

Thick in the Mud and High in the Sky: A Synopsis of Aerial Mapping of Eelgrass in Arcata Bay

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Introduction

Eelgrass (*Zostera marina* L.) is a native, perennial seagrass in the Zosteraceae family. It grows in intertidal and shallow subtidal portions of marine embayments and estuaries throughout the northern hemisphere. Eelgrass meadows provides numerous ecological services and receive protection under state and federal wetland protection policies, in addition to being designated as “Essential Fish Habitat” by the National Marine Fisheries Service.

Humboldt Bay (located 80 miles south of the Oregon border) is home to nearly half of the eelgrass in California. Arcata Bay, a subsection of Humboldt Bay, produces the majority of commercially grown oysters in California. Environmental permitting of oyster farms requires an assessment of potential impacts that may occur to eelgrass within shellfish cultivation areas. Recent advancements in remote sensing technologies, such as, imagery produced by unmanned aerial vehicles (UAVs aka “drones”), have facilitated precise geospatial mosaics composed of thousands of very high resolution images. These new technologies allow for a novel approach to conducting accuracy assessments of traditional airplane-based imagery classifications. This poster presents a “pilot” study to evaluate this “approach.”



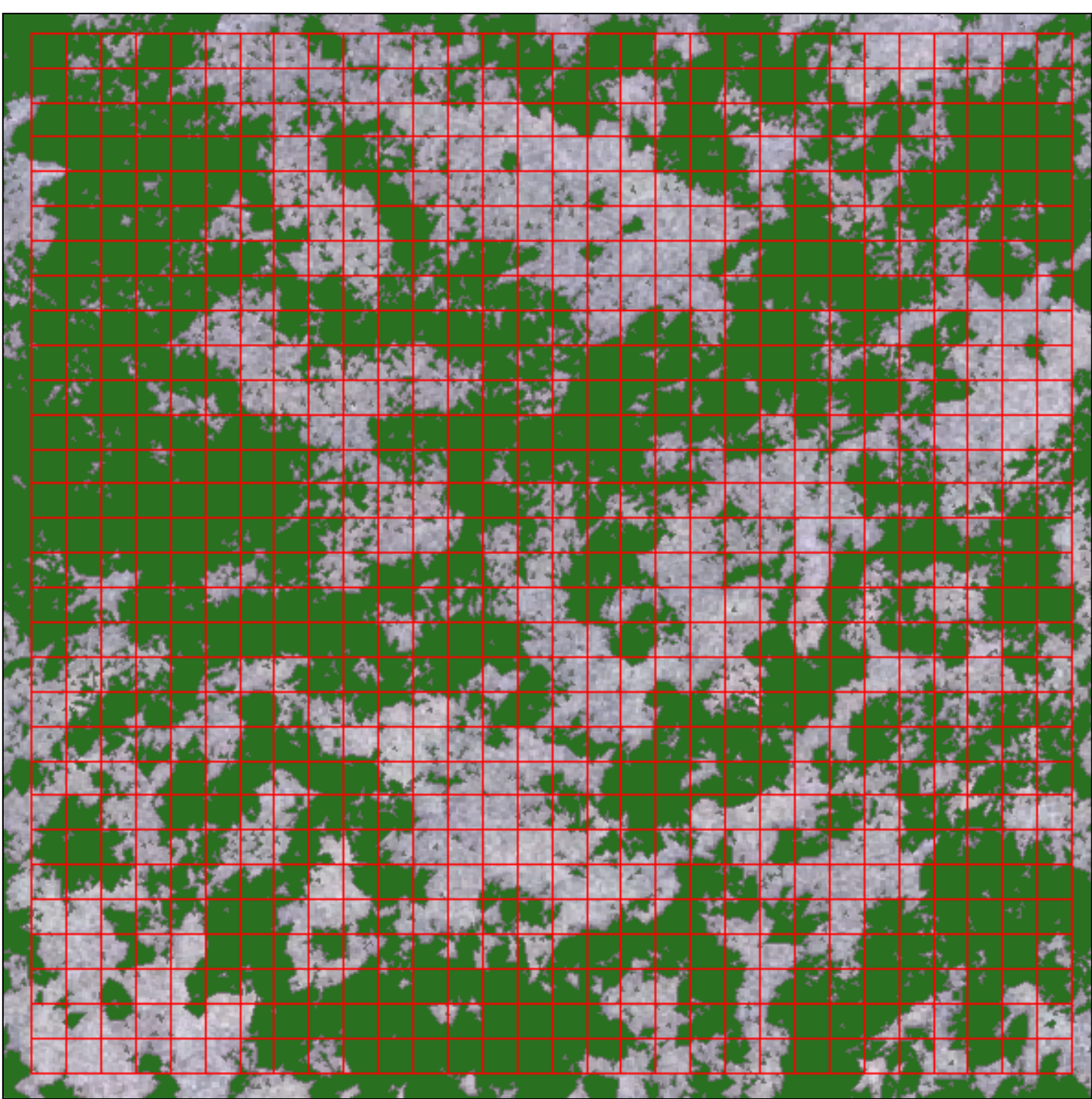
Humboldt Bay, Arcata Bay Circled



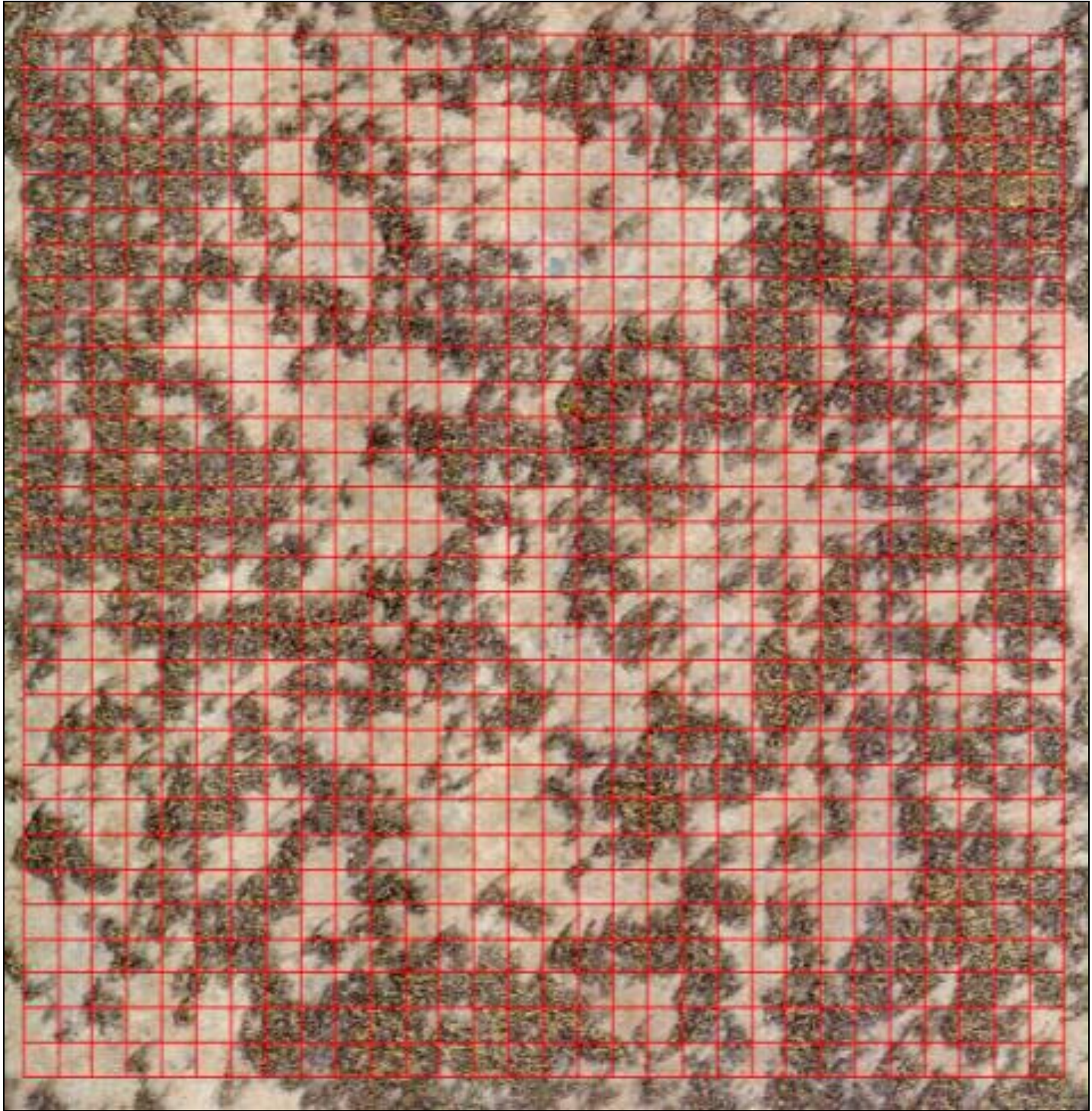
Eelgrass Meadow at -1ft Low Tide

Methods

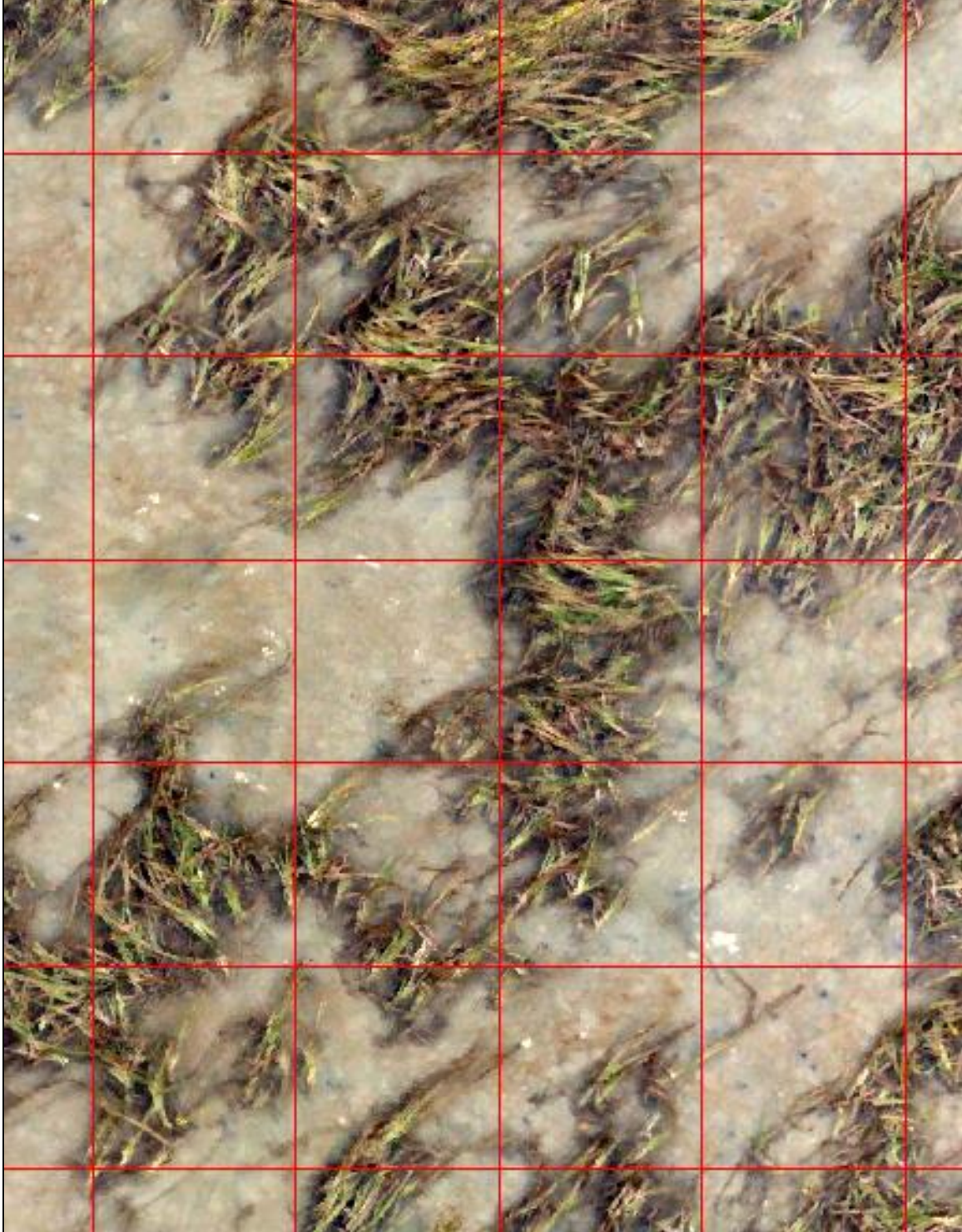
A Cessna airplane, flown at 2,000 feet elevation, produced an average 75 millimeter pixel size over nearly 3,000 acres of georeferenced aerial imagery. Supervised GIS classification of Cessna dataset pixel color was used to create a raster layer indicating presence/absence of eelgrass within each pixel. A second dataset produced UAVs flying at 40 feet elevation over a subset of the Cessna coverage resulted in very high resolution (3 millimeter pixel size) imagery. The georeferenced UAV dataset was then used to conduct an accuracy assessment of the Cessna-based classification. This was accomplished by using the California Eelgrass Mitigation Policy and Implementing Guidelines definition of vegetated eelgrass cover existing when one or more turions per square meter is present . The Cessna dataset was then further classified as presence/absence of eelgrass within each square meter (a sample unit) . Finally, the very high resolution UAV dataset was used to perform an accuracy assessment of the Cessna dataset.



