Hydrodynamic thresholds: the role of tidal current speed and wind-wave exposure as drivers of seagrass spatial configuration

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Seagrasses provide myriad ecosystem services including sediment stabilization and shoreline protection, nutrient cycling, primary production, carbon sequestration, and habitat for a number of important fishery species. Tidal currents and exposure to wind-waves are hydrodynamic drivers that generate local seagrass seascape patchiness. A number of commercially important species have been shown to respond to changes in seagrass spatial configuration. Low cover, patchy seagrass seascapes are more susceptible to loss of cover during acute disturbances like tropical cyclones and it has been suggested that the spatial arrangement of seagrass patches, particularly patch spacing, may have implications for sediment resuspension and deposition, erosion, and patch structure. Discontinuities in sediment composition, percent cover, and perimeter-to-area ratio above and below suggested 'disturbance thresholds' of tidal current speed and wind-wave exposure have been reported. However, previous investigations did not consider other ecologically relevant configuration metrics related to aggregation (i.e., patch-

spacing). We asked: (1) how do hydrodynamic drivers affect seagrass spatial configuration metrics, especially those that describe patch arrangement and (2) can we identify ecological change-points, or numerical values for hydrodynamic drivers that result in an abrupt change in seagrass seascape configuration? Nonlinear relationships, suggestive of ecological change-points, are apparent between wind-wave exposure and a number of landscape metrics. Differences in landscape metrics across increasing wind-wave exposure were more pronounced and less variable than for tidal current speed. Hydrodynamic threshold identification and threshold responses are potentially valuable tools relevant for management and conservation planning in a seascape ecology context.

Word count: 242/250