Human Impact on Sea Turtle Nesting Patterns

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GIS & GPS APPLICATIONS

GEO 327G

INTRODUCTION

Sea turtles have been around for more than 200 million years. They play an important role in marine ecosystems. Unfortunately, today most species of sea turtles found in the U.S. are endangered. From ocean pollution to illegal sea turtle trade, humans have had a negative impact on sea turtle population. With modern technology, we are able to make spatial relationships easier to model and interpret. In this paper, GIS data is used to further understand how humans impact sea turtles. More specifically, their nesting patterns. If we are able to understand how to make better nesting conditions for sea turtles in the modern world, we might be able to combat their depleting numbers.

PROBLEM

How are humans affecting sea turtle nesting patterns? To assess this problem, we look at the state of Florida. Florida is a regular nesting location for loggerhead, green turtle, and leatherback sea turtles. With the available resources, we should be able to detect correlations with the amount of nests and human population density, buildings density, and solid waste facility density.

HYPOTHESIS

With increasing population, there should be a decline in sea turtle nest numbers. This is because with a higher population, there is a higher chance for a disturbance to sea turtles. Higher population is likely correlated to the amount of people on the beach. It is more reasonable for the sea turtle to nest on a more secluded area.

Sea turtles like to nest in dark, quiet spaces. For this reason, it is expected that sea turtles have a lower nesting number in areas close to a lot of buildings. The artificial light would likely discourage the turtle from wanting to nest nearby.

Waste is harmful for marine creatures. Although solid waste sites are limited to their allotted space, strong winds or storms can easily pick up waste. Some of which might travel to the shores. If the shore contains a lot of contaminants, it could deter sea turtles from nesting there.

DATA RESOURCES

United States Census Bureau: https://www.census.gov/geo/maps-data/data/tiger-data.html

1. TIGER/Line Shapefile, 2010, 2010 state, Florida, 2010 Census Block State-based
   - .shp file with outline of the buildings in Florida

2. County 2010 Census Data
   - .shp file with US census data by county for population concentration analysis

Florida Geographic Data Library: https://www.fgdl.org/

1. Statewide coverage of Water Assurance Compliance System Solid Waste Facilities
   - .shp file with solid waste facilities locations in Florida

Florida Fish and Wildlife Conservation Commission: http://geodata.myfwc.com/

1. Sea Turtle Nesting Beaches Florida
   - .shp file with average nesting density in 200+ beaches of Florida

METHODS

First, the Florida nesting data was loaded into a blank map in ArcMap (fig 1). Data had a

default projected coordinate system of PCS_Albers and Geographic coordinate system

GCS_North_American_1983 using the D_North_American_1983 datum.

Figure 1

This shows the beaches where the nesting was recorded, but doesn't give any quantitative

information. Before moving on, a projection of Florida is needed to ground the measurements.

The County census data was loaded and moved behind the nest data (fig 2).
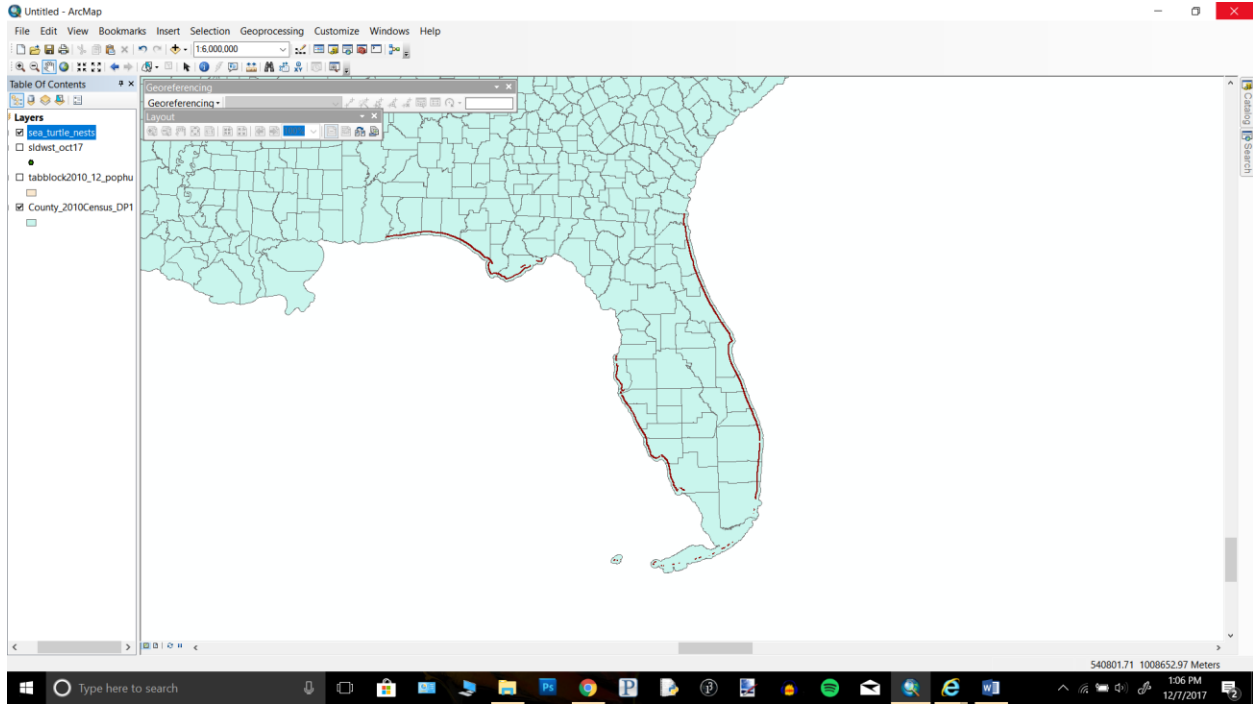
Figure 2

Now we are able to see where in Florida the data was collected. Next, we need to explore

the nesting data (fig 3).

Figure 3

After exploring it, we can see that it has different values for the different types of turtles,

as well as some more information about the distribution and survey. We only want to check for

patterns in nesting numbers so we look at the variables ccMeanDens, cmMeanDens, and

dcMeanDens. These are the mean annual nesting density for loggerheads, green turtles, and

leatherback sea turtles respectively. They are summarized over the survey years covered by these

data. Nest density was defined as the number of nests per kilometer of surveyed nesting beach habitat.

