developed to reach a preferred MSP comprising:

- Do Nothing Scenario – qualitatively considers the islands are left alone with no development, conservation measures or governance changes. Which, based upon the baseline, anticipates that

[1] Ministry of Environment Water and Agriculture (MEWA). 2023. Kingdom of Saudi Arabia Methodology for Studying Strategic Environmental Assessment (SEA)

[2] UNESCO-IOC/European Commission. (2021) MSP Global International Guide on Marine/Maritime Spatial Planning. Paris, UNESCO. (IOC Manuals and Guides no 89. Available from: https://mspglobal2030.org/wp-content/uploads/2021/12/MSPglobal_InternationalGuideMSP_HighRes_202112.pdf Accessed on 26/07/2024

without intervention habitat conditions across the Southern Islands will decline due to pressures from fishing, aquaculture, dumping of waste, climate change and uncontrolled anthropogenic access.

- Conservation Led Scenario – assumes no development and implementing measures protecting ecological priority areas across the Study area.
- Development Led Scenario – identifies key developable areas based upon development and experience desirability that will support mid to high market hospitality offerings and/or include the development of private islands.

A balanced set of criteria were developed with stakeholder feedback (including RSG Development team, National Centre for Wildlife, and Red Sea Authority) for the last two scenarios, discussed in the findings section.

Similar to the Government of Jersey's approach in identifying marine protected areas[3], the study area was divided into 1-hectare square cells, so that weighted criteria can be used to quantify how ecosystem priorities, and development and experience desires vary. This grid approach allowed integration of information collated at different spatial resolutions (i.e. broadscale satellite derived information and discrete walkover observations) to form an evidence basis for decision making.

The thresholds defined by the IFC Performance Standard (PS) 6 Critical Habitat Assessment (CHA) process[4] was used at a strategic level to determine keystone species and critical ecological features. At this strategic stage, detailed understanding of the species occurrence and habitat quality was not available. To overcome this, a literature review established the ecological requirements for each species so their degree of habitat preference could be predictively modelled across the study area. For habitats, it was considered that larger more connected extents were likely to be in better condition and therefore ecologically valuable than smaller isolated extents. Species and habitat priorities were scaled to prioritise the highest preferences in each potential broad ecosystem area. These were used to develop a mosaic of protected areas[5] forming a network across the entire archipelago to act as potential refugia for species to shift into. Thereby allowing the MSP to address the variability of migratory pathways and climate pressures[6,7,8,9]..

[3] Government of Jersey (2023) Marine Protected Area Assessment Methodology. Available from https://www.gov.je/SiteCollectionDocuments/Government%20and%20administration/Marine%20Protected%20Area%20Assessment%20Methodology.pdf Accessed on 25/07/2024 , one of the best practices used within MSP to handle data.

[4] International Finance Corporation (2012). Performance Standard 6. Biodiversity Conservation and Sustainable Management of Living Natural Resources.

[5] Protected areas in this case relate to areas where management measures are applied to implement the mitigation hierarchy which would seek alignment with the IUCN protected area definitions rather than an area that prohibits all use or access.

6 Pinsky, M. L., Selden, R. L., & Kitchel, Z. J. (2020). Climate-Driven Shifts in Marine Species Ranges: Scaling from Organisms to Communities. Annual Review of Marine Science, 12 (Volume 12, 2020), 153–179. https://www.annualreviews.org/content/journals/10.1146/annurev-marine-010419-010916

[7] Owen, A. (2024). Impact of Climate Change on Bird Migration Patterns in Europe. American Journal of Climatic Studies, 4(2), 12–24. https://ajpojournals.org/journals/index.php/AJCS/article/view/1989?srsltid=AfmBOorwHAf0dXK9ro63KcdFgwFD0Nyo4TMoEue6Tw_FNycqLuaK0Upx

[8] Arora, A. & Phillott, A.D. (2023). The impacts of climate change on sea turtles, and methods to assess potential changes in nesting phenology. Indian Ocean Turtle Newsletter – Issue 37. Available from https://www.iotn.org/iotn37-03-the-impacts-of-climate-change-on-sea-turtles-and-methods-to-assess-potential-changes-in-nesting-phenology/ Accessed 30/07/2024.

