Key climate change effects on the coastal and marine environment around the Mediterranean UK Overseas Territories

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EXECUTIVE SUMMARY

- There is clear evidence that the direct and indirect effects of climate change, such as warming seas, reduced dissolved oxygen and presence of invasive species, is prevalent and widespread within the Mediterranean Sea.
- Although evidence is generally increasing, the evidence base in Mediterranean UK Overseas Territories (OTs) is limited.
- The effects of the presence of invasive and alien species (IAS) are observable in both Gibraltar and the Sovereign Base Area Authority (SBAA), with the presence of invasive macroalgae within Gibraltar's waters and the invasive Lionfish around Cyprus.
- Gibraltar has well established Marine Policy regulations and a programme of measures for its Marine Protected Areas (MPAs).
- The SBAA will need to ensure collaboration with Republic of Cyprus to manage impacts from climate change.
- SBAs lack marine habitat and species condition assessments and baselines.
- The SBAA is aware of the threat from invasive alien species but at early stages of biosecurity planning and does not currently have policy in place to manage risks from IAS species.

Citation: Dissanayake, A., Kleitou, P., Johnstone, G., Kletou, D., Warr, S., Crisp, C., Berry, A. and Fa, D.A. (2021) Key climate change effects on the coastal and marine environment around the Mediterranean UK Overseas Territories. *MCCIP Science Review 2021*, 20pp

doi: 10.14465/2021.orc03.med

Submitted: 06 2021
Published online: 21st July 2021.

DESCRIPTION OF OVERSEAS TERRITORIES IN THE REGION

The Mediterranean is one of the most-highly valued seas in the world for its biodiversity due to the number of endemic species, but also in terms of ecosystem services and its cultural value for a wide array of sectors and stakeholders including its inhabitants. The Mediterranean is valued at over US$ 5.6 trillion with regards its ocean assets (Randone et al., 2015).

Gibraltar is one of two UK OTs in the Mediterranean ecoregion. It is specifically located within the Western Mediterranean region and its waters are regarded as a biodiversity 'hotspot' due to their location within the Straits of Gibraltar (Coll et al., 2010), a well-documented migratory corridor between the Mediterranean Sea and Atlantic Ocean. The marine environment is officially known as British Gibraltar Territorial Waters (BGTW). Her Majesty's Government of Gibraltar (HMGoG) implements the requirements of the EU's Marine Strategy Framework Directive (MSFD) in BGTW and adheres to the core principles of the Barcelona Protocol (HMGoG DESCCH, 2017; 2020). BGTW extend out to three nautical miles to the East and South and up to the median line to the West in the Bay of Gibraltar. The largest designated Marine Protected Area (MPA) in BGTW is the Southern Waters of Gibraltar MPA which is approximately 55 km^2 (JNCC, 2016). This equates to 63% of BGTW.

A variety of marine habitats are found within Gibraltar's marine environment including rocky shores, sandy seabeds, submarine canyons, shallow- and deep-water biogenic reefs as well as submerged and partially submerged sea caves. The Southern Waters of Gibraltar Marine Protected Area (MPA) in particular are punctuated with natural and artificial reefs containing impressive Gorgonian communities (e.g. *Paramuricea clavata* and *Eunicella singularis* 'forests'), *Astroides calcycularis* and *Lithophyllum lichenoides* facies. Crucially, Gibraltar's rocky intertidal habitats provide one of the largest single populations of the Critically Endangered gastropod *Patella ferruginea*, which is endemic to the Mediterranean Sea, within the Iberian Peninsula.

Loggerhead turtles *Caretta caretta* and an array of cetaceans are also common in BGTW. They include the Common dolphin *Delphinus delphis*, Striped dolphin *Stenella coeruleoalba* and Bottlenose dolphin *Tursiops truncatus.* These species breed and feed in the Bay of Gibraltar. Whales are also frequently recorded in the Southern Waters of Gibraltar. These include Fin whales *Balaenoptera physalus* and to a much lesser extent Minke whales *Balaenoptera acutorostrata* which use BGTW as a migratory corridor. More recently, Humpback whales *Megaptera novaeangliae* are also being recorded. In addition, Sperm whales *Physeter macrocephalus* and Pilot whales *Globicephala melas* are also found in the Southern Waters of Gibraltar. They can be observed feeding in the Southern Waters particularly during the Spring and Summer months. The Sovereign Base Area Administration (SBAA) is the civil government of the Sovereign Base Areas

(SBAs). The SBAA has an important role in support of military functions as well as undertaking civil functions. Approximately 8% of territorial water and the majority of the terrestrial coastline are designated as conservation sites under SBAA legislation.

The SBAs have a complex coastal and marine habitat assemblage; ranging from sea cliffs to sand dunes and mosaics of seagrass beds, rocky reefs and sand corridors. The marine ecosystems are known to support numerous protected and endangered species, including: vast healthy meadows of the endemic seagrass *Posidonia oceanica* with the Noble Pen shell *Pinna nobilis;* shallow reefs covered with canopy-forming *Cystoseira*, coralligenous sciophilic communities and sponges.

