Comparing Seagrass Distribution and Impacts Affecting Density along the Florida Keys

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Abstract

Seagrass habitats are a foundation plant species as they modify their environments to create unique habitats in which can support an abundance of organisms (Reynolds, 2018). Seagrasses primarily grow in salty to brackish waters and are commonly found in the shallower depths of regions such as the tropics and the poles. These diverse habitats not only support and array of organisms for food and shelter, however, are recognized as being "lungs of the sea" as one square meter of seagrass has the capabilities of generating 10 liters of oxygen daily through a biochemical process known as photosynthesis (Reynold, 2018). In 2003, a seagrass monitoring project was set in place in the Florida Keys National Marine sanctuary (FKNMS), as part of the Water Quality Protection Program, to measure the status and different trends of seagrass communities, as well as to evaluate the progress to protecting and restoring these important marine resources of the sanctuary. Monitoring the health of seagrasses has led to direct trends that reinforce how anthropogenic human activities are causing regional changes in nutrient availability (Fourqurean & Escorcia, 2005) Excessive nutrients in waterways, known as eutrophication, can be linked to human activities. Eutrophication increases macroalgae in the system, which ultimately reduces light exposure that allows seagrasses to perform biogeochemical processes and creates areas of hypoxia. By utilizing GIS techniques, this research compared spatial distributions and densities of seagrass beds and examined if beds are classified as continuous or discontinuous, to further evaluate whether such trends are derived from anthropogenic or natural causes.

Methods

The GIS data set represents a compilation of statewide seagrass data from 1987-2019 and was published by Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute. The study area was determined by looking at the range of continuous and discontinuous (patchy) seagrass beds within the state of Florida, with an abundant amount of seagrass beds being found ranging from South Florida to The Florida Keys (Figures 1 & 2). In order to look at potential impacts on the densities of these seagrass beds, statewide data for boat ramps, marinas, agricultural areas, as well as flowing water sources were downloaded from The Florida Geographic Data Library (Figure 3) . Boat ramps and marinas tend to be in shallow areas, where seagrasses are common. Damage from boats generally occurs when a boat propeller meets either the submerged vegetation or the vegetation and the bay bottom. In addition, propeller scarring occurs when boaters use the propeller to dredge new channels or maintain existing, man-made channels, which ultimately can suffocate and cause the removal of such grasses (Hallac, 2012). Flowing water source data was added to look at how agriculture could potentially affect the transportation of pollutants in which inhibit and deplete seagrass growth. The *2000 National Water Quality Inventory*, reported that agricultural nonpoint source (NPS) pollution was the leading source of water quality impacts on surveyed rivers and lakes, the second largest source of impairments to wetlands, and a major contributor to contamination of surveyed estuaries and ground water. Pollutants like fertilizers, pesticides, and heavy metals are often attached to the soil particles and wash into the water bodies, causing algal blooms and depleting oxygen, killing aquatic life, including seagrass beds (USEPA, 2005). Utilizing GIS data analysis techniques, the vector data was transformed to raster so the analysis could use the same data model. A kernel density of boat ramps and marinas was executed in order to see what seagrass beds would be the most vulnerable to boat propeller scarring. Raster outputs were combined using map algebra with all surfaces assigned an equal weight. The calculation reflected that a 5 would represent low vulnerability, where a 10 would reflect areas of high vulnerability. (Figure 4.)

