Spectral Differentiation for the Improvement of Underwater Hyperspectral Imagery Mapping of Seagrass Distribution in Adelaide, South Australia

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Introduction

Following global and regional trends in southeastern Australia, the metro-coast of Adelaide (South Australia) is experiencing **>50 km² seagrass loss** (*Amphibolis* and *Posidonia* spp. and to a lesser extent *Heterozostera* spp.) since the 1950s.

- Need to 1st establish spectral library (i.e. field observations) to assess seagrass health at a larger-scale (i.e. area, regional, etc.)

Algal **epiphytes** (i.e. non-parasitic plants growing on another plant), which are rominent on seagrass leaf surface, have the greatest **effect on spectral response of seagrasses**.

Objective

Assessing key spectral features unique to benthic vegetation found within study area. particular seagrass species via:

- Irradiance reflectance measurements of different species
- Development of spectral library for common

Methods

Samples collected (dates ranging from Dec 2015 to Jan 2016) and then transported to outdoor research facility run by Australian Water Quality Centre.

- 1) Each sample placed into an open-air 12-L hydraulic vessel
- 2) Black-lined vessel filled with vacuum filtered (1.2 μm) marine water; formed 10-cm between water surface and vessel bottom.
- 3) Reflectance R was then measured with a JAZ-2 spectroradiometer, following protocol (i.e. sample measured at an angle of ~45° nadir).

Study Area

Sampling was based 2 locations (Bolivar and Seacliff) within Adelaide's Gulf St. Vincent known to already have homogeneous, relatively established patches of seagrasses (Figure 1).

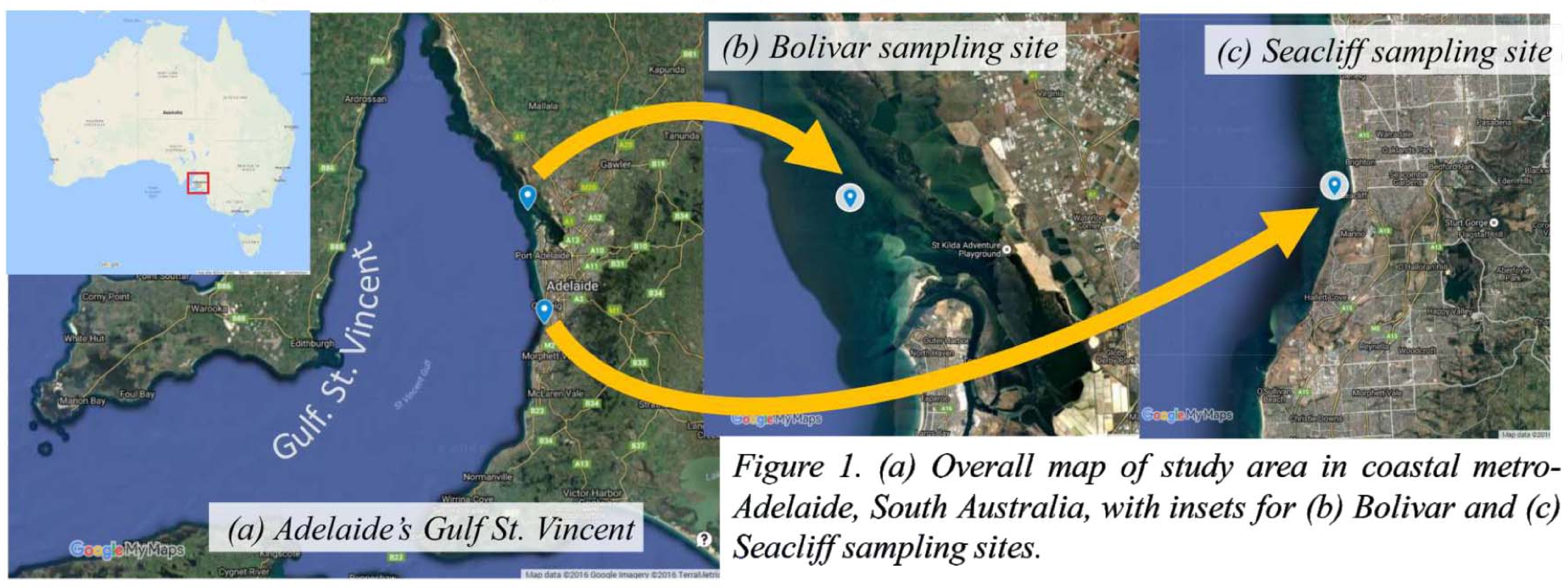


Figure 1. (a) Overall map of study area in coastal metro-Adelaide, South Australia, with insets for (b) Bolivar and (c) Seacliff sampling sites.