We will be looking at the mean density of the loggerhead sea turtles because they have the largest population. Their larger number will help derive a stronger correlation, if any. With this in mind, we want to change the symbology to display the lines with a more quantitative display. We do this by going to the layer properties >> symbology >> Quantities >> graduated colors. Change the value to ccMeanDens. Change classes to 6 to have 6 different breaks (fig 4).
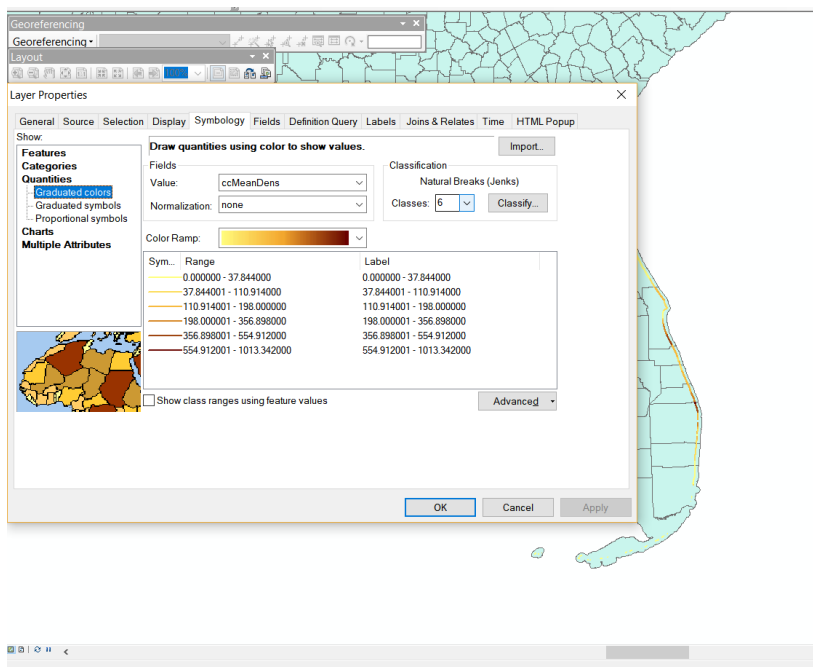

Figure 4

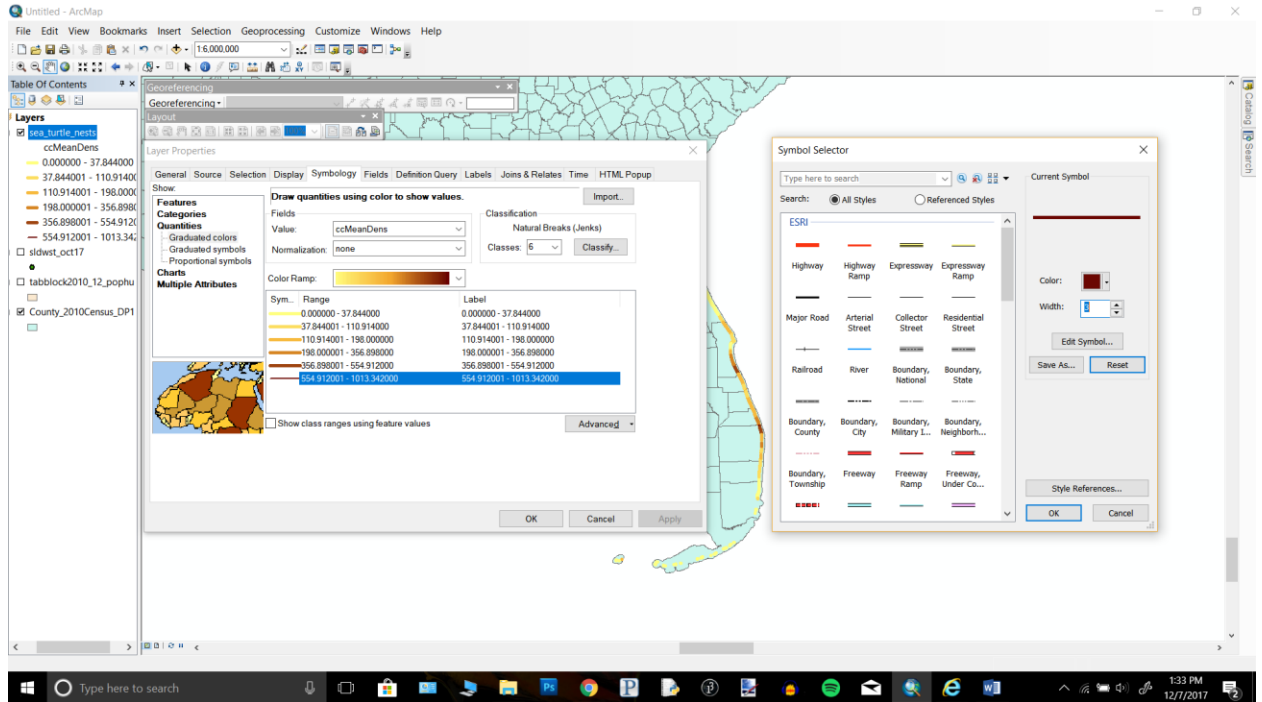Since the line is barely visible, individually change the width of the line to 5 (fig 5).

Figure 5

First, since the census population data is over the counties, we will do a statewide

comparison because the counties cover a large area. First, we select the counties in Florida to
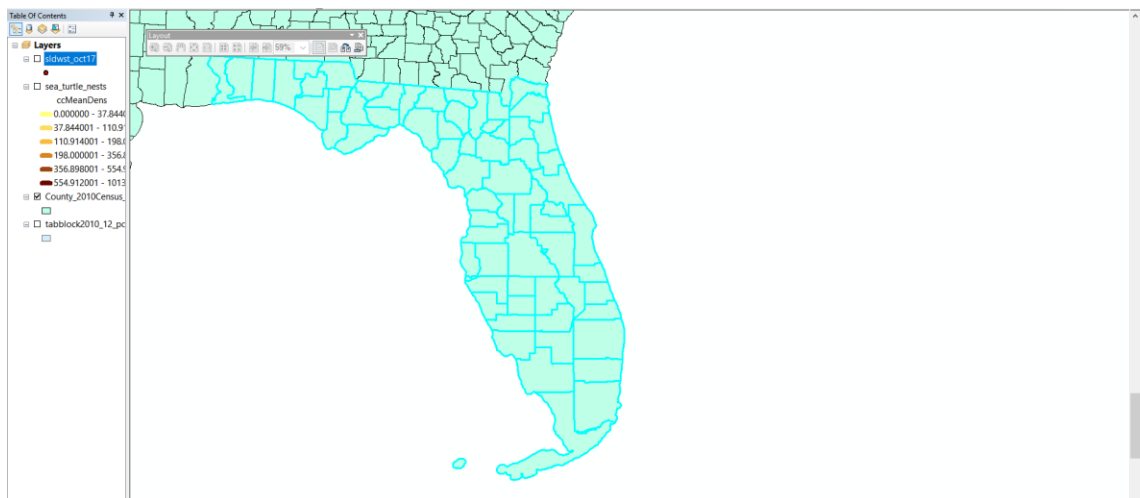
isolate the data (fig 6).

