Mapping Exposure to Sargassum Impacts in Eastern Caribbean small island states as a basis for strategic management

Mapeo de la exposición a los impactos del sargazo en los pequeños estados insulares del Caribe oriental como base para la gestión estratégica

Cartographie de l'exposition aux impacts des sargasses dans les petits États insulaires des Caraïbes orientales comme base pour la gestion stratégique

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EXTENDED ABSTRACT

Since sargassum influxes began in 2011, the negative impacts of these influxes across the environment, society and economy in the Caribbean have been generally well documented. However, impacts are not uniform across the region, in large part because sargassum exposure is not uniform and numerous attributes of the impacted coastline influence the nature and types of impacts. For example, in bays, sargassum often decomposes offshore fouling water quality, whereas some shorelines experience high piling of Sargassum onshore. In general, the region is far less homogenous than is often perceived. The Eastern Caribbean is directly exposed to high energy sea conditions of the Atlantic, whereas the continental states of the Western Caribbean are more sheltered. Small island developing states (SIDS) are especially vulnerable to external shocks and lack the resources to mount an effective response. Sargassum impacts on small islands are different from those on larger continental states, and response logistics are also more challenging due to the fragmented coastlines. Spatial differentiation of the impacts would support more effective allocation of limited resources for management. This, however, is limited by the availability of consistent and systematic monitoring data (Cox, Degia, and Lopez 2021).

The main objective of this research is to support improved response planning for sargassum influxes particularly in Barbados, Dominica, Grenada, St. Lucia, and St. Vincent and the Grenadines through spatially explicit assessment of exposure and vulnerability to sargassum influxes.

A template for a standard country profile consisting of key data relevant to assessment of sargassum influx impacts was developed and populated for each country. To support the spatial assessment, "coastal zone sub-areas" with similar characteristics were identified for each island, using existing designations where possible (for example Barbados has eight designated coastal sub-areas (CZMU et al. 1998)), or creating new delineations where necessary.

Exposure to sargassum influxes was represented spatially using available historical data; predictive modelling for sargassum influxes at the scale of specific island coastlines does not currently exist. In the absence of other data sources on historic influxes, publicly available aerial imagery (Google Earth) was inspected and images showing sargassum influxes in the study area were extracted. The spatial and temporal variation of influxes shown in the extracted images was analysed, to 1) quantify the relative presence/absence of sargassum influxes within each sub-area, and 2) develop a qualitative exposure rating (high, medium, low) for specific sites with the most available data. Exposure maps were produced using ESRI ArcMap, to display the results of the exposure analysis in terms of spatial distribution of historic Sargassum influxes.

Alongside the exposure mapping, existing spatial datasets were compiled to produce maps of 'assets' or resources that may be impacted by sargassum influxes. Assets were organised in categories to produce multiple maps. For this study, asset categories and economic sectors of interest include tourism, fisheries, coastal communities and coastal ecosystems. These asset categories were selected because they are known to be both of significant value nationally and to be significantly impacted by sargassum influxes (Cox, Degia, and Lopez 2021). Spatial data for Barbados, Dominica, Grenada, St. Lucia, and St. Vincent & the Grenadines were obtained from various sources to create the asset.

Exposure maps were overlaid with asset maps, and the exposure of specific asset categories was assessed qualitatively. Overlaying exposure and asset mapping allows identification of the types of impacts that do or do not occur within each sub-area. A summary description of the sargassum influx exposure in the study-area countries is provided, along with two sample maps.

In general, sargassum influxes occur mainly on the windward coast of the islands particularly on the east coast and occasionally on the southern coast for some islands. West (leeward) coasts are generally unexposed or minimally exposed to influx events, due to the sheltered nature of that coastline. As such, assets that are located on the leeward coasts are themselves minimally exposed to sargassum influxes.

In Barbados, Sargassum influxes occur mainly on the south, east and north east coasts. On the South coast, the main exposed assets are related to the tourism and fisheries sectors, while on the east coast, mainly fisheries assets are exposed. Coastal communities are mainly exposed on the south, southeast and east coasts. In terms of coastal ecosystems, wetlands on east coast mainly exposed as well as sea turtle nesting sites on the south and east coasts.