Acknowledgements

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Results

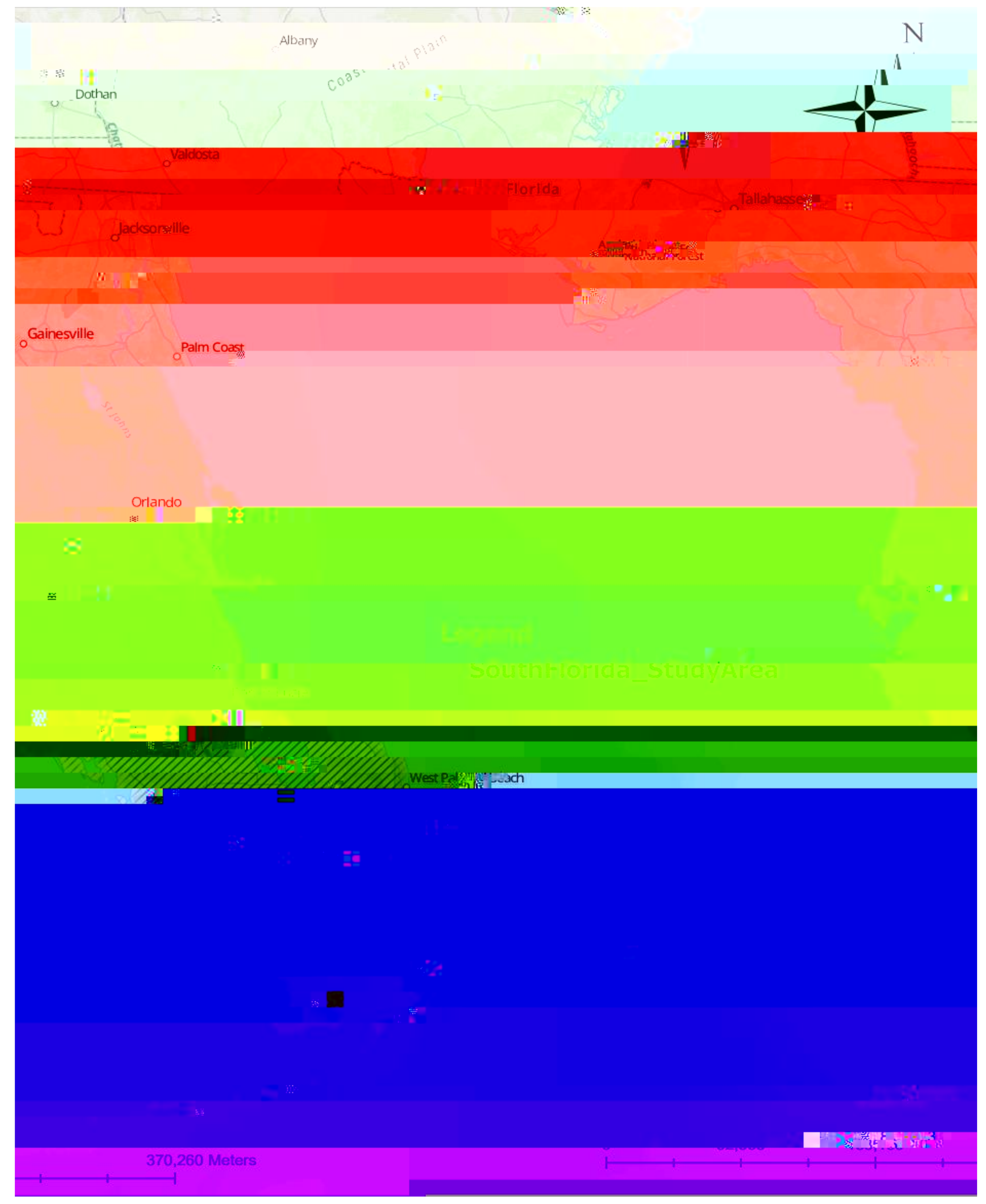

Figure 1. The study area for the intended research was South Florida, USA; with a specific focus on the archipelago of The Florida Keys, USA.

