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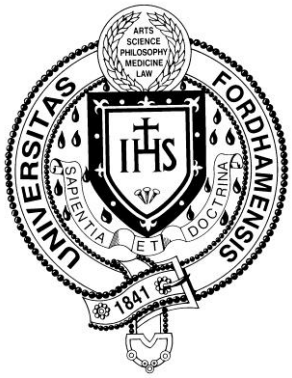

RED TIDE: A BLOOMING CONCERN FOR FLORIDA MANATEES

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RED TIDE: A BLOOMING CONCERN FOR FLORIDA MANATEES

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ABSTRACT

Although red tides are a common and natural occurrence around the coast of Florida, within the last few decades they have intensified and become much more deadly. Several identifiable human-caused factors exacerbate the size, concentration, and duration of the harmful algae bloom and disturb the environment's natural balance. The Florida Gulf Coast provides all the algae's necessary requirements for survival, the perfect storm to create a resilient super bloom that annihilates its host ecosystem.

This article explains the plight of Florida manatees who, like other marine animals and plants, are being injured or killed by this algae crisis. It also provides background information about Florida red tides, including how they are formed and the human activities that are to blame for this disruption in the ecosystem's natural balance. It suggests current laws protecting both manatees and water quality are inadequate or ineffective as they do not directly address nonpoint nutrient pollution, the root cause of these massive super blooms. Using a multifactorial approach, it proposes several simple solutions to mitigate the harmful effects of red tide super blooms and save the manatees along with other marine life.

INTRODUCTION

Red tides are a common occurrence around the coast of Florida.[1] When the harmful algae blooms grow denser due to human activities, the effects on the ecosystem are catastrophic, including decimating the manatee population. In fact, scientists suspect that red

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[1] *Fla. Red Tide FAQs*, MOTE MARINE LAB. & AQUARIUM, https://mote.org/news/florida-red-tide# (last visited Dec. 26, 2020) (Red tides are not exclusive to Florida, as they are also found around the world.).

tide blooms contributed to slightly more than one third of Florida manatee deaths in 2013 and again in 2018.[2] This is particularly troubling as just three years earlier, in 2010, algae blooms did not kill a single manatee.[3] Several laws are in place to provide some protections, but the current legislation is either inadequate or ineffective. Due to the lack of targeted legislation and regulation, the harmful algae blooms continue to escalate year after year, annihilating the majestic manatees. In order to effectuate change, the approach shall include things such as Everglades restoration, the creation of a Federal Statute to regulate nonpoint source pollution, and even the attachment of liability to polluters. By taking a multifactorial approach, it is possible to control the red tide blooms and save the manatees along with other marine wildlife.

Part II introduces the Florida manatee including a physical description of her, information about her behaviors and details her habitat and diet. This section also discusses her small population size and how she is restrained from rapid growth due to her reproductive cycle. Part III provides essential background information on Florida red tides including an explanation of its formation. This part also discusses how red tides are influenced by human activities, which have altered the ecosystem's natural balance. It also describes in great detail the influencing factors that exacerbate the red tide. Part IV details the devastating and catastrophic effect that red tide has on manatees. It explains how they come into contact with the toxins and what happens after they are affected with it. Part V analyzes the current legislation in place for manatee protections. This section discusses the shortfalls of the primary federal statutes that could protect the manatees but falls short either due to the legislation being inadequate or it is not

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[2] *2013 Final Red Tide Manatee Mortalities*, FLA. FISH & WILDLIFE CONSERV. COMM'N, 6 (Aug. 21, 2015), https://myfwc.com/media/11667/2013redtide.pdf; *2013 Final Manatee Mortality Table by County.*, FLA. FISH & WILDLIFE CONSERV. COMM'N, https://myfwc.com/media/11621/2013yearsummary.pdf., FLA. FISH & WILDLIFE CONSERV. COMM'N, 2018 FINAL RED TIDE MANATEE MORTALITIES, (2018) https://myfwc.com/media/24282/2018finalredtide.pdf (last visited Jan. 15, 2021); FLA. FISH & WILDLIFE CONSERV. COMM'N, 2018 FINAL MANATEE MORTALITY TABLE, (2018) https://myfwc.com/media/24281/2018yearsummary.pdf (last visited Jan. 15, 2021).

[3] *Red Tide Manatee Mortalities*, FLA. FISH & WILDLIFE CONSERV. COMM'N, https://myfwc.com/research/manatee/rescue-mortality-response/statistics/mortality/red-tide/ (last visited Dec. 26, 2020).

effectively enforced. Part VI proposes solutions to mitigate the harmful effects of red tide super blooms. This section discusses the specific multifactorial approach that would be necessary to effectuate change in the root cause of the algae crisis. Part VIII concludes with a summary of the Florida red tide problem on the manatees and the environment.

I. FLORIDA MANATEES ARE DESERVING OF OUR ATTENTION

When thinking about Florida marine wildlife, the manatee will inevitably be on the top of everyone's list. This popularity may have something to do with the manatee being Florida's state marine mammal. Or it might be the effect of decades of wildlife education and conservation working. Either way, while the manatee has widespread recognition, not nearly as many people have been lucky enough to witness a manatee in her natural habitat. This is because of the small population size. The Florida manatee has been protected federally under the Endangered Species Act since its commencement in 1973.[4] They remained classified on the list as endangered until March 2017 where they were downgraded to a threatened species,[5] in March 2017 the population was estimated to be at least 6,620.[6]

Manatees are oblong shaped with a paddle-like tail and two flippers.[7] Typically, adults are between eight to ten feet long and weigh

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[4] *Endangered Species Act Profile*, CTR. FOR BIOLOGICAL DIVERSITY, https://www.biologicaldiversity.org/species/mammals/Florida_manatee/endangered_species_act_profile.html (last visited Nov. 21, 2018).

[5] *E.g.*, Endangered & Threatened Wildlife & Plants; Reclassification of the West Indian Manatee From Endangered to Threatened, 82 Fed. Reg. 16668 (Mar. 2017) (to be codified 50 C.F.R. pt. 17).

