A CATASTROPHE IN FULL BLOOM: ANALYSIS OF THE FEDERAL GOVERNMENT'S RESPONSE TO GULF HYPOXIA

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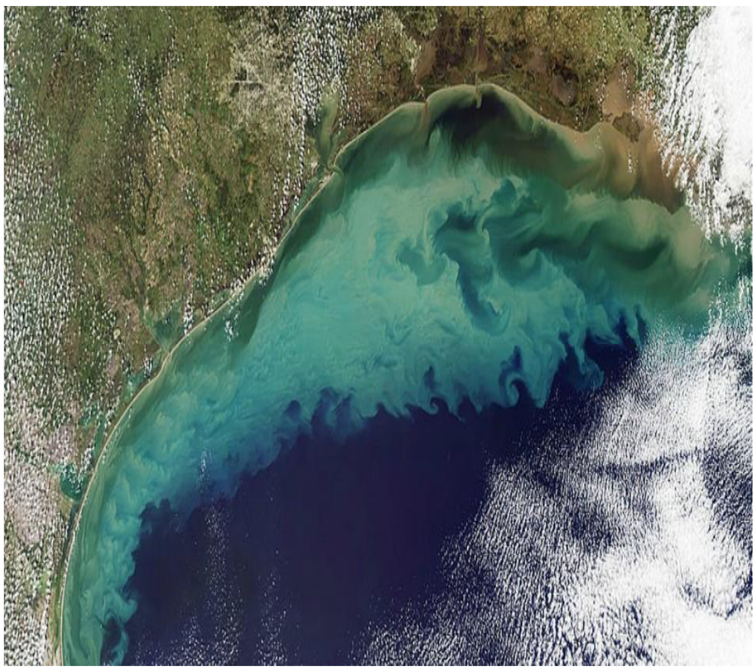

INTRODUCTION

In the continental United States, 41% of the landmass drains into the Mississippi River Basin.[1] Ensconced within the basin are parts of 31 states and the Canadian provinces of Ontario and Manitoba, 18 million individuals who rely on its water, and one of the largest and richest blocks of prime soil in the world.[2] Over the past several decades a troubling reality has come into focus. Research has revealed a connection between increased anthropogenic deposits of the nutrients phosphorous and nitrogen into the river basin and a large hypoxic zone (more commonly referred to as a *dead zone*) in the Gulf of Mexico that is devoid of oxygen and aquatic life.[3] As disruptive effects of the dead zone begin to seriously impact the environment and communities along the Gulf Coast, it is necessary to scrutinize governmental efforts undertaken to try and address the problems presented by Gulf Hypoxia.

This paper analyzes the federal government's efforts to address Gulf Hypoxia under the Harmful Algal Bloom and Hypoxia Research and Control Act (HABHRCA) and parts of other adjacent legislation. Part I details the causes and impacts of HABs and hypoxia. Part II describes how harmful algal blooms (HABs) and hypoxic zones form and the consequences that accompany them. Part III discusses the government's efforts to address Gulf Hypoxia primarily through a series of progress reports required under HABHRCA.[4] Part IV then analyzes alternative and additional measures the government should implement to create a robust effort that can reduce or eliminate the Gulf's hypoxic zone.

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1. Jessie Stolark, *The Farm Bill Represents Fresh Opportunity to Address Growing Issue of Dead Zones*, ENV'T AND ENERGY STUDY INST. (Jan. 5, 2018), https://www.eesi.org/articles/view/the-farm-bill- represents-fresh-opportunity-to-address-growing-issue-of-dead.
2. U.S.D.A Natural Resources Conservation Service, Mississippi River Basin Healthy Watersheds Initiative 1 (2010).
3. Mississippi River/Gulf of Mexico Hypoxia Task Force, *Hypoxia 101: What is hypoxia and what causes it?*, EPA (Jan. 31, 2019), https://www.epa.gov/ms-htf/hypoxia-101.
4. "Algal bloom" is a generalized term used to describe events where one or more species of phytoplankton (plant or plant-like organisms that use photosynthesis for nutrition) aggregate in water and achieve a maximum concentration in a given area of water, followed by a decaying stage; the presence of algal blooms is generally accompanied by an increase of zooplankton (animals and protozoans that consume phytoplankton or one another). LASSE H. PETTERSSON AND DMITRY POZDNYAKOV, MONITORING OF HARMFUL ALGAL BLOOMS 3 (2013); *What are Plankton?*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://oceanservice.noaa.gov/facts/plankton.html (last updated Feb. 26, 2021).

I. THE CAUSES AND IMPACTS OF HABS AND HYPOXIA

A. What Causes HABs?

HABs are characterized by a rapid increase of a single algae species over a large swath of nutrient laden water resulting in one of more of the following negative effects: toxic substances; high levels of biomass; and/or mucilage which can impair oxygen intake of aquatic life.[5] These negative effects may be caused by the phytoplankton themselves or may be caused by a byproduct of the increased presence of zooplankton's biological waste after consuming the phytoplankton.[6]

HABs can occur in both fresh and saline water systems.[7] A variety of factors can cause harmful algal blooms, but the rise in occurrence of HABs over the last few decades[8] can be directly attributed to anthropogenic deposits of the nutrients nitrogen and phosphorous into waterways.[9] Significant sources of nutrient pollution include municipal waste and storm water runoff, fossil fuel use, and household products containing those compounds.[10] However, the primary cause of HABs in most areas correlates to increased agricultural activities that intensively use and generate nitrogen and phosphorous.[11] Two corollary examples are: (1) fertilizer application, and; (2) animal waste from concentrated animal feeding operations (CAFOs).[12] The collateral effects of HABs are cause for concern as they can create hypoxic zones like the one found in the Gulf of Mexico.

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5. *See What are Plankton?*, *supra* note 4 (detailing the science behind how shifts in phytoplankton populations can affect the food chain).

6. Patricia M. Glibert et. al., *Harmful Algal Blooms and the Importance of Understanding Their Ecology and Oceanography,* GLOBAL ECOLOGY AND OCEANOGRAPHY OF HARMFUL ALGAL BLOOMS 9-10 (2018).

7. *See Nutrient Pollution: The Issue*, EPA, https://www.epa.gov/nutrientpollution/issue (last updated Aug. 31, 2021) (asserting that since water sources of many types can become polluted with nitrogen and phosphorus, which are the nutrients algal blooms thrive on, both saline and fresh waters are susceptible to algal blooms).

8. See Appendix I for a depiction of the rise in HABs since 1972.

9. *Nutrient Pollution: Sources and Solutions*, EPA, https://www.epa.gov/nutrientpollution/sources-and-solutions, (last visited Sept. 22, 2021).

10. *Id*.

11. Patricia M. Glibert et. al., *Changing Land-, Sea-, and Airscapes: Sources of Nutrient Pollution Affecting Habitat Suitability for Harmful Algae*, *in Global Ecology and Oceanography of Harmful Algal Blooms* 53, 55-59 (Patricia M. Gilbert et. al. eds., 2018).