Results/Discussion

1) Spectral profiles of primary benthic bottom types

- **There is discernible difference between Amphibolis, Posidonia, and Heterozostera spp. seagrasses**, especially between 575-625 nm.
  - $R_{seagrass}$: *Amphibolis* (high) > *Posidonia* > *Heterozostera* (low).
- Overall, sand had an expectedly higher *R* throughout the visible spectrum than compared to 3 seagrasses (Figure 2).

Results/Discussion (cont'd)

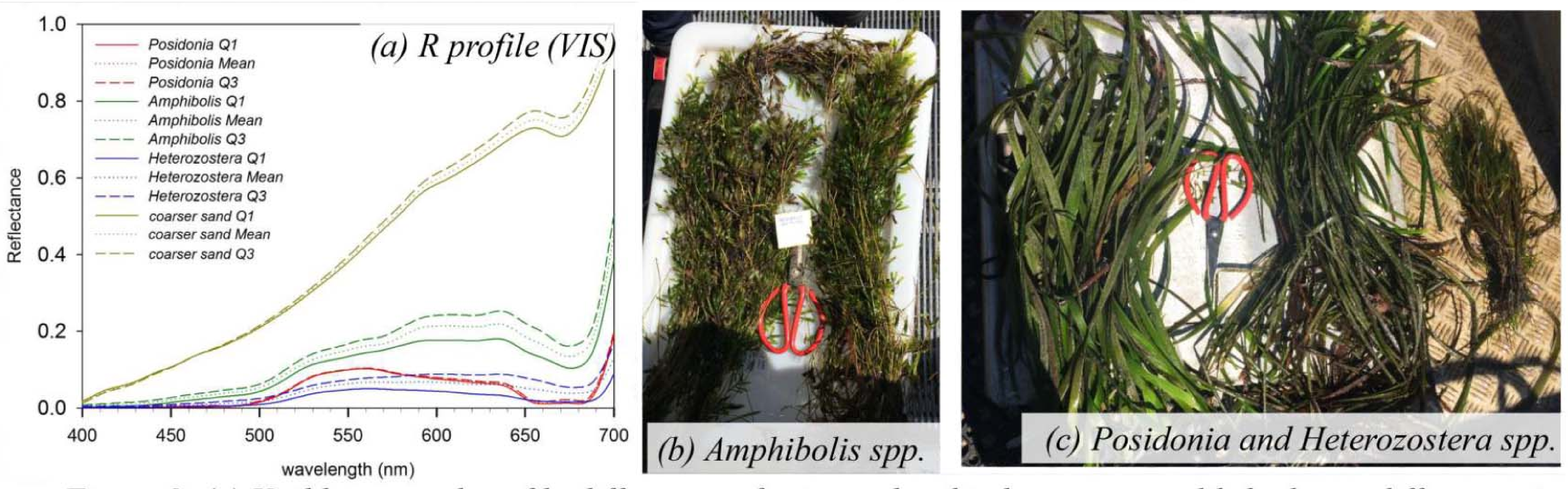


Figure 2. (a) Visible spectral profile differences of primary benthic bottom types, likely due to differences in genus leaf morphology of (b) Amphibolis; and (c) Posidonia and Heterosoztera spp.

2) Deconvolution and Peak Analyses

Key spectral peaks for sand: Four of these peaks, located approximately between 400-480 nm (Figure 4, dotted blue box), can be used in the future to help identify coarser sands in upcoming phases of this study

Key spectral peaks of *Amphibolis* and *Heterozostera* vs. *Posidonia*: Only *Amphibolis* & *Heterozostera* spp. have existing deconvolution peak values between 640 to 660 nm; Posidonia seagrass had none (Figure 4, dotted green box).