Figure 6

Right-click on the census file name in the TOC, and select "Data" - "Export Data". Then choose to Export "Selected Features" and save. Import the data to the TOC, and we have the isolated Florida data (fig 7).
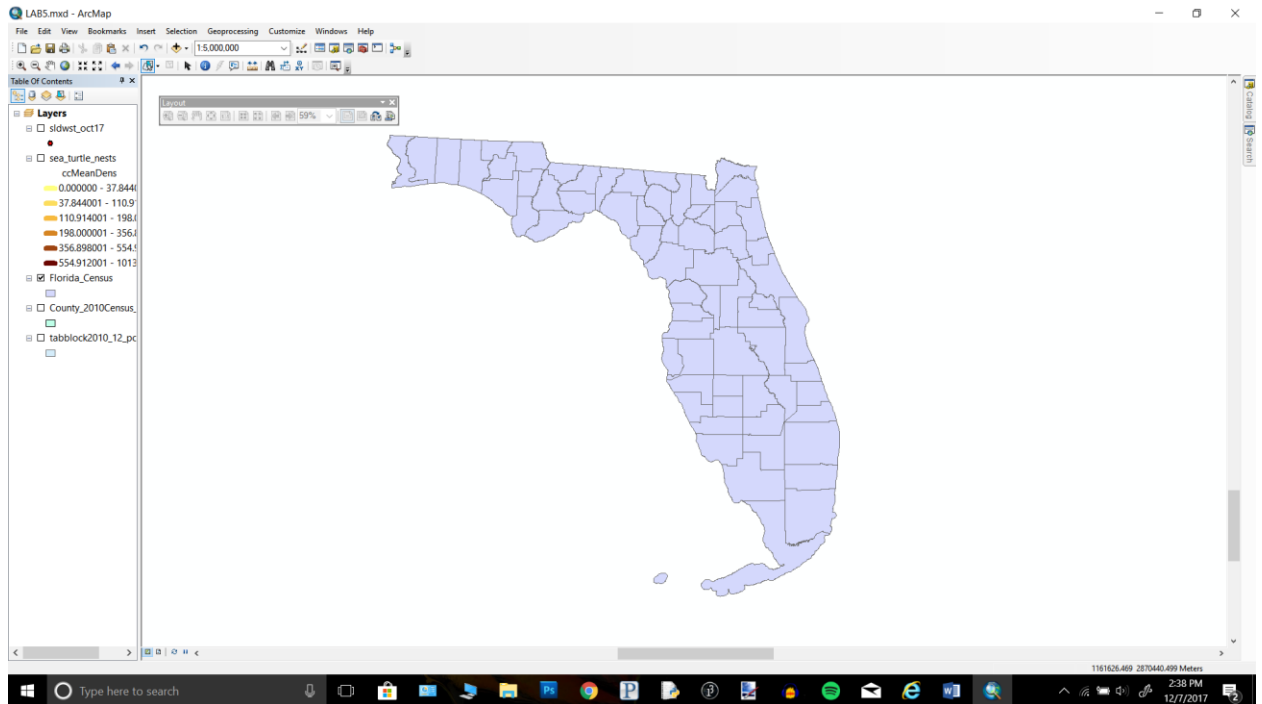
Now, we can add information about the population by adding a color based on the total population variable in the data "DP0010001". Again, we do this by going to the layer properties >> symbology >> Quantities >> graduated colors. This time, the variable is DP0010001. (fig 8).
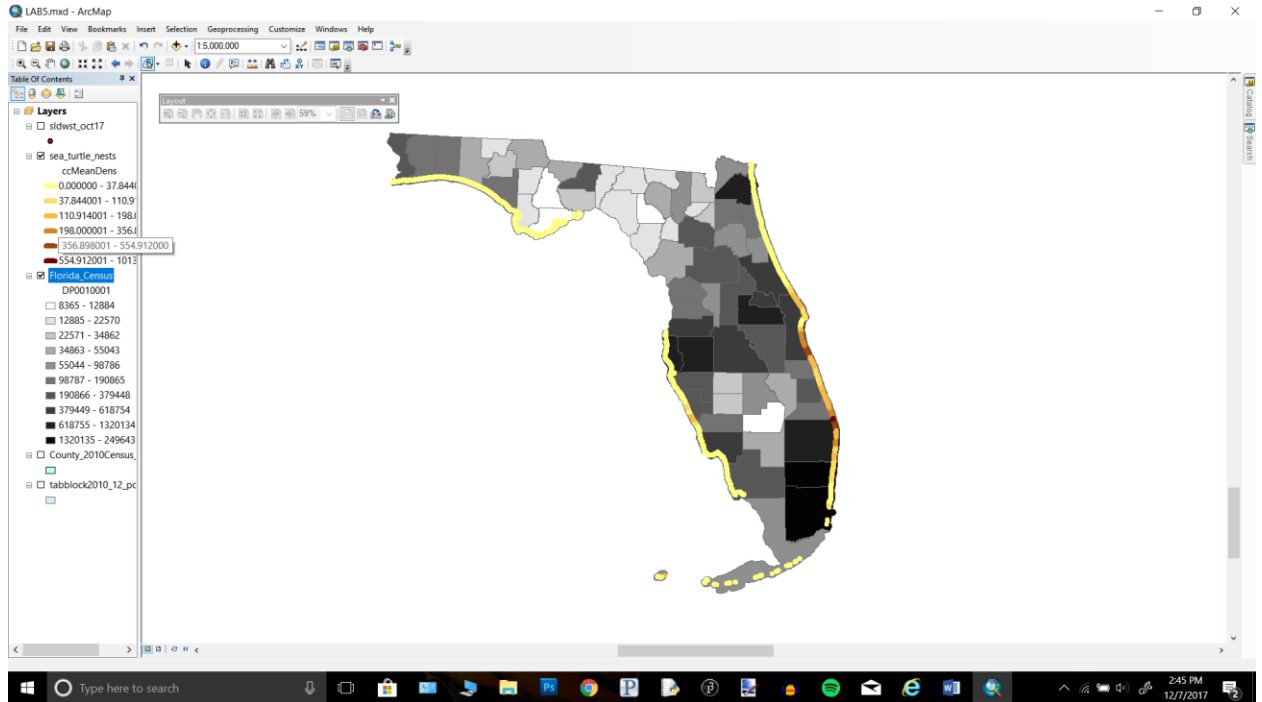
Figure 8