12. *Id.*

B. What Causes Hypoxia?

Hypoxic zones can occur in synchrony with waters that experience HABs. They develop in waters where oxygen levels drop below a critical threshold that is unsupportive of aquatic life.[13] In the Gulf of Mexico, an annual cycle begins as the hypoxic zone expands during the summer months.[14] The Mississippi and Atchafalaya Rivers deposit phosphorous- and nitrogen-rich waters into the Gulf, followed by a shrinking phase during the winter.[15] Though urban runoff contributes a statistically significant amount of nutrients to the Gulf, the largest contributors are agricultural activities.[16] Agriculture accounts for 80% of phosphorous pollution in the Gulf.[17] For nitrogen, agriculture contributes 71%, with corn and soybean growth alone comprising 52% of the total.[18]

As warm and nutrient rich freshwater from the Mississippi River Basin (MRB) enter estuaries and flow outward to the ocean, the freshwater sits atop denser and colder salt water in a process referred to as stratification.[19] The nutrient-laden top layer of water provides a prime condition for phytoplankton to thrive. The technical term for waterbodies (or portions thereof) that contain excessive levels of nutrients is *eutrophication*.[20]

As phytoplankton grow and perish at exponential rates, bacteria consume both the dead algae and the abundant wastes from predatory zooplankton that sink to the lower layers.[21] Meanwhile, the bacteria deplete the oxygen concentration of the water, creating a hypoxic zone (or *dead zone*) within the Gulf.[22] The dead zone's size varies on a year-to-year basis.[23] The size depends on weather patterns and events, such as hurricanes, which can

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13. Mohammad N. Allahdadi, & Chunyan Li, *Modeling Coastal Hypoxia: Numerical Simulations of Patterns, Controls and Effects of Dissolved Oxygen Dynamics* 1, 2 (Dubravko Justic et al. eds. 2017) (defining hypoxic zone as an area in water with an oxygen concentration of less than two milligrams per liter).
14. *Id.*
15. *Id*.
16. *Differences in Phosphorus and Nitrogen Delivery to the Gulf of Mex. from the Miss. River Basin*, UNITED STATES GEOLOGICAL SERV. (Mar. 4, 2014), https://water.usgs.gov/nawqa/sparrow/gulf_findings/primary_sources.html.
17. *Id.*
18. *Id*.
19. Daniel R. Obenour et. al., *Quantifying the Impacts of Stratification and Nutrient Loading on Hypoxia in the Northern Gulf of Mexico,* 46 ENV'T SCI. TECH. 5489, 5489 (2012).
20. *Id.* at 5490.
21. *About Hypoxia: What Causes Hypoxia?,* HYPOXIA RSCH. TEAM AT LUMCON (2018), https://gulfhypoxia.net/about-hypoxia/ (see appendix II for visual representation of the process).
22. *Id.*
23. R.E. Turner, et. al., *Predicting Summer Hypoxia in the Northern Gulf of Mex.: Redux*, 64 MARINE POLLUTION BULL. 319, 320 (2012).

replenish the oxygen levels in bottom water through turbulent winds and rainfall.[24] For example, in 2019 the dead zone measured 18,005 square kilometers, whereas in 2020 it was only measured at 3,405 square kilometers due to Hurricane Hanna.[25]

C. The Impacts of Hypoxia and HABs

1. Economic

Toledo, Ohio's drinking water was declared unsafe in 2014 due to a cyanobacteria bloom in Lake Erie.[26] The HAB was severe enough that services could not be restored for three days.[27] In response to concerns over water quality, the city installed a $54 million treatment system capable of filtering out toxins created from blue-green algae.[28] Since 2010, communities have spent over a billion dollars treating their water supplies, with Ohio residents bearing the lion's share at over $800 million invested.[29] Property values can also be adversely affected by the presence of HABs in an area.[30] One study looking at six Ohio communities posited that homes in the area lost anywhere from 11%–22% of their value as a result of HABs.[31] The most important factor in the reduction of home value was proximity to polluted waterbodies.[32]

West Coast fisheries are also suffering from the impacts of HABs. In 2015, a crab fishery that was expected to generate $97.5 million of revenue was forced to close when the region experienced its largest algal bloom on record.[33] The same bloom increased toxin levels in clams to dangerous levels,

24. *Id.*
25. Miss. River/Gulf of Mex. Hypoxia Task Force, *Northern Gulf of Mex. Hypoxic Zone*, U.S. ENV'T PROT. AGENCY (2020), https://www.epa.gov/ms-htf/northern-gulf-mexico-hypoxic-zone.
26. Sarah Graddy, *4 Years Since Toledo Water Crisis, Toxic Algal Blooms on Rise Across U.S*, ENV'T WORKING GRP. (May 15, 2018), https://tinyurl.com/y8mhyswc.
27. *Id.*
28. Anne Schechinger, *The Huge Cost of Toxic Algae Contamination*, ENV'T WORKING GRP. (Jun. 7, 2019), https://www.ewg.org/news-insights/news/huge-cost-toxic-algae-contamination.
29. Anne Schechinger, *The High Cost of Algae Blooms in U.S. Waters: More Than $1 Billion in 10 Years*, ENV'T WORKING GRP. (Aug. 26, 2020), https://www.ewg.org/research/high-cost-of-algae-blooms/.
30. David Wolf and H. Allen Klaiber, *Bloom and Bust: Toxic Algae's Impact on Nearby Property Values*, 135 ECOLOGICAL ECON. 209 (2017).
31. *Id.* at 217–18.
32. *Id.*
33. HITTING US WHERE IT HURTS, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://noaa.maps.arcgis.com/apps/Cascade/index.html?appid=9e6fca29791b428e827f7e9ec095a3d7 (last visited Oct. 10th, 2021).

which cost Washington state approximately $40 million dollars in tourism revenue that recreational clam diggers provide.[34] Negative impacts to the community cascaded because commercial fisheries could not employ their workers, seafood markets had nothing to sell, and the hospitality industries suffered from reduced clientele.[35]

Regarding Gulf Hypoxia, the dead zone creates difficulties for those whose livelihood depends on a thriving aquatic ecosystem.[36] Research shows that the hypoxic zone's effect on the growth potential for brown shrimp has driven up prices for the larger version of the crustacean relative to the smaller variety.[37] This phenomenon has the potential to spread to other markets due to the environmental impacts of hypoxia on the Gulf as the *edge effect* puts a target on the resident aquatic life for fisheries, who can easily locate their catch.[38]

2. Environment and Ecology

The edge effect in a hypoxic zone occurs when animals at the bottom of the food chain congregate at the perimeter of the oxygen-deprived environment.[39] This is due to their food sources compiling at these locations, and because retreating into the inhospitable waters is useful as an escape route from predators.[40] Predatory animals like fish and shrimp aggregate around the zone's border, leading fisheries to target these areas for their catch.[41] This situation is problematic from a resource depletion standpoint for fisheries; large numbers of sea life are situated around the zone's edge, so the potential for overfishing exists in an area where the habitat's delicate equilibrium is already dangerously imbalanced.[42] Consequences for the aquatic inhabitants themselves are much more dire.

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34. *Id.*
35. *Dealing with Dead Zones: Hypoxia in the Ocean* (NOAA Ocean Podcast Feb. 22, 2018), https://oceanservice.noaa.gov/podcast/feb18/nop13-hypoxia.html.
36. *Id.*
37. *Price of Shrimp Impacted by Gulf of Mexico "Dead Zone,"* NCCOS (2017), https://coastalscience.noaa.gov/news/price-of-shrimp-affected-by-gulf-of-mexico-dead-zone/ (last visited Sep 21, 2021) [hereinafter *Price of Shrimp*].
38. *See generally* Elizabeth D. LaBone et. al., *Comparing Defauly Movement Algorithms for Individual Fish Avoidance of Hypoxia in the Gulf of Mex.ci,* MODELING COASTAL HYPOXIA CH. 10 (D. Justic et. al eds., 2017)(showing that fish avoid hypoxic areas).
39. *Dealing with Dead Zones: Hypoxia in the Ocean*, *supra* note 35.
40. *Id*.
41. *Id*.
42. LaBone*, supra* note 38.

Creatures such as shellfish and worms are unable to move away from the dangerous waters and suffocate as a result.[43] Fish can swim out, but occasionally schools become trapped in bayments resulting in large fish kills.[44] Other mobile creatures face similar issues.[45] But even for those organisms that do escape, the loss of large swaths of habitat and bottom-fauna food sources cause sub-lethal damage which makes living conditions difficult.[46] Research is shining light on the effects that intermittent exposure to hypoxic waters has on bottom dwellers who suffer from growth reductions and impairments to their reproductive cycle.[47] In years where the hypoxic zone is large, the brown shrimp endures these struggles, and the species-wide inability to reach its full growth potential depresses its economic value.[48]

Freshwater HABs can be just as destructive to their local environment.[49] While some algal blooms only impact the aesthetics of water supplies by causing discoloration, others have much more troubling effects.[50] Some blooms kill off native zooplankton species that are critical components in their respective food chains.[51] Others create hypoxic conditions similar to the Gulf of Mexico or are so prolific that they simply block sunlight from reaching the bottom areas of a waterbody.[52] Other blooms, however, have a much more pernicious effect on local fauna.[53]