In Dominica, Sargassum influxes occur mainly on the south, east and north-east coasts. On the South and East coasts,

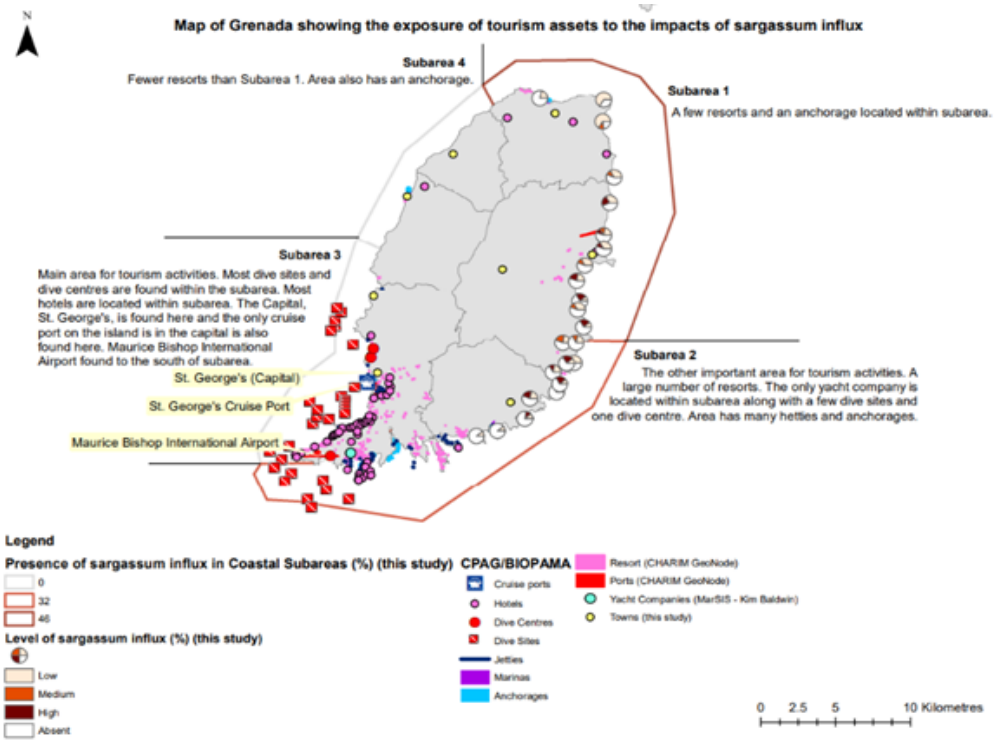

Figure 1. Map of Grenada showing the exposure of tourism assets (main towns, hotels, resorts, ports dive centres and sites, jetties, marinas, and anchorages) to the impacts of sargassum influx.

the main exposed assets relate to the fisheries sector, while coastal communities are exposed mainly on the southeast and east coasts. In terms of coastal ecosystems, sea turtle nesting sites on the east and north east coasts, mangroves on east coast and seagrasses on north east are exposed.

In Grenada (mainland), Sargassum influxes occur mainly on the southeast, east, and north coasts. On the Southeast and East coasts, the main exposed assets relate to the fisheries sector. With the majority of tourism assets are located in the south-west, those on the south coast are more exposed, while those on the west are only minimally exposed (Figure 1). Coastal communities are mainly exposed on southeast and east coasts. Various coastal ecosystems are exposed, including mangroves and seagrasses on southeast, east and northeast coasts and leatherback nesting sites on the east and northeast. While in the Grenada Grenadines, Sargassum influxes occur mainly on the east and north coasts. On these coasts, the tourism and fisheries assets are minimally exposed. In terms of coastal ecosystems, sea turtle nesting sites and seagrasses on the east and north coasts and mangroves on the north coast were exposed.

In St. Lucia (Figure 2), Sargassum influxes occur mainly on the south, east, and north coasts. On the South coast, both tourism and fisheries assets are exposed, while on the East coast, mainly fisheries assets are exposed. Coastal communities are mainly exposed on south, east and north coasts, and various coastal ecosystems are exposed, including wetlands and mangroves, seagrasses and sea turtle nesting sites on south, east, and north coasts.

