ID10- MONITORING AND MAPPING OF INTERTIDAL MACROALGAE USING LOW-COST GEOSPATIAL AUTOMATED TECHNIQUES

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Abstract
The global extent of macroalgae is declining with important consequences on marine biodiversity and ecosystem processes. Tracking the status and trends of macroalgal cover is, therefore, an emerging priority for ocean and coastal management. A remote sensing technique combining UAVs surveys with in situ data acquisition was developed to map intertidal macroalgae from rocky shores in a marine protected area, the Atlantic Islands of Galicia National Park (Illas Cíes, NW Spain). The classification by groups (brown and green macroalgae) achieved a good precision. A more precise classification would be achieved by focusing on those spectral bands where the highest differences between species appeared.

Keywords
Multispectral camera, UAV's images, image classification, photogrammetry, spectral signature

INTRODUCTION
Due to the high ecological importance of macroalgae on ecosystem processes, habitat provision, and food web support [1, 2, 3], there is a need to monitor their coverage and diversity in marine areas. This is especially relevant in the case of marine protected areas that comprise one potential tool providing ecosystem resilience of native communities to human-induced stressors. However, in situ surveys are costly and time consuming tasks that need to move specialized staff to the intertidal, with important logistic and economic efforts. Our main objective was to provide with a free user-friendly online tool that offers a quick diagnosis of the macroalgal coverage. For that, we developed an innovative geo-spatial automated methodology that uses images from unmanned aerial vehicles (UAV) for the quantification of the abundance of intertidal macroalgae.

METHODOLOGY
A supervised classification was performed with the Semi-Automatic Classification Plug-in (SCP) [4] in the free software tool QGIS. The SCP was trained with field data (geo-referenced manual photography) and with multispectral images from UAV in order to obtain the spectral signatures of the macroalgae.

Field work
a) In situ data collection. Three plots of 100 m2 in the intertidal of the Illas Cíes were visited once a month from July to October 2019. In each visit, 45 photographs of the macroalgal community within sampling quadrats of 0.5 x 0.5 meters were taken. The position of the
photographs was measured with a GPS Trimble R8 (Figure 1).

b) Uav survey. The aerial images of the macroalgae were obtained from an UAV DJI-Matrice 600 Pro equipped with a multispectral MICASENSE ALTUM sensor. The images were georeferenced by measuring the coordinates of targets deployed in the intertidal.

Acquired data were processed with the software PIX4D to obtain reflectance values (bands: RGB, Red Edge and NIR), that were later used for the image classification (Figure 1).

Data processing
The photographs were geo-referenced and the 8 target macroalgae (the most abundant species in the intertidal) were manually delimited and labelled in a new vectorial shape file, generating a manual classification.

First, the manual classification shapefiles were used to train the software by indicating the ground truth. For that, a virtual raster containing the reflectance of the target spectral bands was generated. The bandwidth was adjusted and the spectral signature for each class was calculated. The final classification was performed using the algorithm "minimum distance" (Figure 1).

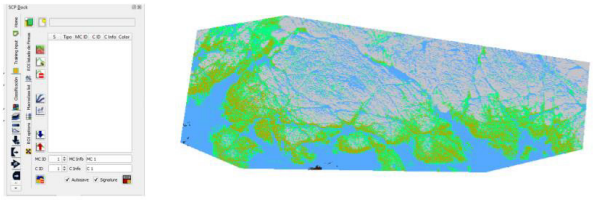
Three types of classification were performed: general (macroalgae, inerts and water), groups (green and brown macroalgae, inerts and water) and species (the 8 species, inerts and water). Finally, the success rate of each classification with respect to the ground truth was calculated.

1. Field sampling (transects)

2. Dron flight with multispectral camera

3. Mapping of macroalgae - training

4. Image classification



RESULTS
Results showed that the species classification was the less precise (~50-60 % of success), groups classification achieved a success rate of 60%, whereas the general classification achieved an 80% (Figure 2). Therefore, a higher level of detail implied a lower success rate of the classification.

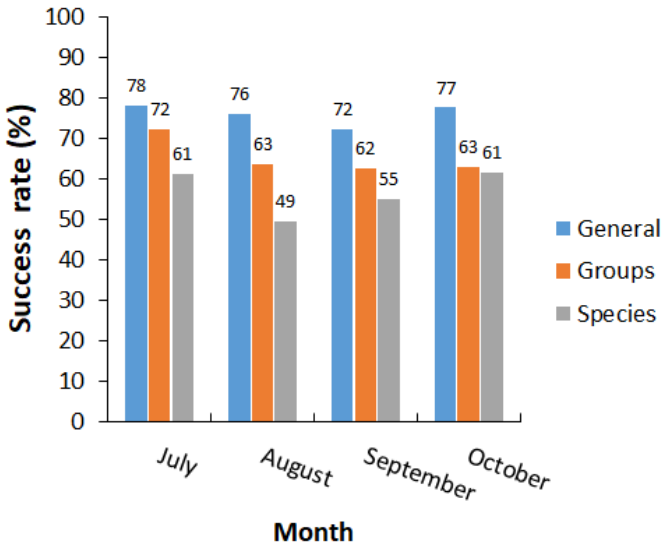


Fig 2. Success rate of the three classifications performed

CONCLUSIONS

The developed tool showed a good performance for a large-scale rapid assessment of the macroalgal coverage at the intertidal. However, the high similarity among the analyzed spectral signatures limited the rate of success of the classification at a species level. The success rate would increase by further analyzing those bands of the electromagnetic spectrum where higher differences between species appear.

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