3. Social and Health

HABs pose a variety of different effects, threatening the health of humans and animals who encounter them.[54] In saltwater environments, exposure to toxins produced by HABs can happen through direct contact or aerosolized air droplets.[55] Shellfish that are exposed to HABs and then

43. *Dealing with Dead Zones: Hypoxia in the Ocean*, *supra* note 35.
44. *Id*.
45. *Id*.
46. *Id.*
47. *Id.*
48. *Id.*
49. *See generally* SANTOSH KUMAR SARKAR, MARINE ALGAL BLOOM: CHARACTERISTICS, CAUSES AND CLIMATE CHANGE IMPACTS (2018).
50. *Id*. at 24.
51. *Id*.
52. *Algal Blooms,* NAT'L INST. OF ENV'T AND HEALTH SCI., https://www.niehs.nih.gov/health/topics/agents/algal-blooms/index.cfm (last visited Sept. 08, 2021).
53. KUMAR SARKAR, *supra* note 49, at 23–26.
54. *Harmful Algal Bloom (HAB)- Associated Illness, Illness and Symptoms: Marine (Saltwater) Algal Blooms*, CDC, https://www.cdc.gov/habs/illness-symptoms-marine.html (last visited Sept. 21, 2021).
55. *Id.*

consumed by humans can cause a wide range of effects from nausea associated with Azaspiracid Shellfish Poisoning to paralysis and respiratory failure connected to Paralytic Shellfish Poisoning.[56] In 2007, a bloom of the dinoflagellate *Akashiwo sanguinea* located in Monterey Bay off the coast of California created a substance that covered the feathers of seabirds and reduced their ability to repel water; as the bird feathers soaked in water, the birds became stranded and their body temperatures fell to alarming levels.[57] Freshwater HABs are most commonly caused by cyanobacteria that sometimes produce cyanotoxins that can damage the nervous system, liver, skin, stomach, or intestines in both humans and animals.[58] Cyanotoxins have not caused any known human deaths in the United States, but have caused deaths to dogs, livestock, and wild animals.[59] As a result of these effects, at-risk areas have to maintain procedures to warn the public and close off affected waterbodies, resulting in the loss of valuable recreational activities such as fishing and swimming.[60]

D. Factors Exacerbating the Frequency and Intensity of Hypoxia and HABs

Climate change exacerbates HABs and hypoxia in the Gulf of Mexico through higher and more intense rainfall totals that increase flooding.[61] This causes municipal sewer overflows and higher amounts of nitrogen and phosphorus runoff from nonpoint sources.[62] Changes in ocean and freshwater temperatures spread HABs into new ecosystems that can be devastated by the compound's arrival.[63] Growing populations will also increase nutrient loads into waterways; more people means a greater concentration of individuals to highly-populated areas which will be acutely felt in coastal zones.[64] Additionally, the need for greater agricultural

56. *Id.*
57. *Id.*
58. *Id.*
59. *Id.*
60. *See, e.g.,* Sarah Graddy et al., *Toxic Beaches: Bacteria and Algae Triggered Hundreds of Warnings and Closures This Year,* ENV'T WATCH GRP., (Sept. 30, 2020), https://www.ewg.org/research/toxic-beaches/.
61. Rebecca Lindsey, *Wet Spring Linked to Forecast for Big Gulf of Mexico 'Dead Zone' this Summer*, CLIMATE.GOV, https://www.climate.gov/news-features/features/wet-spring-linked-forecast-big-gulf-mexico-%E2%80%98dead-zone%E2%80%99-summer (last updated Apr. 18, 2021).
62. *See id.* (stating that heavier runoff would increase nutrient input into the Gulf of Mexico).
63. Christopher J. Gobler, *Climate Change and Harmful Algal Blooms: Insights and Perspective*, 91 HARMFUL ALGAE DOI: 101731, 2020, at 1, 1-2.
64. Donald Anderson, *HABs in a Changing World: A Perspective on Harmful Algal Blooms, Their Impacts, and Research and Management in a Dynamic Era of Climactic and Environmental*

production will lead to higher levels of nonpoint source phosphorus and nitrogen into waterways.[65]

II. GOVERNMENTAL EFFORTS TO ADDRESS HYPOXIA AND HABS

A. Government Regulations and Programs Pertinent to Nutrient Reduction

1. Farm Bill Provisions

Several programs sponsored by the federal government provide resources that can assist farmers with reducing their nutrient load without adversely affecting their economic standing.[66] The 2018 Farm Bill reauthorized five programs overseen by the National Resources Conservation Service that can be utilized to help keep nitrates and phosphorus out of waterways:[67] the Environmental Quality Incentives Program (EQIP),[68] the Conservation Stewardship Program,[69] the Agricultural Management Assistance Program (AMA),[70] the Agricultural Conservation Easement Program (ACEP),[71] and the Regional Conservation Partnership Program.[72] The Farm Bill also reauthorizes the Conservation Reserve Program (CRP), which is administered by the Farm Service Agency.[73]

The particulars of each of these programs are not central to this work outside of demonstrating the bureaucratic complexities involved in their

Change, Harmful Algae 2012, 2-3 (2012), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4667985/pdf/nihms691284.pdf.

65. *Id.*

66. NAT'L RES. CONSERVATION SERV., FARM BILL 2018, https://www.nrcs.usda.gov/wps/portal/nrcs/ main/national/programs/farmbill/ (last visited Sept. 22, 2021).

67. *Id.*

68. *Environmental Quality Incentives Program*, USDA: NAT'L RES. CONSERVATION SERV., https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/ (last visited Nov. 5, 2021).

69. *Conservation Stewardship Program*, NAT'L RES. CONSERVATION SERV., https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/csp/ (last visited Nov. 5, 2020).

70. *Agricultural Management Assistance*, USDA NAT'L RES. CONSERVATION SERV., https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/ama/ (last visited Nov. 5, 2021).

71. *Agricultural Conservation Easement Program*, Nat'l Res. Conservation Serv., https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep/ (last visited Nov. 5, 2021).

72. *Regional Conservation Partnership Program*, NAT'L RES. CONSERVATION SERV., https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/rcpp/ (last visited Nov. 5, 2021).

73. *Conservation Reserve Program,* FSA, https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/ (last visited Sept. 21, 2021).

administration. It is sufficient to say that, broadly speaking, they provide technical and financial support to agricultural operations to install and maintain conservation practices such as: planting cover crops, rotating crops, and maintaining native grasslands.[74] Agriculturally-oriented conservation advocates recognize that CSP and EQIP are the government's weightiest efforts to create a sustainable agricultural model.[75] However, the statutory language that enables these programs holds keeping a high level of agricultural production and environmental protections in equal esteem.[76] It also states a desire to avoid enacting further regulations on farming activities to assist operators.[77]

2. Clean Water Act

Section 303 of the Clean Water Act (CWA) requires states to label a waterbody as impaired when nonpoint source pollutants, such as agricultural nutrient runoff, threaten or render inutile the waterbody relative to the waterbody's designated use.[78] For example, if a lake's designated use is categorized as swimmable, but is not safe to swim in due to nonpoint source pollution, the lake's status would be impaired.[79] States must create management programs to address waters polluted by nonpoint sources that list best management practices (BMPs) and a plan that describes: (1) how to implement the practices; (2) identifies regulation and nonregulatory mechanisms to reduce pollution, and; (3) discerns technical and financial federal resources that can be used to ameliorate the pollutant's effects.[80] State management programs that fail to meet the statutory standards can be rejected, whereupon the state must amend its program provisions and begin the approval process anew.[81] Section 319 of the CWA also provides financing

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74. *A Closer Look at the 2018 Farm Bill: Working Lands Conservation Programs*, NAT'L SUSTAINABLE AGRIC. COAL., https://noaa.maps.arcgis.com/apps/Cascade/index.html?appid=9e6fca297 91b428e827f7e9ec095a3d7 (last visited Sept. 18, 2021).

75. *Id.*

76. *Id.*

77. *See, e.g.,* 16 U.S.C. § 3839aa (2018) (explaining the reasons for assisting producers and the need for regulatory programs).

78. 33 U.S.C. § 1329(a)(1) (1998); 33 U.S.C. § 1313(d) (2000).

