

Biology Student,

My AMI packet for you consists of science news/research articles with analysis questions. Please read the article for the appropriate AMI day and answer the questions on the space provided or a separate sheet of paper (some articles do not leave much room for answering). Answers need to be complete. Restating is not necessary but answers should be in proper sentence form. Don't forget to put your name on your work. I don't anticipate these assignments to take you more than 20 minutes to complete. Each AMI assignment will be due the day you return from corresponding snow day. Leave the rest of your packet at home. If you need help shoot me an e-mail. I hope you enjoy your snow day (spend some time outside). 😊

Mrs. Donaldson

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AMI Day 1: *How Do Carbon Dioxide Levels in the Atmosphere & Photosynthesis Vary by Season and Latitude?*

AMI Day 2: *Invasive Species Cost the World Billions a Year*

AMI Day 3: *Microplastics are Showing Up in Mount Everest's Snow*

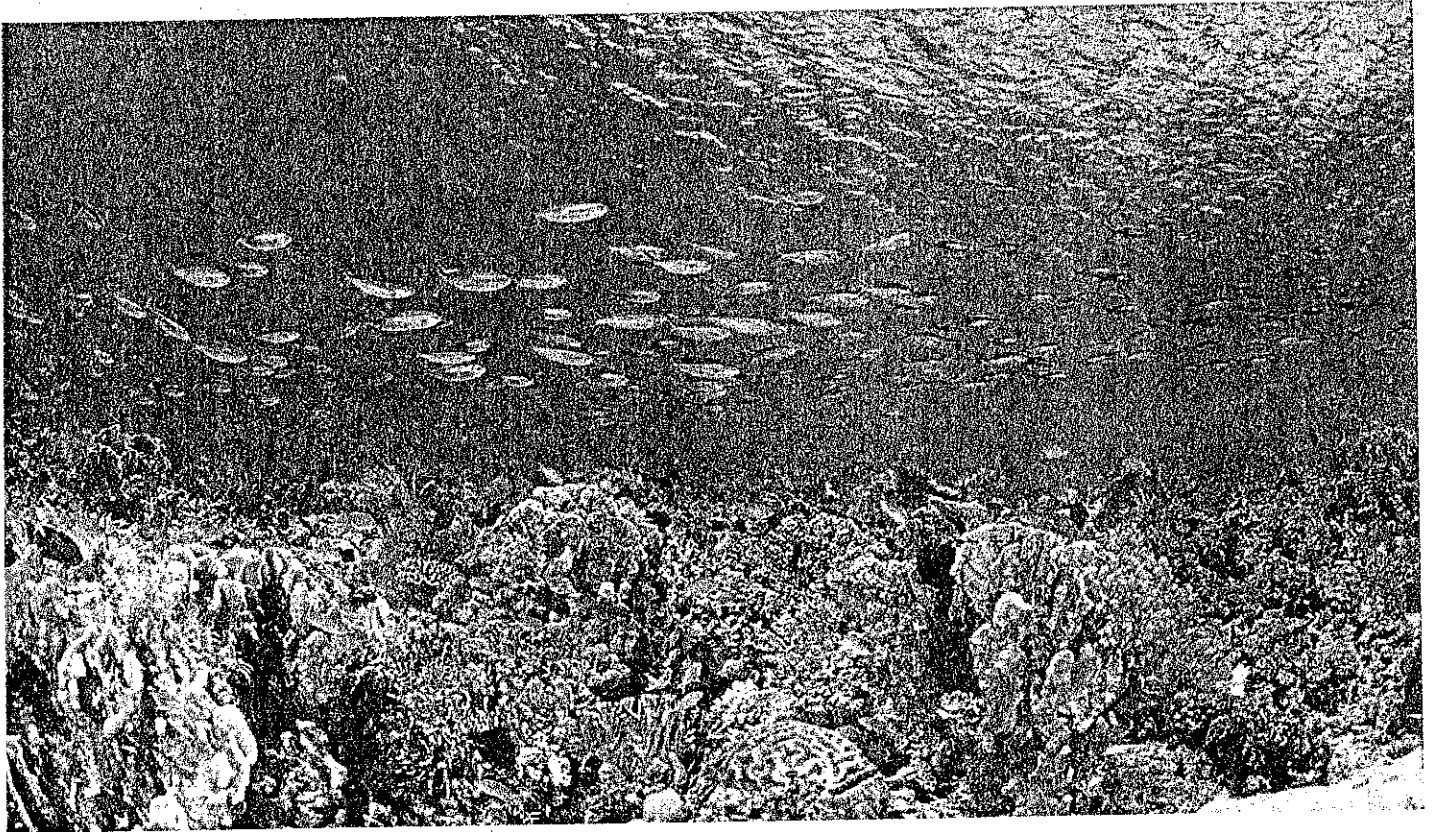
AMI Day 4: *Electric Eels' Zaps Are More Powerful Than a Taser*

AMI Day 5: *The Nutrients from Sewage May Harm Coastal Ecosystems*

ANALYZE THIS! // EARTH

Analyze This: Nutrients from sewage may harm coastal ecosystems

A new model gives clues about where corals and seagrass may be at risk from excess nitrogen



Fish and other creatures thrive at coral reefs off the coast. People benefit from reefs too, by earning money through fishing and tourism. But human activities threaten reefs. Now a new study finds that nitrogen from human sewage adds to the dangers these fragile ecosystems face.