The SBAs also support mobile fauna such as the critically endangered blackchin guitarfish *Glaucostegus cemiculus*, the endangered Mediterranean Monk seal *Monachus monachus* (Nicolaou, 2019*)*, shortfin mako *Isurus oxyrinchus*, as well as being a migration point for the endangered *Mobula mobular* (Giovos et al., in prep.), cetaceans (Boisseaeu et al., 2017), groupers and more.

Coastal habitats are important for an equally diverse species assemblage, including beaches used for nesting by the endangered Green turtle *Chelonia mydas* and Loggerhead turtle *Caretta caretta* (Charilaou and Perdiou, 2012), as well as cliff-dwelling bird species such as Eleonora's falcon *Falco eleonorae* (Hadjikyriakou et al., 2020) and Griffon vulture *Gyps fulvus.*

MAIN CLIMATE CHANGE DRIVERS

The Mediterranean is described as experiencing a 'tropicalisation', i.e. the increased incidence of warm-water species, particularly, lessepsian migrants from the Suez Canal, recorded in the Eastern Mediterranean (Bianchi and Morri, 2003). One such invader is the silver-cheeked toadfish *Lagocephalus sceleratus*, as it has been found to cause considerable damage to fishing nets and longlines. This species of fish, which is of Indo-Pacific origin, is of particular concern as it is contains tetrodotoxin and is, therefore, poisonous and a high risk to human health (EastMed, 2010). The first record at the Western Mediterranean basin was recently reported at Ceuta, the Straits of Gibraltar – 28 km from Gibraltar.

Varying factors affecting the Mediterranean include:

- ***Sea surface temperature (SST)*** – SST is widely recognised as increasing with an increase of +1.5 ºC from 1982 up to 2018 (Pisano et al., 2020) and predictions ranging from +1.73 and +2.97 ºC for the latter end of the 21^{st} Century (Adioff et al., 2015).
- ***Salinity*** – Being a semi-enclosed basin, the Mediterranean suffers from high evaporative rates, particularly, in the Eastern Mediterranean, resulting in saline water being exported to the Atlantic at depth at the Straits of Gibraltar. Under the most severe [RCP 8.5

scenario], salinity will increase at surface waters as well as at depth (0.05–0.33 psu).

- ***Sea-level rise and erosion*** – sea-level rise is of particular concern due to the location of coastal human communities; potentially, 5 million inhabitants will be affected by severe flooding, with estimated sea-level rise of between 45–81 cm by 2100 (Vousdoukas et al., 2017). There is no evidence as yet for effects of coastal erosion, however, Gibraltar has invested in coastal defence to mitigate beach erosion (see below).
- ***Dissolved oxygen*** – Declining dissolved oxygen concentrations in seawater are reported to be of concern globally with surface waters becoming stratified. Stark contrasts are observed at both ends of the Mediterranean basin with deoxygenation occurring in shallow water at the Eastern end. At the Western end, deoxygenation is not considered to be an issue due to surface-water intake of colder, relatively more-oxygenated Atlantic water. Deep water circulation with the Mediterranean is not considered to be a significant issue of concern.
- ***Oceanic pH*** – oceanic acidification and decreased seawater pH have been reported in both incoming Atlantic water and within water masses within the Eastern Mediterranean. Intensification of this acidification process is forecasted to exacerbate natural processes. Iconic, vulnerable habitats of coldwater corals of Mediterranean Sea are expected to be affected.

There are two broad issues of concern, affecting the Mediterranean UKOTs, classified here as:

1. Ecosystem function and food webs: critically endangered species, alien and invasive species.
2. Human health, coastal communities and infrastructure.

The increased presence of invasive alien species is of ‘high’ concern since this is facilitated by ballast-water exchange associated with maritime traffic. This is particularly relevant in the Straits of Gibraltar, which is one of the busiest shipping lanes in the world. Levantine Seas are also at increased risk due to their proximity to the Suez Canal where a range of 16-66 species have previously been recorded (Molnar et al., 2008; WOR, 2010).

The low-lying Akrotiri Salt Lake (Ramsar) and peninsular are likely to be where impacts of climate change will be most apparent, especially impacts on civil and military infrastructure, with important socio-economic implications for local communities.

Located at the eastern most-warm part of the Mediterranean (Figure 1), the SBAs are vulnerable to climate-change effects. In nearby countries, an unprecedented biodiversity collapse and restructuring of trophic levels has been observed due to climate change and invasive species (Givan et al., 2018; Albano et al., 2021).

The marine ecosystems are also under threat, the biggest challenge being the warming, which aids the spread and establishment of thermophilic invasive species. Acidification threatens coralligenous communities: the seagrass meadows are vulnerable to heat waves already being near tolerance limits. The sea level rise will likely diminish vermetid reefs of the rocky intertidal, overall community shifts and trophic cascades may result.