79. *See id.* § 1329(d)(2-3) (declaring that management programs may be rejected because the proposal (1) is not adhering to statutory mandates or is unlikely to achieve the statute's prescribed goals, (2) the state does not have the legal authority or funding to carry out the program, (3) the timeframe for implementation is not sufficiently expeditious, and (4) the proposal is not expected to adequately reduce nonpoint source pollution).

80. *Id.* § 1329(b).

81. *See id.* § 1329(d)(2-3) (declaring that management programs may be rejected because the proposal (1) is not adhering to statutory mandates or is unlikely to achieve the statute's prescribed goals,

and grant programs that states can apply to for assistance with the costs of implementing management plans.[82]

B. The Harmful Algal Bloom and Hypoxia Research and Control Act: Tracking Progress from 2008 to the Present

The Harmful Algal Bloom and Hypoxia Research and Control Act (HABHRCA) creates a multi-agency task force (the Task Force), formed under the guidance of the National Science and Technology Council.[83] It works with coastal state, local, and tribal governments to develop strategies addressing the "prevention, reduction, management, mitigation, and control of" HABs.[84] The Act requires the Task Force to submit an assessment to Congress once every five years detailing the causes, impacts, and social/economic costs of hypoxia in the Great Lakes and coastal regions.[85] The Task Force must also provide a scientific assessment detailing HABs in both coastal and freshwater systems every five years.[86] State, local, and tribal governments may apply for federal assistance in analyzing problems associated with HABs and hypoxic events.[87] The action strategy must set out specific actions, the timeframe for their application, and a list of regional areas that need additional research.

The Act authorizes a National Harmful Algal Bloom and Hypoxia Program administered by the National Oceanic and Atmospheric Administration (NOAA).[88] The program must be based on comprehensive research and include an *action strategy* to address the harms of HABs and hypoxia.[89] The action strategy must set out specific actions, the timeframe for their application, and a list of regional areas that need additional research.[90] Regions targeted in the action strategy must have regionally-specific issues articulated.[91] Prevention and mitigation measures specific to the area must be identified, such as the implementation of technologies or

(2) the state does not have the legal authority or funding to carry out the program, (3) the timeframe for implementation is not sufficiently expeditious, and (4) the proposal is not expected to adequately reduce nonpoint source pollution).

82. *See id.* § 1329(h) (discussing grant programs to help fund management programs).
83. 33 U.S.C. §§ 4001(a)-(b)(2019).
84. *Id.*
85. §§ 4001(f)(1)-(2).
86. *Id.* § 4001(g).
87. *Id.* § 4001(e).
88. *Id*. § 4002(d).
89. 33 U.S.C. § 4003(a) (2014).
90. *Id.* §§ 4003(a)(1)-(3).
91. *Id.* § 4003(b)(1).

techniques that lessen the frequency of hypoxic events and HABs, along with capable mechanisms to detect unsafe waters.[92] A regional strategy must also include a means by which the information obtained can be disseminated to interested parties such as state and local governments and other researchers.[93]

Provisions in HABHRCA directly address Gulf hypoxia by requiring a progress report, made by the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (MRTF),[94] to be submitted to Congress.[95] Reports must outline the effectiveness in carrying out the goals listed in the region's 2008 action plan.[96] The progress report must relay information regarding nutrient reduction, the water quality of both the Gulf's hypoxic area and the waters of the Mississippi River Basin, and the social or economic impacts that have resulted.[97]

1. Gulf Hypoxia Action Plan 2008—Overview

The 2008 plan set three goals to address Gulf hypoxia.[98] The first was to shrink the hypoxic zone's surface area to lower than 5,000 square kilometers by 2015 through voluntary governmental actions and addressed the sources that deposit nutrients to the gulf.[99] Second, the plan sought to protect human and aquatic health by implementing nutrient reduction practices in the 31 states that feed into the Mississippi River Basin.[100] The third goal looked to improve economic conditions within the basin, particularly for "the agriculture, fisheries, and recreation sectors."[101] This goal focused on

92. *Id.* § 4003(b)(2).
93. *Id.* § 4003(b)(6).
94. *See Mississippi River/Gulf of Mexico Hypoxia Task Force, Hypoxia Task Force Members,* EPA, https://www.epa.gov/ms-htf/hypoxia-task-force-members (last visited Sept. 25, 2021) The MRTF is comprised of member states, federal agencies, and tribal representatives. The member states are Arkansas, Illinois, Indiana, Iowa, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Ohio, Tennessee and Wisconsin. States are generally represented by their respective agricultural, environmental, natural resource, or other related departments. The federal agencies involved with the MRTF are the National Oceanic and Atmospheric Administration, Environmental Protection Agency, Department of Agriculture, Department of the Interior, the Army Corps of Engineers, the U.S. Geological Survey and the Fish and Wildlife Service. Native American interests are represented by the National Tribal Water Council. *Id.*
95. 33 U.S.C. § 4004(a).
96. *Id.*
97. *Id.* § 4004(b)(1).
98. *Mississippi River/Gulf of Mexico Watershed Nutrient Task Force: Gulf Hypoxia Action Plan 2008*, EPA, https://www.epa.gov/sites/default/files/2015-03/documents/2008_8_28_msbasin_ghap2008_update082608.pdf (last visited Sept. 21, 2021).
99. *Id*.
100. *Id*.
101. *Id*.

improving both public and private land management practices and introduced incentives for the installation of remediation measures.[102]

To effectuate these goals, MRTF promulgated a list of actions designed to expedite the reduction of nutrients into the basin.[103] The first was to create comprehensive nutrient reduction strategies for each state with a significant water source that flows into the Mississippi River.[104] MRTF noted that this approach was necessary because each state will have varying conditions affecting their capability to reduce runoff.[105] Second, the MRTF developed strategies to reduce nutrients for basin-wide projects, starting with projects that have heavy federal involvement such as fishery management and the setting of water quality standards.[106] Lastly, the 2008 plan aimed to use existing mechanisms and management authority to examine and implement opportunities that further protect local water supplies and the Gulf.[107] The MRTF stated that their local goals and their 2008 plan's goals have overlap: nutrient reduction is good for drinking water supplies.[108] Therefore, using already-in-place measures and asking states to consider their mitigation strategy's impact on the Gulf was an efficient means of achieving nutrient reduction.[109] The MRTF further advocated for including a robust system of monitoring, information gathering, and distribution of the knowledge and best practices learned to inform policy decisions.[110]

2. Overview of the 2013 Update and Federal Agency Reports

The MRTF issued a report in 2013 (the 2013 Progress Report) to track the progress made since their 2008 plan.[111] Action Item One created the State Nutrient Reduction Strategy Work Group (Nutrient Reduction Group) in 2010.[112] The Nutrient Reduction Group worked on implementing nutrient

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102. *Id*.
103. *Id*. at 29.
104. *Id*. at 32.
105. *Id*.
106. *Id*. at 34.
107. *Id.* at 36.
108. *Id.*
109. *Id.*
110. *Id*. at 44-59 (listing seven additional steps which include actions such as performing cost benefit analyses, developing more productive and less expensive solutions, quantifying harms, consolidating data to facilitate easy access, and developing a full scientific understanding of nutrient pollution's causes and effects).
111. *Reassessment 2013: Assessing Progress Made Since 2008*, Miss. River Gulf of Mex. Watershed Nutrient Task Force, https://www.epa.gov/sites/default/files/2015-03/documents/hypoxia_reassessment_508.pdf (last visited Nov. 5, 2021).
112. *Id.* at 2.

reduction practices for states whose membership comprised tribal, state, and federal participants.[113] This group also worked to identify the critical components needed to implement nutrient reduction practices at the state level.[114] The work group's critical components aligned with the EPA's recommendations published in 2011, including: prioritizing the protection of watersheds at a statewide level; controlling agricultural runoff; creating accountability measures, and; submitting annual reports covering implementation and bi-annual reports regarding nutrient reduction and the impacts on the environment.[115] Both the EPA and the work group agreed that, while no one strategy will be a panacea to nutrient loading issues, these components must be addressed for any plan to be effective.[116] Action Item Two, creating basin-wide reduction strategies for projects (starting with those that have heavy federal involvement), focused on materials in the federal strategy (further discussed in detail below).[117]

