Assessment of seagrass communities in the northern Gulf of Aqaba: Mapping their distribution

Within the Gulf of Aqaba, coral reefs have been considered the dominating ecosystem, attracting not only scientific attention, but also restoration efforts, aquarium exhibits and outreach educational programs. Seagrasses, which are known worldwide as a highly important ecosystem, have not received much attention by the public, scientists or authorities involved in conservation and management in this region. This is surprising considering the value of ecosystem services associated with seagarsses and the fact that many of these services are important to adjacent coral reefs. The absence of comprehensive seagrass maps for this region, prohibits other downstream activities such as evaluations of the associated ecosystem services and implementation of potential conservation and management tools. Here we present efforts to map seagrass meadows along the Israeli coast of the northern Gulf of Aqaba. Mapping was done by snorkeling with a GPS and a handheld echo-sounder. Transects perpendicular to the shore were conducted with measurements taken every 10-20 m that included water depth, GPS position and percent of seagrass cover estimated visually up to 13-23 m depending on visibility. In addition to these transects, we also tracked the shallow boundary of the meadows parallel to shore, usually at 3-5 m depth. Both data sets were then fed into Arc-GIS to create an interpolated GIS layer. Out of 11 km available shoreline, we swam along 9.7 km and collected a total of 2830 data points. Seagrasses were found growing along 7.5 km of these shores, with seagrass meadows covering 707,000 sqm^2.estimated to be worth = US$ 2,000,000 $year^{-1}$ in associated ecosystem services. In addition to mapping the seagrass meadows themselvs, we also mapped the potential dangers to seagrasses in the region. Disturbances were ranked as low, medium or high according to severity and frequency. We expect that these maps (GIS layers) will allow us to not only understand the current distribution of seagrasses in the area, but also to develop a GIS-based tool that will

improve our understanding of how changes in the Gulf could affect the cover and state of seagrasses, and thus improve conservation efforts in the region.

Assessment of seagrass communities in the northern Gulf of Aqaba: 1. mapping their distribution

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INTRODUCTION

Within the Gulf of Aqaba, coral reefs have been considered the dominating ecosystem. Seagrasses, known worldwide as a highly important ecosystem, have hardly received any attention in this region. This is surprising considering the value of ecosystem services associated with seagarsses[1,2] and the fact that many of these services are important to adjacent coral reefs.

The absence of seagrass distribution maps in this region, prohibits other downstream activities, such as accurate evaluations of the associated ecosystem services and implementation of potential conservation and management tools.

OBJECTIVES

Create a geographic information system (GIS) layer describing the geographical and depth distribution of seagrasses in the northern Gulf of Aqaba. Such a map will contribute to the future conservation and management of seagrasses in the region.

MATERIAL AND METHODS

Transects perpendicular to the shore were made while snorkelling above meadows with a GPS (Trimble Recon), hand held echo-sounder (Hondex PS-7; Honda Electronics, Japan) and camera (Fig. 1a-c). Depth (m), GPS position and seagrass cover (0-100%) were recorded every 5-15m, with 10% of such points also photographed from the surface. GPS track function was used to record shallow boundaries of meadows parallel to shore (~ 3-5 m depth; Fig. 1d).

Fig. 1. Field work involved in making the seagrass GIS layer. Snorkelling with a hand held echo-sounder (a,b) and GPS (c). Transects perpendicular to the shore (d) with measurements every 5-15 m, followed by tracking the shallow boundary.

Seagrass cover and bathymetric GIS layers were integrated with a shoreline layer and a digitized and geo-referenced aerial photograph of the region, then imported into QGIS (http://www.qgis.org). Percent of seagrass cover and depth were interpolated using triangulation, with depth interpolation used to create depth contours (Fig. 2a) and seagrass cover transformed into a continuous color-coded layer (Fig. 2b), later combined to one layer (Fig. 2c).