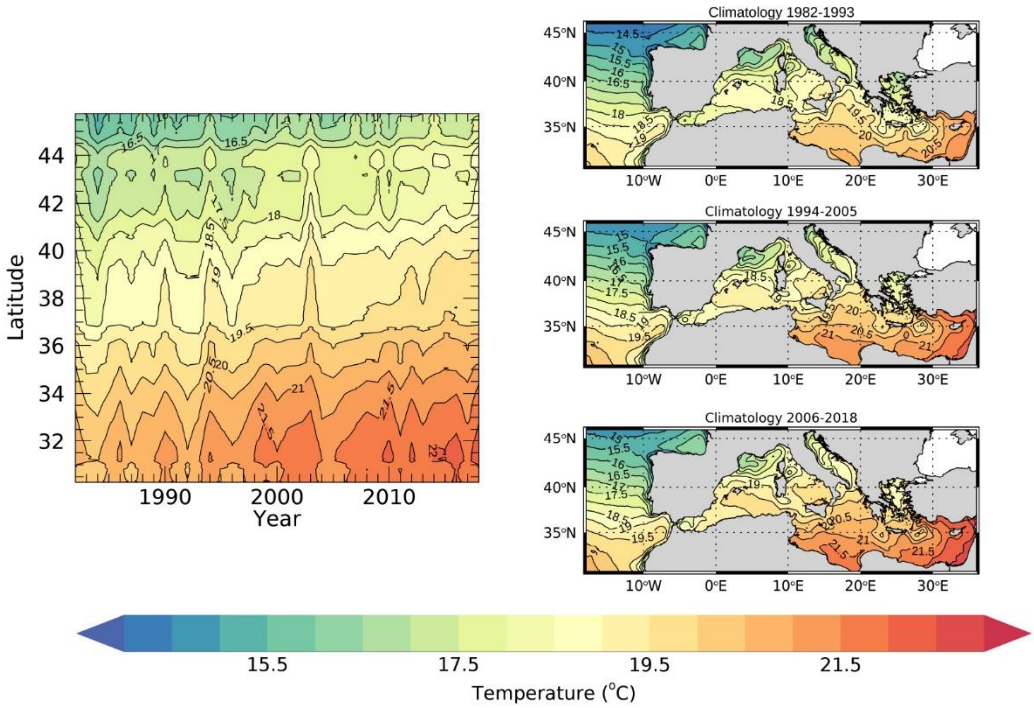

Figure 1. Hovmöller diagram of SST from 1982 to 2018 in the Mediterranean Sea and climatology in different year periods showing the temperature changes over the last decades. (Source: Pisano et al., 2020).

PRIORITY 1: ECOSYSTEM FUNCTION AND FOODWEBS - CRITICALLY ENDANGERED SPECIES AND INVASIVE ALIEN SPECIES (IAS)

WHAT HAS HAPPENED

It is likely that numerous species have already been affected by climate change and wider ecosystem-function impacts are as yet unknown. Evidence is increasing yet lacking in some areas of the case study regions. The overall confidence rating has been set as ‘low’ for now, but it is likely to improve in the near future, especially in Gibraltar, given that surveillance monitoring programmes have been established and will continue to be reviewed in response to data collected and pressures observed.

The SBAs have designated priority seagrass meadow habitat *Posidonia oceanica* (SBA, SAC citation. see https://sbaadministration.org/home/legislation/01_02_09_06_PIs/01_02_09_06_56_PI_2015/20151230_PI-26_G1795.pdf), a habitat that forms the basis of the ecosystem in the region that is experiencing dramatic declines, arguably due to climate change (Marbà and Duarte, 2010; Marbàet al., 2014). Local mortalities of *Posidonia oceanica* were reported in Akrotiri (Figure 2) and climate change acting synergistically with local stressors. The drivers for these changes have not yet been established. Within the wider Mediterranean, sewage inputs, coastal impacts and biological invasions are highlighted as drivers influencing decline of these habitats.

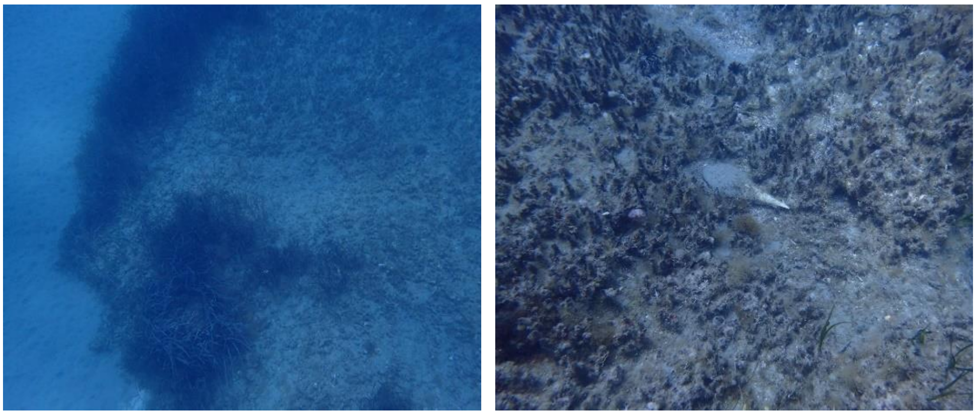

Figure 2. Local mortalities of Posidonia oceanica observed at Akrotiri SBA in May, 2019. (Copyright: Kostas Aristeidou).

The most-recent turtle nesting data from the SBAs indicates a potential change in nest timing, gestation periods and a gradual increase in nest flooding or wash-out events (SBA data, unpublished).