[9] Fuentes, M. M. P. B. , Santos, A. J. B. , Abreu-Grobois, A. , Briseño-Dueñas, R. , Al-Khayat, J. , Hamza, S. , Saliba, S. , Anderson, D. , Rusenko, K. W. , Mitchell, N. J. , Gammon, M. , Bentley, B. P. , Beton, D. , Booth, D. T. B. , Broderick, A. C. , Colman, L. P. , Snape, R. T. E. , Calderon-Campuzano, M. F. , Cuevas, E. … Monsinjon, J. R. (2024). Adaptation of sea turtles to climate warming: Will phenological responses be sufficient to counteract changes in reproductive output? Global Change Biology, 30, e16991. https://doi.org/10.1111/gcb.16991a

Findings and Discussion

Conservation Led Scenario

Seven categories of ecosystem features (Figure 2) were developed to prioritise native species and habitat diversity, connectivity, productivity and functioning. This seeks to ensure a healthy and valuable ecosystem, in line with ecosystem based[10], climate smart[11], and international MSP guidance[12].

Figure 2 Conservation Led Scenario Categories

Keystone species (Figure 3) and critical ecological features (corals, seagrasses and mangroves) were identified from the CHA. The combined degree of preference of these species and the potential quality of CHA habitats were weighted highly under this scenario. Central to the southern island ecosystem are the seabird and coastal bird colonies which formed a main keystone feature reflected in this scenario as their guano provides the main natural nutrient inputs, which is a common feature in other archipelagos[13,14].

Increased weightage was given to processes (upwelling, fronts and stratification) that drive connectivity and vulnerable water bodies (low mixing zones, lagoons[15]). In addition, submerged reefs and shoals, providing protection from increased erosional processes likely from climate change, were given increased weightage in line with climate smart objectives[11]. Past and current pressures primarily from artisanal fishing, aquaculture and small areas of past cultural use altering the environment were also reflected in the weighting.

The results forming the potential environmental priority across some of the southern islands are illustrated in Figure 4.

[10] Foley, M. M., Halpern, B. S., Micheli, F., Armsby, M. H., Caldwell, M. R., Crain, C. M., Prahler, E., Rohr, N., Sivas, D., Beck, M. W., Carr, M. H., Crowder, L. B., Emmett Duffy, J., Hacker, S. D., McLeod, K. L., Palumbi, S. R., Peterson, C. H., Regan, H. M., Ruckelshaus, M. H., Steneck, R. S. (2010). Guiding ecological principles for marine spatial planning. Marine Policy, 34(5), 955–966. https://doi.org/10.1016/j.marpol.2010.02.001

[11] Frazão Santos, C., Agardy, T., Crowder, L.B. et al. Key components of sustainable climate-smart ocean planning. npj Ocean Sustain 3, 10 (2024). https://doi.org/10.1038/s44183-024-00045-x

[12] UNESCO Intergovernmental Oceanographic Commission (IOC). (2021) Marine Spatial Planning: A Step-by-Step Approach toward Ecosystem-based Management. Available from https://unesdoc.unesco.org/ark:/48223/pf0000186559

[13] Adame, M. F., Fry, B., Gamboa, J. N., & Herrera-Silveira, J. A. (2015). Nutrient subsidies delivered by seabirds to mangrove islands. Marine Ecology Progress Series, 525, 15–24. https://www.jstor.org/stable/24895154

[14] Hentati-Sundberg, J., Raymond, C., Sköld, M. et al. Fueling of a marine-terrestrial ecosystem by a major seabird colony. Sci Rep 10, 15455 (2020). https://doi.org/10.1038/s41598-020-72238-6

[15] Newton et at. (2014). An overview of ecological status, vulnerability and future perspectives of European large shallow, semi-enclosed coastal systems, lagoons and transitional waters. Estuarine, Coastal and Shelf Science. Volume 140 Pages 95-122. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0272771413002461