In the third action, the MRTF described how existing programs can be used to address agricultural nutrient deposition.[118] The report discusses how CWA § 319 funding is available to mitigate nonpoint source pollutants like agricultural runoff.[119] A State Revolving Fund program under the CWA offers additional assistance (including financial assistance) to states.[120] The report also covers how NRCS offers financial and technical help to states through EQIP.[121] The Army Corps of Engineers has projects dedicated to restoring aquatic habitats and diverting nutrient-heavy water sources into wetlands.[122] The United States Geological Survey (USGS) Cooperative Water Program and National Wetlands resource center offers further assistance for, and coordination among, states.[123] The National Wetlands Research Center focuses on distributing information to states concerning wetlands' critical role in preventing nutrients from entering into larger bodies of water.[124]

113. *Id*.
114. *Id.*
115. *Id*.
116. *Id*.
117. *Id*. at 8.
118. *Id*. at 10.
119. *Id*.
120. *Id*.
121. *Id*.
122. *Id*. at 11.
123. *Id*.
124. *Id.*

Under Action Item Four,[125] the 2013 Report discussed USDA's preliminary efforts in the development of environmental markets where nonpoint polluters would be assigned an allotment of nutrients they would be able to discharge.[126] Entities who fall beneath the prescribed limit could sell their leftover balance to those who need to make discharges beyond what their permit allows.[127] Action Item Six, which covers how the MRTB will aggregate and disseminate data to states, lays out how agencies have made several helpful and innovative tools for states (such as the aforementioned Water Quality Portal).[128] This facilitates informed decision-making about regulating nutrient loads but stresses the need for additional resources to provide a fully informed set of data upon which states can rely when crafting policy.[129] This dovetails with Action Item Seven's goal of annually tracking the progress of program actions in reducing nutrients.[130] The 2013 Report acknowledges that contemporaneous research was insufficient to gauge the efficacy of agriculturally-oriented conservation measures regarding the amount of nutrients they remove, and to what extent they need to be implemented to succeed.[131]

In pursuit of developing a nutrient reduction strategy for basin-wide projects, agencies with membership in the MRTF created a comprehensive federal strategy.[132] A document was created in 2012 with a consolidated list of the various financial and technical assistance agencies could offer to the 12 member-states.[133] In 2013, federal members of the MRTF issued a report entitled *Looking Forward: The Strategy of the Federal Members of the Hypoxia Task Force* (the 2013 Federal Report) regarding how the various agencies could further assist the "development, refinement, and implementation of state nutrient reduction strategies."[134] The agencies pledged to improve nutrient monitoring by working with states and other

125. *Id*. at 15.
126. *Id*. at 17.
127. *Id*.
128. *Id*. at 35.
129. *Id.*
130. *Id*. at 37.
131. *Id*.
132. *Id*. at 7-8.
133. *See generally Federal Support to Hypoxia Task Force States on Nutrient Reduction Strategies Report: Appendix*, MISS. RIVER GULF MEX. WATERSHED NUTRIENT TASK FORCE (Sept. 2012), https://www.epa.gov/sites/production/files/2015-03/documents/hypoxia_annual_federal_strategy_appendix-508.pdf (explaining how agencies can offer financial and technical assistance to member-states).
134. *Looking Forward: The Strategy of the Federal Members of the Hypoxia Task Force*, MISS. RIVER GULF OF MEX. WATERSHED NUTRIENT TASK FORCE (Sept. 2013) at 1, https://www.epa.gov/sites/production/files/201503/documents/hypoxia_annual_federal_strategy_508.pdf.

researchers to create a standardized and accessible monitoring system that collects relevant data on water sources that flow into the basin.[135] A system of monitoring for the Gulf itself was also in development, centered around using autonomous gliders to gather data on the hypoxic zone.[136] The 2013 Federal Report also detailed plans on how the agencies would consolidate and disseminate information, such as through the creation of the Water Quality Portal.[137] This allows regulators, and other interested parties, to access information about monitoring sites.[138]

The USDA also developed models to track the effect of conservation measures on agricultural land through the Conservation Effects Assessment Project (CEAP).[139] A related project was the use of the Agricultural Policy/Environmental Extender model, which gathers data about how nutrients flowing from the Raccoon and Boone Rivers affect the water quality of the Des Moines River in Iowa.[140] Another related project, the Soil and Water Assessment Tool (SWAT), provided data on impacts to the environment resulting from implemented conservation practices.[141] Other modeling projects included improving in-stream measurement capability and making an annual forecast for the hypoxic zone size.[142] The size is based on available data collected from autonomous underwater vehicles.[143]

On the regulatory and policy spectrum, the 2013 Federal Report emphasized the need for states to adopt numeric criteria for nitrogen and phosphorus levels in waterways.[144] States can then track the levels of nitrogen and phosphorus therein and what remedies need to be implemented to reduce nutrient loads.[145] The EPA developed an online toolkit to help states determine the best route toward achieving this goal.[146] The report also called for collaboration between agricultural agencies and land grant universities to best utilize their collective resources when developing nutrient reduction strategies.[147] Additionally, an association of private landowners named Delta

135. *Id.* at 3–6.
136. *Id*. at 4.
137. *Id*. at 5-6.
138. *Id*.
139. *Id*. at 6.
140. *Id*.
141. *Id.*
142. *Id*. at 6-8.
143. *Id.*
144. *Id*. at 10.
145. *Id*.
146. *Id*.
147. *Id*. at 11.

Farmers Advocating Resource Management worked with the Army Corps of Engineers to design and promote a broad range of conservation measures.[148]

States could receive help to create agricultural certification programs from the National Resource Conservation Service (NRCS).[149] Certification programs provide guarantees to farmers that if they adopt and maintain state-approved conservation practices, the state will consider them in compliance with state water quality expectations for a predetermined time period.[150] NRCS sought to further develop technical assistance for agricultural operations through public-private partnerships.[151] This would ensure the implementation and success of conservation programs.[152] The NRCS was also advancing efforts to maintain soil health and quality by encouraging the northern states in the basin to adopt better water drainage management practices.[153]

3. Progress Reports 2015 and 2017 and Measuring Nutrient Reduction

The 2014 amendments to HABHRCA shortened the length of time between progress reports from five years down to two.[154] The first report under the new rules was issued to Congress in 2015 (hereinafter the 2015 Report).[155] New goals were adopted by the Task Force regarding shrinking the Gulf hypoxic zone.[156] The Task Force maintained its goal to bring the hypoxic zone to under 5,000 square km, but moved the target date back from 2015 to 2035 citing the following reasons: the size of the MRB; the lack of funding for projects that need to be implemented, and; complications posed by climate change.[157] The Task Force set an interim goal to reduce nutrient totals in the Gulf by 20% before 2025.[158] The MRTF stresses the need for resources and investment in the programs to realize these goals.[159]

148. *Id*. at 6-8.
149. *Id*. at 15.
150. *Id*.
151. *Id*.
152. *Id*.
153. *Id*. at 16.
154. *See* MISS. RIVER GULF OF MEX. WATERSHED NUTRIENT TASK FORCE, *May 2019 Hypoxia Task Force Meeting Accomplishments and Next Steps* (2019), https://www.epa.gov/sites/default/files/2019-10/documents/meeting_summary_public_document_508_0.pdf (explaining that the EPA is currently preparing the 2019 Report to Congress).
155. 33 U.S.C. § 4004(b)(3).
156. *Id*.
157. MISS. RIVER GULF OF MEX. WATERSHED NUTRIENT TASK FORCE, 2015 REP. TO CONGRESS, 10 (2015).
158. *Id*.
159. *Id*.