We go back to our plain version of Florida to have a clearer view of the other relations. Now, finish up the map by adding a legend and titles. Now that we are able to see the nesting patterns, we need to look for an appropriate area of interest to inspect more closely for our comparisons. There are areas in the west coast that do not vary much, so the results will be inconclusive. We need areas with varying densities to check for relationships with the other data. There are two areas on the east coast that look promising (fig 8). We will choose these two as our areas of interest to test our hypotheses.
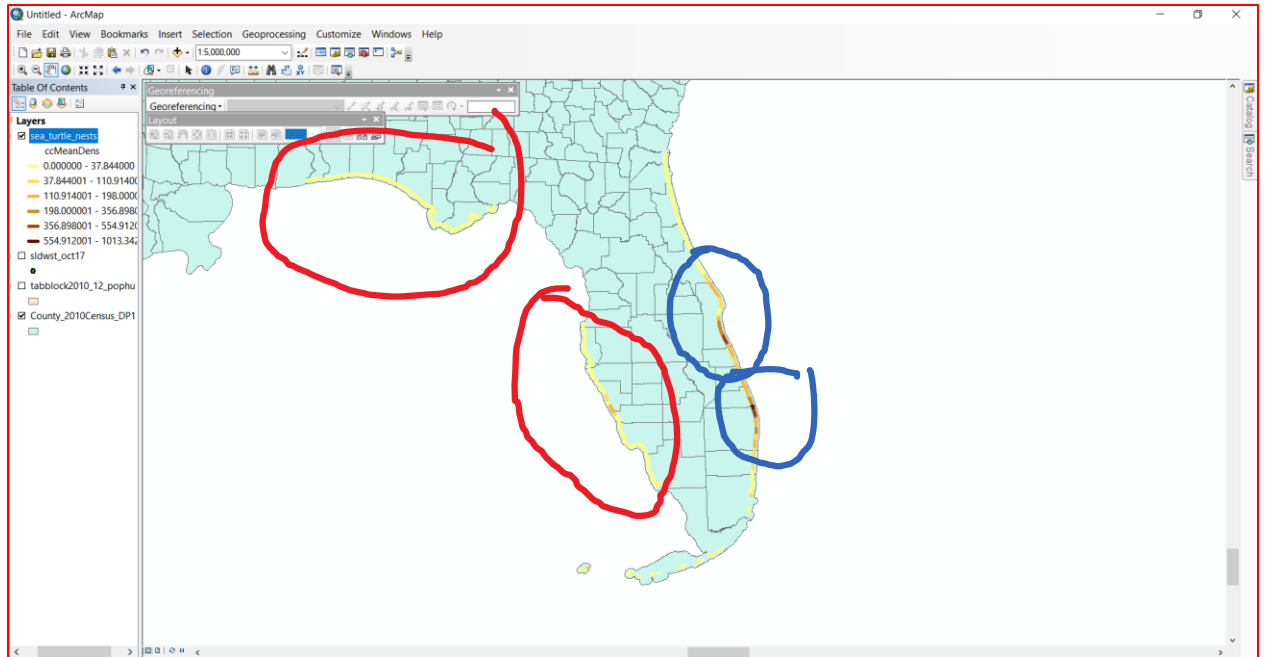
Figure 9 Red circle shows areas that will not show a good correlation. In blue, we might be able to show a relation.

For area of interest 1, we will get the northern circle area from fig 9. Then, we will compare this to the building density. Load the block census data into ArcMaps and place it under the turtle nest data (fig 10).
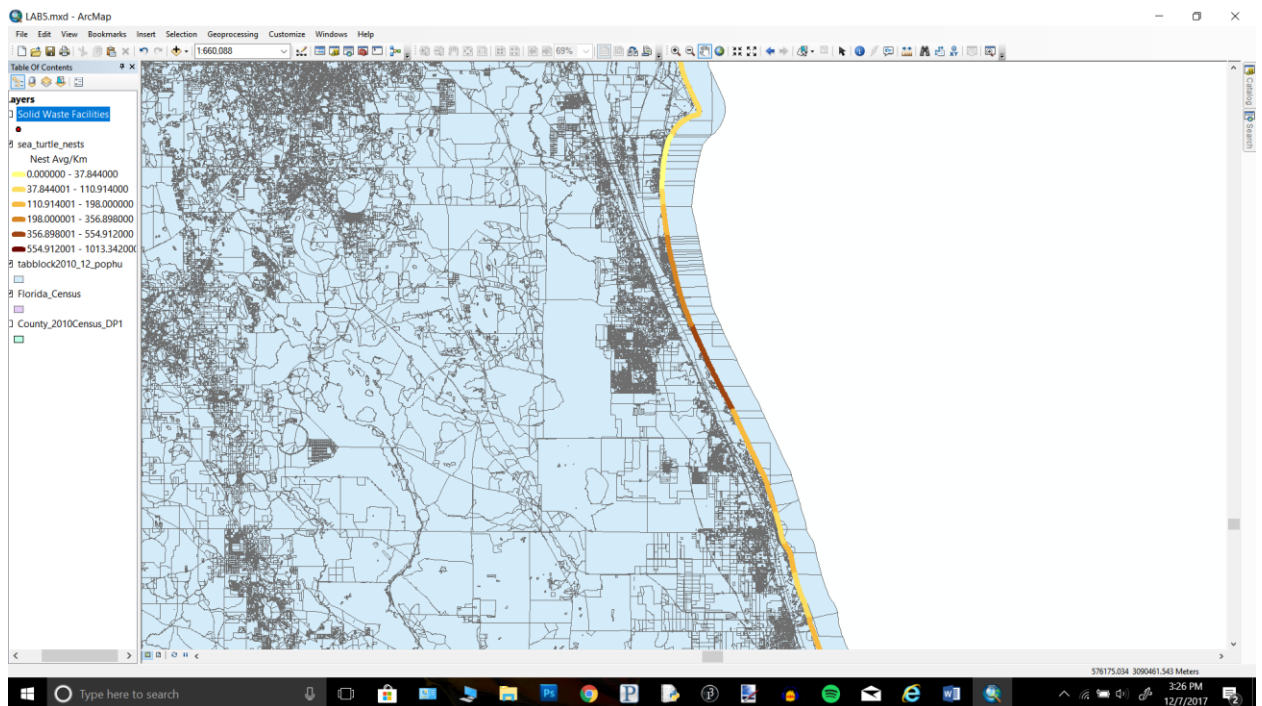