[6] *Manatee reclassified from endangered to threatened as habitat improves and population expands - existing federal protections remain in place*, U.S. FISH & WILDLIFE SERV. (Mar. 30, 2017), https://www.fws.gov/southeast/news/2017/03/manatee-reclassified-from-endangered-to-threatened-as-habitat-improves-and-population-expands-existing-federal-protections-remain-in-place/.

[7] *Florida Manatee*, FLA. FISH & WILDLIFE CONSERVATION COMM'N, https://myfwc.com/wildlifehabitats/profiles/mammals/aquatic/florida-manatee/ (last visited Dec. 26, 2020).

around 1,000 pounds.[8] Their color ranges from gray to grayish-brown.[9] As a marine mammal, she needs air to breath.[10] Accordingly, manatees have nostrils at the end of their snout, adapted with valves that shut while swimming underwater.[11] Generally the Florida manatee will surface for air every five minutes but is capable of holding her breath for up to twenty minutes when resting.[12] She has a life span of about sixty years in the wild.[13] However, due to the high mortality rate, only half the manatees who reach maturity are predicted to survive at least into their twenties.[14]

The Florida manatee is a subspecies of the West Indian Manatee.[15] She is a Florida native who lives primarily in and around the state.[16] Although an excellent navigator and can travel great distances, she can usually be found along the shallow coastal waters of Florida, in local rivers, springs, and estuaries.[17] While she can live in both fresh and salt water, she needs freshwater for drinking and will seek it out; sometimes even from industrial and other drainage outflows.[18] Manatees are commonly referred to as sea cows due to their large size and strict diet of plants. She usually spends up to eight hours a day grazing on seagrasses and other marine vegetation and the rest of the day sleeping.[19] Amazingly, she can consume four to nine

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[8] *2016-17 Save the Manatee Trust Fund Annual Report Fiscal Year*, FLA. FISH & WILDLIFE CONSERV. COMM'N, 7, https://myfwc.com/research/manatee/trust-fund/annual-reports/2016-2017/; *Florida Manatee*, *supra* note 7 (However, manatee can reach over thirteen feet long and weigh as much as 3,500 pounds.).

[9] *W. Indian Manatee*, U.S. FISH & WILDLIFE SERV., https://www.fws.gov/southeast/wildlife/mammals/manatee/#appearance-section (last updated Mar. 25, 2019).

[10] *See Sea Stats*, FLA. FISH & WILDLIFE CONSERV. COMM'N 2 (Mar. 2016), https://f50006a.eos-intl.net/ELIBSQL12_F50006A_Documents/Manatees.pdf.

[11] *Fla. Manatee Facts & Info.*, FLA. FISH & WILDLIFE CONSERVATION COMM'N, http://myfwc.com/education/wildlife/manatee/facts-and-information/ (last visited Dec. 26, 2020).

[12] *Sea Stats*, *supra* note 10, at 2.

[13] *Save the Manatee*, *supra* note 8, at 7.

[14] *Id.*

[15] *Fla. Manatee Facts & Info.*, *supra* note 11.

[16] *Id.*

[17] *Sea Stats*, *supra* note 10, at 1; *Id.* (Florida manatees have been reported to travel as far north as Massachusetts and as far west as Texas.).

[18] *Id.* at 3.

[19] *Fla. Manatee Facts & Info.*, *supra* note 11.

percent of her body weight in vegetation daily.[20] Although manatees appear fat due to their shape and size, they do not have much insulation.[21] This makes them very sensitive to the cold. When water temperatures drop below sixty-eight degrees Fahrenheit, they must seek warmer waters to avoid cold distress and survive.[22]

Florida manatees' reproductive cycle is the bottleneck to population growth.[23] Females do not reach sexual maturity until the age of three to five years, while males do not reach it until the age of five to seven years.[24] That is a long time for an animal in the wild to have to survive before they can begin repopulating. Additionally, the gestation period is time consuming as it lasts between twelve to fourteen months; at which time she will only give birth to one calf and on rare occasions twins.[25] After the male mates, he leaves and does not become part of the family unit.[26] The only true family unit exists between the mother and her calf.[27] She will stay with her calf for up to two years, during which she will not mate again until the calf ventures off on its own.[28] This again leaves years where the already small population is not able to replenish. Due to the long time to reach sexual maturity, the long gestation period, and long delay while the mothers are with their calf, the population cannot see rapid growth.

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[20] *Id.*

[21] *Sea Stats*, *supra* note 10, at 2.

[22] *W. Indian Manatee*, U.S. FISH & WILDLIFE SERV., https://www.fws.gov/southeast/wildlife/mammals/manatee/#habitat-section (last updated Jan. 21, 2021).

[23] *Sea Stats*, *supra* note 10, at 3.

[24] *Fla. Manatee Facts & Info.*, *supra* note 11.

[25] *Sea Stats*, *supra* note 10, at 3.

[26] *Fla. Manatee Facts & Info.*, *supra* note 11.

[27] *Id.*

[28] *Id.* (A mature female will mate no more than once every three years, sometimes as long as five years.).

II. RED TIDES ARE NATURALLY OCCURRING, BUT HUMAN ACTIVITIES ARE TO BLAME FOR THEIR INTENSITY AND FREQUENCY

A. Background Information on Red Tides

Unfortunately, Florida is not a stranger to red tides; they are a naturally occurring phenomena,[29] that has affected the state since before human settlement.[30] Commonly referred to as harmful algae blooms, they are made up of elevated concentrations of microscopic algae.[31] In Florida, the microscopic alga responsible is *Karenia brevis*.[32] It produces powerful neurotoxins called brevetoxins, which can be fatal to any species who inhales or ingests it depending on the concentration of the algae.[33]

Red tides range greatly in size, from small clusters to clusters covering up to 10,000 square miles, with algae present from the surface of the water to the seafloor.[34] They naturally form up to forty miles offshore and then travel through the water moved by wind and current.[35] While the root cause of red tide formation stems from natural forces, there are several identifiable factors that exacerbate the size,

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[29] *See About Fla. Red Tides*, FLA. FISH & WILDLIFE CONSERV. COMM'N, http://myfwc.com/research/
redtide/general/about (last visited Dec. 26, 2020) (Red tide cells are usually present in the background year-round and found in low concentrations of 1,000 cells per liter or less.).

[30] *Fla. Red Tide FAQs*, *supra* note 1.

