

# FROM THE POLLS TO DEATH TOLLS

## Analyzing anthropogenic and environmental effects on *K. brevis* algal blooms from 2000-2018 in Florida

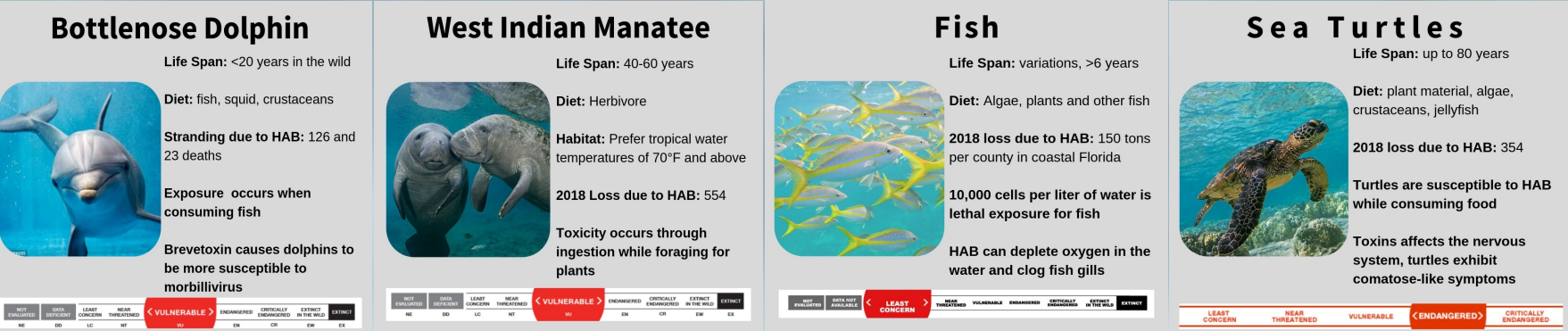
### K. BREVIS IN FLORIDA

Harmful algal blooms have debilitating effects on human health, environmental health, animal health as well as the economic environment. Algal blooms occur when dinoflagellate organisms like *Karenia brevis* and algal plants use nutrients like phosphorus and nitrogen, sunlight, and slow moving water to sequester oxygen sources. Some, like *k. brevis* can produce potent neurotoxins called brevetoxins that can be lethal to wild animals, and cause severe symptoms in humans through inhalation, and the consumption of shellfish and fish. Economically, the loss is evident in the fisheries industry, public health impacts are through treating illnesses, and covering sick days, to finances spent on aiding, rehabilitating and medically treating wild animals. Tourism declines dramatically during what is typically the peak season on the west coast of Florida due to the unsightly pile of carcasses, and pungent odor. NOAA estimates a total of \$82 million a year in economic loss is contributed to the toxic algal blooms in the United States. There are many factors that contribute to the increasing spread of the algal blooms over the years, factors such as; rainfall which can cause run off, temperature increases-which make a hospitable environment for the growth of algal blooms, and fertilizer use. Minimal effort has been put forth by policy makers, and the death toll of the wildlife is increasing, as are the human impacts. In this poster I will attempt to find a correlation of factors that can contribute to the increasing duration of the algal blooms and propose a solution to increase the health of our environment and community.

