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The Effect of Population Density on Harmful Algal Blooms in Southwest Florida

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Background

Karenia brevis is a species of algae native to the Gulf of Mexico. Times when its growth becomes uncontrollable are called harmful algal blooms (formerly called “red tide events”), and they are often caused by increased nutrients in the water[3]. These excessive nutrients come from watersheds and runoff that contain anthropogenic materials like fertilizer, and the phosphate and nitrogen in fertilizers catalyze the growth of algae[3]. As population density in Florida increases, fertilizer runoff increases as well. Harmful algal bloom events are dangerous to both humans and the environment [1,7]. Thick layers of algal growth on the water’s surface create “dead zones” where sunlight cannot penetrate the ecosystem below the surface. This results in the death of aquatic animals, and an increase of *Karenia brevis* close to the shore causes respiratory irritation in humans[5, 7]. I examined the relation between algal blooms and increased population density between 1953 and 2023 in coastal Southwest counties of Florida. I predicted that the increase in population density has increased severe harmful algal blooms.

Methods

Population data was attained through the US Census. The government gets census data through surveys and financial records. The purpose of the NHGIS tables is to collect population data from censuses to create organized databases for public use[6].

Florida's algal cell counts are reported by a network of monitoring entities (Florida Fish and Wildlife Research Institute (FWRI), Mote Marine Laboratory (MML), Sarasota County Health Department (SCHD), and Collier County Pollution Control and Prevention Department (CCPCPD)). They used laboratory analysis of water samples to determine cell counts[4]. These cell counts were transformed into a bloom severity index (BSI) based on cells per Liter[7]. I used a BSI based on counts over 100k cells/L. If sample’s cell count is less than 100k cells/L, then it is assigned a value of 0.000. If no cells were present in a sample, then it was assigned with N/A.

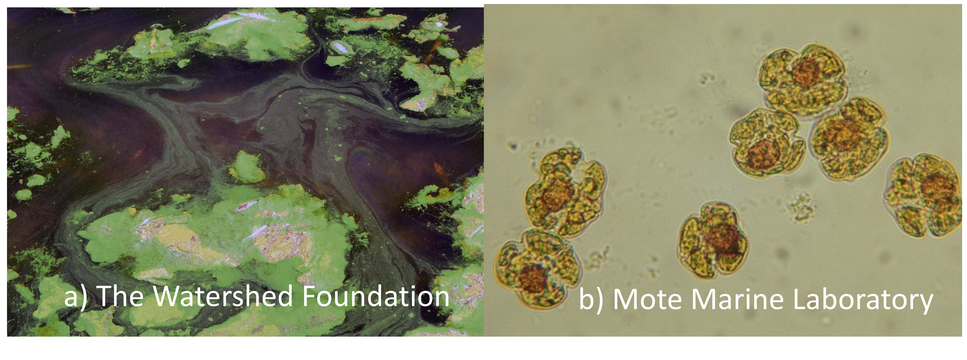

Fig. 1 a) algal blooms on the surface of the water. b) *Karenia brevis* cells

Results

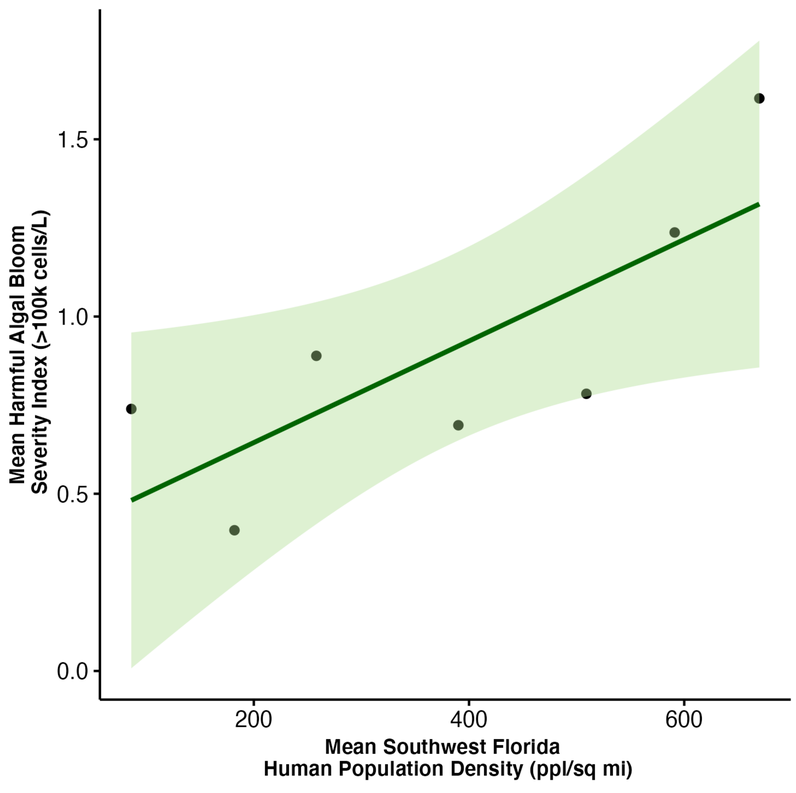

Fig. 2 Mean change in human population density change in relation to the mean change in harmful algal bloom intensity throughout seven decades in Southwest Florida counties. Each point is a decade from the 1950’s to the 2010’s.

Population density did have a significant effect on harmful algal bloom severity in Southwest Florida counties from 1953 through 2019 (ANOVA, $F = 7.8231$, $df = 1/5$, $p < 0.05$). As the human population increased, so did the harmful algal bloom (HAB) events that exceeded 100,00 cells/L. For this project, samples over 100k cells/L is considered a severe HAB event.

Conclusions

Like my predictions, human population density affected the number of severe HAB events recorded in Southwest Florida. This is likely because of the increase in anthropogenic effects that create an increase of nutrients in water bodies. The decreased harmful algal bloom events observed in the middle decades could be explained by under sampling. The years of increasing population density and decreasing algal bloom cell count line up with years of increased off-shore wind[6]. Without on-shore winds that carry respiratory aggravators from the *Karenis brevis* blooms to the coastal population, researchers might have been less pressured to take samples.

Acknowledgments

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References

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