[31] *See Red Tide FAQ*, FLA. FISH & WILDLIFE CONSERV. COMM'N, http://myfwc.com/research/redtide/faq/ (last visited Jan. 21, 2021); *see also Red Tide Current Status*, FLA. FISH & WILDLIFE CONSERV. COMM'N, http://www.myfwc.com/research/redtide/statewide/ (last visited Jan. 21, 2021) (Very low concentrations are defined as having 1,001 - 10,000 red tide cells per liter of water. In this range, there may be respiratory irritation. Low concentrations are defined as having 10,001 - 100,000 algae cells per liter. The possible effects of low concentration exposure are respiratory irritation and plausible marine animal death. Medium concentrations are defined as having 100,001 - 1,000,000 red tide cells per liter. In this range there will be respiratory irritation and likely marine animal deaths. High concentrations are defined as having more than 1,000,000 red tide cells per liter of water. The effects of high concentration red tide are also respiratory irritation, marine animal deaths, and water discoloration.).

[32] *Fla. Red Tide FAQs*, *supra note 1*.

[33] *Red Tide FAQ*, *supra* note 31.

[34] *Id.*

[35] *Id.*

concentration, and duration of the harmful algae bloom once it reaches the coast of Florida. The influencing factors are: warm water temperature, higher salinity levels, and the abundance of nutrients in the water.[36] Due to human activities, these factors are out of their natural balance. The Florida Gulf Coast provides all the algae's necessary requirements for survival, creating a perfect storm. Thus, once the algae bloom reaches the Florida Gulf Coast, it creates a resilient super bloom that annihilates its host ecosystem.

B. Climate Change is Having Monumental Effects to Red Tide Blooms

Karenia brevis algae thrive in the warm, coastal waters of Florida.[37] Specifically, the algae flourish in water temperatures between sixty and eighty-six degrees Fahrenheit, with a preference for the warmer end of that spectrum.[38] Water temperatures outside that range will stress out the algae, usually causing the blooms to die off.[39] Historically, the average water temperature for the Gulf Coast of Florida is within that thriving range, with exceptions during the peak months of summer and winter.[40] However, recent trends show that the coastal waters have become warmer and are predicted to persist due to climate change.[41] Just like an incubator, this produces optimal conditions for red tide to grow and reproduce with reduced limitations. Although the peak months of summer surpasses the algae's ideal living conditions, researchers have found that they can still thrive if given

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[36] *Fla. Red Tide FAQs*, *supra* note 1.

[37] *See* Priya Shukla, *Why is Fla. Experiencing Its Most Toxic Algae Bloom In A Decade?*, FORBES (Aug. 10, 2018, 6:00 AM), https://www.forbes.com/sites/priyashukla/2018/08/10/why-is-florida-experiencing-its-most-toxic-algae-bloom-in-a-decade/#418b360a587e.

[38] Hannah Morse, *Despite frigid Fla. temperatures, water too warm to kill red tide, experts say*, BRADENTON HERALD (Jan. 3, 2018, 5:17 PM), https://www.bradenton.com/news/local/article192821084.html.

[39] *Id.*

[40] *Water Temperature Table of All Coastal Regions, Gulf of Mexico Coast: Eastern*, NAT'L CTR FOR ENVTL. INFO – NAT'L OCEANIC & ATMOSPHERIC ADMIN. [NOAA]., https://www.nodc.noaa.gov/dsdt/cwtg/all_meanT.html (last visited Nov. 24, 2018).

[41] Jason Samenow, *Gulf of Mexico waters are freakishly warm, which could fuel strong spring storms*, CHI. TRIB. (Mar. 23, 2017, 7:34 PM), https://www.chicagotribune.com/news/nationworld/science/ct-gulf-of-mexico-warm-waters-20170323-story.html.

more carbon dioxide.[42] The surplus of atmospheric carbon dioxide from fossil fuel consumption is enough to sustain a red tide.[43] Furthermore, this increase in water temperature suggests that even in the peak of winter, it still may not get cold enough to kill the algae.[44] Without a true ceiling and no capabilities of extending below the floor, red tides will continue to take over Florida's coastal waters.

Water with a high salinity content, such as in an ocean, bay, or estuary, is necessary to support the survival of red tides.[45] Recently, researchers have confirmed that climate change, caused by human activities, alters salinity levels in water.[46] The increasing temperatures cause a redistribution of salt content, where oceans are getting saltier and freshwater is getting fresher.[47] Specifically, the Atlantic ocean salt content has risen half a percent over the past fifty-years.[48] Although only a slight increase in salinity, it is still enough to alter the natural balance of the ecosystem.[49] These more favorable living conditions are a direct result of human activities; which strengthens a red tide into an unstoppable force.

C. Nutrient Pollution is the Primary Problem

Nutrient pollution is a man-made problem that has had a significant impact on the red tide crisis.[50] The surplus of nitrogen and

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[42] Angela Fritz, *How climate change is making 'red tide' algal blooms even worse*, THE WASH. POST (Aug. 15, 2018), https://www.washingtonpost.com/news/capital-weather-gang/wp/2018/08/14/how-climate-change-is-making-red-tide-algal-blooms-even-worse/?utm_term=.d2e8a59babcf.

[43] *Id.*

[44] Morse, *supra* note 38.

[45] *Red Tide FAQ*, *supra* note 31.

[46] Joel Shurkin, *Human Activity Changing Ocean Salt Levels*, INSIDE SCIENCE (Dec. 26, 2012), https://www.insidescience.org/news/human-activity-changing-ocean-salt-levels.

[47] *Id.*

[48] *Id.*

[49] *See generally, id.*

[50] *See Harmful Algal Blooms*, EPA, https://www.epa.gov/nutrientpollution/harmful-algal-blooms (last visited Dec. 26, 2020).

phosphorus[51] are primarily due to agricultural and urbanized use of fertilizers and livestock waste.[52] With rainfall, those nutrients runoff the land and into nearby bodies of water.[53] The navigable waterways collect the excess nitrogen and phosphorus and carry the nutrients to larger bodies of water; either to the ocean or a lake.[54] When the nutrients travel through the waterways that lead to the ocean, the continuous flow of nitrogen and phosphorus supply the present algae with an "all you can eat buffet" of steroids.[55] With a perpetual flow of nutrients, the algae grow in rapid numbers.[56] This creates large super blooms of red tides assembling in estuaries.