The 2015 Report rearticulates the importance of fashioning a robust monitoring system to understand the complex interactions that occur in the Gulf.[160] MRTF created a set of priorities to maximize available funding, the first of which is to further develop glider technology that can span the distance of the dead zone.[161] The next two priorities are: expanding other methods to gather information over greater distances for longer periods of time, and; creating a system of sensors that can detect how hypoxic conditions affect wildlife.[162] Other goals from the 2015 Report involve the MRTF working to achieve hypoxia zone reduction by working with states to fully implement their nutrient reduction strategies and using quantitative data to track nutrient reductions in the MRB.[163] The MRTF also wants to identify and apply federal conservation programs (e.g., EQIP) to the areas where those dollars will achieve their highest benefit.[164]

The most recent progress report was submitted in 2017 (the 2017 Report).[165] It discusses the launching of the Hypoxia Nutrient Data Portal, which allows policy makers to access data at water quality monitoring stations to address hot spots of nutrient pollution.[166] The report also discusses the development of the Runoff Risk Advisory Forecast.[167] This tool is tailored to the needs of each state and designed to establish BMPs for fertilizer application, reducing the chances that nutrient-rich material runs off into vulnerable waters.[168] USGS's SPARROW model provided a breakthrough as a mapping tool that allows for the tracking of nutrient loads on a basin-wide scale.[169] SPARROW confirmed the findings of USDA's SWAT-CEAP[170] model, which determined that the bulk of nitrogen and phosphorus in the Gulf originates from cultivated land uses in the "Upper Mississippi, Lower Mississippi, and Ohio basins."[171] However, the 2017

160. *Id*.
161. *Id.* at 13.
162. *Id*.
163. *Id*.
164. *Id*. at 82.
165. *Id.*
166. *See* 2017 U.S. ENV'T PROT. AGENCY BIENNIAL REP. MISS. RIVER/GULF OF MEX. WATERSHED NUTRIENT TASK FORCE, at 16, https://www.epa.gov/sites/default/files/2017-11/documents/hypoxia_task_force_report_to_congress_2017_final.pdf, [hereinafter 2017 EPA BIENNIAL REP.] (describing several implementation systems like Gulf of Mexico Coastal Ocean Observing System (GCOOS), a Regional Association of the Integrated Ocean Observing System (IOOS) network).
167. *Id.*
168. *Id*. at 17.
169. *Id.*
170. *Id*. at 26.
171. *Id*. at 26-27.

Report acknowledges the likelihood of incongruencies between models like SPARROW and future state model reports because of variances in data inputs and modeling assumptions.[172]

Overarching goals in the 2017 Report emphasize creating a measurement framework that demonstrates the effectiveness of conservation measures designed to reduce nutrient loads.[173] Using the EPA's National Rivers and Streams Assessment, the Task Force intends to gather information on the ecological conditions and the concentrations of rivers and streams within the MRB.[174] The Task Force also wants to aggregate long-term information that reveals changes in environmental conditions on a decade-based time scale using tools such as the National Water Quality Assessment (NAWQA), which collates 25 million nutrient data sets dating back to 1972.[175] Additionally, the Mississippi River Basin Monitoring Collaborative will identify and gather data on streams that have long monitoring records (to help gauge the impact of conservation measures installed at nearby sites) where nitrogen and phosphorus have historically flowed into the waterways.[176]

In 2018, MRTF issued a report proposing a framework designed to measure the effectiveness of conservation practices in reducing nonpoint source nutrient loads.[177] A MRTF workgroup was formed in 2014 to determine the best way to track nonpoint nutrient pollution focused on agricultural sources.[178] The workgroup realized that any measurement tool is dependent upon state data inputs and established two guidelines for the creation of their model.[179] First, measurement reporting "must be reasonably reportable for all member states." Second, the measuring tool must be "impactful towards reducing nutrient loads to the Gulf of Mexico.[180] With those guidelines in mind, the workgroup determined that tracking the progress of nutrient reduction is best accomplished through a *practice summary*.[181] The practice summary incorporates data from sources such as CEAP, SPARROW, NAWQA, and annual hypoxic zone measurements

172. *Id.* at 27.
173. *Id*.
174. *Id.*
175. *Id*.
176. *Id.* at 110.
177. PROGRESS REP. ON COORDINATION FOR NONPOINT SOURCE MEASURES IN HYPOXIA TASK FORCE STATES, MISS. RIVER GULF OF MEX. WATERSHED NUTRIENT TASK FORCE, at 4 (May 2018), https://www.epa.gov/sites/production/files/2018-05/documents/nps_measures_progress_report_1-_may_2018.pdf.
178. *Id.* at 3.
179. *Id.*
180. *Id*.
181. *Id.* at 5.

made by NOAA to identify basin-wide, regional, and local fluctuations of nutrient levels in waterways.[182]

III. ANALYSIS AND DISCUSSION

A. Assessment of the Efficacy of Governmental Efforts

The success or failure of the government's efforts to address Gulf hypoxia depends on the frame that those efforts are viewed through. From one perspective, the work of the MRTF and Task Force have been admirable in modeling the sources of nutrient pollution through items such as CEAP and SPARROW, as well as gathering and disseminating information through items like the Water Quality Portal.[183] However, the glacial pace at which a successful means of tracking the effectiveness of conservation measures is a significant detraction.[184] And even with the development of the practice summary to detect trends in nutrient loads, significant challenges exist that might undercut the model's usefulness.[185]

Difficulties can arise with the use of the practice model when assessing nutrient data due to the differences in topography and local weather patterns from one area of the MRB to the next.[186] In some given areas one practice model is applicable, but not in other areas.[187] Another issue is that some inputs that will inform the practice summary were not designed specifically to detect the changes as a result of conservation efforts and might not be an accurate representation of a given practice's effects.[188] Variances in practice applications can also cause irregularities, such as agricultural operators who vary in the methods used to plant cover crops, which can obfuscate data.[189] Also, differences among the state policies and regulations will play a role in the quality of the practice summary.[190] For example, Indiana's measurement

182. *Id*.
183. MISS. RIVER GULF OF MEX. WATERSHED NUTRIENT TASK FORCE, *supra* note 154, at 32.
184. *See State Progress Toward Developing Numeric Nutrient Water Quality Criteria for Nitrogen and Phosphorus*, EPA (Sept. 21, 2021), https://www.epa.gov/nutrient-policy-data/state-progress-toward-developing-numeric-nutrient-water-quality-criteria#tb3.
185. *Id.*
186. *Id.* at 7.
187. *Id.*
188. *Id.*
189. *Id*.
190. *See e.g.,* Julie Harrold & J. Ryan Benefield, *Nonpoint Source Measurement Framework: Advancements, Next Steps and Lessons Learned in Indiana and Arkansas that Can Inform Progress Tracking in All HTF States*, TETRA TECH (May 16, 2019), https://water-meetings.tetratech.com/Hypoxia/Content/Docs/2%20-

of nutrient load reductions only records data related to sediment.[191] Indiana's measurements do not record dissolved nutrients from stormwater or snowmelt, which creates a critical gap in the data used to construct the model.[192] However, there is an argument to be made that these faults had more to do with a lack of available resources, as opposed to poor choices or decision-making on the part of the Task Force and the MRTF.

The prime deficiency of the federal government's strategy in addressing hypoxia, and a theme that arises time and again in the progress reports, is inadequate funding and resources.[193] Consider that the combined size of the Mississippi River Basin, the Atchafalaya River Basin, and the average-sized hypoxic zone is approximately 800 million acres.[194] A 2016 Government Accountability Office report estimated that federal agencies spent \$101 million on HAB-related activities (not exclusive to the Gulf) beginning in fiscal year 2013 through 2015 for a yearly average of approximately \$43.7 million.[195] If we assume that agency spending was on par with this total during the 12-years from the adoption of the 2008 Action Plan through 2020, and even if we generously assume, for simplicity's sake, that every dollar spent went toward solving Gulf hypoxia, then annual spending by the agencies charged with rehabilitating the Gulf ecosystem and safeguarding the economic interests of Gulf Coast communities averages out to about five-cents per acre of land and surface water.[196] Under-resourcing leads to results

%20Nonpoint%20Source%20Measurement%20Framework.pdf (explaining the state models in Arkansas and Indiana).

191. *Id.*

192. *Id.*

193. Kevin Degood, *A Call to Action on Combating Nonpoint Source and Stormwater Pollution,* Ctr. for Am. Progress (Oct. 27, 2020), https://www.americanprogress.org/issues/economy/reports/2020/10/27/492149/call-action-combating-nonpoint-source-stormwater-pollution/.