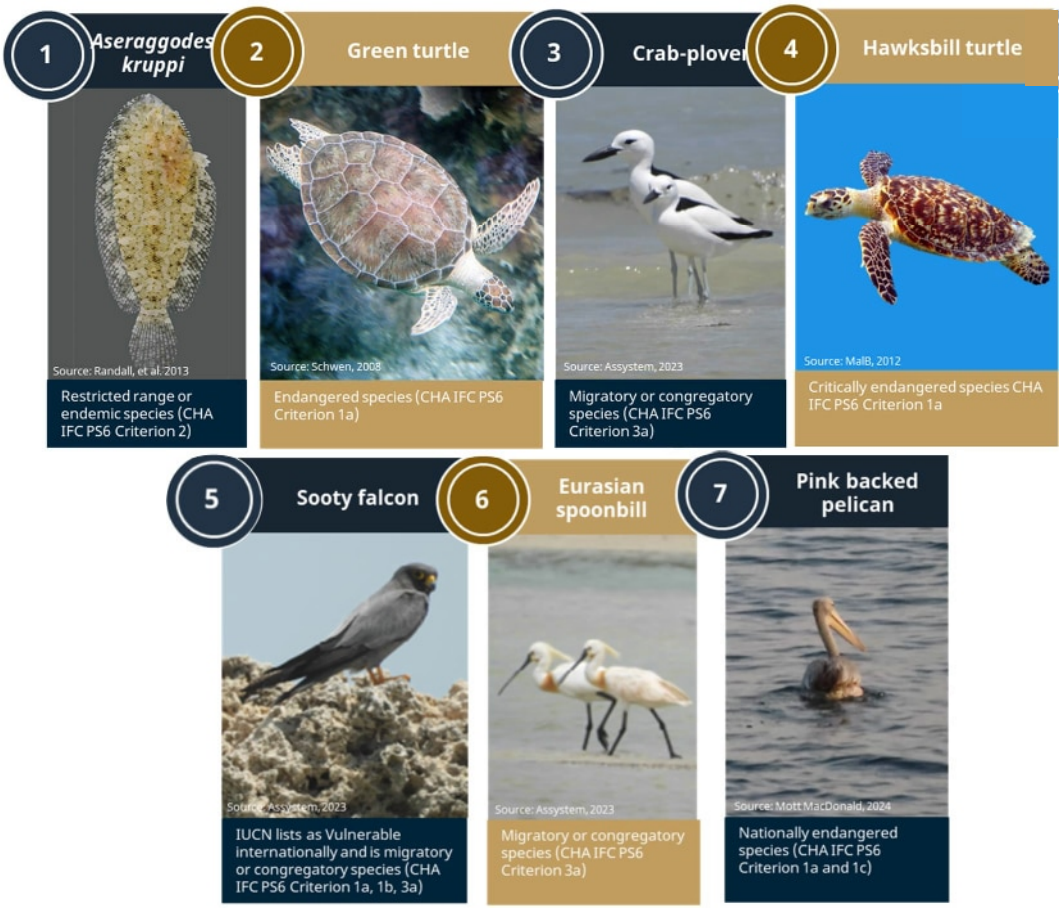


Figure 3 **Priority species meeting CHA thresholds**

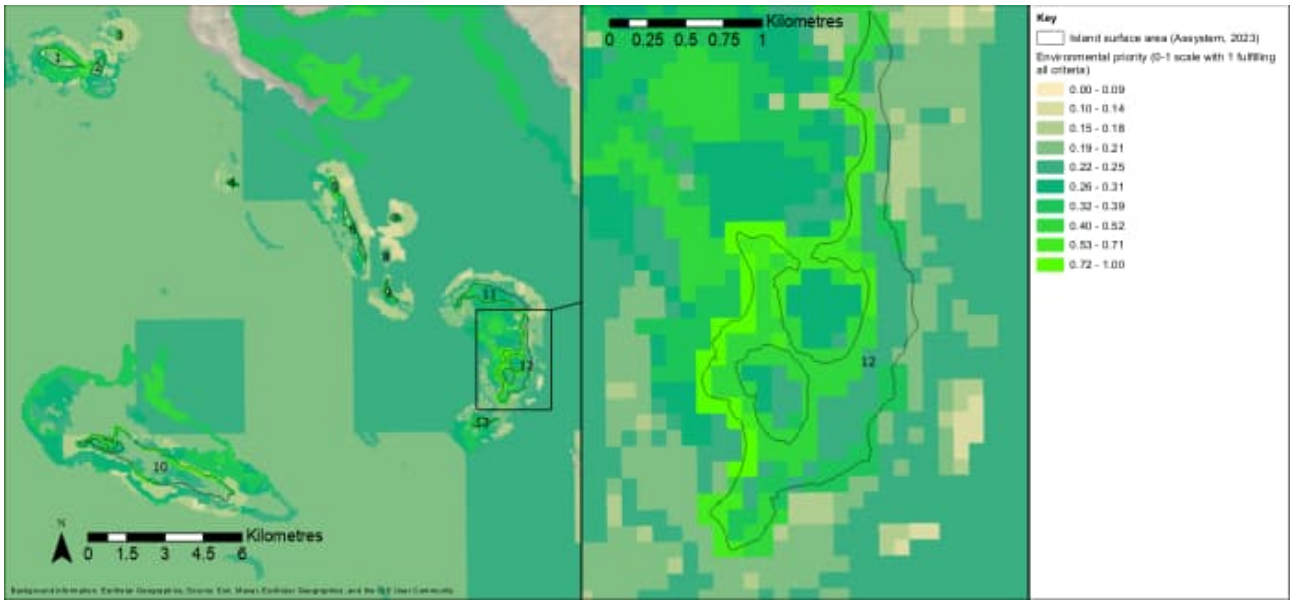


Figure 4 **Environmental Priority Results**

Development Led Scenario

Six categories (Figure 5) were developed, in alignment with the SDP, through stakeholder engagement reflecting both development and experiential needs. These categories reflect the developer's idea of inherent beauty and nature of the islands including island clustering, visibility of attractive habitats, and sheltered swimming locations. However, the environment also hosted challenges, reflected through steep escarpments or cliffs, and other barriers that could constrain development. The summed outcomes are presented in Figure 6.

	Criteria	Bases
	Visibility of attractive habitats	Proximity to mangroves, lagoons, coral reefs coupled with relative elevation used to consider whether habitats viewable from each point.
	Barriers to get to specific point on island	Quantity of steep gradients, shallow reefs, sheer cliffs and dense vegetation around each location. Locations with greater number of mean barriers around the location were given a lower score.
	Long sandy beaches	Relative proximity to longer, deeper and sandy beaches on exposed shoreline aligned with wave direction
	Coastal morphology	Proximity to complex shapes of coast and variety of habitat. This has been interpreted by locations close to coasts which form a cove more attractive than those are a flat expanse. This has been determined by the relative curvature of coastline within a specific distance.

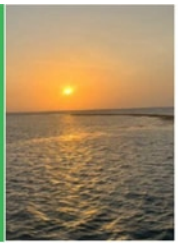
	Criteria	Bases
	Shelter	Proximity to shelter side of island plus relative distance to mainland
	Island clustering	Proximity to nearest project island