Figure 10

Next up, we will do a comparison for the same part, but with the solid waste facilities. For this, we turn off the block data, and load in the waste facility points data (fig 11). Make sure to place the points on top so they are noticeable.
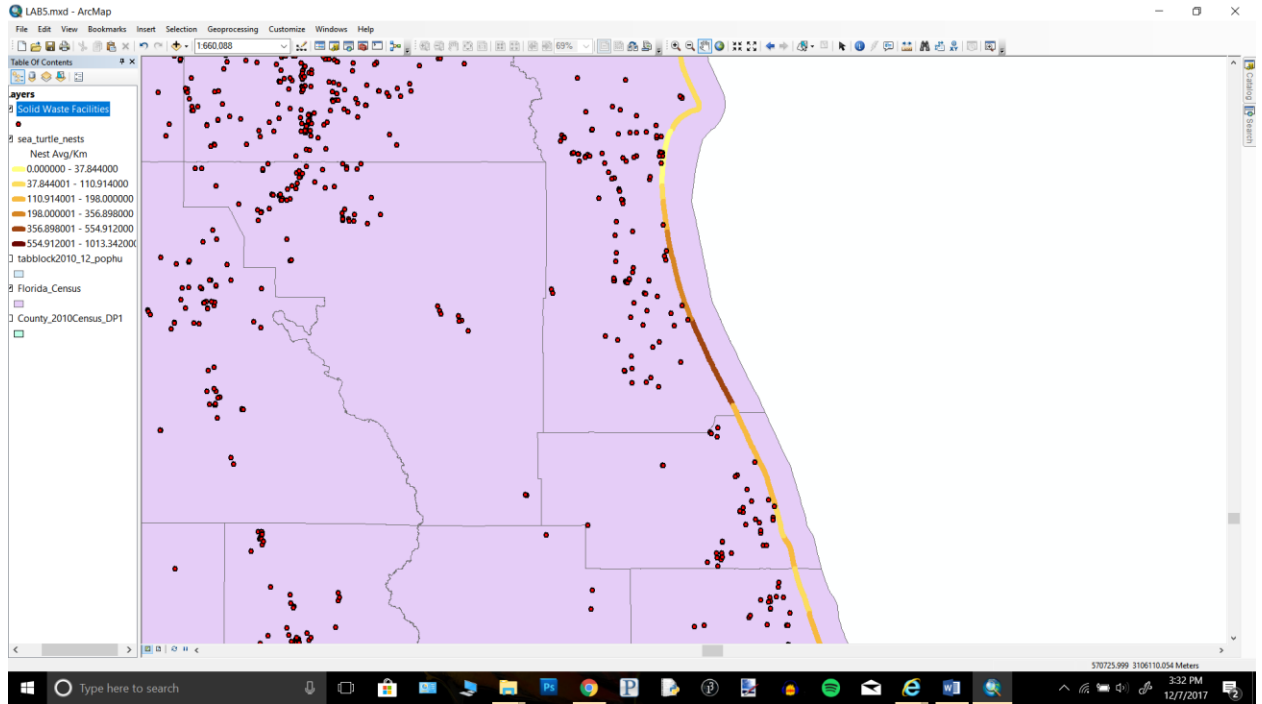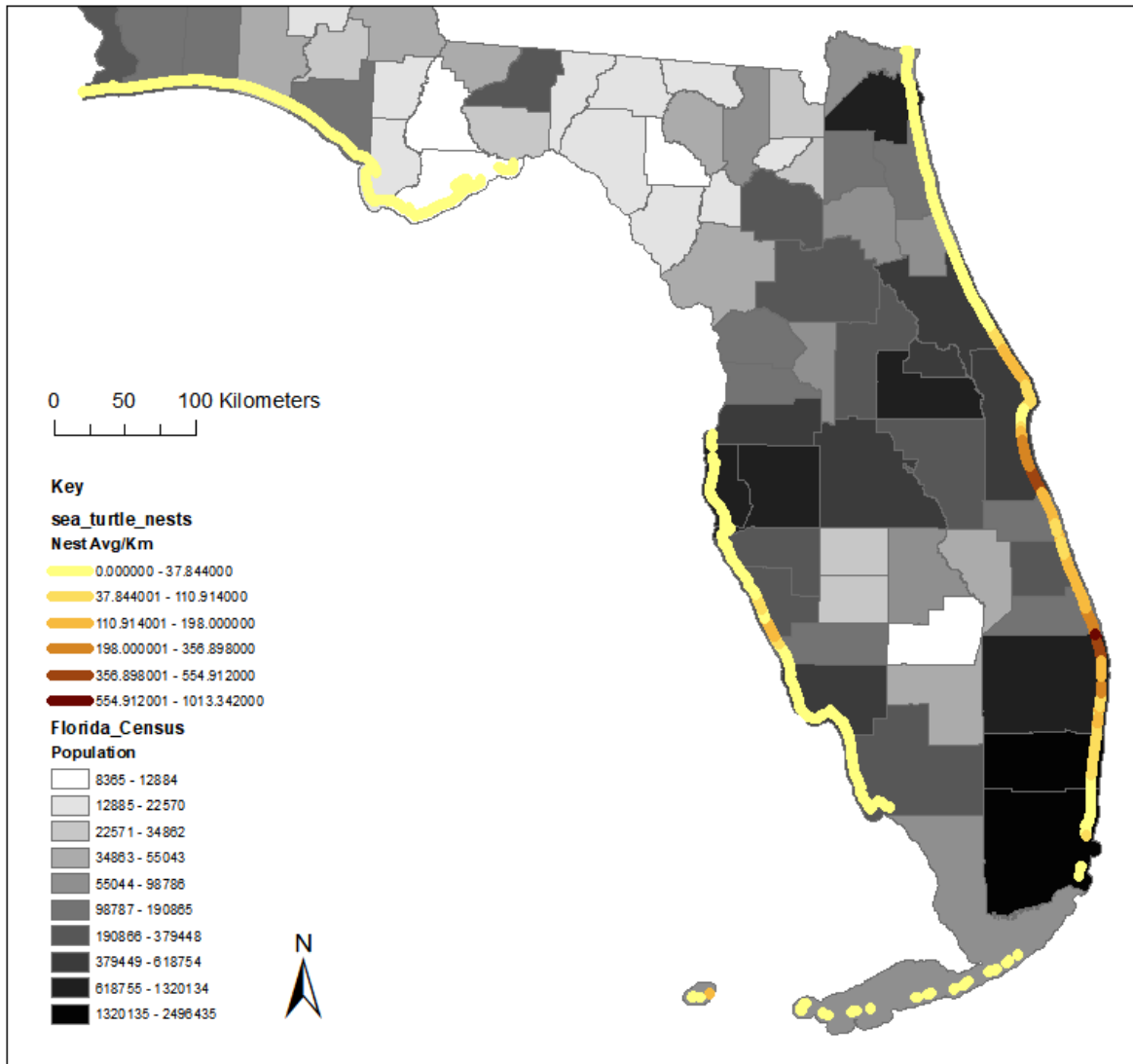
Figure 11

Now we repeat the last steps for area of interest 2, and we're done with data processing.