Another form of nutrient pollution originating from runoff occurs when the nutrients travel through the waterways to Lake Okeechobee.[57] Although Lake Okeechobee is in the center of the state, it still has a mounting effect on the oceans due to the overall water ecosystem.[58] Lake Okeechobee is amidst its own water quality crisis; engulfed with the toxic freshwater blue-green algae and fueled by decades of nutrient pollution.[59] Currently, there is such a buildup of nutrients in the lake that even if no more were added, it would take fifty years just to reach water quality targets.[60] Even though the blue-green algae appears to be confined to the lake, this toxic water is often

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[51] *See What forms of nutrients can Karina brevis use to grow and bloom?*, FLA. FISH & WILDLIFE CONSERV. COMM'N, http://www.myfwc.com/research/redtide/research/current/richardson/ (last visited Dec. 26, 2020) (Nitrogen and Phosphorus are the leading nutrients that induce algae growth.).

[52] *See generally Sources and Solutions*, EPA, https://www.epa.gov/nutrientpollution/sources-and-solutions (last visited Dec. 26, 2020).

[53] *Id.* (This is an example of nonpoint source nutrient pollution.).

[54] *Where Nutrient Pollution Occurs*, EPA, https://www.epa.gov/nutrientpollution/where-nutrient-pollution-occurs (last visited Dec. 26, 2020).

[55] *See generally Nutrient Pollution: The Issue*, EPA, https://www.epa.gov/nutrientpollution/problem (last visited Dec. 26, 2020).

[56] *Id.*

[57] *See generally* Marcus Stern et al., *Toxic Lake: The Untold Story of Lake Okeechobee*, THE WEATHER CHANNEL (July 27, 2017), https://weather.com/news/news/florida-toxic-lake-okeechobee/.

[58] *Id.*

[59] *Id.*

[60] Jenny Staletovich, *Lake Okeechobee: a time warp for polluted water*, ORLANDO SENTINEL (Aug. 20, 2016, 10:30 AM), https://www.orlandosentinel.com/news/environment/os-ap-okeechobee-polluted-water-20160820-story.html.

discharged[61] through both the St. Lucie River and the Caloosahatchee River.[62] The discharges containing the toxic blue-green algae flow through the rivers and out to the estuaries.[63] Since the blue-green algae cannot tolerate the high salinity of the estuaries and the ocean, it dies.[64] The high concentrations of blue-green algae flow into coastal waters, causing the freshwater algae to die in the saltwater, where it eventually decays and then transforms into nutrients that feed the red tide.[65]

Furthermore, it is well documented[66] that the Mississippi River, the second largest drainage system in North America, is responsible for the dead zone in the northern part of the Gulf of Mexico.[67] A dead zone is an area where the oxygen level is so low that any fish or marine life will perish.[68] The Mississippi River flows through ten states, collecting nutrient pollution from each state, and depositing it into the Gulf of Mexico.[69] Additionally, due to the merging of hundreds of tributaries, the Mississippi River actually

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[61] *See generally* Stern et al., *supra* note 55 (The discharges are due to the failing infrastructure of the Herbert Hoover Dike. When the water levels rise to a specified level, it adds too much pressure to the weakened Dike. To prevent a complete catastrophe, the U.S. Army Corp. of Engineers must release this toxic water out of the lake and into its arms: the Caloosahatchee River and St. Lucie River.).

[62] *Id*.

[63] *Id*.

[64] Karl Havens, *The Algae Bloom is Back. But Why?*, FLA. SEA GRANT (July 6, 2018), https://www.flseagra
nt.org/news/2018/07/the-algae-bloom-is-back-but-why/.

[65] Shukla, *supra* note 37.

[66] Letter from Dr. M. Granger Morgan, Chair, Science Advisory Board & Dr. Virginia Dale, Chair, SAB Hypoxia Advisory Panel, to Stephen L. Johnson, Admin., EPA (Dec. 21, 2007) (On file with *Hypoxia in the Northern Gulf of Mexico*, EPA SCIENCE ADVISORY BOARD (Dec. 21, 2007), https://yosemite.epa.gov/sab/sabproduct.nsf/C3D2F27094E03F90852573B800601D93/$File/EPA-SAB-08-003complete.unsigned.pdf (Reports of the dead zone in the Gulf of Mexico from to the Mississippi River date back to 1985.).

[67] *See Gulf of Mexico 'dead zone' is the largest ever measured*, NOAA (Aug. 2, 2017), https://www.noaa.gov/media-release/gulf-of-mexico-dead-zone-is-largest-ever-measured.This is the largest drainage basin in the United States; *see also The Mississippi/Atchafalaya River Basin [MARB],* EPA, https://www.epa.gov/ms-htf/mississippiatchafalaya-river-basin-marb (last visited Nov. 25, 2018).

[68] *MARB*, *supra* note 67.

[69] *Id*.

receives water from thirty-one states, totaling 41% of the continuous United States.[70]

In 2007 the Science Advisory Board evaluated the dead zone in the northern region of the Gulf of Mexico and concluded that it was primarily an effect of nutrient loading from the Mississippi River.[71] The Board recognized that environmental, agricultural, and energy policies must be aligned to achieve a reduction in nutrients and thus mitigate this large dead zone.[72] The Board also urged the Agency to consider all sources of nutrient pollution, both point[73] and nonpoint[74] sources; acknowledging that nonpoint source has been long recognized as the primary source of nutrient loading.[75]

In addition to the existence of the dead zone, the overwhelming flow of nutrients from the Mississippi River is associated to Florida's red tide problem.[76] In 2007, a peer-reviewed and published research model linked these two occurrences as related.[77] Typically, the Mississippi River nutrients are deposited into the Gulf of Mexico where winds and currents push them to the west.[78] However in early summer, the time frame when most red tide super blooms are formed, the prevailing winds blow them eastward, directly towards Florida.[79] This additional influx of nutrients provides a never ending supply to

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[70] *Id.*

[71] *Hypoxia in the Northern Gulf of Mexico*, *supra* note 66, at ii.

[72] *Id.* at ii-iii.