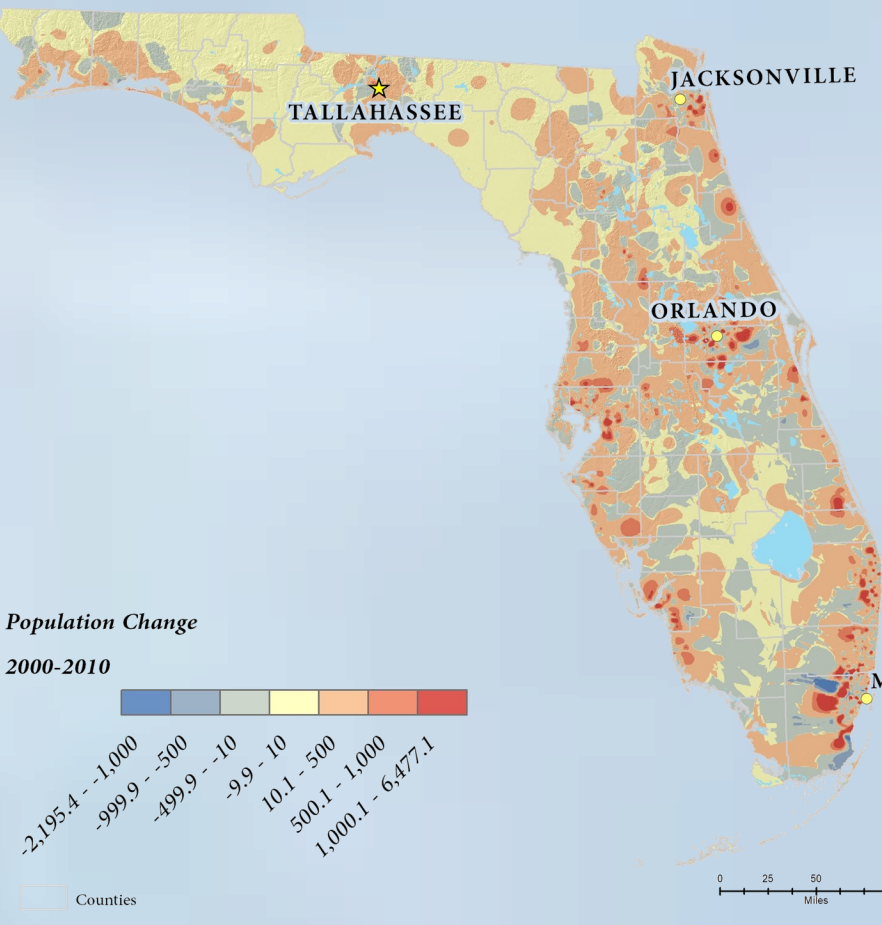


### ELECTIONS AND THE ENVIRONMENT

From 2000 to 2018 the state of Florida has had three different governors. Jeb Bush's term was from 1999-2007, Charlie Crist's term was from 2007-2011, and Rick Scott, his term has been from 2011 to present day. All three candidates pledged to make a difference if elected with no results, and the issue was deemed to expensive to fix when the opportunity came to honor their pledges. Throughout the ten years of prevarication towards the issue it has become increasingly severe every year. It was only until recently that Rick Scott declared a state of emergency during the tail end of this years bloom and promised \$3 million to aid in relief and clean up. Acreage of filtering marshes have been promised, as there is some belief that filtering marsh could aid in mitigating the effects of harmful algal blooms. Mote Marine Lab will begin research later this week in an attempt to prove this theory. Florida does have a clean water act, which by permit only can the discharge of dredged or fill materials be dumped into waters, including wetlands.



