Improved seagrass change detection using linear spectral unmixing

Amy V. Uhrin, Zoology Department, University of Wisconsin, Madison WI

Background/Question/Methods

Seagrass beds provide myriad ecosystem services including habitat for many important fishery species. Accurate classification of seagrass is challenging, particularly in NC where seagrass ranges from continuous meadows (extending 10s of kilometers) to aggregations of patchy mounds often no more than a meter across. These patches are frequently undetected when mapping from low resolution (30 meter) multi-spectral imagery. For this reason, manual delineation of seagrass habitat from higher resolution (≤ 1 meter) aerial photography remains the most widely adopted approach despite frequent inclusion of unvegetated gaps, leading to overestimates of actual seagrass acreage. I developed a linear spectral unmixing technique for seagrass in which representative endmembers (seagrass and sand) were chosen directly from aerial photos and the unmixing process reported the proportion of each endmember present in each image pixel. Seagrass pixel proportions ranging from 0 to 1 were evaluated in 0.1 increments. Overall accuracy increased with increasing pixel proportion (range: 81 – 98%), peaking at a pixel proportion of 0.4. Kappa statistics were consistently high (K_{hat} > 0.980) across all pixel proportions indicating strong agreement for seagrass "observed" via unmixing versus that "expected" by chance; all pixel proportions were significantly better than random ($p = 0.001$). At peak overall accuracy, seagrass classified via unmixing represented only 6.6% of the manually-delineated polygon. Spectral information from aerial photos is rarely used in seagrass classification. I have shown that linear spectral unmixing can be applied to aerial photographs for classification of shallow seagrass in NC and that manual delineation overestimates actual seagrass acreage.

Linear spectral unmixing can improve seagrass maps providing fisheries managers with more realistic representations of seagrass extent and acreage available for use by commercial species. A distinct advantage of unmixing is the ability to identify subtle differences in landscape composition through quantitative classification of pixels as proportions of representative image elements. This technique may be useful in other systems, coastal or terrestrial, where the landscape is composed of a mixture of highly contrasted cover types or cover types having sparse representation.

Keywords: spectral unmixing, seagrass mapping, remote sensing, aerial photography, WorldView