Akrotiri peninsular is believed to host an important population of the protected Ghost crab *Ocypode cursor* which might have already been affected by climate change effects. A sixfold decrease in the populations of tufted *O. cursor* was observed between 1994 and 2017 in Cyprus; possibly driven by invasive species, warming seawater and air temperatures, and increases in extreme weather conditions (Barakali et al, 2020).

The status of SBAs populations of the critically endangered bivalve *Pinna nobilis* are currently not known (indicatively, large populations were mapped close to Dhekelia by MER in 2017, Figure 3). This species has been severely affected throughout the Mediterranean Sea due to a recently described endoparasite *Haplosporidium pinnae* (Cabanellas-Reboredo et al., 2019; IUCN, 2019). The origins of the endoparasite are unknown but could be facilitated by climate change.

Over 1000 invasive alien species (IAS) have been recorded in the Mediterranean, and Cyprus is highly vulnerable due to its proximity to the Suez Canal. About half of Mediterranean NIS were introduced via the Suez

Canal. Apart from horizon-scanning exercises to prioritise IAS (Martinou et al, 2020; Peyton et al., 2019; 2020), and two events targeting lionfish removal that were conducted in Akrotiri as part of RELIONMED LIFE project, no other NIS-related study has been conducted in the SBAs. The citizen-science project *"Is it Alien to you…. Share it!!!"* of the NGO iSea recorded opportunistically 52 and 47 NIS in Akrotiri and Dhekelia (and nearby areas), respectively. The number and impacts of NIS present is expected to be significantly high in the SBAs.

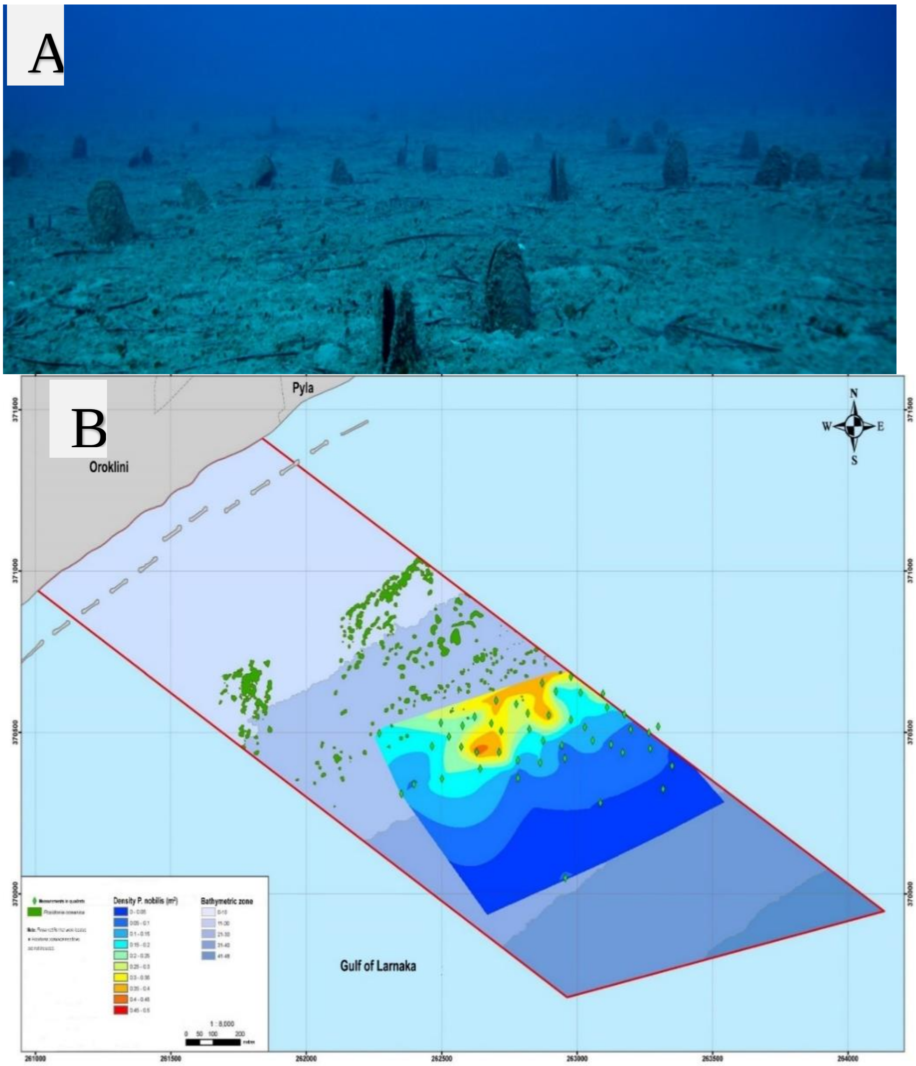

Figure 3. (A) Pinna nobilis field near Dhekelia in 2017; (B). Density extrapolated from measurements (n=223) within 46 quadrats 25 m^2 each (Cyprus SBA) in 2017. (Source: Marine and Environmental Research (MER) Lab.)

