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Application of color infrared aerial photography to assess macroalgal distribution in an eutrophic estuary, Upper Newport Bay, California

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ABSTRACT

Newport Bay is a large estuary in southern California that is subject to anthropogenic nutrient loading, eutrophication, and hypoxia. Ground-based methods of assessing algal extent for monitoring and management are limited in that they cannot provide a synoptic view of algal distribution over comparatively large areas. The goal of this study was to explore the application of color infrared aerial photography as an alternative for analyzing the changes in the abundance of exposed macroalgae. Three surveys combining remote sensing (color infrared aerial photography) and ground-based sampling to quantify macroalgal mat coverage were carried out in Upper Newport Bay (UNB) between July and October 2005. Airborne photographs (scale 1:6000) collected during daytime low tides, clear skies and appropriate sun angle were digitized to 25 cm resolution, orthorectified, georegistered and combined into three mosaic composite digital images: one for each survey. During each aerial photography survey, macroalgal percent cover was measured on the ground by the point-intercept method in a 6.25 m^2 area at ~30 locations distributed along the water's edge throughout the intertidal mudflat area. There were three main types of cover: *Ulva* spp. (green algae), *Ceramium* spp. (red algae), and bare surface (mud and mussel beds). To analyze similarities between spectral signatures in the images and cover types, the pixels corresponding to the ground samples from each survey were grouped into clusters based on similarity of their spectral signatures. To establish relationships between spectral signatures in the images and cover as determined from ground data, pixels in each composite image corresponding to ground samples from the same day that were characterized by >90% of one cover type were attributed to that cover type. Ground samples comprised of a mixture of cover types were used for accuracy assessment. Before classification, each digital image was transformed by the Minimum Noise Fraction Rotation method to remove noise and enhance contrast between the classes. For classification of each composite image, the Spectral Angle Mapper scheme was used: all pixels in each image were attributed to the identified classes and the areal extent of each class was estimated. According to these assessments, the macroalgal coverage in UNB increased from 37% in July to 57% in September to 80% in October, and during this time *Ulva* spp. replaced *Ceramium* spp. as the dominant alga. This analysis showed that color infrared aerial photography is an effective tool for assessing estuarine, intertidal macroalgal coverage.

Full Text

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