In St. Vincent (mainland), Sargassum influxes occur mainly on the south, east, and northeast coasts. On the Southeast coast, a small number of tourism assets are exposed. On the East and Northeast coasts, fisheries assets are exposed as well as a small number of tourism assets. Coastal communities are exposed on south, east and northeast coasts, and in terms of coastal ecosystems, sea turtle nesting sites on south and east coasts are exposed. In the Grenadines islands, Sargassum influxes occur mainly on the south, east and north coasts. On these coasts, the tourism and fisheries assets are exposed. In terms of coastal ecosystems, mangroves, sea turtle nesting sites and seagrasses on the east and north were exposed.

Despite significant active research on Sargassum influxes in the region, there remains a lack of spatial data on the specific locations and extent of Sargassum influxes and how these vary over time. In this study, Google Earth aerial imagery was used to develop indicative exposure mapping, but this is limited because images are not frequent and not taken at regular time intervals. Despite these limitations, general conclusions can be drawn about where particular types of impacts occur based on types of assets present/absent in exposed areas. It is expected that this indicative exposure mapping can be used as a basis for more detailed exposure analysis, further differentiation of impacts (for example by coastal morphology or coastal dynamics), vulnerability assessment of exposed assets, and strategic management responses. It is envisaged that these maps and the assessments that build on them would be useful to by technical officers involved in planning responses to

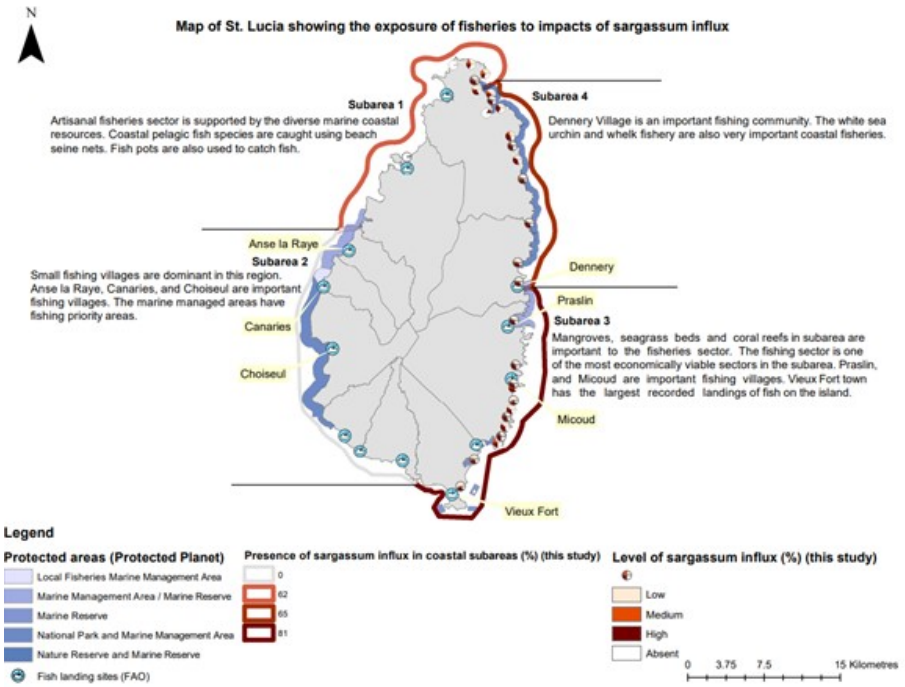

Figure 2. Map of St. Lucia showing the exposure of fishery assets (marine protected areas and fish landing sires) to the impacts of sargassum influx sargassum influx on 30 July 2014.

sargassum influxes

KEYWORDS: sargassum influxes, exposure mapping, asset mapping, small island developing states, coastal zone management.

LITERATURE CITED

CZMU. 1998. Integrated coastal management: the Barbados policy framework. Bridgetown: Government of Barbados.

Cox, Shelly-Ann, A. Karima Degia, and Ileana C. Lopez. 2021. “Sargassum White Paper – Turning the Crisis into an Opportunity.” Ninth Meeting of the Scientific and Technical Advisory Committee (STAC) to the Protocol Concerning Specially Protected Areas and Wildlife (SPAW) in the Wider Caribbean Region. United Nations Environment Programme - Caribbean Environment Programme.