

How Does Runoff cause/affect Dead Zones and Ocean life within them?

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Abstract:

The Gulf of Mexico is currently facing a biodiversity crisis. It is estimated that in May 2019, more than 153,000 tons of nitrate and 24,000 tons of phosphorus were washed into the Gulf. That meant one of the largest dead zones on record, which was only curtailed by Hurricane Barry the next month. If not for Barry, much more aquatic life would have died that year, because of deoxygenation and nutrient runoff. We cannot rely on natural events anymore to reduce this man-made problem, and need to make an effort to ensure that nutrient runoff, and consequently deoxygenation and dead zones, are reduced to protect biodiversity in our local area. The purpose of this report is to raise awareness and confirm this threat to our local watershed before more damage is done. A watershed is a land area that channels rainfall and snowmelt to creeks, streams, and rivers, and eventually to outflow points such as reservoirs, bays, and the ocean, according to NOAA.

The hypothesis of this report is that if runoff that is made up of nitrogen, phosphorus, manure, chemicals, and fertilizers continue to be dumped into the Mississippi river, then biodiversity in the Gulf of Mexico will continue to decrease due to deoxygenation and dead zones. To test this hypothesis, we looked at several reports and articles related to this topic to find data. We also used other resources, such as the director of the Ahmad ibn Majid Project for Marine Mapping & Sustainable Development, and the Infinity Space Center. We concluded that our hypothesis was correct, and this real threat could cost us the remaining biodiversity in the Gulf of Mexico and our local watershed.

In conclusion, our results suggest that at current rates, biodiversity in the Gulf of Mexico will continue to decline due to nutrient runoff and dead zones. If we want our local watershed to maintain its health, this problem must be resolved, before it's too late.

Research Questions:

1. What is runoff, and how does it cause algae blooms and deoxygenation?
2. In what ways does runoff affect ocean life, and what are the causes?
3. How does the amount of nitrogen, phosphorus, manure, fertilizers, and other runoff being dumped into the Mississippi River correlate with biodiversity in the Gulf of Mexico?
4. How do fertilizers contribute to the development of dead zones in the Gulf of Mexico?

Question:

How Does Runoff cause/affect Dead Zones and Ocean life within them?

Hypothesis:

If runoff that is made up of nitrogen, phosphorus, manure, chemicals, and fertilizers continue to be dumped into the Mississippi river, then biodiversity in the Gulf of Mexico will continue to decrease due to deoxygenation and dead zones.

What prompted research / Why it is important to research:

We decided to research this topic because this is an important issue in our local region. On the Mississippi Gulf Coast and in the Mississippi sound, we are seeing notable decreases in biodiversity and increases in annual algae blooms that kill people and animals. These algae blooms are the primary reason for deoxygenation and dead zones in general. We understand that this is because of the pollution of the Mississippi river, especially with trash, fertilizers, chemicals, and other runoffs. It is important for people to research what is going on in our local watershed so that we can identify the problem and take initiative to solve it.

Introduction:

The annual dead zone in the Gulf of Mexico is caused by an overflow of nutrients from the Mississippi River, mainly nitrogen and phosphorus. The Mississippi River Watershed drains a large part of the USA, from Pennsylvania to Montana, and extends southward along the Mississippi River. Most of the nitrogen input comes from major farming states in the Mississippi River Valley, including Minnesota, Iowa, Illinois, Wisconsin, Missouri, Tennessee, Arkansas, Mississippi, and Louisiana. Nitrogen and phosphorus enter the river through runoff of fertilizers, soil erosion, animal wastes, and sewage, mostly from farming and animal husbandry. In a natural system, these nutrients aren't significant factors in algae growth because they are depleted in the soil by plants. However, with humans increasing nitrogen and phosphorus input, algae growth is no longer limited. Consequently, algal blooms develop, the food chain is altered, and dissolved oxygen in the watershed is depleted. This process is known as deoxygenation.

Farmers who use the fertile soil in the Mississippi River Basin dump fertilizers into the river. When this fertilizer reaches New Orleans and the Gulf of Mexico, algae eat the nutrients that come with the fertilizer, the population explodes, and oxygen levels drop. This loss of oxygen causes a dead zone, where plants and animals in the water die off. This is a major problem in our local watershed that is killing off our native sea creatures. If this practice continues, there will be a shortage of biodiversity in the Gulf of Mexico.