Figure 5 **Development and Experience Categories**

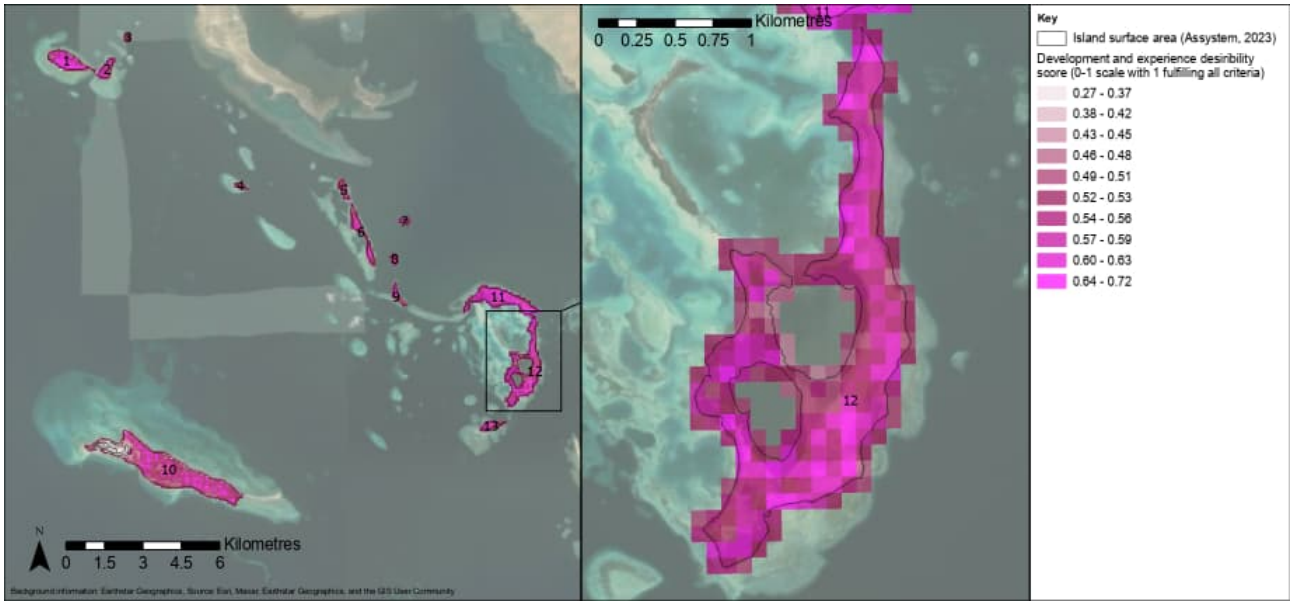


Figure 6 **Development and Experience Desirability Results**

Interactions

To achieve a balanced ecosystem approach, results from the Conservation and Development Led Scenarios were overlain to identify areas where environmental needs and development objectives either aligned or conflicted (See Figure 7). Interactions found are detailed in Table 2.

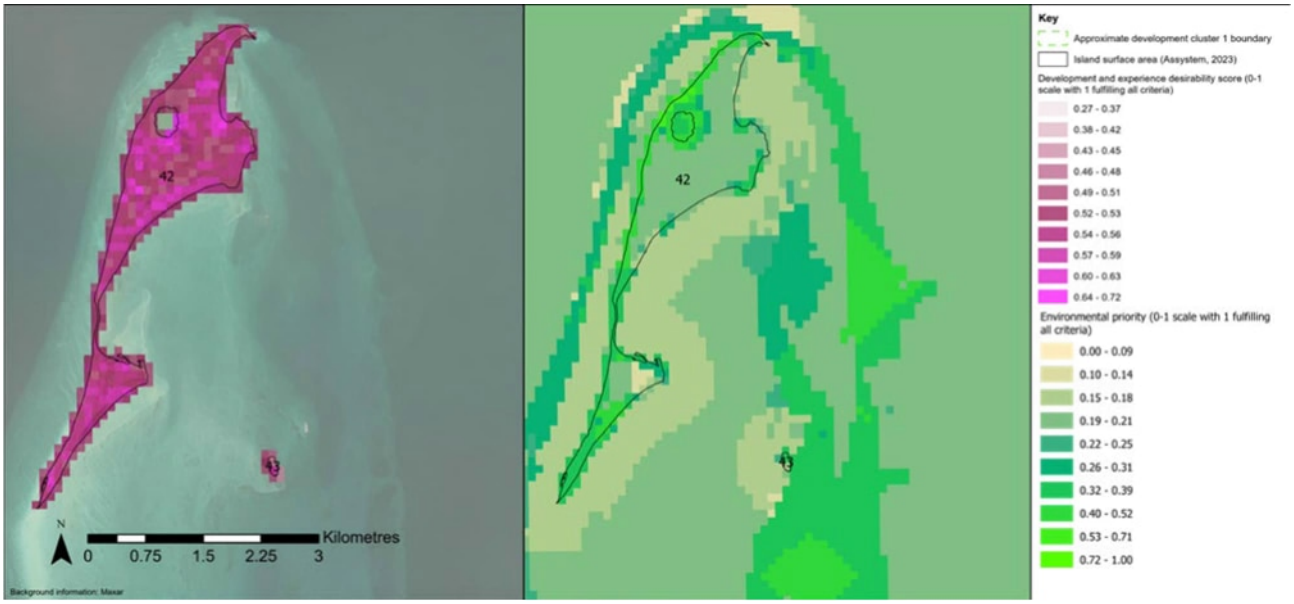


Figure 7 Example overlay of maps to identify spatial synergies and conflicts between scenarios

Description: Left hand map illustrates brighter pink areas being more desirable for development whilst brighter green illustrates greater environmental priority. Where areas of bright pink coincide with areas of bright green it would mean a conflict between scenarios whereas bright areas overlapping with dull colour areas would be areas of potential synergy.

Table 2 Development and experience categories interaction with environmental priority area

Environmental Categories	Level of Interaction
Species identified in the CHA	Largest capacity to be affected with most overlap of highest development and experience score area with species preferences for nesting the main point of interaction.
Habitats identified in the CHA	Second largest interaction with habitats that are likely to trigger CHA being overlapped by areas with higher development and experience score
Existing and proposed Protected Areas (nationally and/or internationally)	Some overlap between scenario scores though existing regulations, and restrictions would conflict with development.
Oceanographic processes	Limited interaction with the highest development and experience score areas.
Cultural heritage features	Very limited interaction with highest development and experience score areas.
Fisheries activities and aquaculture	Direct data limited though there is interaction with predicted fishing opportunity areas with highest development and experience score areas. Likely to be easily managed as negative interactions with tourism development.
Coastal protection	Limited interaction though preservation would be beneficial to these development locations.