194. Cliff R. Hupp et. al., *Recent Sedimentation Patterns Within the Central Atchafalaya Basin, Louisiana*, 28 WETLANDS 125, 125 (2008) (noting the size of the Atchafalaya Basin at 5,670 square km, which translates to 1,423,327 acres); *The Mississippi/Atchafalaya River Basin (MARB)*, MISS. RIVER/GULF OF MEX. HYPOXIA TASK FORCE (Sep. 9, 2016), https://www.epa.gov/ms-htf/mississippiatchafalaya-river-basin-marb (noting the size of the Mississippi River Basin at 1,245,000 square miles, which translates to 796,800,000 acres); *Average-sized Dead Zone Forecasted for the Gulf of Mexico*, UNITED STATES GEOLOGICAL SURV. (June 2018) (noting the size of the average Gulf dead zone at 5,460 square miles, which translates to 3,494,400 acres).

195. U.S. GOV'T ACCOUNTABILITY OFF., GAO-17-119, INFORMATION ON FEDERAL AGENCIES' EXPENDITURES AND COORDINATION RELATED TO HARMFUL ALGAE (2016).

196. It should be noted that this total is meant to give a general idea of how woefully underfunded the goals of HABHRCA and the 2008 Action Plan are and is not intended to be taken as an accurate representation of total spending. State and private funds spent on HABs are not accounted for here, and the fact that some of those 800 million acres within the basin are more problematic than others should be acknowledged. Conversely, it should also be pointed out that these federal agency dollars are not spent exclusively on Gulf hypoxia, as the GAO report notes that agency spending in the context of HABs is divided across several arenas, such as the Chesapeake Bay and Bay Delta conservation efforts.

such as the utterly inexcusable circumstance of NOAA not being able to perform a survey of the hypoxic zone in 2016. A mechanical problem to the vessel used in the measuring process prevented the survey from taking place despite NOAA's efforts to find a replacement.[197] If the United States government is serious about addressing Gulf Hypoxia, it should at least have a backup plan to collect the central data points against which all other efforts are measured.

Finally, the most glaring hole in the federal efforts is that, despite the efforts of the Task Force and MRTF, there is no noticeable impact on the size and frequency of the hypoxic zone.[198] One needs to look no further than the 2017 hypoxic event when the NOAA survey recorded the largest dead zone on record despite HABHRCA's enactment twenty years prior.[199] The following section addresses what changes should be made at the federal level to produce a healthy Gulf ecosystem.

B. Proposed Solutions to the Shortcomings of HABHRCA

1. Short Term Actions

One change in policy that should be immediately carried out is that the EPA must use its authority under §303(d) of the CWA to reject states' impaired water submissions and force them to develop total maximum daily loads (TMDLs) for lakes, rivers, and streams that have high contents of phosphorus and nitrogen.[200] A TMDL sets a maximum amount of a given pollutant a waterbody may contain.[201] Once a TMDL is established for a given waterbody, states must then identify both point and nonpoint sources that contribute the pollutant to the water source and develop plans to keep the pollutant at, or under, the prescribed level.[202] Of the twelve states that are part of the MRTF, only two have statewide nutrient-based numeric criteria

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197. *NOAA and Partners Cancel Gulf Dead Zone Summer Cruise*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.noaa.gov/media-release/noaa-and-partners-cancel-gulf-dead-zone-summer-cruise (last updated July 29, 2016).

198. *Gulf of Mexico Dead Zone is the Largest Ever Measured,* NAT'L OCEANIC & ATMOSPHERIC ADMIN. (Aug. 2, 2017), https://www.noaa.gov/media-release/gulf-of-mexico-dead-zone-is-largest-ever-measured.

199. *Id*.

200. 33 U.S.C. § 1313(d).

201. *Id*.

202. *Id*.

listed for lakes, reservoirs, rivers, and streams.[203] Two MRTF states have partial criteria listed for certain lakes and reservoirs, and the remaining eight states do not have any regulations for nutrient loads in any water body.[204] This reality makes efforts such as those put forth by the NRCS working with states to create certification programs look pointless. If only two states have meaningful regulations against which a certification program could be measured, is spending effort developing those programs the best use of the agency's time and resources? States are not ignorant to the problems caused by nitrogen and phosphorus ending up in waterways. Forcing their hand is entirely justifiable as a response to any further refusals to take action.

Next, Congress should allocate a large stream of funding to research the best management practices for nutrient reductions within each region of the MRB. Additional funding is necessary to at least begin implementing those practices in areas where conservation measures are most needed. Closing the knowledge gaps and uncertainties regarding which conservation efforts work best at a given location has to be the first step in addressing excess nutrient loads. This step should include accelerating the timeframe to put the automated gliders in the water to achieve a markedly better system of continuous monitoring at greater depth than what is currently achievable. At the very least, funding should be made available so that a similar situation to the 2016 failure of recording a survey cannot happen absent extreme circumstances. As for implementing the practices once BMPs are established, states must receive financial help from grant and loan programs.[205] One study suggested a sum upwards of $20 billion in grants and loans for states to implement conservation practices.[206]

2. Long Term Solution

The long-term solution to addressing Gulf Hypoxia is making conservation practices mandatory for agricultural operations in the MRB. While a great deal of research and debate would need to take place to iron out the particulars of how such legislation would operate, there are some principles from the CWA's regulation of point sources that can be applied to regulating nonpoint agricultural runoff. First, agricultural operations in the

203. *State Progress Toward Developing Numeric Nutrient Water Quality Criteria for Nitrogen and Phosphorus*, ENV'T PROT. AGENCY (Jan. 23, 2020), https://www.epa.gov/nutrient-policy-data/state-progress-toward-developing-numeric-nutrient-water-quality-criteria#tb3.

204. *Id*.

205. Kevin Degood, *supra* note 193, at 23–24.

206. *See id*. (totaling the amount recommended Congress should allocate for state conservation programs).

Mississippi River Basin, or other sensitive watersheds, should be subject to a permit process in order to start or maintain operations.[207] The permit would spell out what conservation practices need to be performed and how they need to be maintained, and where applicable, for a farming or animal feeding operation to be in compliance with the CWA.[208] Second, states should be allowed to monitor their own water supplies and control what types of practices are used to mitigate agricultural runoff, subject to an approval plan by a reviewing authority (likely the EPA or a joint agency effort between the EPA and USDA).[209] Such a process would help ensure that nutrient loads are kept at manageable levels.[210]

Third, agricultural operations should be subject to escalating control technologies depending on the type of activity they are engaged in. For example, a relatively small ten-acre plot that primarily grows soybeans, a crop that customarily does not produce as much nutrient runoff as corn, would not need nearly the level of control as a concentrated animal feeding operation because these operations typically generate large amounts of nutrient runoff through animal manure.[211] Congress and the USDA could consider additional grant funding at sites that require extra controls to ensure the cost of remediation does not make an operation non-competitive in the marketplace. The law could also contain a carve-out where, if a given operation in a sensitive watershed will not, or is not likely to, produce nitrogen or phosphorus runoff, it is exempt from the permit process.

CONCLUSION

A review of the MRTF progress reports reveals human ingenuity, scientific accomplishment, and the failures of political bureaucracy where leaders are either unable or unwilling to act despite staring down the barrel of dire and potentially irreparable consequences. Whether or not the efforts of the Task Force and MRTF are ultimately considered a success or failure depends upon how policymakers act on the wealth of information gathered—it spells out the daunting magnitude of effort required to stop nutrients from flowing to the Gulf. It is past time for the United States to earnestly address that our cheap food system has immense hidden costs, and that the

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207. See, *e.g.*, 33 U.S.C. § 1342(a)(1) (2019) (explaining the Administrator may issue a discharge permit).

208. See, *e.g.*, 33 U.S.C. § 1342(b) (explaining the current guidelines requires under this title).

209. *See*, *e.g.*, 33 U.S.C. § 1313 (2000) (explaining water quality standards and implementation plans).