[73] Point source pollution is defined as "[t]he discernible and identifiable source from which pollutants are discharged." *Point Source*, BLACK'S LAW DICTIONARY (10th ed. 2014).

[74] *Basic Information about Nonpoint Source (NPS) Pollution*, EPA, https://www.epa.gov/nps/basic-information-about-nonpoint-source-nps-pollution (last visited Dec. 26, 2020) (Nonpoint source pollution "generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification. NPS pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters and ground waters.").

[75] *Hypoxia in the Northern Gulf of Mexico*, *supra* note 66, at ii.

[76] *New NOAA Model Links Mississippi River Nutrient Outflow to Florida Red Tides*, GULF BREEZE NEWS (Nov. 15, 2007), https://news.gulfbreezenews.com/articles/new-noaa-model-links-mississippi-river-nutrient-outflow-to-florida-red-tides/.

[77] *Id.*

[78] *Id.*

[79] *Id.*

Karenia brevis algae. The study also found that nitrogen levels were more sensitive than originally thought and even minor increases may be the blame for the formation of red tides off the Florida Gulf Coast.[80]

III. THE VIOLENT EFFECT OF RED TIDES ON FLORIDA MANATEES

The harmful algae blooms have several ways of injuring the defenseless Florida manatees. Once a red tide is brought to the coasts, it invades the manatee's habitat and hostilely takes over.[81] The harmful algae blooms grow due to the presence of the influencing factors and become more concentrated.[82] The higher the concentration of the red tide, the greater the likelihood of harm. This is because each *Karenia brevis* cell contains brevotoxin.[83] The crashing of waves can disrupt the cells, causing them to break open; aerosolizing the brevetoxin into the air.[84] The more concentrated the algae, the more brevetoxins that can be released into the air. Since manatees are mammals who must surface to breathe air every few minutes, they are constantly inhaling the brevetoxins. When inhaled, the brevetoxins cause neurological[85] and respiratory problems, and even suppress the immune system.[86] Depending on the overall health of the manatee and the concentration of the brevetoxins, even a single exposure can be fatal to the manatee.[87] The brevetoxins can also build up in the manatees and slowly kill them over time.[88]

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[80] *Id.*

[81] *Fla. Red Tide FAQs*, supra note 1.

[82] *Id.*

[83] *Id.*

[84] *Id.*

[85] *Threats to Fla. Manatees*, DEFENDERS OF WILDLIFE, https://defenders.org/florida-manatee/threats (last visited Jan. 15, 2021) (The neurotoxin causes the manatee to have seizures. If the seizure is severe enough, the manatee will drown to death.).

[86] Daniel Moritz-Rabson, *Fla. Red Tide Update: Manatees 'Pretty Much Comatose,'* NEWSWEEK (Aug. 16, 2018, 7:04 AM), https://www.newsweek.com/florida-toxic-red-tide-manatees-comatose-1075196.

[87] *See generally* George Waldenberger, *FWC: Red Tide factor in 2017 manatee deaths*, WFTV, https://www.wftv.co

m/news/local/fwc-red-tide-factor-in-2017-manatee-deaths/679611569 (last updated Jan. 8, 2018, 5:26 PM).

[88] *Id.*

The brevetoxins inflict grievous bodily harm to the manatees when they unknowingly ingest the algae.[89] Consuming the algae disrupts the algae's cells and causes them to release the powerful neurotoxin.[90] Since manatees are herbivores who spend a majority of their day eating seagrasses and other marine vegetation it is easy to see how she can either mistake the algae for other marine vegetation or unknowingly eat it with her food. Additionally, she may consume water that has brevetoxins in it.[91] When ingested the brevetoxin cause neurological and gastrointestinal problems, along with a suppressed immune system.[92] Again, depending on the overall health of the manatee and the concentration of the brevetoxin, the manatee can either die quickly or the toxin can poison her slowly.[93]

As red tides grow larger and last longer than in prior years, its effect on the Florida manatees is a mounting concern.[94] In 2003, a year in which red tides were notably severe, 26.32% of known manatee deaths were attributed to suspected red tides.[95] In fact, scientists suspect that red tides contributed to slightly more than one third of 2013 Florida manatee deaths.[96] Again in 2018, 34.95% of overall manatee deaths are attributable to red tides.[97] Without some

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[89] *See generally Effects of Fla. Red Tide on Marine Mammals*, FLA. FISH & WILDLIFE CONSERV. COMM'N, http://myfwc.com/research/redtide/general/marine-animals/ (last visited Jan. 15, 2021).

[90] *Fla. Red Tide FAQs*, supra note 1.

[91] *See Effects of Fla. Red Tide on Marine Mammals*, *supra* note 89.

[92] *See generally* Moritz-Rabson, *supra* note 86.

[93] *Id.*

[94] *E.g.*, Melissa Gomez, *The Deadly Toll of the Red Tide*, N.Y. TIMES (Aug. 31, 2018), https://www.nytimes.com/20 18/08/31/us/algae-toxic-florida-dead-animals-red-tide.html.

[95] FLA. FISH & WILDLIFE CONSERV. COMM'N, 2003 FINAL RED TIDE MANATEE MORTALITIES, 2 (Oct. 6, 2011), https://myfwc.com/media/11676/2003-fianl-red-tide-06-oct-2011.pdf; FLA. FISH & WILDLIFE CONSERV. COMM'N, 2003 FINAL MANATEE MORTALITY TABLE BY CITY, (2003) https://myfwc.com/media/11631/2003yearsummary.pdf (last visited Jan. 15, 2021).

[96] FLA. FISH & WILDLIFE CONSERV. COMM'N, 2013 FINAL RED TIDE MANATEE MORTALITIES, (2013), https://myfwc.com/media/11667/2013redtide.pdf (last visited Jan. 15, 2021); FLA. FISH & WILDLIFE CONSERV. COMM'N, 2013 FINAL MANATEE MORTALITY BY CITY, (2013) http://myfwc.com/media/3217953/2013.pdf (last visited Jan. 15, 2021).

[97] FLA. FISH & WILDLIFE CONSERV. COMM'N, 2018 FINAL RED TIDE MANATEE MORTALITIES, (2018) https://myfwc.com/media/24282/2018finalredtide.pdf (last visited Jan. 15, 2021);

sort of interference, this problem will continue to kill every single one of Florida's precious manatees. Humans have a moral obligation to step in and protect the manatees since humans are the root cause of the red tide super blooms.

