Adopting Sentinel-2 for Baseline Mapping of Seagrass Meadows in Watamu-Malindi Marine Reserve Kenya (Ongoing Study)

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1 Background

Scarcity and absence of data on spatial distribution of seagrass meadows is a major hindrance to management efforts of these valuable habitats, especially in large and remote areas. Spatial mapping of distribution of seagrass meadows can be important tool for baseline surveys, consolidation of data in integrated databases, monitoring management effectiveness and fulfilling legislation objectives. Most seagrass assessment and monitoring efforts have been conventionally conducted by combining a range of ground-based sampling (*in situ)* methods *e.g.* scuba/snorkeling surveys. Although i*n situ* surveys are effective for fine/micro-scale area (covering <1 ha) studies they are often too costly, time consuming and hence inconvenient for mapping large coastal areas.

Optical satellite remote sensing (RS) comprises one of the most convenient way to supplement the conventional *in situ* methods in surveying seagrass ecosystems because of their rapidity, large area coverage, repeatability of observations and time- and cost-effectiveness. The Multi-Spectral Imager (MSI) instrument on Sentinel-2 has been demonstrated to be suitable in conducting baseline assessments and subsequent monitoring of the spatial extent of seagrass in sub-tropical seascapes with high accuracy in shallow waters due to the spatial resolution, band availability and radiometric accuracy.

This ongoing study aims to use Sentinel-2 imagery to conduct a baseline survey estimating the spatial distribution of seagrass meadows and concurrently create a map indicating other habitats within the shallow coastal seascape of the marine reserve section of Watamu-Malindi Marine Protected Area (WMPA), the oldest marine protected area in Kenya. Although there have been numerous studies within the park section, habitats within the marine reserve section have not been comprehensively mapped and studied.

2 Methodology

The marine reserve section of WMPA is located along the longest fringing reef on the east coast of Africa and is dominated by coral reef and seagrass habitats, except Mida creek section, which has extensive mangrove forests.

The presence/absence and area distribution criteria will be used to assess and estimate area of seagrasses meadows and will be conducted by combining remotely sensed data at 10m resolution from Sentinel-2 and *in situ* diver observations.

Sentinel-2 is a European Space Agency's mission dedicated to monitoring land and coastal areas.

We are processing and analyzing a Sentinel-2 data obtained on 2nd January 2019 at 0726hrs. A detailed pre-processing methodology involving land masking, water column correction, radiometric calibration, supervised classification and accuracy estimation will be applied using Semi-automatic classifier plugin, QGIS 2.18.23.

Parallel *in situ* boat-based surveys are conducted between 25th January to 6th February 2019, through stratified random sampling to ensure adequate representation of all physical habitats in their different depth range. Snorkelling and diving (in larger depths) will be used as the optimum sampling method, involving the following procedure:

i. Photography

At least two photographs; one directly above the quadrat and at an angle of 45-60° and a video footage of about 30 seconds will be taken at about 50 – 75cm above the plot depending on the water depth.

ii. Abundance and Species composition

Seagrass abundance will be estimated using percentage cover within a quadrat. A quadrat is randomly tossed within a radius of 5m around a stationary point. Overall percentage cover of seagrass within the quadrat will be estimated. Seagrass species present within the quadrat will be identified and percentage contribution of each to the species to the total cover estimated.

iii. Shoot density

All shoots in two alternate division of the quadrat (half of the quadrat) or some percentage of the quadrat depending on the density will be counted to determine the shoot density. Depth of the plot will be measured using a measuring stick and sediment type recorded. Other dominant substrate types within the transect maybe noted.

3 Results

Expected classification classes include beach sand, seagrass, coral reef and sand in water. We will produce a map showing seagrass coverage area in Km^2.

4 Conclusion

We expect Sentinel-2A to bridge the data gap on distribution of seagrass meadows and facilitate well-informed management decisions in future. However, due to the habitat complexity and rugosity it may not be possible to achieve firm habitat classification based on satellite data with 10m resolution, and higher resolution commercial imagery may be needed.