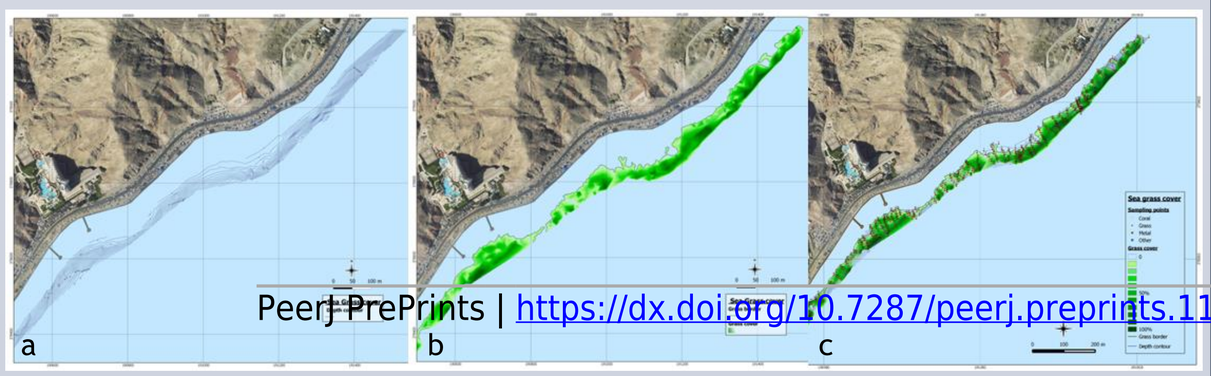

Fig. 2. GIS work involved in making the seagrass layer (using QGIS in this case). Creating a GIS layer of position and depth contours (a), position and seagrass cover (b) and combining both layers (c).

RESULTS

Halophila stipulacea was the only seagrass species found throughout the mapping work described here (Fig. 3).

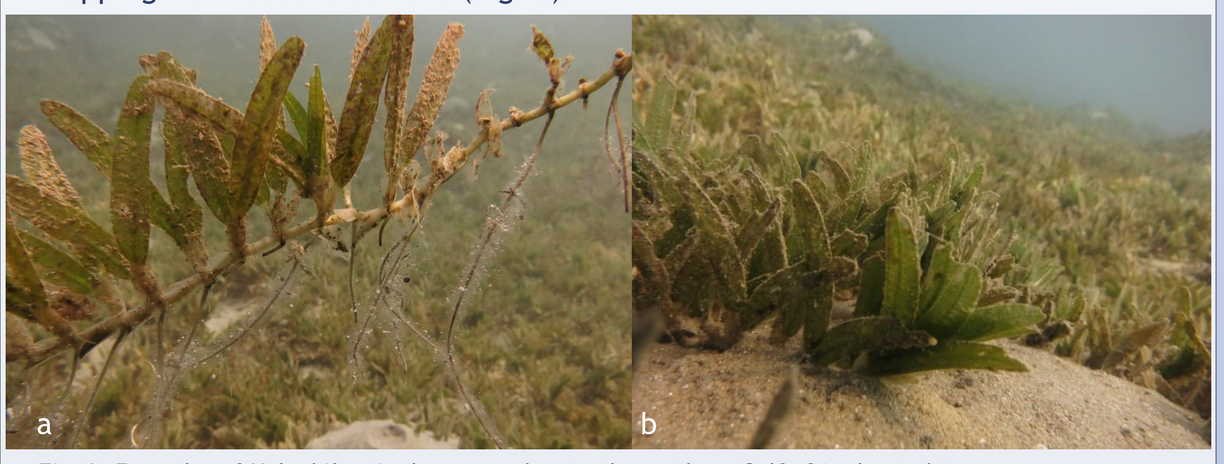

Fig. 3. Examples of *Halophila stipulacea meadows* in the northern Gulf of Aqaba (a, b).

All in all, 2830 data points were collected in 39 days (06/2013-09/2014). Out of the 11 km available shoreline, we were able to swim along 9.7 km. Seagrasses (*H. stipulacea*) were found growing along 7.5 km of these shores, covering a total of 707,000 m^2, an area estimated to be worth US$ 2,000,000 $year^{-1}$ in ecosystem services[1] (Fig. 4).