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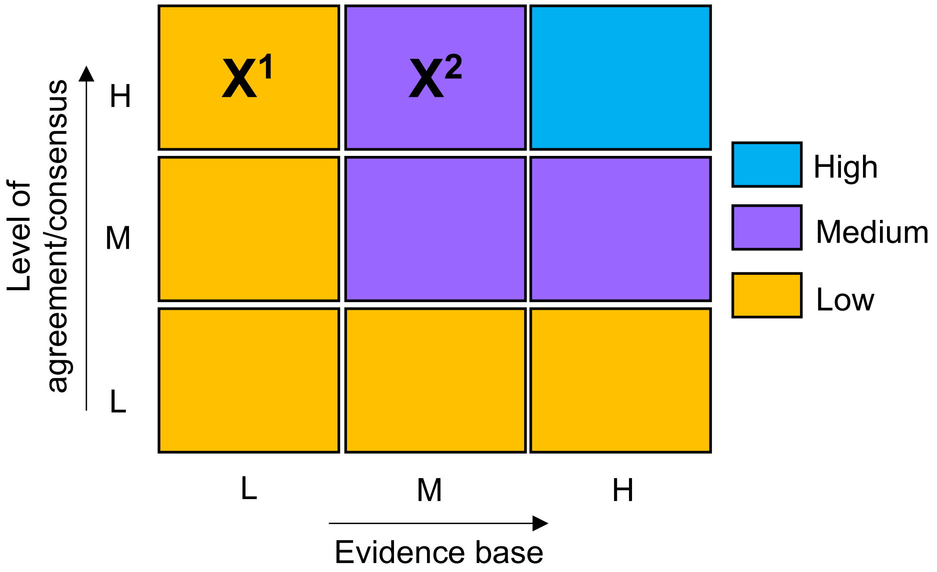

For Gibraltar, There is local and regional evidence of widespread colonisation, settlement and growth of the invasive algae *Rugulopteryx okamurae*. Information on the long-term ecological impacts is lacking. In the SBAA there is local and regional evidence of impacts of invasive species, in particular, the impacts of lionfish as well as the local mortality of *Posidonia* meadows.

X^1 = Mediterranean Monk Seal (*Monachus Monachus*).

X^2 = *Posidonia Oceanica* seagrass meadows; Invasive Alien Species; Sea turtles (*Caretta caretta*, *Chelonia mydas)*; The Mediterranean fan mussel (*Pinna Nobilis*).

WHAT MIGHT HAPPEN

Impacts of climate change on native biodiversity are expected to intensify in all ecosystems from intertidal reefs to the deeper ecosystems in the Mediterranean Sea (Corrales et al., 2018; Rilov et al., 2020; Albano et al., 2021). Simulations have shown that climate change may further diminish large-sized native fish populations, whereas pelagic, thermophilic, and generally IAS of Indo-Pacific origin will be increasingly favoured (Moullec et al., 2019). IAS impacts are expected to exacerbate with important implications to marine biodiversity. Predictions have been made that *Posidonia oceanica* meadows might face extinction by 2050 (Jordà et al., 2012).

Akrotiri hosts important nesting grounds for two turtle species *Chelonia mydas* and *Caretta caretta*, climate change could affect the ratio of males and females in the nests. A preliminary survey at Akrotiri in 2010 found mean nest temperature to be around 29 °C (Baker, 2010), the critical threshold above which can lead to excessive feminisation of hatchling sex ratios. Rising temperature could result in reduced fertility rates, and loss of genetic variation compromising the population's ability to overcome pressures (Hamann et al., 2010). Heatwaves can also result in reduced reproductive output of turtles (Stubbs et al., 2020) while sea-level rise and flooding can reduce climatically suitable habitats for nesting grounds (Fuentes et al., 2020).

Sea-level rise could have a negative impact, of unknown magnitude, on the habitats of the Mediterranean monk seal *Monachus monachus*. The Akrotiri area has several caves where Mediterranean monk seals breed, feed, and mate (a pup was discovered in 2011). The cliffs of Akrotiri and Episkopi host also some of the most important bird areas of Cyprus, and climate change (extreme events, tidal flooding, changes in conditions) poses a threat to habitats of both migratory and residential birds.

In Gibraltar, sea-level rise will force a shift in the distribution of endemic Mediterranean species such as *Patella ferruginea*. Whether or not numbers will increase within the territory are unclear at this stage. Climate-change impacts on breeding, e.g. Mediterranean shag *Phalacrocorax aristotelis desmarestiiI*, and migratory seabirds are also difficult to foresee with certainty. The situation is similar with to the potential impacts on cetaceans that breed and feed in BGTW such as the Common dolphin *Delphinus delphis*, Striped dolphin *Stenella coeruleoalba* and Bottlenose dolphin *Tursiops truncatus.*