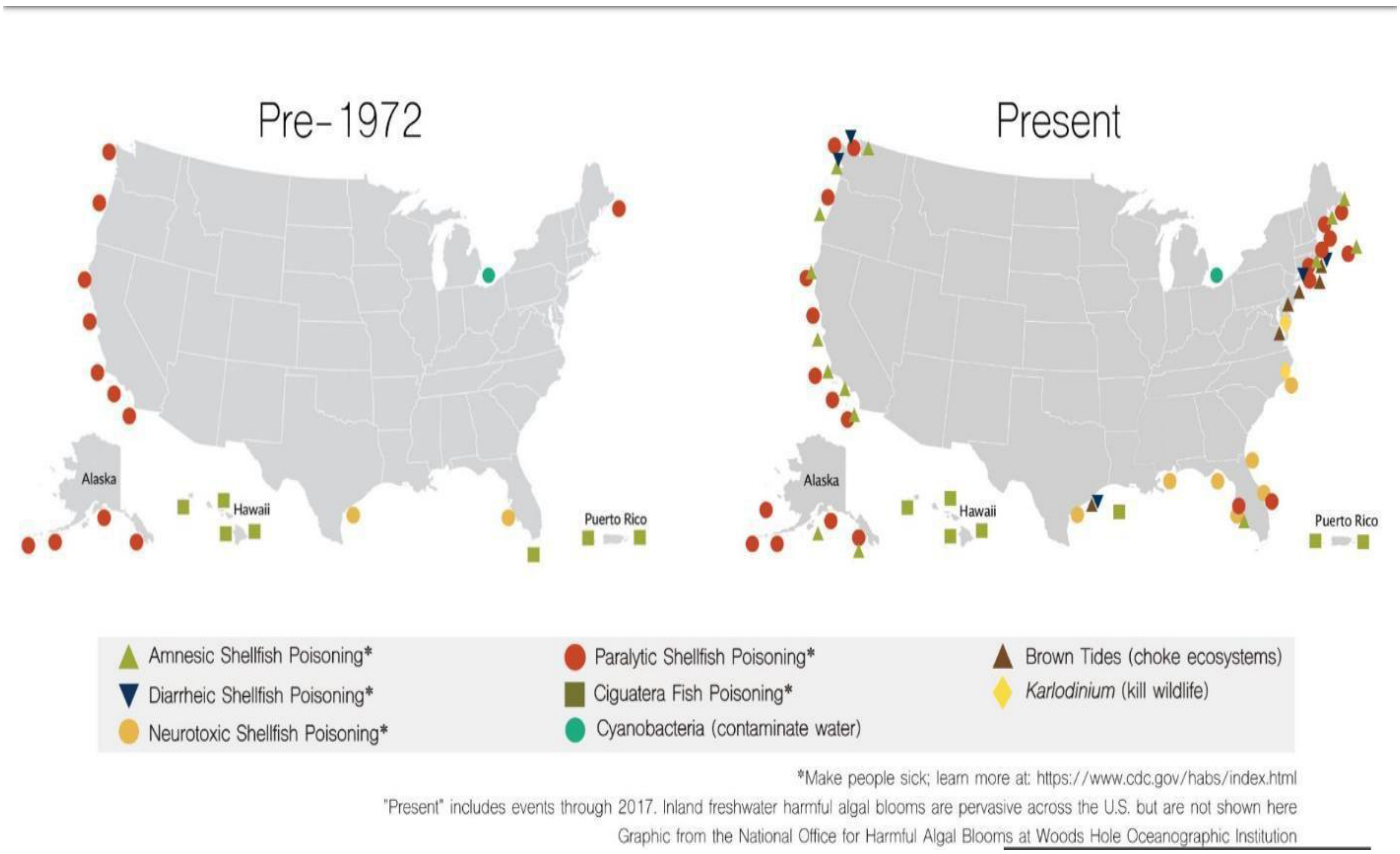
210. *Id.*

211. *See*, *e.g.*, 33 U.S.C. § 1314(b) (2000) (explaining the effluent limitation guidelines).

responsibility of doing so should not be entirely cast upon agricultural producers. This might be a less dire circumstance if nutrient pollution in the Gulf were a single, isolated problem, but that is not the case. Nutrient pollution sits among a litany of other stressors such as rising sea temperatures, increases in hurricane activity, wetland reduction, urban development, and the unmitigated disaster of Deepwater Horizon.[212] Something must be done to stop the degradation now, because the price of inaction is too high to pay.

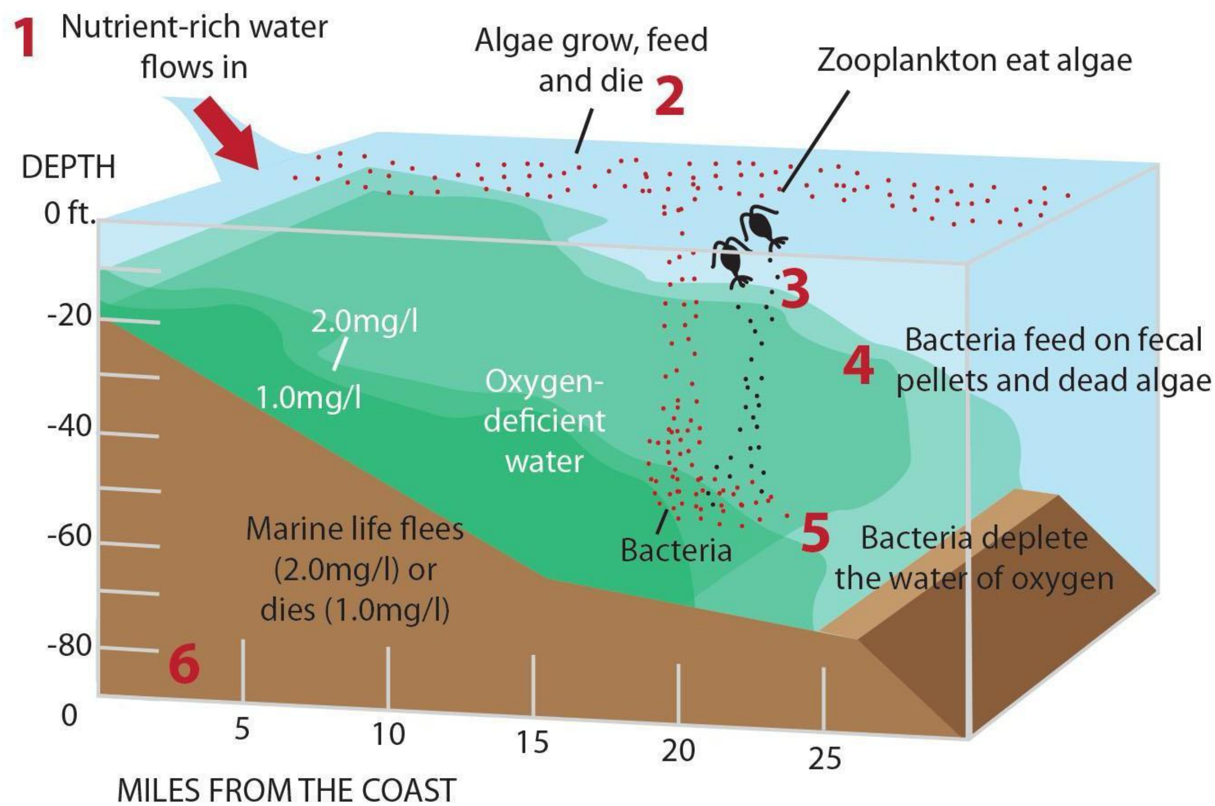
212. Alejandra Borunda, *We Still Don't Know the Full Impacts of the BP Oil Spill, 10 Years Later,* NAT'L GEOGRAPHIC (Apr. 20, 2020), https://www.nationalgeographic.com/science/2020/04/bp-oil-spill-still-dont-know-effects-decade-later/.

Appendix I: Increase in Frequency and Variety of HABs Since 1972



Source: *Hitting Us Where It Hurts: The Untold Story Of Harmful Algal Blooms*, NAT'L OCEANIC & ATMOSPHERIC ADMIN. NORTHWEST FISHERIES SCIENCE CTR. (Dec. 10, 2020), https://noaa.maps.arcgis.com/apps/Cascade/index.html?appid=9e6fca29791b428e827f7e9ec095a3d7.

Appendix II: Visual Depiction of the Creation of the Gulf's Dead Zone



Source: *About Hypoxia: What Causes Hypoxia?*, HYPOXIA RESEARCH TEAM AT LUMCON (2018), https://gulfhypoxia.net/about-hypoxia/.