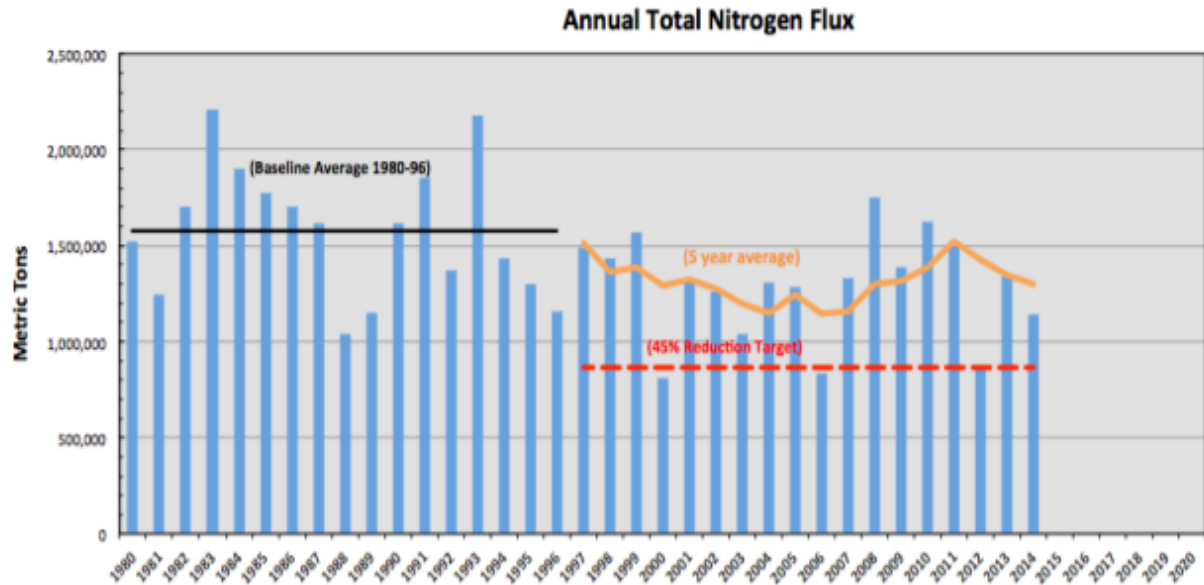
Research Methods:

- We looked through multiple different websites to gather information and data relating to our question.
- We talked to an actual scientist, Samantha Allyson Sooknarine, the Project Director for the Ahmad ibn Majid Project for Marine Mapping & Sustainable Development. We asked several questions related to our topic.
- We traveled to the Infinity Space center to test water samples from the local Pearl River.

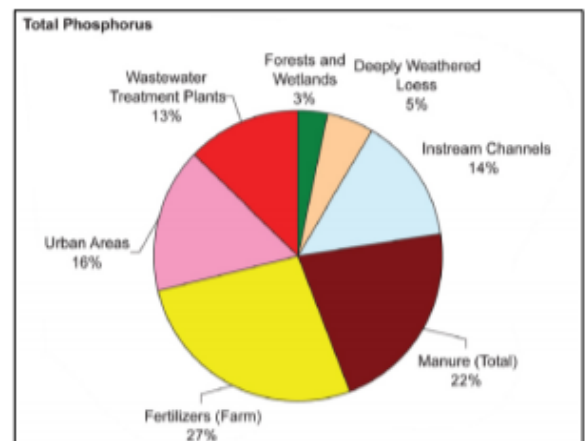
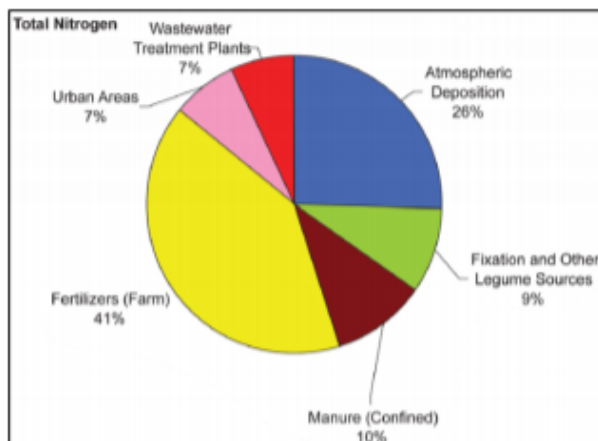
Results:

Nutrient flux from the Mississippi River Basin is strongly influenced by changes in streamflow, which in turn is influenced by changes in precipitation and runoff.