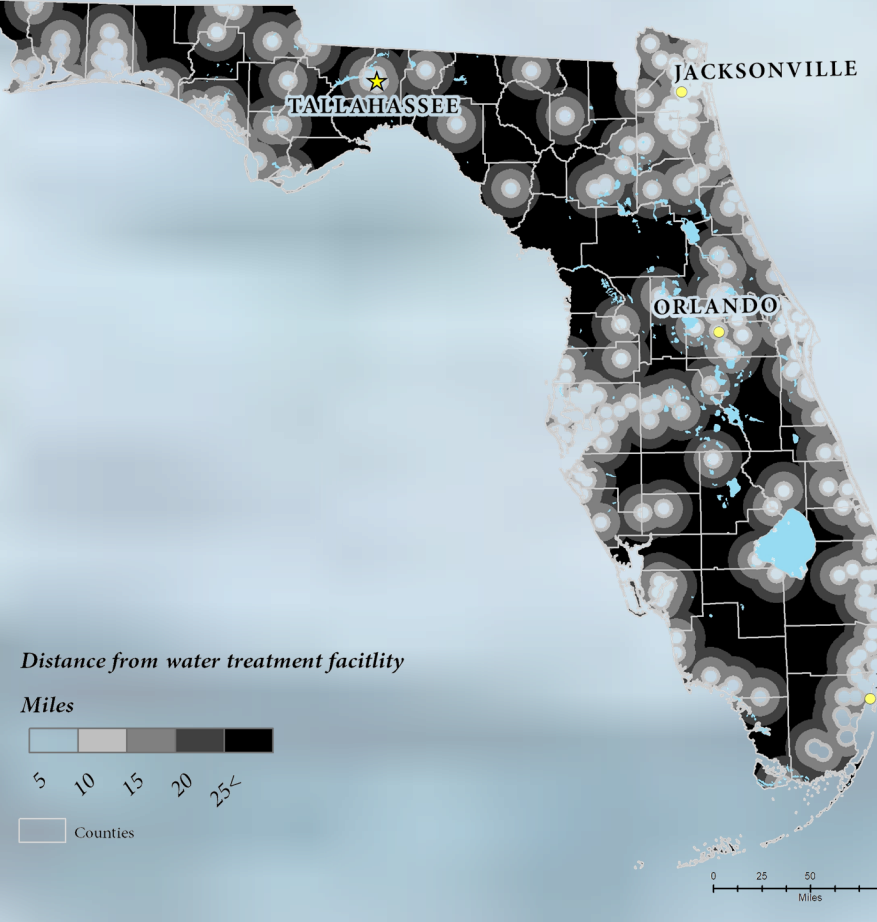
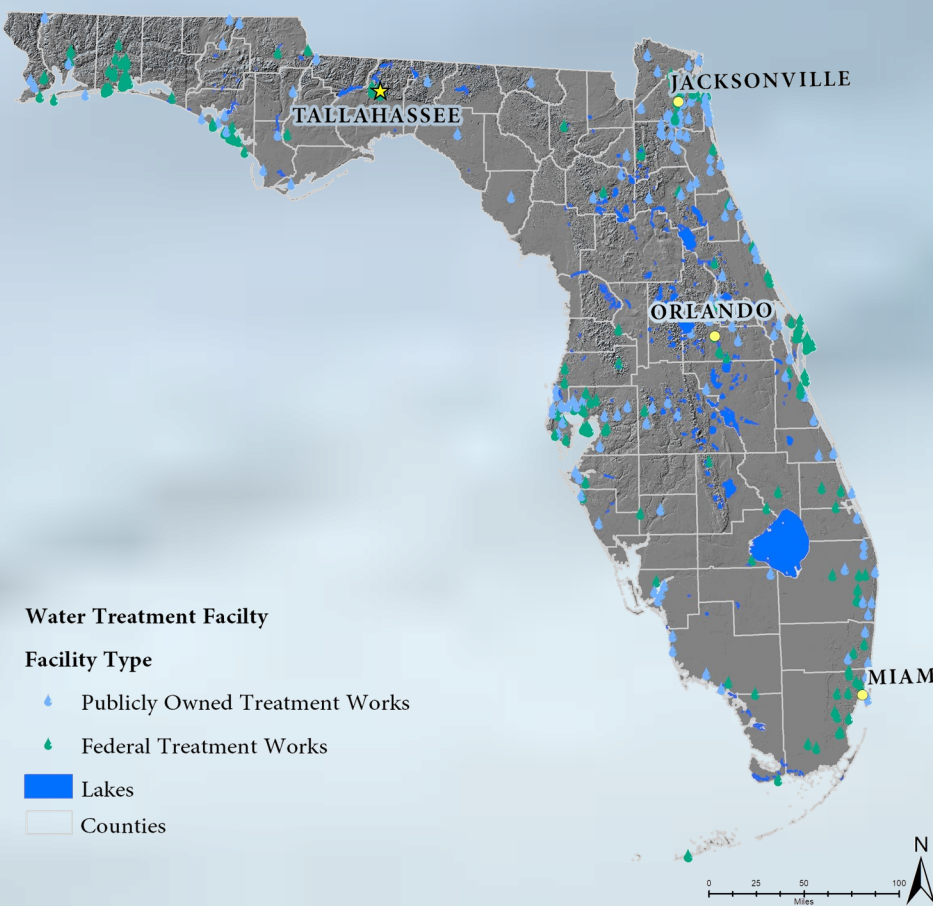
### WHAT TO ANALYZE



Census tracts data was taken from the 2000 and 2010 U.S. census to determine the population density per square mile. The difference was calculated using the field calculator and subtracting the 2010 census per square mile from the 2000 census per square mile. Change over time was done using areal interpolation. Increases in the population occurred in the majority of the state, predominantly on the coast in the ten year span. It can be assumed that with an increase in human population there is an increase of septic waste. Thus fueling