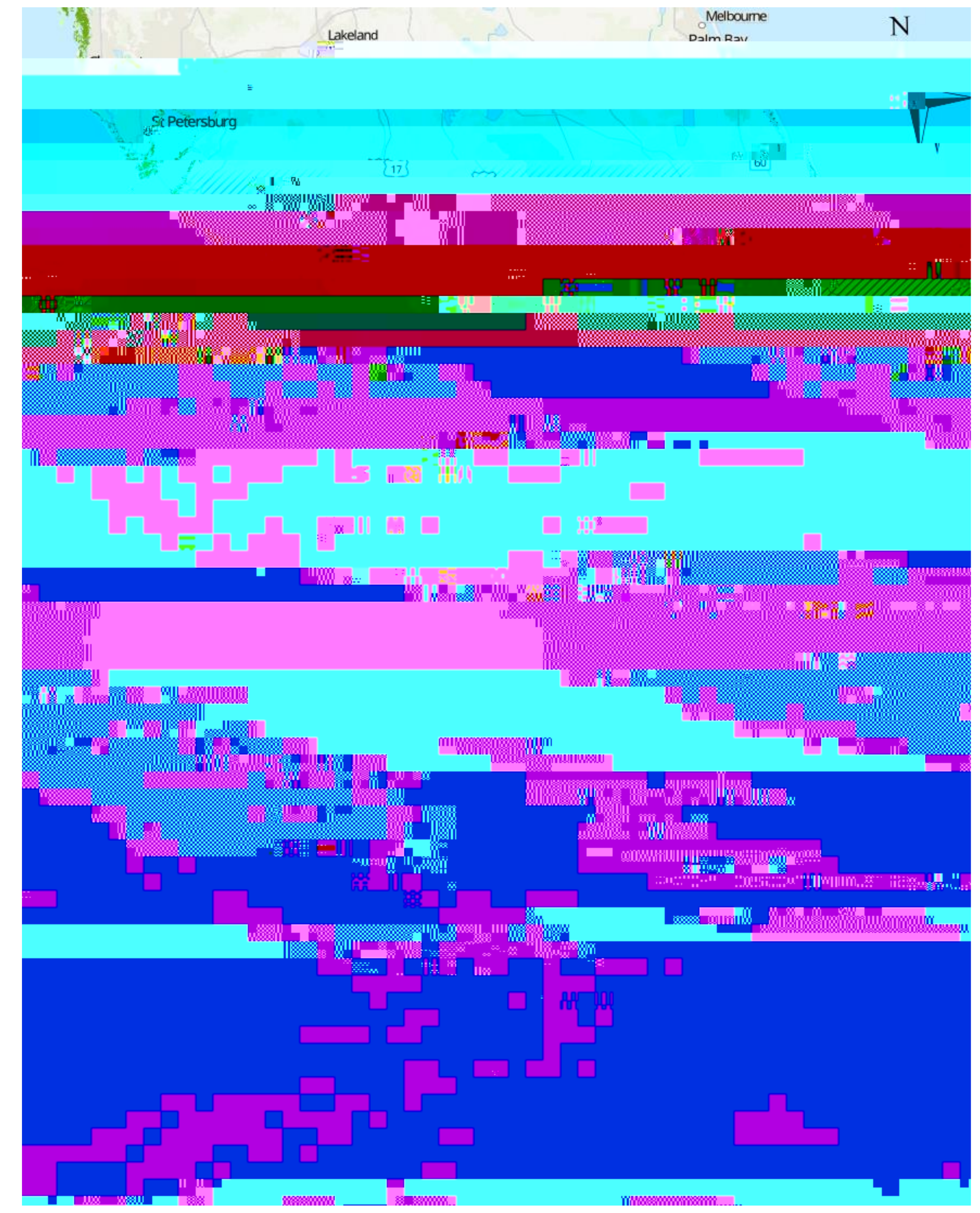

Figure 2. This map displays continuous and discontinuous (patchy) seagrass beds within the indicated study area. The dark green on the descript indicates areas of continuous seagrass in which is classified as an area of seagrass of 0.4 ha (hectares) in size, equivalent to 1 acre, and have less than 15% of exposed sediment observed within the given area. The lighter green indicates areas of discontinuous seagrasses in which are recognized as "patchy" areas that less than 0.4 ha in size and have more than 15% exposed sediment (Handley, 2007) .

Figure 3. This map displays potential anthropogenic influences on seagrass density, such as: boat ramps, marinas, and agricultural areas. Flowing water sources, such as streams, canals, and rivers, were also mapped in order to identify areas in which could be potentially vulnerable to agricultural run-off.

