Best Aquatic Environment Poster Presentation at Environ 2022

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Unmanned aerial vehicles for mapping seaweed: RGB and multispectral sensors

Why would we need to map seaweed, one might ask. Well, there can be a number of reasons to know how much seaweed is available and where. Seaweed can be used as livestock feed or fertiliser, which may be particularly important these days when chemical fertilisers are so expensive.

Mapping seaweed species is also important for environmental monitoring as a certain amount of biomass has to be left for future regrowth and to maintain the balance in the subtle coastal ecosystem.

And, of course, seaweed is a nutrient-rich food source. It has been a staple of the Irish diet throughout history. Mentions of seaweed can be found in Críth Gablach, the seventh century Irish legal tract which sets out hospitality rules which stipulated that dulse (dillisk or, more scientifically, *palmaria palmata*) was to be offered to people of status who came to one's door. Seaweed also helped coastal communities a thousand years later to survive during the Famine.

These are just some examples of why knowing the availability of seaweed resources cis important. There are several ways to map seaweed. Direct observations and ground surveys are the first approaches that come to mind. I wish I could do that on foot because the Irish coastal landscape is stunningly picturesque, but I'm afraid my whole lifetime won't be enough to walk across Ireland to map seaweed despite its small size. Another, more efficient, way to map seaweed is to use remote sensing. For that I use fixed-wing drones (Figure 1), which allow me to map large areas of the coast without sacrificing the high level of detail that ground surveys provide as the spatial resolution of the drone sensor allows it to capture small details down to a centimetre level.

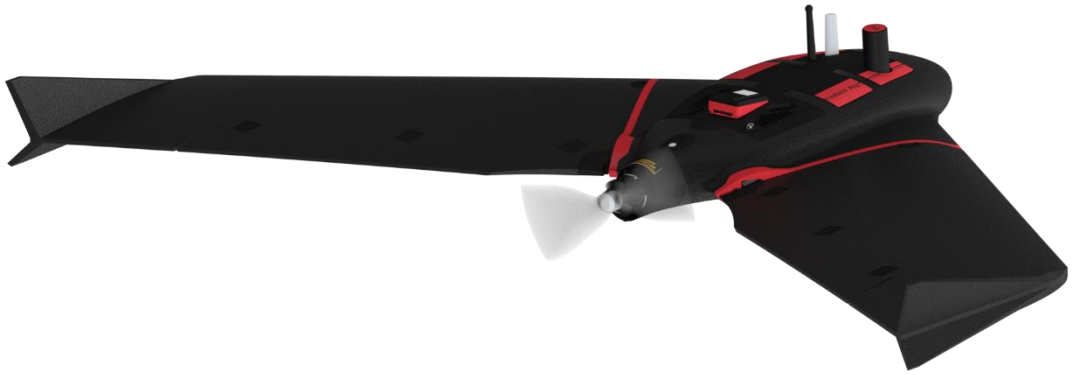

Figure 1. Fixed-wing drone with a multispectral sensor

Furthermore, sensors on the drone captures information that cannot be obtained by traditional ground surveys. Apart from a true colour, or red-green-blue, camera, which captures usual images, the drone camera also has multispectral bands, which collects information beyond visual part of the spectrum-in the near-infrared region-which is not visible to our eyes, but where plants are very active (they absorb a lot of red light as energy for photosynthesis and emit part of the energy in the near-infrared region, which the sensor detects). This additional information allows me to classify seaweed species using machine learning techniques, and multispectral bands provide additional information that help the algorithm to correctly separate between different seaweed species. And combining RGB data with multispectral (RGB-MS) improves the classification output even further (Figure 2 shows such an example of image classification using support vector machines (SVM)).