DATA

Map 1

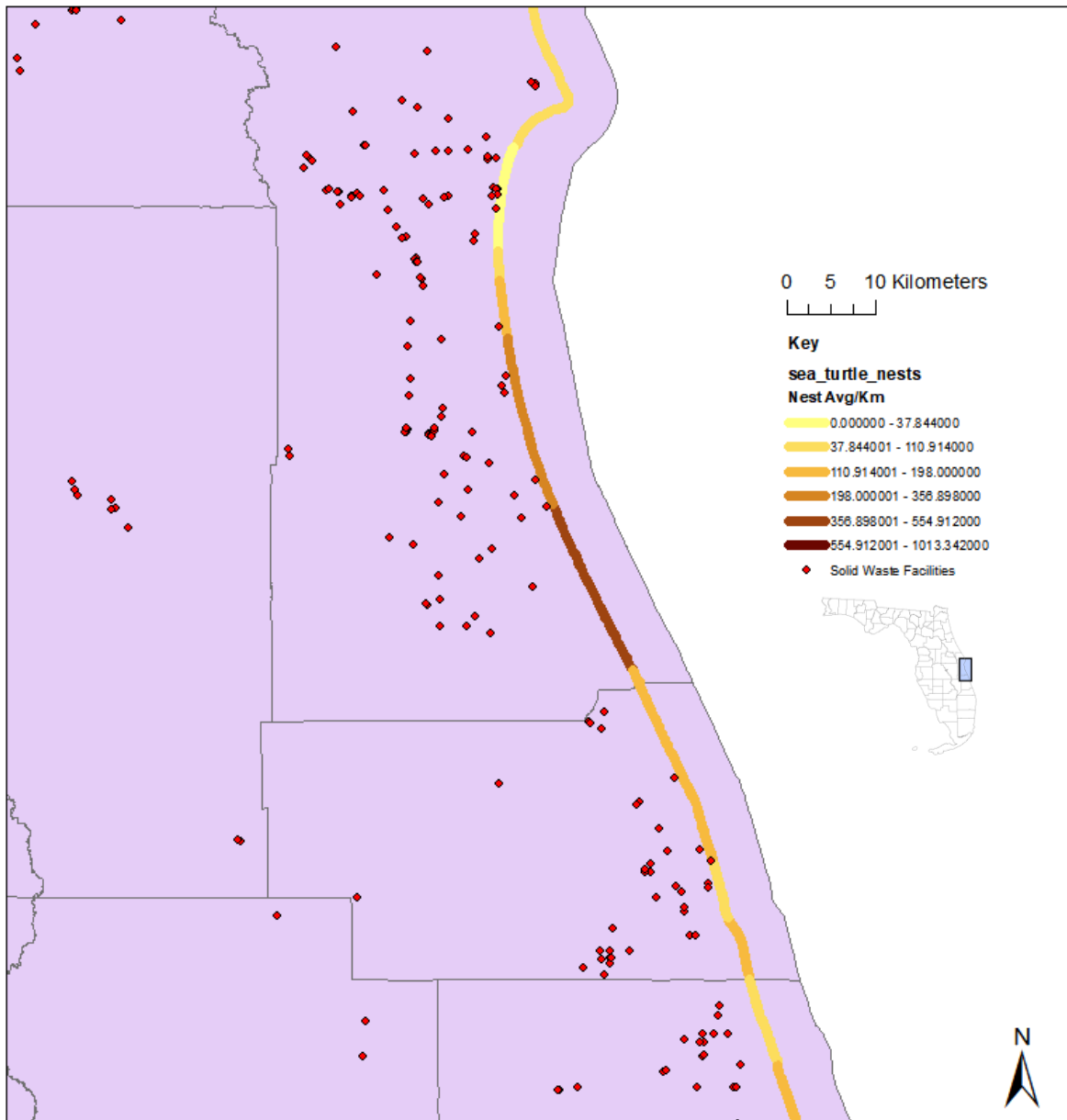# Florida Loggerhead Nests vs Buildings (A.O.I. 1)

