THE CHRISTIAN SCIENCE MONITOR csmonitor.com

'To injure no man, but to bless all mankind'

BOSTON • THURSDAY, MAY 27, 2004

■ GLOBAL ENVIRONMENT

'Dead zones' threaten fisheries

By MARK CLAYTON
STAFF WRITER

In midsummer, the northern Gulf of Mexico, where the Mississippi River empties into it, may shimmer like any other swath of sea. But a few score feet below, bottom-dwelling fish and other creatures struggle just to breathe.

This area — one of the world's biggest coastal "dead zones" — is rapidly being joined by a growing number of "hypoxic," or oxygen-depleted areas around the world. At least 146 such zones have been documented through 2000 — from the northern Adriatic Sea to the Gulf of Thailand to the Yellow Sea, according to a United Nations Environment Program (UNEP) report released in March. And their number has been doubling every decade since 1960, it adds. At risk: coastal fisheries near the most populous regions.

A handful of efforts are under way that could mitigate the effects. But because of lag times involved, the problem is likely to get worse before it gets better.

"I'm convinced this is going to be the biggest environmental issue in the aquatic marine realm in the 21st century," says Robert Diaz, a marine biologist and professor at the Virginia Institute of Marine Science, who coauthored the study undergirding the UNEP report. "It won't take too much for these annual lower-oxygen events to expand throughout the year and actually eliminate fisheries."

Dead zones often grow where populations grow. But the real driver is the spread of nitrogen, many observers say, caused by runoff of nitrogen-based fertilizers, sewage outflows, and nitrogen deposits from burning fossil fuels. Some waters remain oxygen-depleted year-around. In other waters, the problem appears periodically.

In the northern Gulf of Mexico, one of the best-known and best-studied dead zones, hypoxia occurs seasonally from April to September. The zone's size depends on the weather and how much flow the Mississippi brings each year. Its waters are laden with fertilizer runoff from farms and lawns across the Midwest. Sewage and fossil-fuel emissions exhaust (from power plants and autos) are also factors, says a 1999 University of Alabama study sponsored by the fertilizer industry.

> **"I'm convinced this is going to be the biggest environmental issue in the aquatic marine realm in the 21st century."**
>
> — Robert Diaz, marine biologist

Excess nitrogen combined with placid summer weather results in an oxygen-poor bottom layer of water. The process works this way: In the top layer, the nitrogen and sun feed phytoplankton, which grow rapidly, then die and fall to the bottom. As they decay, they consume oxygen. Called eutrophication, the cycle depletes oxygen in isolated bottom waters. In 2002, one of the worst years since it was first documented in the 1970s, the northern Gulf's hypoxic zone reached more than 7,700 square miles. Despite its size, the problem is largely hidden from view, except to the trained eye.

"I see massive schools of stingrays, bottom dwellers, moving on the surface. Even shrimp come up 20 feet or so off the bottom trying to get to oxygen," says Nancy Rabalais, a marine biologist at the Louisiana Universities Marine Consortium in Chauvin, La. Only because they are desperate to breathe do such bottom-dwelling creatures flee upward, risking becoming easy prey.

More mouths to feed

Such scenes will become more common worldwide, scientists predict. As populations grow, nitrogen and phos-phorous-caused eutrophication will more than double in coastal areas by 2050, predicts a 2001 study published in Science magazine.

"There's been a big increase in these hypoxic zones that correlates strongly with increased use of nitrogen fertilizers, particularly in the '60s and 1970s," says Robert Howarth, a coauthor of the Science study and professor of environmental biology at Cornell University in Ithaca, N.Y. "About half of the nitrogen fertilizer used on Earth in all of history has been used in the last 15 years."

One positive trend: Total global fertilizer use seems to be growing more slowly than in the past few decades. It plateaued in 1990 then declined after the collapse of the Soviet Union. In the mid-'90s, global growth resumed, but much more slowly. For the decade, nitrogen fertilizer rose only slightly from 79 million to 82 million tons.

Still, scientists say it takes time for a rise in fertilizer use to harm coastal ecosystems. In a 2002 study, Howarth and other scientists found that falling levels of dissolved oxygen in coastal waters lagged 10 to 20 years behind increased chemical fertilizer use beginning in the 1940s. That lag effect is worrisome, he says, because fertilizer use has more than quadrupled globally since 1960.

The use of nitrogen has increased, too. Nitrogen fertilizers were 37 percent of all fertilizers used in 1961, but grew to 60 percent by 2001, according to Fertilizer Institute data. "If you look globally at what humans are doing to the nitrogen cycle, we're increasingly making nitrogen available to the environment," Dr. Howarth says. "Almost 75 percent of the increase is through fertilizers."

The fertilizer industry in the US has been working with farmers to reduce fertilizer overuse and resulting runoff since the 1960s. But pressure from the Environmental Protection Agency in the '90s also has pushed the industry toward new technologies. Global positioning satellite technology, linked to fertilizer applicators on tractors, permits "precision farming" in which each acre gets specific chemicals according to its soil condition.

"Applying more won't necessarily get

To save coasts, new ways to fertilize

more crop, and farmers understand that it's not good for their bottom line," says Rino Maddalena of the Fertilizer Institute in Washington D.C.

Even so, several farm authorities say it is not uncommon for farmers to use more nitrogen and other fertilizers than they need as a modest insurance policy. Better to slightly overfertilize than underfertilize and underproduce, the thinking goes.