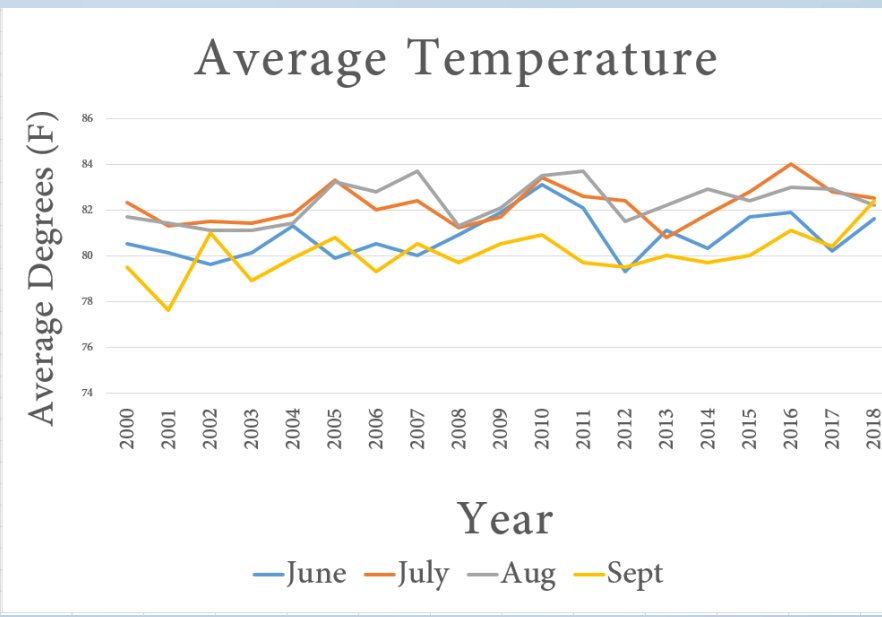
harmful algal blooms with a surplus of nutrients. This could be a contributing factor in the extended duration of the algal blooms

Data from the Florida Department of Environmental Protection introduced the locations of water treatment facilities around Florida to this map. Of the 750 total water treatment facilities, 480 are federally owned treatment works, and 270 are publicly owned treatment works. Large clusters of both types of facilities are found in Jacksonville, Tampa and Miami areas. Through this map it is evident that there are counties that have a considerable about of distance between the growing communities and treatment facilities



Data from the Florida Department of Environmental Protection introduced the locations of water treatment facilities around Florida to this map. Euclidean distance output raster was used to determine the measured distance from every cell to the nearest water treatment facility. Euclidean distance is done as the crow flies, in this map the areas closest to water treatment facilities are white with a five mile radius. The black areas are the counties MIAM where water treatment facilities are a distance greater than twenty five miles away, with the intermediate shades projecting in five mile intervals.

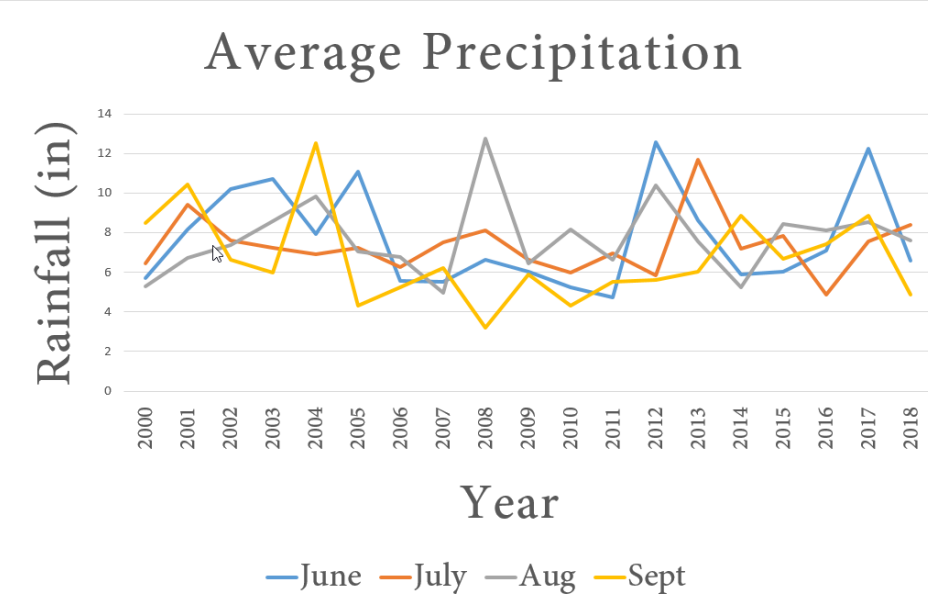
### CLIMATE



Climate is an issue of concerns globally and through the data collected in from the Southern Regional Climate Center this average temperature line graph is able to show a slight but still significant increase in overall temperature in the state of Florida in the last 10 years. Data was collected during the months of June,

July, August and September to show a range during the peak time of the algal blooms. Warmer climates are ideal living conditions for the *k.brevis* organism. If this trend continues it is likely the severity of the blooms will follow suit.