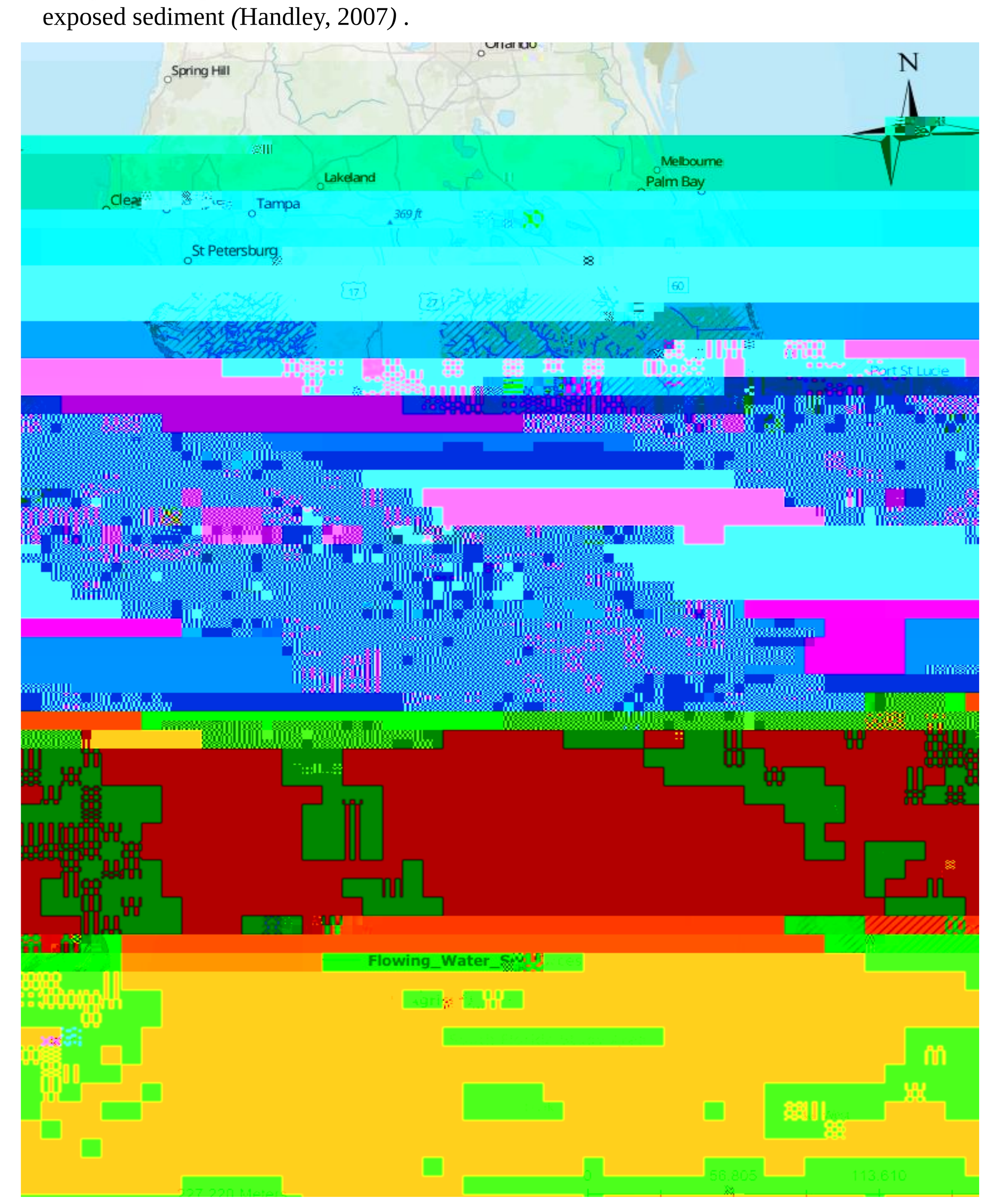

Figure 4. This map displays areas of conflict in which are the most vulnerable to the anthropogenic influences, such as boat ramps and marinas, mentioned in Figure 3. A further analysis on agricultural impacts, in relation with flowing water sources, was not completed due to time constraints.

Python

Examples of code that were utilized for this project:

arcpyanBxgagemeindDi(sdive3(F'lso_u)–F3(r.is)"5(solv)L.,)]TJETQ EMC P MCID 146

Conclusion & Discussion

The results of this analysis displays a higher vulnerability for anthropogenic influences such as boat ramps and marinas, around John Pennekamp Coral Reef State Park, further down south of the archipelago located around Marathon, FL, as well as around Miami, FL, as displayed in orange, purple, and light blue on the map (Figure 4) . The areas in which are considered to have a lower vulnerability were in areas which were further away from the 7-mile bridge as well as further away from the cities and towns in the archipelago, as displayed in pink and lime green on the map (Figure 4) . The conflict overlay was changed from a polygon to raster data, for the data types to match on this map as well as being able to perform a further analysis on the density of boat ramps and marinas in these areas, in which could be a contribution to the depletion and growth rates of these continuous and discontinuous seagrass beds. The scale displayed in Figure 4 ranges between a 5-10, where a score of 5 represents areas of lower vulnerability on seagrass and 10 being areas of higher vulnerability. Areas of higher vulnerability reflect areas with more boat traffic such as in Miami, FL and in Marathon, FL. Also, the polygon data, displayed in red, can reflect how dense as well as the relative amount of boat ramps and marinas were found within the study area (Figure 3). Within the entire study area, there was found to be 1,977 boat ramps and marinas, with about 418 of them being located along the Florida Keys. Due to time constraints, a further analysis of agricultural influence on seagrass beds could not be completed. However, I would like to further investigate how agricultural areas, along with flowing water sources, can impact continuous and discontinuous seagrass beds due to the transfer of pollutants into the water column and potentially how this is affecting continuous and discontinuous seagrass beds overtime.

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