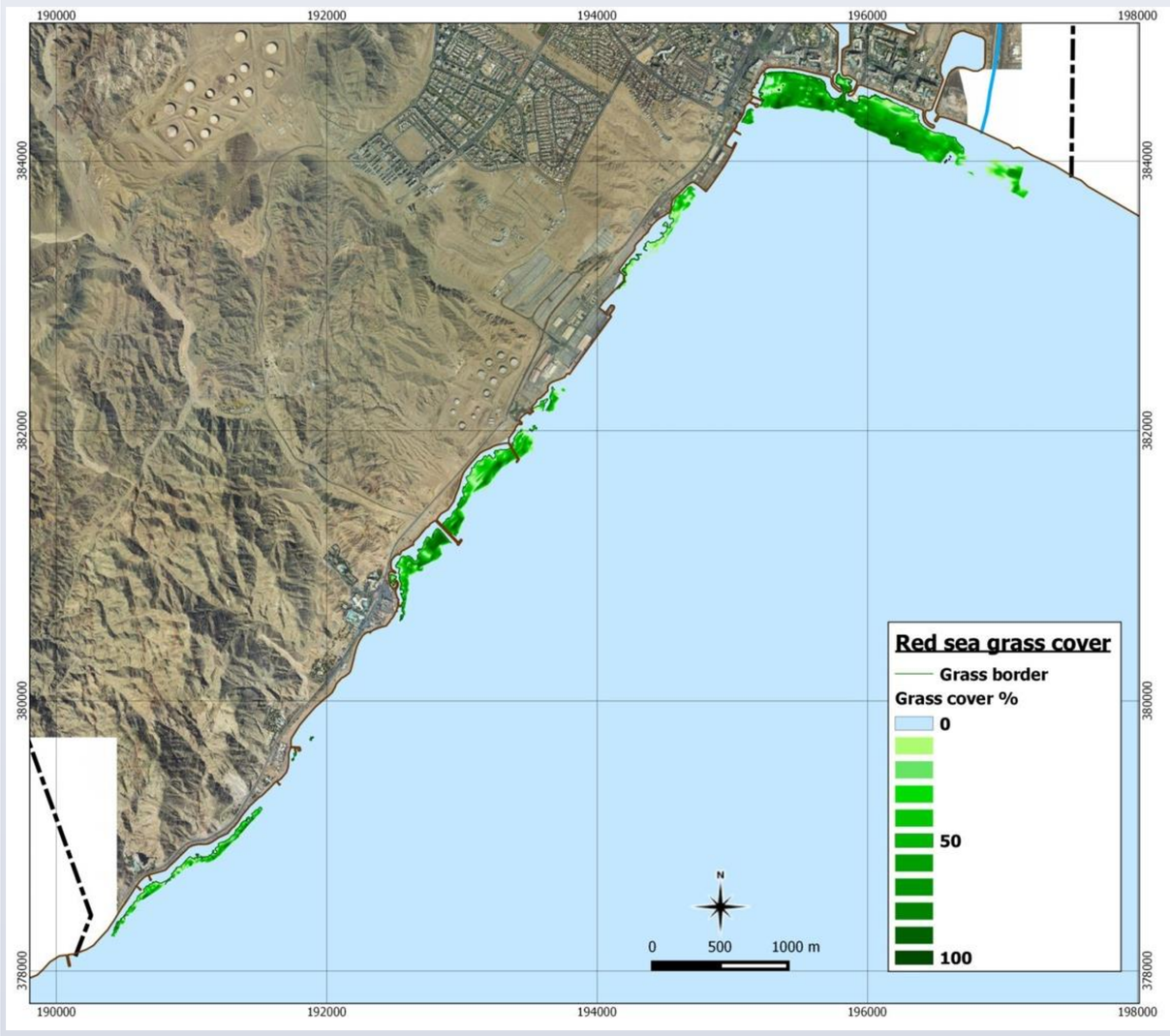

Fig. 4. Distribution of *Halophila stipulacea* in the northern Gulf of Aqaba.

CONCLUSIONS

This is the first time seagrasses are being mapped and quantified in the northern Gulf of Aqaba. It is clear we did not reach the maximum depth limits of *H. stipulacea*, known to grow to 48 m in the region[4], hence the real area covered by seagrass meadows is expected to be even larger.

Future mapping will involve drop cameras allowing us to deepen the maps presented here. Inclusion of other GIS layers (sediment type, Kd, etc.) will further our understanding of the current distribution of *H. stipulacea* meadows in the region. Mesocosm experiments on *H. stipulacea*, will allow us to predict how changes in local conditions (e.g. increased water temperatures, decreased salinities) might effect the distribution of *H. stipulacea* in the Gulf.

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