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Abstract: Barrier islands and coastal salt marshes are complex ecosystems that move and change through time in response to many factors. For example, hurricanes bring strong winds, rain, and storm surge which can greatly change the distribution of surficial deposits. Through time the islands can migrate and inlets change their positions. A study of back-barrier salt marshes in southeastern North Carolina, USA, was conducted to map changes in the distribution and fragmentation characteristics of the marshes. Topsail Island and Masonboro Island were chosen as comparative study sites since Topsail has had increasing urbanization since the 1930s while Masonboro is a protected, undeveloped, island. By gathering, rectifying, interpreting, and digitizing historical aerial photography (from 1938 to 2002) we computed the rate of change in the back-barrier land cover types as well as used GIS spatial analysis tools to compute the degree of fragmentation through time and place. Results have been mixed where the marshes behind Masonboro Island are most affected by storms while Topsail Island marshes have changed mostly due to urbanization and inlet location/migration.

To quantify the significance of this historical change, a series of tests were designed and conducted to describe the amount of spatial variability and accuracy of the rectified photographs, the digitized polygons, and the quantification of change. A digitizing accuracy assessment was conducted where 140 randomly chosen locations were identified on the aerial photographs and compared with the digitized data. Using an error matrix, the overall accuracy was greater than 80 percent which was acceptable. Second, we measured the impact that the degree of crenulation, or curviness of the digitized marshes had on the change detection results. To compute this we used a subset of the study area, used progressive smoothing functions (from 5m to 70m), and recomputed the change detection matrices. Results indicated that the interpretation of the photographs and the resulting digitization was not a factor in the computation of change.

Third, we incorporated a fuzziness test (using derived epsilon bands) into the GIS data to identify and quantify real changes in the marsh habitats versus positional changes or sliver polygons. Results indicate that rectification of aerial photography (although an RMS error of less than 1), photointerpretation, and digitizing can lead to some erroneous results however by using fuzziness techniques we can minimize the errors and predict which areas are changing through time. Statistically, the removal of small polygons of change using the epsilon band method did not alter the general outcome of the change detection analyses, however it is a worthwhile data processing method.

***Keywords**:* Aerial photography, Barrier island, Change detection, Epsilon bands, Fragmentation, Salt marsh.