Rain is close to a daily occurrence in Florida, this can aid in the ideal environment for the harmful algal blooms even if the rain is predominantly inland. The average precipitation data was taken from the Southern Regional Climate Center in their long term trend reports. Using their data, average precipitation from 2000-2018 was collected for the months of June, July, August and September to show a change in the amount of precipitation over the last ten years. This line graph was created and shows a slight increase in average precipitation during the peak of the harmful algal bloom season. This can increase the occurrence of potential run-off of fertilizers and contaminants to enter the sewage and waste water system that eventually lead to the oceans and provides nitrogen and phosphorus in plentiful amounts to *K.brevis*.



### FERTILIZER USE

Fertilizer use in the state of Florida exceeds more than 90% of the United States (EPA,2017). This can be because of year round crops due to favorable rain and temperature conditions, but the soil quality is predominantly sand in Florida and humans intervene to supplement the soil with fertilizers in hopes to improve the nutrient quality. Fertilizer sales are regulated in part by the Florida Department of Agriculture and Consumer services, and the University of Florida Extension program collected data for the consumers between July 2011 and June 2012, and categorized them in Table 1. This table shows the majority of the fertilizers being used in Farms, Non-Farms, Lawns and Athletic fields the most.

Table 1. Tons of fertilizer used in Florida by market sector from July 2011 to June 2012 (FDACS 2012).									
	Lawn	Golf and Athletic	Garden	Nursery	Potting Soil	Non-Farm Total	Farm Total		
Multi-Nutrient	9118	5624	1733	2655	462	22993	99905		
Nitrogen	1110	2305	1085	862	171	5613	39143		
Phosphate	4686	4520	4159	1612	268	14717	130616		
Potash	280	1361	439	471	364	2702	23900		
Single-Nutrient	15	1	2	3	13	36	358		
Nitrogen	1800	519	444	197	122	3081	13267		
Phosphate	164	22	102	2	0	488	1521		
Potash	148	8	89	1	0	247	529		
Total	9368	7307	6274	2598	566	26330	128476		
Nitrogen	1481	2312	1366	886	184	5330	46420		
Phosphate	14331	1336	4488	1410	391	31071	144389		
Potash	14331	1336	4488	1410	391	31071	144389		

### HARMFUL ALGAL BLOOMS OVER TIME

Data was collected from the Florida Fish and Wildlife conservation commission, this organization tests the water surrounding the peninsula of Florida weekly and creates maps in order to educate the general public of the current state of the harmful algal blooms. From their downloaded data, samples were separated into five- three year interval maps and, one- four year span map. Kernel density was used to evaluate the magnitude per unit area from the points obtained. This was done in order to show the severity of the algal blooms over time. Through this series of maps it is visually clear that the harmful algal blooms have insidiously been able to engulf the state of Florida over the 10 year time frame.

### CONCLUSIONS AND HOW TO IMPROVE THE FUTURE

In order for policy makers and the citizens to make informed decisions about the fate of our environment they should be well informed of the opportunities to create better outcomes. When comparing the Euclidean distance map to the population change map and the algal blooms over time, there is a 100 mile gap on the coast line where there are no water treatment facilities, minimal change in population and steady growth of algal bloom concentrations. Furthermore, the *k. brevis* algal blooms have increased dramatically in the last 10 years, as has the population, temperature and average precipitation. All of these factors aid the algal blooms in thriving and extend this natural occurrence well past its natural duration. Policy makers have the opportunity to be more proactive about creating a resolution to this issue. This can be done through creating more water treatment facilities and regulating the amount of fertilizer sold to decrease the amount of potential run off. Creating cleaner water and a rigorous filtration system, and limiting the amount of dumping permits even more so could show change as early as next year's bloom, Implementing these changes will increase tourism, limit the amount of spending on rehabilitating sick and deceased animals, treating human illnesses and improve the quality of the oceans.