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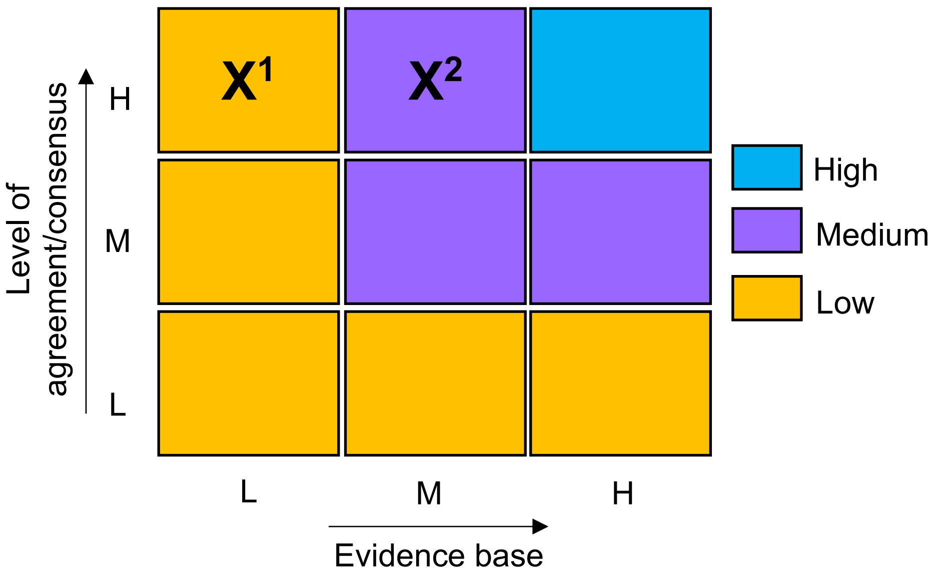

For justification, see what has happened confidence assesment.

PRIORITY 2: HUMAN HEALTH, COASTAL COMMUNITIES AND INFRASTRUCTURE

WHAT HAS HAPPENED

The Straits of Gibraltar have been colonised by an invasive species of macroalgae *Rugulopteyrx okamurae*, which was initially observed at the African coast of the Strait in 2015 and it has now extended to both the Atlantic and Mediterranean coasts of the Iberian Peninsula. The exact reasons for its initial colonisation are unclear but could be attributed to ballast-water exchange in the Straits. This colonisation has been facilitated by favourable temperatures which rarely drop below 15ºC in winter and reach over 25ºC in summer. *R. okamurae's* ability to quickly colonise both natural and artificial substrates and, thus, outcompete native species in the process (García-Gómez et al., 2020) is yet another crucial factor.

Gibraltar obtains its drinking water supply by way of desalination (annual consumption of < 1,750,000 m^3) (DESCCH, 2020). *R. okamurae* has been found to clog desalination intake pipes due to its impressive ability to rapidly colonise hard surfaces. The annual removal cost is approximately GBP£12,000. Significant removal efforts take place during the summer in particular (AquaGib, *pers comm*). In addition, the clean-up cost of removing invasive macroalgae stranded on Gibraltar's beaches averages £45,000-60,000 per annum.

The extent to which climate change will or has impacted the prevalence of *R. okamurae* is presently unknown.

Figure 4. Dense accumulations of R. okamurae washed up on Gibraltar's North West littoral environment.

In the last few decades, high-density populations of jellyfish have been observed in many coastal areas around the world including the Mediterranean Sea (Canepa *et al.*, 2014). Blooms of the Mauve stinger *Pelagia noctulica* and Portugese man o' war *Physalia physalis*, for example, are a common and natural phenomenon in BGTW. However, any increase in the abundance and extent of these gelatinous zooplankton blooms will result in increased societal nuisance impacts as well as economic costs. At present, costs of approximately GBP£60,000 are incurred per year to reduce the impacts of jellyfish blooms in Gibraltar's beaches during the bathing season.

Figure 5. Jellyfish boom deployed in Camp Bay within the Southern Waters of Gibraltar MPA.

With regards coastal defence and flood protection, approximately GBP £12 million were spent in Gibraltar between 2012 and 2019 (HMGoG DESCCH, 2020). It is likely that the costs associated with coastal works will increase depending on how sea-level rise predictions in the study region materialise.

Due to lack of studies and available data, no impacts can be described on human health, coastal communities and infrastructure in the SBAs of Cyprus. Climate change can affect fishery resources in many direct (distribution, reproduction timing, dispersion of propagules, abundance, size) and indirect ways (uncertainty, variation in prices) (Pincinato et al., 2020). Climate change can cause substantial biomass decrease (Corrales et al., 2018), and shifts in species communities (Arndt, 2018) that is observed in surrounding countries like Israel. Nuisance species such as the various pufferfishes (Family: Tetraodontidae), the striped eel catfish *Plotosus lineatus*, and the nomad jellyfish *Rhopilema nomadica* strongly interfere with or alter fishery activities by damaging gears and fishery catches (EastMed, 2010; Galanidi et al., 2018; Kalogirou, 2013). The increasing numbers of jellyfish blooms have been also observed in Cyprus due to climate change (rise in temperature, extreme events) and local pressures that cause nutrient loading (pers. observation). In Israel, *Rhopilema nomadica* outbreaks also caused significant costs to power plants by clogging intake pipes and to the tourism industry as they can release venomous stinging cells (Ghermandi et al., 2015). The increasing abundance of lionfish *Pterois miles* over the last five years is alarming.