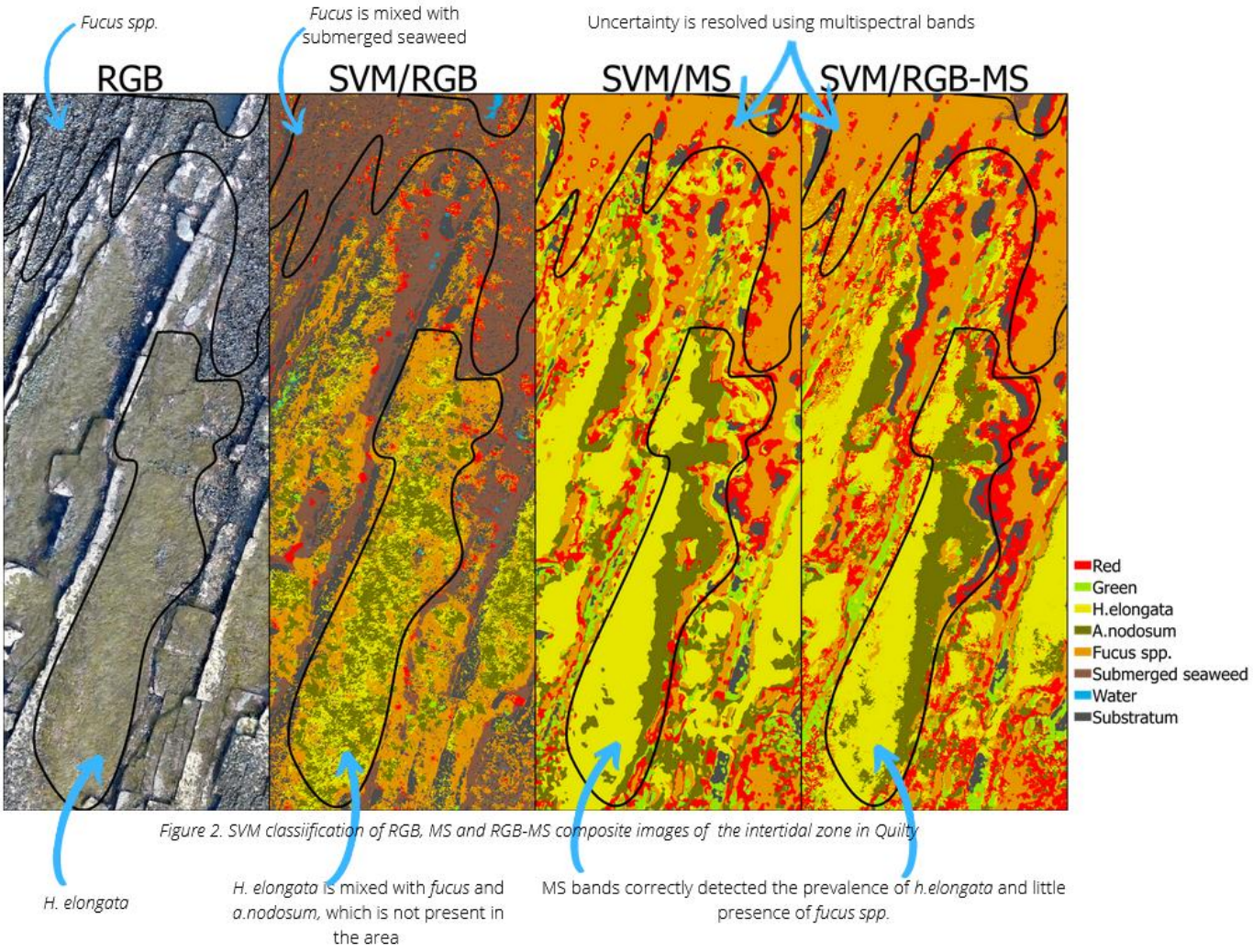

Figure 2. SVM classiification of RGB, MS and RGB-MS composite images of the intertidal zone in Quilty

Drone surveys are a great tool to perform large-scale mapping, and automated image classification techniques can help researchers deliver reliable seaweed species distribution maps. It should be said, however, that ground surveys cannot be replaced altogether and are still an important part of drone surveys as a means of verification and accuracy assessment, so I still get to see the beauty of the Irish coastline:

A photograph from the ground survey during the low tide near Quilty village in Co. Clare

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