Figure 1

	2019	2018	2017	2016	2015	2013	2012	2011	2003
Overall Percentage of Manatee Deaths from Red Tide	15.18%	34.95%	12.45%	14%	3.7%	33.37%	8.67%	5.08%	26.32%

IV. CURRENT LEGISLATION IS NOT ADEQUATE PROTECTION AGAINST TIDE

There are several federal statutes that provide direct protections to Florida manatees. The primary direct laws in place are the Endangered Species Act[98] and the Marine Mammals Protection Act.[99] Manatees also receive indirect protections based on water quality standards from the Clean Water Act[100] and the Comprehensive Everglades Restoration Act. Although manatees receive protections from several sources addressing multiple threats, the legislation is inadequate or inapplicable in the context of red tides.

A. The Endangered Species Act

The Endangered Species Act provides a platform and regulatory scheme for the conservation of established endangered and threatened animals, plants, and their habitats.[101] The Act grants the U.S. Fish and Wildlife Service and the National Marine Fisheries Service – in conjunction with other approved federal, state, and local agencies – to enforce ambitious legislation that prohibits: the "taking"

FLA. FISH & WILDLIFE CONSERV. COMM'N, 2018 FINAL MANATEE MORTALITY TABLE, (2018) https://myfwc.com/media/24281/2018yearsummary.pdf (last visited Jan. 15, 2021).

[98] 16 U.S.C. §§1531 *et seq.* (1973).

[99] 16 U.S.C. §§ 1361 *et seq.* (2018).

[100] 33 U.S.C. §§ 1251 *et seq.* (1987).

[101] 16 U.S.C. §§1531 *et seq.* (1973).

of the listed species and any federal actions that are likely to jeopardize the survival of the listed species or its designated critical habitat. [102] Taking is defined to include harassing, harming, killing and other related conduct.[103] All actions and programs that the agencies execute, fund, and authorize must be not likely to compromise the survival of any protected species or cause detrimental damage to their designated critical habitats.[104] As an established threatened species under this Act, the Florida manatee and all her designated critical habitats are entitled to these Federal protections.[105]

Although the Endangered Species Act provides for some protections from destruction or adverse modification to manatee habitats, it is limited in its scope of application. The protection awarded to a designated critical habitat is limited to activities that require federal authorization,[106] and where those activities are likely to jeopardize the listed species.[107] In the instances where a person or entity is seeking a federal permit to alter land and where the proposed project may effect a protected species, a biological opinion is required from the entrusted agencies.[108] For the project to proceed, the biological opinion must come to the conclusion that the proposed project will not jeopardize the species or designated critical habitat.[109] The agency is given deference and the decision will generally be upheld unless determined to be arbitrary or capricious.[110] Thus, if the threat to manatees falls within this narrow bracket, her overall protections are generally upheld.[111]

However, because the protections are limited in application, manatees are left completely vulnerable against all other designated critical habitat threats. Although general degradation of the manatee's habitat from inadequate water quality laws is a major threat to the species, it falls outside the protections of the Endangered Species Act. Even when there is federal action that may jeopardize the listed species

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[102] *Id*.

[103] 16 U.S.C. § 1532(19) (1988).

[104] 16 U.S.C. § 1536(a)(2) (2018).

[105] 50 C.F.R. § 17 (2017).

[106] Only activities that involve a federal permit, license, or funding.

[107] 16 U.S.C. §1536(a)(2) (2018).

[108] 16 U.S.C. §1536(b)(3)(A) (2018).

[109] *Id.*

[110] 5 U.S.C. § 706(2)(A) (1966).

[111] *See generally Envtl. Coal. of Broward County, Inc. v. Myers*, 831 F.2d 984, 987 (11th Cir. 1987).

and their designated critical habitat, the agencies have failed to protect them. For example, in a 2020 Notice of Violation there was a documented correlation between a federal action to discharge toxic water from Lake Okeechobee and increased red tide super blooms in a designated critical habitat.[112] The agency determined that the actions were not likely to jeopardize the survival of listed species or designated critical habitats.[113] Thus, this Act is ineffective against combating red tide and preserving the manatee population.

B. The Marine Mammals Protection Act

The Marine Mammals Protection Act was created as a defensive response to safeguard all marine mammals and their essential habitats[114] due to the detrimental effects of humans on their populations.[115] This law sets out a national plan to prevent marine mammal populations from reaching such low levels where their role in the ecosystem will be significantly reduced,[116] and where they no longer are at optimal population levels.[117] The first of its kind, this Federal law takes an overall ecosystem-based approach to marine conservation rather than a species-specific approach.[118] Like the Endangered Species Act, this Act achieves its purpose by preventing the taking[119] of marine mammals in United States waters. Permits are issued to allow a limited use, method, and quantity of marine mammal takings.[120] The approved agencies have a duty to enforce this law, create conservation plans, and among other things, implement plans that reduce the bycatch of mammals in commercial fishing gear.

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[112] Letter from Jaclyn Lopez & Jason Totoiu to Colonel Andrew Kelly & Dr. Roy E. Crabtree, 20 (Apr. 20, 2020), https://www.biologicaldiversity.org/programs/environmental_health/pdfs/2020_04_20-NMFS-LORS-NOI.pdf.

[113] *Id.* at 12.

[114] 16 U.S.C. § 1361(2) (2018) (This differs from the Endangered Species Act where only specific listed species are protected and while with this Act all marine mammals are awarded protection.).

[115] 16 U.S.C. § 1361(1)-(2) (2018).

[116] Altering the natural balance of the ecosystem.

[117] 16 U.S.C. § 1361(2) (2018).

[118] *Id.*

[119] 16 U.S.C. § 1362(13) (2018) ("Take" is defined as: "harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal.").

[120] 16 U.S.C. § 1374 (2003).

Although at first blush, this ecological-based approach would appear to give adequate protections to manatees because their population is decreasing from red tide (which is enhanced by human activities), however, it does not have any bite in this application. The act serves great purposes, in other contexts. But other than reporting that the population is decreasing below optimal levels, which would trigger the limitation of permitted takings of manatees to counteract the decline, it does not have any real effect.