This map shows the average number of loggerhead turtle nests per kilometer against the density of buildings in area of interest 1.
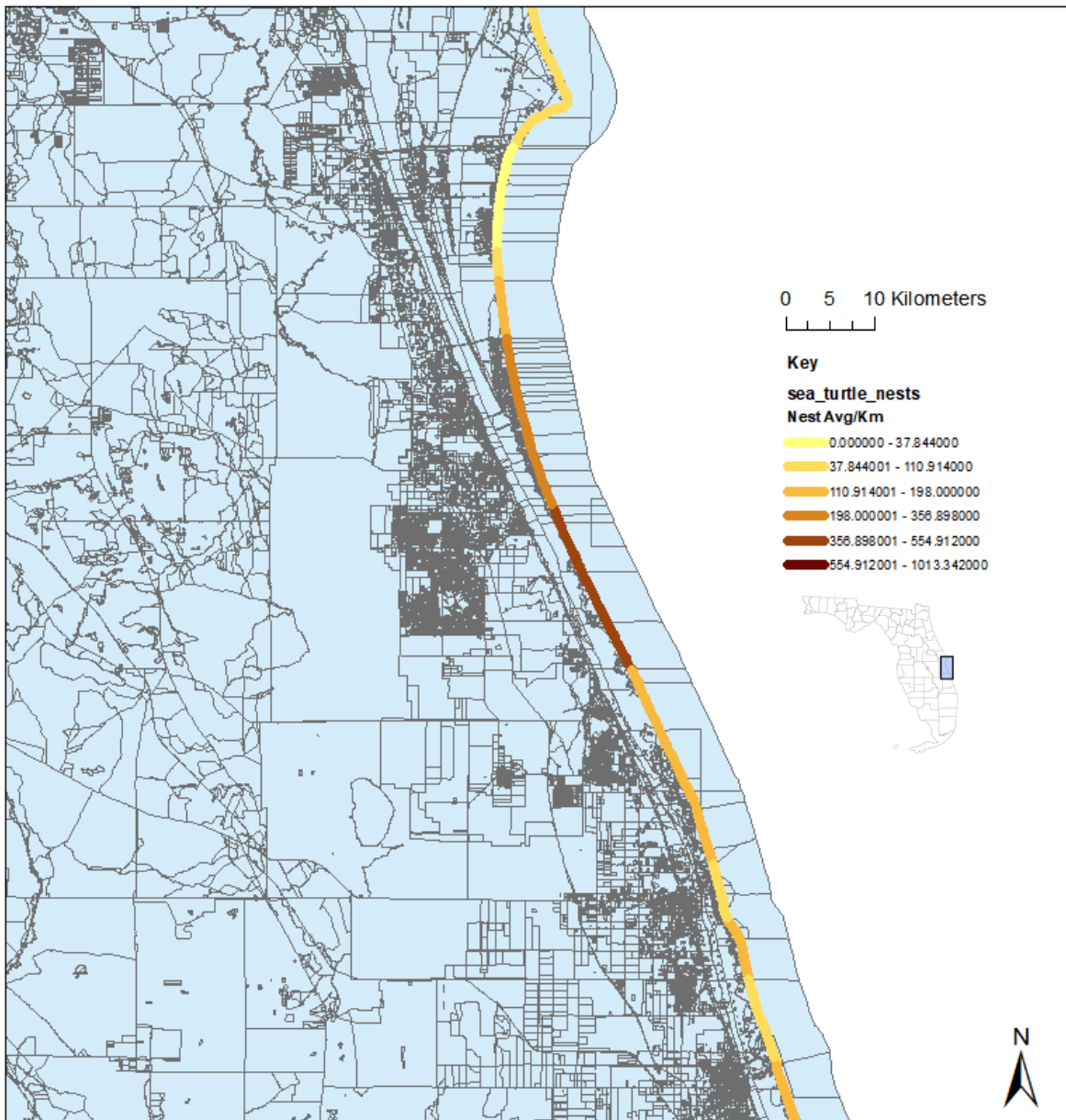
Map 2

Florida Loggerhead Nests vs Solid Waste Facilities (A.O.I. 1)

This map shows the average number of loggerhead turtle nests per kilometer against the solid waste facilities in area of interest 1.

Map 3

Florida Loggerhead Nests vs Buildings (A.O.I. 2)

This map shows the average number of loggerhead turtle nests per kilometer against the building densities in area of interest 2.