SINGAPORE PHOTOGRAPHER IMRAN AHMAD/MOMENT/GETTY IMAGES

By Carolyn Wilke

December 7, 2021 at 6:30 am

Excess nutrients, such as nitrogen and phosphorus, can harm coastal ecosystems. In the past researchers have mostly focused on excess nutrients from farms, usually from fertilizer that runs off fields instead of sticking around in the soil. Now, a new model explores the global impact of nitrogen from sewage and finds that nutrients in our poop and pee are also causing harm.

Explainer: The fertilizing power of N and P

Coastal areas face dangers ranging from climate change to overfishing to pollution. And sewage may pile on to these problems. An influx of nutrients can lead to eutrophication. That process causes oxygen levels in the water to drop to low levels that can kill fish and other creatures.

Coral reefs and seagrass beds are important ecosystems that are home to many creatures. Researchers at the University of California, Santa Barbara wanted to explore which coastal areas receive the most nitrogen and determine the risks to these key ecosystems. So they created a computer model.

However, there's a lot scientists don't know about the flow of nutrients from sewage into the ocean. And what they do know isn't spread evenly around the world. For example, researchers have more data on nutrients from sewer systems. But many places lack sewers.

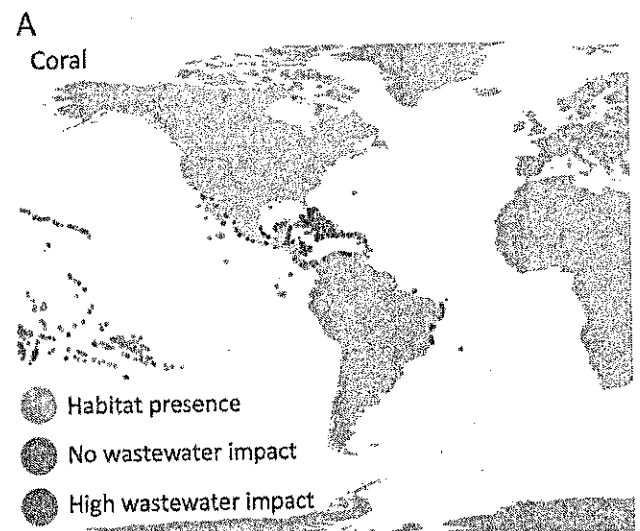
To get past that data shortage, the researchers looked at what people eat. Protein from food is a major source of nitrogen in wastewater. The scientists used protein consumption and population size and density to calculate how much nitrogen people excrete in various locations. They then accounted for how wastewater treatment removes nitrogen.

The researchers combined this data with a high-resolution map of watersheds worldwide. That showed where the nitrogen flows. Overall, wastewater dumps 6.2 teragrams (13.7 billion pounds) of nitrogen into the ocean, according to the model. That's equal to about 40 percent of the nitrogen that comes from agriculture, the scientists report November 10 in *Plos One*.

The new results suggest that 58 percent of coral reefs and 88 percent of seagrass beds receive wastewater nitrogen. And the model allows researchers to zoom in on specific areas. This could help guide conservation efforts, the authors suggest.

Coral reefs and seagrass under threat

These maps show where nitrogen may threaten coral reefs (A) and seagrass (B). (Use the arrows at left and right to switch between the images). They are based on a computer model that researchers developed. The model simulates how nitrogen gets into coastal environments. First, the model estimates how much nitrogen ends up in sewage based on what people eat and where they live. Then it adjusts the nitrogen levels in the sewage based on wastewater treatment. Finally, using a very detailed map of the world's watersheds, the model simulates how the nitrogen flows out to sea. These maps take results from the model and label whether nitrogen concentrations are high ("High wastewater impact") or low ("No wastewater impact") at areas with corals (A) and seagrass (B). [Click here to see both graphs in one image.](#)



TUHOLSKE ET AL/PLOS ONE 2021 (CC BY 4.0)



Data dive:

1. Open up a visualization of the model [here](#). It's easiest to see the nitrogen data when "Dark mode" is selected. Make sure there's a check mark next to "Location Names" and "Nitrogen Plumes." Zoom in on the coastal area closest to where you live. What is the concentration of the nitrogen there?
2. Can you find any places that receive 100,000,000 grams of nitrogen/year? (Hint: you may have to zoom in a lot.) How about 1,000,000,000 grams?
3. Check the box next to "Nitrogen Source." What do you notice about the places that light up?
4. Look at Map A above. Some areas are hotspots for coral wastewater impact. These have lots of red dots clustered together. Where are these areas? What do they have in common?
5. Where are corals less likely to experience risks from nitrogen?
6. Look at Map B. What are hotspots for seagrass wastewater impact?
7. Where is seagrass less likely to experience risks from nitrogen?

CITATIONS

Journal: C. Tuholske et al. [Mapping global inputs and impacts from of human sewage in coastal ecosystems.](#) *Plos One*. Published online November 10, 2021. doi: 10.1371/journal.pone.0258898.