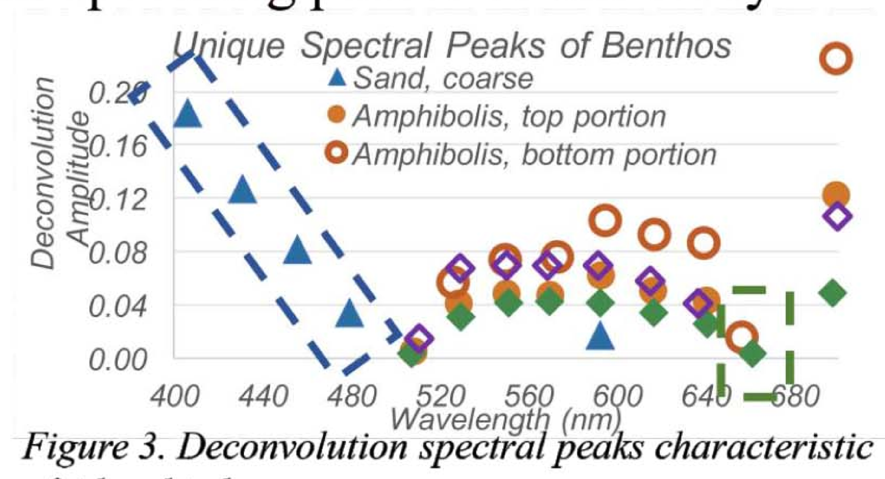
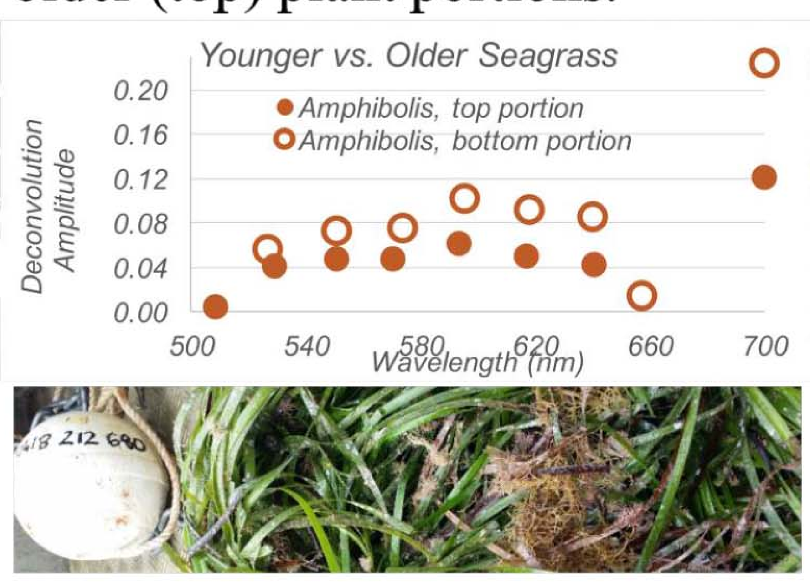


Figure 3. Deconvolution spectral peaks characteristic of 4 benthic bottom types.

3) Epiphyte presence on younger seagrass leaves

Amplitude height of deconvolution peak is actually a more obvious method of differentiate differences between the younger (bottom) and older (top) plant portions.



From 525-700 nm,

- Bottom portion of *Amphibolis* was consistently ~2x amplitude than the top portions (Figure 4*(a)*).
- Likely due to higher epiphytes of presence on upper, younger plant portion, which in turn causes ⇩light availability and ⇩seagrass productivity (Figure 4*(b)*).

← Figure 4. (a) Differences in R within Amphibolis spp. (b) Example of epiphyte presence.

Conclusions

- First, deconvolution peak analyses in this study – particularly in the visible light spectrum – is shown to differentiate between *Amphibolis* seagrasses from *Posidonia* and *Heterozostera* spp.
- Second, deconvolution analyses successfully identified hidden peaks and/or bandwidths represented within the visible spectral range of a particular benthic bottom type.
- Finally, although these deconvolution peaks can help us distinguish between species, they may not necessarily help identify within-species differences; instead amplitude may be a more useful tool.

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