Map 4
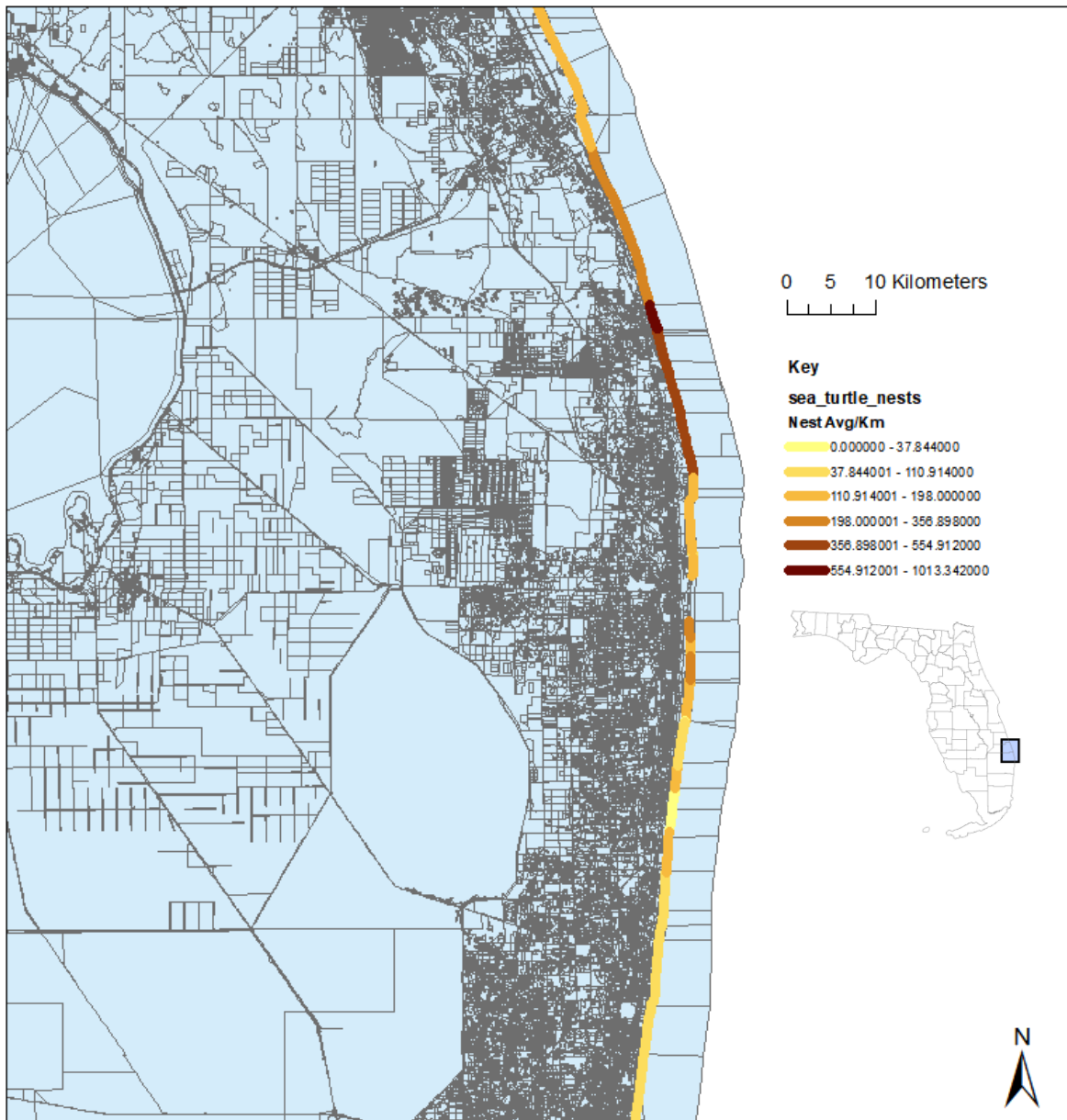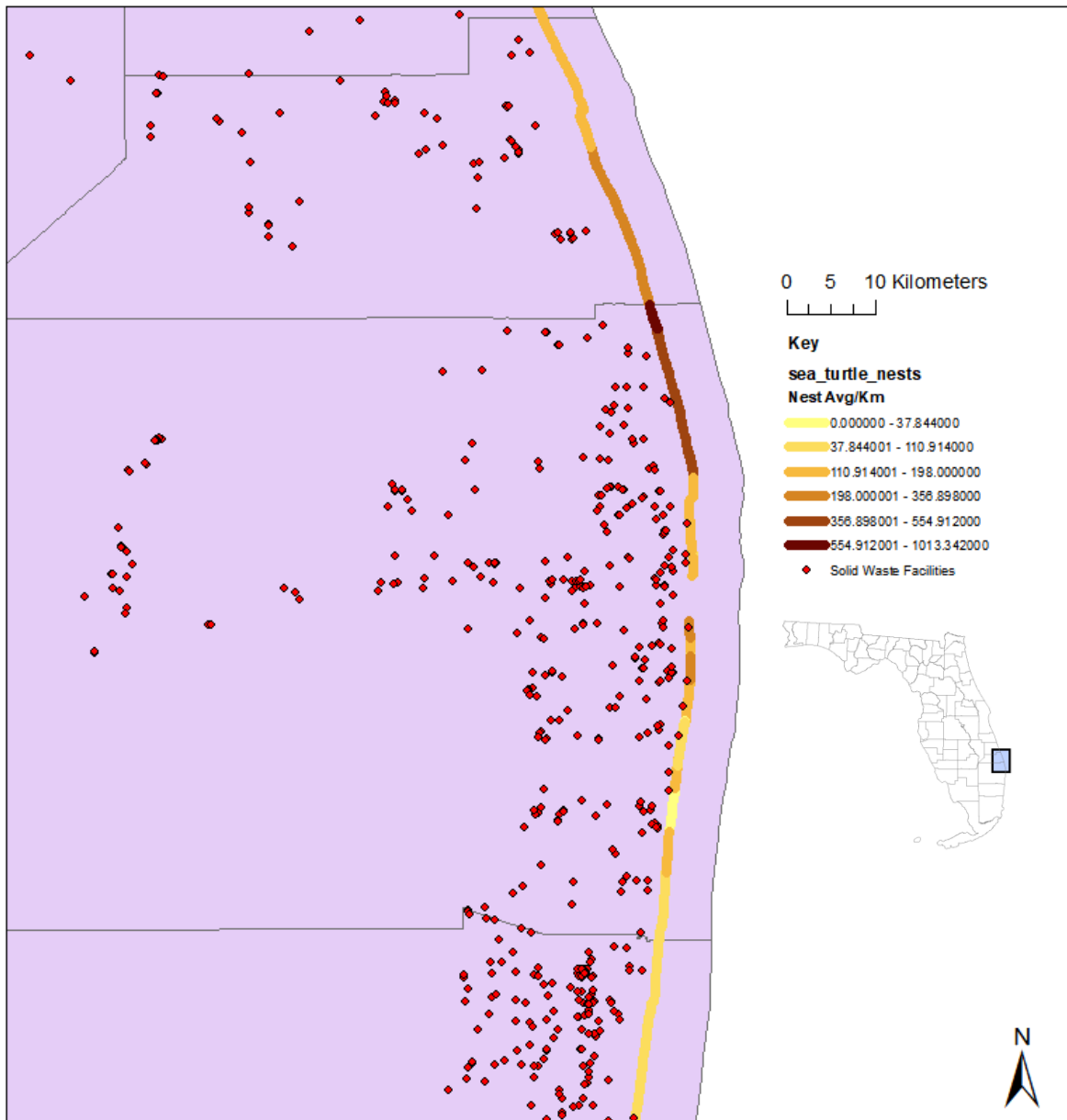
Florida Loggerhead Nests vs Solid Waste Facilities (A.O.I. 2)

This map shows the average number of loggerhead turtle nests per kilometer against the solid waste facilities in area of interest 2.

Map 5

ANALYSIS

In map 1, there is no real trend in the western side of Florida with population and number of nests. The nests seem to be evenly distributed throughout, but low in numbers. The same goes with the south. It does seem to be positively related on the eastern side as it goes from N to S on the upper part of it. This goes against the hypothesis, but there is a small part where population increases and nest number decreases. One reason why this might be is because the county size is too big for correctly correlating the nesting turtles and the population. To get a more accurate result, it should only account for neighborhoods near the shore.

In the area of interest 1, map 2 shows a similar result to the hypothesis. If you look closely, to the building densities close to the shore and nest sites, the more dense places tend to have less nests nearby. This could be due to the amount of artificial light they provide. The turtles seek a more calm and dark place, so places near less buildings would be preferable for them. We see a similar result with the solid waste facilities. The part that has the greatest number of nests has almost no sites near for at least a 5 km radius. One of the reasons this could be linked to the building densities is that it follows the same trend; more buildings equals more solid waste sites, meaning that although we see a correlation, it might not be due to the solid waste contaminants.

In area of interest 2, we see a similar trend. Building densities seem to increase southward, and the nesting seems to decrease southward. If we look at the solid waste sites, we can almost see the same thing happening. At first glance, the waste facilities are more evenly distributed in the southern part, meaning we can't really draw a conclusion. However, if you take the point with the greatest number of nests, you can see that northwards are less solid waste sites

than compared to the southern part. You can also see that the mean density nests declines at a lower speed northward than it does southward. This reaffirms the hypothesis made.

CONCLUSION

Seeing the results from the analysis, we can conclude that the hypothesis was mostly correct. With the given data, we reach a valid conclusion as far as population density affecting sea turtle nesting patterns. However, we can conclude that high building densities near the shore discourage the sea turtles from nesting nearby. This could be due to a number of reasons. It could be that the light at night disturbs them, or even the noise. With more buildings, there could tend to be more traffic, and noise by people there. Another thing that might deter sea turtles from nesting could be a high density in solid waste facilities. Debris could get to the shores and oceans, and make it less habitable for sea turtles. This, in turn could affect the number of turtles that come to nest in that area, as they seek better conditions. Knowing how we are affecting sea turtle nesting patterns can help guide a better conservancy program to aid turtles so they can nest comfortably in more areas, and perhaps it can lead to an increase in nest numbers across the board.