Preferred plan

Interactions were balanced based upon their ecosystem service provisions identified as part of the SEA. Zones were set to incorporate appropriate ecological, economic, social and cultural measures at a coordinated ecosystem scale[16]

Four different zones sought to provide a balance of protecting ecological priorities, minimising disturbance, promoting connected enhancements and still allowing opportunities for development. Zones (Figure 8) were set hierarchically as follows with specific features allocated in high and medium zones:

High priority zone: Designated for protection of habitats and species that may be rare, endangered, unique or with narrow distribution ranges, and high-risk areas with limited capacity for disturbance i.e. low flushing areas.

Medium priority zone: Provide areas where use in a low impact and sustainable way is balanced with conservation of marine resources[17]. Characterised by defined levels of biodiversity (in terms of habitats and species) or relative condition of features.

Optimised conservation and enhancement zone: Opportune areas where habitats can be enhanced, restored or created (to support biodiversity net gain) given connectivity to adjacent high or medium priority features is present.

Multiple use zones: Identified for multiple uses and economic activity including high value and/or high priority areas for the marine sectors that use waters for economic, social and cultural benefits, supporting ecotourism and research.

Zones containing increased natural or cultural sensitivities, or greater ecosystem services would have stringent management measures, and would also reflect increased challenges for sustainable development. Priority zones comprised ecologically appropriately scaled spatial areas[18] reflecting greater habitat preference for targeted species, core areas representing essential ecosystem services or irreplaceable social and cultural heritage features.

Management measures follow the EU's Habitats Directive approach to manage protected areas. Specifically, the precautionary principle that requires demonstrable evidence of no negative impacts on

[16] Foley, M.,Halpern, B. & Micheli, F., Armsby, M. & Caldwell, M. & Crain, C. & Prahler, E. & Sivas, D. (2010) Guiding ecological principles for marine spatial planning. Guiding ecological principles for marine spatial planning.

[17] In line with UNESCO and IUCN definitions conservation refers to the protection, care, management and maintenance of ecosystems, habitats, wildlife species and populations within or outside of their natural environments in order to safeguard the natural conditions for their long-term permanence. As such, selected features and associated management measures of this zone would seek as minimum to maintain the biodiversity functioning within the region and promote enhancement where possible whilst allowing certain sustainable uses. See UNESCO World Heritage Convention (2024) Policy Compendium. Policies regarding Conservation of the World Heritage Properties. https://whc.unesco.org/en/compendium/?action=theme&id_theme=3

[18] The percentile thresholds are set so they can achieve an average minimum area of protection which has been proven to provide quantifiable benefits from these habitats (refs needed given we state 'proven'). In the case of coral reefs, for example, applying a 2km wide partially protected area results in the conservation of 56% of species (Krueck et al 2018). For mangroves, areas with a 1km width provide significant coastal protection during storms (Wood, 2020) which, in turn, can provide long term stability to fish nurseries within them. No equivalent value has been determined for seagrasses so the same threshold as that for mangroves has been applied.

Krueck, N.C., Legrand, C., Ahmadia, G.N., Estradivari, , Green, A., Jones, G.P., Riginos, C., Treml, E.A. and Mumby, P.J. (2018), Reserve Sizes Needed to Protect Coral Reef Fishes. Conservation Letters, 11: e12415. https://doi.org/10.1111/conl.12415

Wood Environment & Infrastructure Solutions UK Limited. 2020. The Role of Mangroves in Coastal Protection. Natural Capital in the UK's Overseas Territories Report Series – Supplementary Report (Caribbean Region). Contracted report to JNCC.

each zone objectives by developments and activities before they can proceed regardless of their location within the MSP area. Such measures include but are not limited to:

- biosecurity measures,
- noise limits (i.e. Critical bird areas below 90th percentile of baseline plus 6dB[19] or underwater noise below US NMFS 2023 thresholds[20]),
- reducing vessel risks (speed limits, exclusion zones),
- preservation of heritage features,
- low impact fishing methods (ghost fishing reduction, trawling ban), and
- upskilling and employing impacted communities.

Measures were also aligned with both international best practise (such as UN SDGs, IUCN, IFC PS, UNESCO, UNEP, IPBES, PERSGA, WWF, World Bank, RAC/SPA, ICRI, OECD, Mangrove alliance etc.,), KSA regulations (i.e. MEWA executive regulations), and academic recommendations. The SEA aided development of measures to integrate into wider regional and social objectives.