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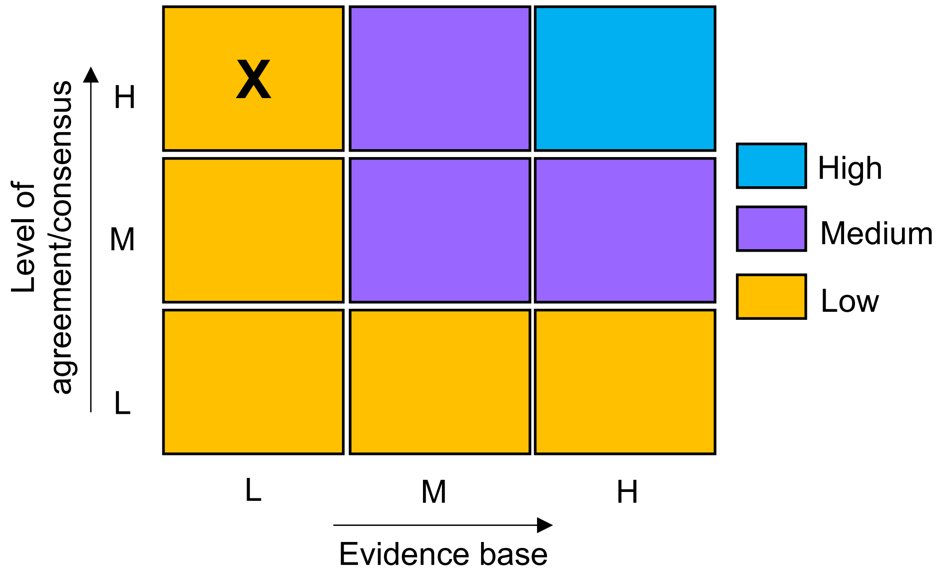

For Gibraltar, there is high agreement on the potential for impact to coastal assets by sea-level rise but evidence is limited. For the SBAA, there is high agreement on the potential for impact to coastal assets by sea-level rise but evidence is limited. There is however, consensus on the potential for the degradation or loss of ecosystem services associated with marine habitats with significant economic impacts on fisheries, tourism and infrastructure; the mortality of Posidonia being a key example.

WHAT MIGHT HAPPEN

Thermophilic invasive species of Indo-Pacific origin are expected to increase in abundance and biomass, and their impacts will likely exacerbate affecting fisheries, tourism and other industries. Venomous and poisonous species will likely increase in abundance posing an additional threat to sea users and consumers. It was estimated that the cost of damages to the artisanal gear of small-scale fishers, of Turkey alone, caused by the pufferfish *Lagocephalus sceleratus* are around € 2 million per year (Ünal et al. 2015), while an outbreak of jellyfish *Rhopilema nomadica* in Israel can cost an annual monetary damage from tourism losses of €1.8–6.2 million (Ghermandi et al., 2015).

Flooding, coastal erosion, and rise in sea levels might affect coastal roads, infrastructure, and intertidal sessile communities. Risk assessments of climate-change impacts within the SBAs (DIO, 2018) have identified "the loss of assets due to sea level rise (including natural assets such as beaches)", as well as "impacts on biodiversity and ecosystem services". Similar assessments using GIS tools reveal a similar picture for nearshore coastal infrastructure in Gibraltar. Potential socioeconomic effects can hardly be predicted due to lack of available studies/data and the complexity of such elucidations.

The degradation or loss of ecosystem services associated with marine habitats could have significant economic impacts on fisheries, tourism and infrastructure. Services attributed to Posidonia beds (Díaz-Almela et al 2008) are a key example for the SBAs.

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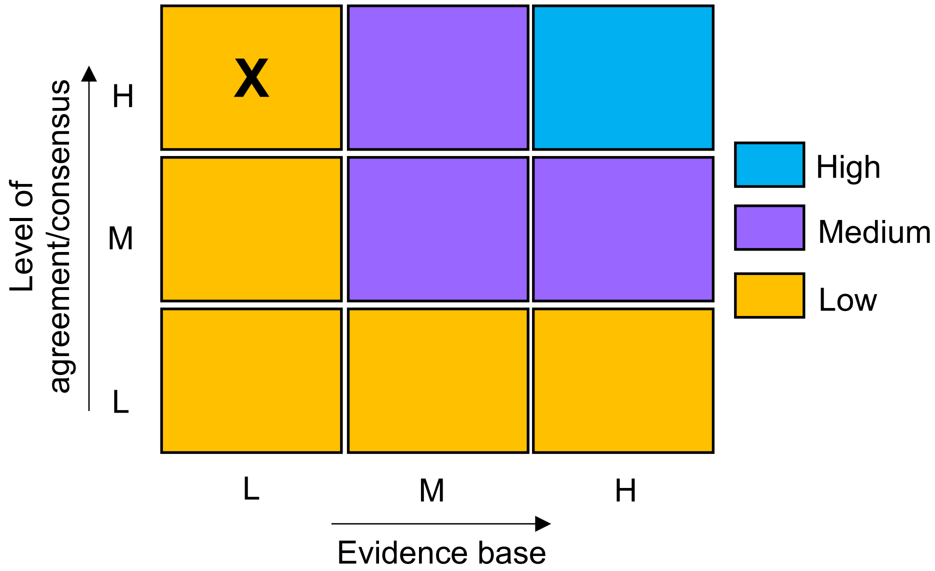

For justification, see what has happened confidence assesment.

REGIONAL NATURE-BASED SOLUTIONS: CASE STUDY

Nature-based solutions (NbS) are "actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits (IUCN, 2021)".