To address this concern, the American Farmland Trust (AFT), a nonprofit group that attempts to protect cropland, has developed a new form of crop insurance. The risk-management program encourages farmers to apply less nitrogen fertilizer. In this scheme, a farmer agrees to use a lesser amount of nitrogen fert-ilizer, based on nutrient management advice. If the farmer's output falls below the output of a test plot on his land that has the maximum nitrogen fertilizer applied to it, then he receives the difference in cash.

So far, 27 pilot projects are under way in Minnesota, Wisconsin, Ohio, and Illinois, says Brian Brandt of the AFT's Agricultural Conservation Innovation Center. In three years, the project has seen a 24 percent reduction in nitrogen use among the farmers. Only a handful saw yields fall. They were paid the difference, about $6 per acre.

It pays to use less

One participant, Burley Hall, a farmer with 2,100 acres north of Urbana, Ohio, now uses some 35 pounds less nitrogen per acre of corn — a reduction of more than 20 percent. That reduction saves him money. And once, when his crop came in a fraction of a bushel less than his test strip, he got reimbursed $900. But his enthusiasm for the program runs deeper than economics.

"We've got creeks that run through our land," Mr. Hall says. "We live here and drink the water. If I'm buying this stuff [nitrogen], I don't want to see how far down the stream I can run it. You've got to watch out for the environment by all means and this is one way of doing it."

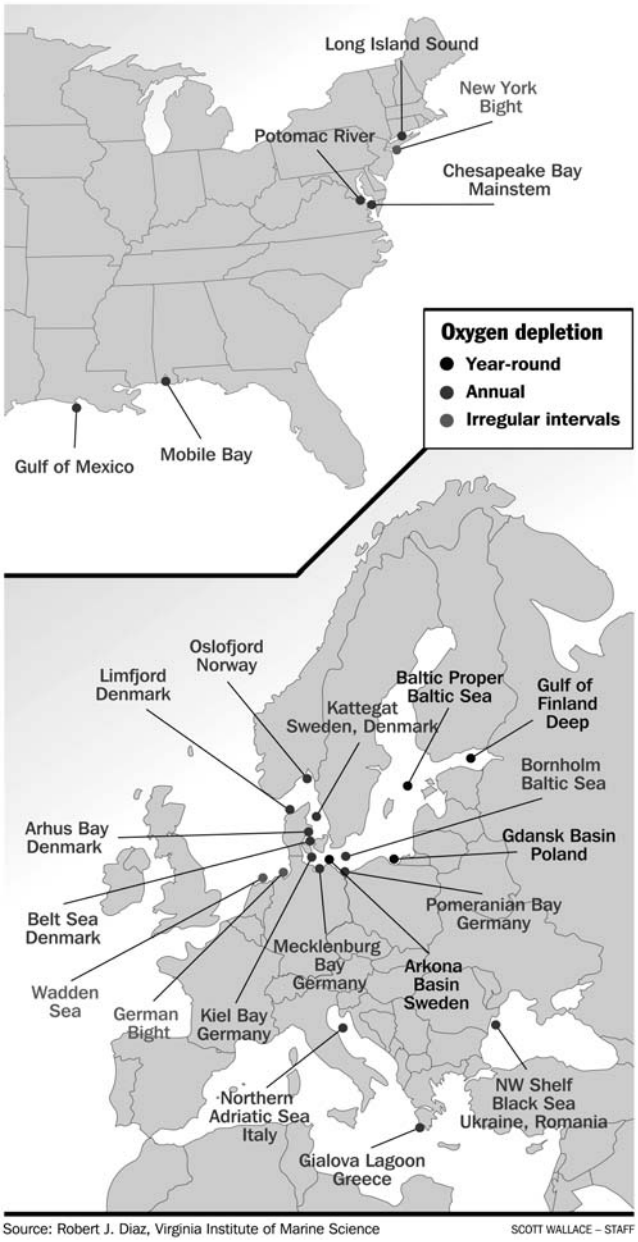
One high-tech idea in the works would take another big whack at nitrogen use - but from the other end of the equation. Arcadia Biosciences in Davis, Calif., is working to make corn and other plants more efficient users of nitrogen already in the soil. For example, using genetic engineering, it has modified canola with a gene found in barley. The effect is to activate the plant's roots to absorb nitrogen more aggressively than before.

"We've grown the same yield as a conventional crop of canola using less than half as much nitrogen," says Eric Rey, the firm's president.

Arcadia has conducted three years of tests for the US Department of Agriculture. But the first commercial canola and rice seeds won't be ready until 2008 or 2009, Mr. Rey says. He acknowledges, too, current concerns over genetic engineering. On the other hand, farmers cut costs and use less fertilizer, he adds. "So the environment is improved by farmers making more money."

Oxygen-deprived coastal areas

The number and size of "dead zones" is growing rapidly worldwide, according to a United Nations report. At least 146 such areas have been documented globally. The main causes: population growth and nitrogen from fertilizer runoff. Following are the largest dead zones.



Source: Robert J. Diaz, Virginia Institute of Marine Science

SCOTT WALLACE – STAFF

Top fertilizers

Nitrogen-based fertilizers are contributing to an increase in coastal 'dead zones,' areas where oxygen levels are low, say scientists. These countries consume the most nitrogen fertilizer.

Nitrogen, in millions of metric tons

Country	2000/01	2001/02
China	22.1	22.5
India	10.9	11.3
US	10.5	10.9
France	2.3	2.4
Pakistan	2.3	2.2

SOURCE: The Fertilizer Institute

STAFF