Integrating Field and Remote Sensing Approach for Mapping Seagrass Leaf Area Index

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Leaf area index (LAI), defined as the horizontally oriented leaf area per unit substrate area is one of the most important factors for characterizing plant canopy structure and process, including seagrass. It represents a total photosynthetic area of plant canopy which in turn determines standing stock (biomass). As a consequence LAI is correlated well with photosynthesis process and has been used as a diagnostic variable for crop growth rate, radiation intensity and above-ground biomass. It has also been used for modelling seagrass photosynthesis.

While the development of non-destructive method for estimating seagrass LAI has been initiated, destructive method by harvesting the seagrass is still dominant. Valuable time-series seagrass data have been collected in this way through international seagrass initiatives, e.g. SeaggrassNet, SeagrassWatch, but this method could face logistical constraints and conservation issues if the area to be mapped is large and its accessibility is limited. Remote sensing method offers synoptic and repetitive measurement with less logical demands and can provide accurate information on seagrass provided that the relationship between remote sensing reflectance and parameters of interests can be established.

Considering the importance of LAI, it is surprising that LAI is one of the least frequent seagrass parameters studied using remote sensing data. Previous study on empirical LAI algorithm development by directly relating *in situ* LAI to image reflectance needs to be considered cautiously as homogenous pixel assumption should be met. For the present study two types of LAI algorithm were developed : biomass-based and reflectance-based algorithm. The first algorithm was developed by analysing seagrass core samples and then establishing relationship between aboveground biomass and LAI. One main ouput of this method was to produce LAI map from multi years WorldView-2-based biomass maps available for the study site. The reflectance-based LAI algorithm was established from the correlation between LAI measured from biomass core sample analysis and simultaneous underwater reflectance taken over the core samples. The result of the biomass-based LAI algorithm development using biomass sample analysis shows significant correlation between LAI and aboveground biomass either at species or total species level (R^2 = 0.70 – 0.86, $p < 0.0001$, n = 10 – 95). The result also reflects maximum correlation between LAI and biomass at high LAI values due to canopy shelf-shading. This result would facilitate the generation of seagrass LAI map from available image-based biomass maps of the area. All resulted algorithms will be analysed and compared, and then applied to WorldView-2 images.

Key words : Leaf area index, plant canopy, photosynthesis, remote sensing, WorldView-2, aboveground biomass