NbS offer a spectrum of dynamic and cost-effective solutions to climate change impacts such as ecosystem protection and restoration, ecosystem-based adaptation and mitigation, natural climate solutions, agroecology, blue/green urban design and ecosystem-based disaster risk reduction. Crucially, NbS work to protect biodiversity and ecosystem integrity, while ensuring livelihoods, water and food security and human wellbeing.

NbS are applied to a limited extent in the Mediterranean to address the various socio-ecological impacts resulting from climate change (Canals Ventín and Lázaro Marín, 2019). Not all NbS activities are directly relevant to Mediterranean OTs that prioritise marine and coastal related issues. For example, forest protection, restoration and sustainable management in Morocco may not directly benefit the marine environment in Gibraltar.

NbS activities of relevance to Mediterranean OTs include:

- Sustainable management of Morocco's marine resources in the Marine Protected Area of Alboran Mar Chica Lagoon, Al Hoceima National Park (Panorama, 2021).
- Corso Commune coastal dune ecosystem rehabilitation project in Boumerdes, Algeria (Panorama, 2021).

LIFE Blue Natura – Andalusian blue carbon for climate change mitigation: quantification and valorisation mechanisms for marine and coastal habitats (Life Blue Natura, n.d.)

The amount of CO_2 captured by healthy seagrass meadows through metabolic processes and by trapping suspended particles averages 586 to 681 g CO_2 m^{-2} $year^{-1}$ (Duarte *et al.*, 2010; Kennedy *et al.*, 2010). Globally, it is estimated that seagrass ecosystems can store as much as 19.9 Pg of organic carbon (Fourqurean *et al*., 2012). Within Gibraltar, HMGoG's Department of the Environment, Sustainability, Climate Change and Heritage (DESCCH) have carried out initial seagrass restoration trials within the Southern Waters of Gibraltar Marine Protected Area. Plans are in place to carry out a more-extensive seagrass restoration project for two species namely *Cymodocea nodos*a and *Zostera marina*. The project is expected to run over three years and includes DESCHH and the University of Gibraltar and regional partners such as the Centre of Marine Sciences (University of Algarve and the University Mohammed V, Faculty of Sciences, Rabat.

The lionfish, *Pterois* miles, is a recent invader in the Mediterranean but poses a serious risk to marine ecosystems (Savva et al., 2020). At Akrotiri, the RELIONMED LIFE project (https://relionmed.eu/) undertakes activities with divers and is dependent on citizen support to remove the invasive lionfish (*Pterois miles*). The project seeks to make Cyprus the 'first line of defence' against the invasion of the lionfish in the Mediterranean; 74 individuals of lionfish were removed in one expedition alone but removals are not frequent nor intensive. Goals of the project seeks to capacity-build and raise awareness for adaptive management efforts to promote biosecurity measures.

NEXT STEPS

NbS can effectively and sustainably address the challenges imposed by climate change in the Mediterranean, but their uptake in policy and planning, particularly in coastal and marine sectors, is limited. Greater emphasis on mapping stakeholder perspectives and case studies is also required. Key knowledge gaps (KGs) of relevance to coastal and marine environments have been identified. If these KGs are met, the greater implementation of NbS in Mediterranean OTs is expected (Grace et al., 2021).

- Addressing the lack of data and evidence is an essential initial step in managing threats and pressures on the marine environment, including those directly or indirectly attributable to climate change.

- Management of wider threats and pressures on marine ecosystem to reduce synergistic impacts of climate change, such as addressing significant threat from invasive alien species.

- Undertaking assessments and evaluations to enable integration of marine ecosystem services into decision-making process and long-term planning in the Mediterranean OTs.

- Ensuring decision makers understand the economic value or ecosystem service benefits of protecting our marine environment, such as ensuring *Posidonia oceanica* beds function as a carbon store (Kletou et al., 2020) and invest in natural capital assets (protection of important predators, establishment of stricter protected zones), targeted removals of invasive species, and promotion of an adaptive management to limit socioeconomic losses (see Kleitou et al., 2021).

- Development of an integrated coastal zone management plan to allow policy creation and management objectives for SBA coastal zone.

ACKNOWLEDGEMENTS

MCCIP wishes to acknowledge the contributions of Minna Raban (Foreign Commonwealth and Development Office) who also contributed to the Meditteranean Region Workshop and helped to identify the priority climate change issues.

MCCIP would also like to thank to two anonymous reviewers whose constructuve comments helped to improve this work.

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SBAA CITATIONS AND DESIGNATED SITE DOCUMENTATION

SPAs – https://www.sbaadministration.org/images/AEEIC/consultations/20100714_SPA.pdf (species include: Eleonora’s falcon, Red-footed falcon, Griffon vulture, Ferruginous duck, Demoiselle crane, Kentish plover, Greater flamingo – at least 32 bird species listed on Annex I of the European Birds Directive are known from Akrotiri Salt Lake)

SACs – https://sbaadministration.org/home/legislation/01_02_09_06_PIs/01_02_09_06_56_PI_2015/20151230_PI-26_G1795.pdf (citations are not currently published, but are available on request)

Ramsar site - Akrotiri (Salt lake) https://jncc.gov.uk/jncc-assets/RIS/UK32001.pdf