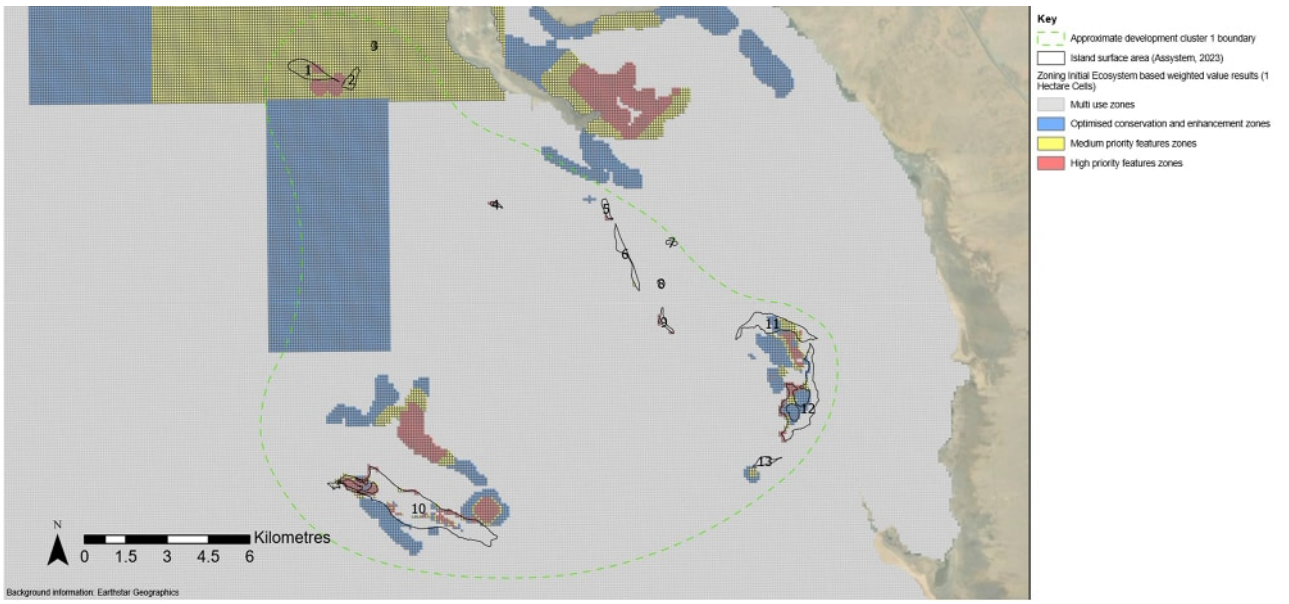


Figure 8 Preferred Plan

Conclusion

Using a structured framework, MSP plays a vital role in balancing human activities and identifying - optimal areas for tourism and recreation while providing environmental protection especially to sensitive habitats and species. RSG and Mott MacDonald developed an MSP which utilises an ecosystem-based approach aligned to UNESCO–IOC guidelines, informed by the baseline screening and appraisal studies, and specifically addressing the IFC PS6, it provides strategic avoidance of harm to critical ecological habitats and functions.

The MSP explored three scenarios for analysis and recommended a preferred plan which preserves irreplaceable social and cultural heritage, along with robust stakeholder engagement, providing critical insights to identify key sensitivities, enabling greater flexibility in development and use. A notable feature of the MSP is its network of refugia—four priority zones designed to support species

[19] Dooling, R.J. (2019). The Impact of Urban and Traffic Noise on Birds. Acoustics Today. Available from: https://doi.org/10.1121/AT.2019.15.3.19.

[20] National Marine Fisheries Service (2023) Summary of Endangered Species Act Acoustic Thresholds (Marine Mammals, Fishes, and Sea Turtles) Available from: https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf Accessed 28/05/2024

conservation, especially in the face of climate change. The MSP aligns with the Saudi National Vision and supports RSG's regenerative tourism goals, offering defined management objectives for each zone so that as technology progresses new mitigation approaches can be more easily integrated to comply with those objectives.

The MSP has identified the need for continual governance and stakeholder consultation especially with regulatory bodies to ensure adoption of the MSP and implementation of proposed management measures. The findings of MSP can assist and even pave the way to formally designate areas into Marine Protected Areas in line with national and international standards.