C. The Clean Water Act

The Clean Water Act is the closest form of legislation that actually attempts to address nutrient water pollution,[121] the root cause of the algae crisis. This intricate law directly regulates water pollutants and their points of origin.[122] The Clean Water Act grants power in the states to individually enforce and implement the minimum standards.[123] The flaws in this Act are in both the substance of the legislation and the enforcement scheme.

Although there are two main classifications for water pollution points of origin, the Clean Water Act only regulates one of them, point source.[124] Point source is defined for this Act as any specific, definite, and identifiable location where pollutants may be discharged into the water.[125] The Clean Water Act prohibits the discharge of any pollutant from a point source into navigable waters, unless a permit was granted permitting it.[126] The permits are a way to regulate and enforce the guidelines set for controlling the discharge of pollutants. While the Clean Water Act has success in reducing point source pollutants, it cannot achieve its overall purpose until all sources of pollution are addressed and regulated.

The other main classification, nonpoint source, is not specifically defined by statute, but is defined by exclusion from point source.[127] Nonpoint source pollution is interpreted under this Act to

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[121] 33 U.S.C. §§ 1251 *et seq.* (1987).
[122] 33 U.S.C. § 1251 (1987).
[123] *Id.*
[124] *Id.*
[125] *See* 33 U.S.C. § 1362(14) (2014).
[126] *See* 33 U.S.C. § 1342 (2014).
[127] *See* § 1362(14) (2014).

mean water runoff that is difficult to attribute to a single polluter.[128] By limiting the statute to only point source pollution, nonpoint source pollution is essentially unregulated. The only regulation nonpoint source pollution receives is through the optional federal grant program.[129] As one of the conditions to receive 319 grant money, state entities may opt to receive training on best management practices for their specific land usage.[130] The best management practices goal is to reduce nonpoint source pollution from land activities through education and self-regulation.[131] Although best management practices is effective to those who opt for the grant money, it does not have a large enough reach to make a significant change. This Act's lack of true regulation and enforcement of all sources of pollution prevents the ecosystem from reaping the full benefits of its intentions.

D. The Comprehensive Everglades Restoration Act

The Comprehensive Everglades Restoration Act has been approved by Congress since 2000,[132] with sixty-eight approved project plans, and a slated thirty-year execution timeframe.[133] This extensive multibillion-dollar project is the largest of its kind ever undertaken in the United States.[134] The Federal and State government are jointly responsible for funding this effort.[135] The purpose of this great endeavor is to restore the historic waterflow back into the Everglades, which, among other things, would naturally filter the polluted runoff.[136]

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[128] *See Trustees for Alaska v. E.P.A.*, 749 F.2d 549, 558 (9th Cir. 1984).

[129] 33 U.S.C. § 1329(h) (1998).

[130] *Id.*

[131] *See generally id.*

[132] Water Resources Development Act, Pub.L. No. 106–541, Title VI, § 601, 114 Stat. 2572, 2683 (2000).

[133] *Comprehensive Everglades Restoration Plan [CERP]*, NAT'L PARK SERV. (updated May 8, 2019), https://www.nps.gov/ever/learn/nature/cerp.htm (last visited Jan. 15, 2021).

[134] *Id.*

[135] *Id.*

[136] *President Clinton and Vice President Gore: Restoring an American Natural Treasure* (Dec. 11, 2000), https://clintonwhitehouse4.archives.gov/textonly/WH/new/html/Mon_Dec_11_154136_2000.html.

Despite the passage of over twenty years, as of the date of this publication, over half the original time frame, little progress has been made. As of early 2017, only six of the sixty-eight scheduled projects had even begun construction, none of which were complete.[137] The National Academies of Sciences issued an assessment citing the source of the delay as bureaucratic creep and chronic underfunding across both State and Federal governments.[138] They estimated that at its current pace, the Everglades restoration project will take an additional 100 years to complete.[139] This long delay allows the ecosystem to gradually degrade,[140] which plausibly could be lethal for the manatees. Until real progress happens with the restoration project, the red tide super blooms will persist, thus jeopardizing Florida manatees' fate as a species.

E. Proposal for Change

A huge problem exists based on the shortcomings of the current legislation and the ineffective enforcement of that legislation. In effect, Florida manatees are not being adequately protected and are suffering. To safeguard this species, more action needs to be done. In order to effectuate change, the natural flow of the Everglades must be restored, a Federal Statute that regulates nonpoint source pollution shall be created, liability for polluters must be enforced, their habitat must remain clean, and a program to educate the public must be instituted. The answer does not lie solely in one specific thing or action, but requires a multifactorial approach, done in conjunction with each other, and addressing each root cause of this worsening problem.

F. Restore the Natural Flow of Water to the Everglades

Although Everglades restoration projects are currently in the works, the time delay created due to funding constraints needs to be resolved. The restoration project must include the creation of a large reservoir directly south of Lake Okeechobee where the discharges would primarily flow through. From there, a set of canals would direct

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[137] Jenny Staletovich, *Is Florida moving too slow to save the Everglades?*, MIAMI HERALD (Feb. 6, 2017), https://www.miamiherald.com/news/local/environment/article130702984.html.

[138] *Id.*

[139] *Progress Toward Restoring the Everglades: The Sixth Biennial Review – 2016*, THE NAT'L ACADS. PRESS, 59 (2016), http://nap.edu/23672.

[140] *Id. at 59.*

the polluted water through the Everglades, enlarging the wetlands closer to its historic size. The wetlands naturally filter the pollution out, allowing clean water to eventually flow back into the oceans, through the southern region of the state. Due to the constant inflow of additional nutrient pollution into Lake Okeechobee, and the extreme amount already built-up in there, this natural filtration method will be the best way to effectively dispose of the contaminated water. This process is a key factor in controlling the size, frequency, and length of red tides because the polluted water is fueling these super blooms.

Since most of the Lake's water would be discharged to the southern reservoir for filtration through the Everglades, less of the polluted water would be discharged into the Caloosahatchee and St. Lucie River. By refraining from the use of Lake Okeechobee's arms, there will be less polluted water being released into known manatee habitats that are located on both sides of the state. These areas tend to have the highest manatee mortality rate due to red tide. By eliminating the fuel for the red tide blooms, the ecosystem has a chance to fight it, and thus relieves the stress on the manatee population.