- The hypoxic zone in the northern Gulf of Mexico is one of the largest in the world and its size is related to the flux of nutrients from the Mississippi River Basin
- The 2007 Mississippi River Basin Science Advisory Board Panel recommended a dual nutrient reduction strategy targeting a 45% reduction in total nitrogen and total phosphorus loads flowing into the Gulf of Mexico to reduce the hypoxic zone to a five year running average of 5,000 km²....The total nitrogen five year moving average for 2011-2014 was about 18 %. Below is the baseline period:

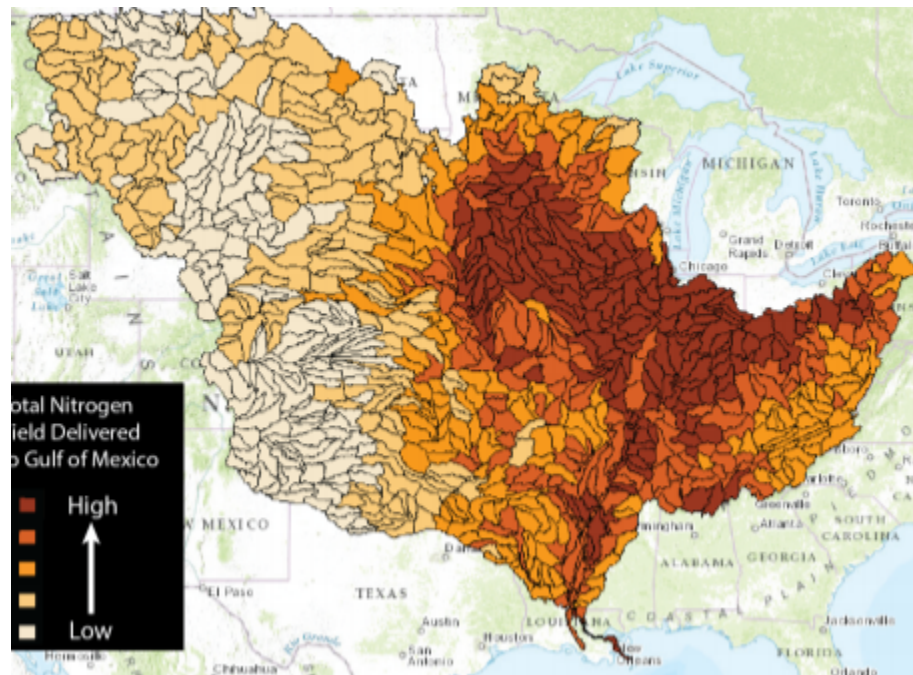


- Above: Annual total nitrogen load/s in the Mississippi/Atchafalaya River basin transported to the Gulf of Mexico from 1980-2014.
- Flow-normalized nitrate concentrations at the Mississippi River outlet to the Gulf of Mexico increased 12% from 2000 to 2010.
- Nitrate levels in the Illinois River decreased by 21% between 2000 and 2010, marking the first time substantial, multiyear decreases in nitrate had been observed in the Mississippi River Basin since 1980. Nitrate levels during the same period decreased by about 10% in the Iowa River.



- At the basin scale, agricultural inputs (i.e., manure, fertilizer, and legume crops) were the largest total nitrogen source (60% of the total), with farm fertilizers contributing 41% of that amount.

- Agricultural inputs (manure and fertilizers) were also the largest total phosphorus source: 49% of the total, with 27% from chemical fertilizers and 22% from manure.
- The sources of nutrients transported to local water bodies in each of the 12 HTF states draining to the Mississippi River can vary significantly. The nutrient reduction strategies developed by each of the HTF states provide comprehensive assessments of nutrient sources at the state scale and describe suites of actions to be taken to reduce nutrients.



Discussion:

New Orleans, the Ohio and Illinois river watersheds, and the main pathway of the Mississippi River have the most concentrated areas of nitrogen and other nutrients/fertilizers flowing into the Gulf of Mexico. The watersheds of the Missouri, Red, and Arkansas rivers have the lowest concentration of nitrogen and other nutrients/fertilizers flowing into the Gulf. It appears that all of the nutrients eventually flow into the Gulf of Mexico due to the New Orleans area being shaded the darkest color.

Conclusion:

In conclusion, fertilizers and chemicals that runoff from farms into the Mississippi travel to the Gulf of Mexico, cause dead zones, and damage the biodiversity of the area. In response, efforts have been taken to reduce the toll taken by marine life in the Gulf of Mexico. An example is the recommendation of a dual nutrient reduction strategy targeting a 45% reduction of fertilizers entering the Mississippi river. If efforts like this continue to be at least mildly successful, then there is hope for our local watershed.

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Badge Descriptions/Justifications:

Make an Impact

Description:

The report clearly describes how a local issue led to the research questions or makes connections between local and global impacts. The students need to clearly describe or show how the research contributed to a positive impact on their community through making recommendations or taking action based on findings.

Justification:

Our project meets the criteria for this badge. The dead zones forming annually in the Gulf of Mexico, where we live, are directly affecting our community in a negative way. They are killing our wildlife and sea creatures, which is not only hurting the environment, but also the economy and our health. By getting the word out about this issue, we can help protect the biodiversity in the species in our areas. This will have a positive impact not only on the environment, but also the economy through tourism, hospitality, and fishing.