Cessna Imagery



UAV Imagery



UAV Imagery Close-up

Results

Accuracy Assessment Contingency Matrix

		Reference Data (UAV)		Total	Users's Accuracy
		Present	Not Present		
Classified Data (Cessna)	Present	57	3	60	95%
	Not Present	7	14	21	67%
Total		64	17	81	
Producer's Accuracy		89%	82%		
Total Correct: 71 Total Samples: 81 Overall Accuracy: 88%					

User’s Accuracy- error of commission (inclusion)

“What the classification called it”

The classified the Cessna dataset included 3 false detections of eelgrass and included 7 false negatives, resulting in 95% and 67% user’s accuracies.

Producer’s Accuracy- error of omission (exclusion)

“What is really was”

The classified the Cessna dataset omitted 7 true occurrences of eelgrass and omitted 3 instances where eelgrass was absent, resulting in 89% and 82% producer’s accuracies

An overall accuracy of 88% was achieved for the classification.

Summary and Conclusions

The combined use of the Cessna and UAV data sets to classify and perform accuracy assessments of areal imagery shows great promise. The high user’s accuracy for presence of eelgrass demonstrates the ability of the classification to correctly identify eelgrass. However, the lower user's accuracy for absence of eelgrass is likely the result of the lower number of sample units that were classified in the Cessna dataset as unoccupied, resulting in a low pool to subsample from. It’s anticipated that if a larger number of sample units were classified as unoccupied and available in the pool for sub-sampling that both user’s accuracy metrics would be high. The high producer’s accuracy indicates a low rate of false omissions. In conclusion, the 88% overall accuracy indicates that the classification does a good job at predicting presence and absence of eelgrass. Large sample sizes may be needed to determine the true limitations of of this technique.

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