G. A Federal Statute

Another method for addressing the root cause of this red tide crisis needs to be through the implementation of a federal statute relating to nonpoint nutrient pollution. The universal law would set minimum limits of allowable nonpoint and point nutrient pollution in bodies of water, at which each state must, at minimum, abide by. Although a federal statute is extreme and could be viewed as government overreaching into state powers, it is necessary for the welfare of its citizens. The United States Constitution grants authority to legislate when the spending is for the general welfare. It is undeniable that a universal minimum standard for controlling nonpoint nutrient pollution is for the general welfare.

Furthermore, the dead zone in the northern region of the Gulf of Mexico created by the Mississippi River is proof that this is an interconnected country-wide problem that needs to be addressed uniformly and simultaneously. Since the Mississippi River is composed of water that comes from thirty-one states, it deposits all those states' runoff into the Gulf of Mexico. A blanket regulation is

the only way to effectuate change. Without every state's participation and a uniform regulation, this problem will persist.

H. Creating Liability

Florida should create supplemental legislation to the suggested federal statute that creates liability for both individuals and entities who do not follow the protocol designed to prevent nonpoint nutrient pollution. A civil penalty, based on a sliding scale, and considering the frequency and severity of each infraction, should be assessed to all offenders. The civil penalty cannot be so minimal where the tortious parties are not deterred, but also may not be so high that it would be viewed as an egregious, punitive penalty and thus challenged. This fine would be assessed upon a random, periodic inspection, or situationally when the red tide levels surpass the allowable variance. The fine will help fund the enforcement of this statute and assess liability for cleanup costs. Without a deterrent and the ability to collect from those tortfeasors, the federal statute will not be effective.

I. Maintaining a Clean Habitat

Florida should enact legislation requiring the Florida Fish & Wildlife Conservation Commission and other approved entities to maintain a clean habitat for the manatees. This regulatory obligation would be executed several ways. First, when red tide levels reach a specified benchmark, it would trigger a mandatory cleanup event. Equipped with respirators and masks, the agencies would dispatch representatives to remove as much dead and decaying algae and as many marine species from the coastlines as possible. The removal would prevent further decay and the break down into nutrients, which in turn fuels the red tide.

The second method is the utilization of ozone for the removal of *Karinia brevis* in the shallow areas where manatees live. Ozonation is a patented process that Mote Aquarium created and uses to eliminate red tide from its own aquariums and animal hospitals.[141] It works by pumping water through the device, where it is subjected to high

[141] *Fla. Red Tide FAQs*, *supra* note 1.

pressure and ozone.[142] Once the ozone destroys the algae and toxins, the water gets pushed out.[143] The process is known to work in smaller bodies of water such as canals and bays.[144] By increasing the scale of this process, it is possible to maintain pockets of safe and clean habitats for manatees.

Another mitigation technique involves the disbursement of modified clay to combat red tide. This method is currently being tested for use in the United States, but it is used in other places around the world.[145] It involves special modified mineral clay that is dispersed in mass quantities over the water.[146] The clay will bind with the red tide cells and their brevetoxins, causing the toxins to sink to the seafloor before they can cause damage.[147] Once at the seafloor, the algae will be deprived of its necessities for survival and should eventually die off and decay. If successful, this mitigation method may be able to reduce the size of super blooms, preventing mass casualties.

J. Education

Like every well-rounded plan, proper education to the public is imperative. Most people want to help a good cause and are capable of effectuating serious changes if executed in numbers. Manatees fight for survival is that worthwhile cause. When the general population is well informed of the manatee's fragile state, red tide's catalysts, and preventative measures, they can make changes to fix the problem. The public can make a significant difference just by reducing the preventable harm from nonpoint nutrient pollution. Unless the public is well informed that what they are doing is harming the manatees, they cannot be expected to change their ways. Having a well-educated population is the best defense to red tide.

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[142] Kimberly Kuizon, *Machine uses ozone to kill red tide*, FOX 13 (Aug. 14, 2018, 8:40 PM), http://www.fox 13news.com/news/local-news/machine-uses-ozone-to-kill-red-tide.

[143] *Id.*

[144] *Fla. Red Tide FAQs*, *supra* note 1.

[145] *Assessing mitigation of the Fla. red tide using modified red clay*, ANDERSON LAB & WOODS HOLE OCEANOGRAPHIC INST., https://www2.whoi.edu/site/andersonlab/current-projects/florida-clay-mitigation/ (last visited Nov. 25, 2018).

[146] *Id.*

[147] *Id.*

CONCLUSION

As her name suggests, the Florida manatee is a Florida native. She is a marine mammal who lives all along the Florida coastlines. She has a prolonged reproductive cycle with delayed mating behaviors, causing a long time to pass between the birth of each calf. Due to this time-consuming process, manatees cannot have a rapid population growth. In addition to their reproductive bottleneck, they also have a small population. Thus, any real threat to their population is a threat to the existence of the whole species. Currently the Florida red tide is one of the most serious concerns in regards to her population.

The Florida red tide is a natural occurrence stemming from higher than normal concentrations of *Karenia brevis* algae. The algae contain a neurotoxin that travels through both air and water, harming all who get in its way. The algae clusters begin forming about forty miles offshore and are brought in by winds and currents. Once brought into the shores, red tide grows at astonishing speeds. They are exacerbated by the effects of human activities. Climate change has increased the water temperature and salinity levels of the Gulf of Mexico to red tide's optimal preferences. Additionally, the nutrient pollution due to runoff fuels the red tide's growth to unstoppable levels.

As a result, the manatee population is declining, and these defenseless animals are suffering from the effects of neurotoxin released in red tide blooms. The current legislation in place does not directly address the root cause of these massive super blooms, nonpoint nutrient pollution. Thus, they are all inadequate and ineffective. The only legislation that might indirectly provide relief to the manatees due to policies effecting her habitat is the Comprehensive Everglades Restoration Plan. Unfortunately, due to political reasons and budgetary restraints, this massive project will not be operational for at least a hundred years. In the meantime, the manatees are left completely vulnerable to the effects of man-kind. Something else needs to be done in order to adequately protect this susceptible species.