Altered Oceans: Part One: A Primeval Tide of Toxins

**Note: This is a condensed version of the original article intended for use with Oceanography 100 Lab activity. The entire article (as well as all five parts to the original award-winning series can be found by contacting the Los Angeles Times newspaper.*

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Corresponding YouTube video: https://youtu.be/6mQrJz9tCSI

**Note: Video is a short introduction to the article, it is not a substitute for reading the version of the article presented here.*

The fireweed began each spring as tufts of hairy growth and spread across the seafloor fast enough to cover a football field in an hour.

When fishermen touched it, their skin broke out in searing welts. Their lips blistered and peeled. Their eyes burned and swelled shut. Water that splashed from their nets spread the inflammation to their legs and torsos.

"It comes up like little boils," said Randolph Van Dyk, a fisherman whose powerful legs are pocked with scars. "At nighttime, you can feel them burning. I tried everything to get rid of them. Nothing worked."

As the weed blanketed miles of the bay over the last decade, it stained fishing nets a dark purple and left them coated with a powdery residue. When fishermen tried to shake it off the webbing, their throats constricted and they gasped for air.

Scientist Judith O'Neil put a tiny sample under a microscope and peered at the long black filaments. Consulting a botanical reference, she identified the weed as a strain of cyanobacteria, an ancestor of modern-day bacteria and algae that flourished 2.7 billion years ago. O'Neil, a biological oceanographer, was familiar with these ancient life forms, but had never seen this particular kind before. Why was it so toxic? Why was it growing so fast?

The venomous weed, known to scientists as *Lyngbya majuscula,* has appeared in at least a dozen other places around the globe. It is one of many symptoms of a virulent pox on the world's oceans.

In many places, the atolls of the Pacific, the shrimp beds of the Eastern Seaboard, the fjords of Norway, some of the most advanced forms of ocean life are struggling to survive while the most primitive are thriving and spreading. Fish, corals and marine mammals are dying while algae, bacteria and jellyfish are growing unchecked. Where this pattern is most pronounced, scientists evoke a scenario of evolution running in reverse, returning to the primeval seas of hundreds of millions of years ago.

Jeremy B.C. Jackson, a marine ecologist and paleontologist at the Scripps Institution of Oceanography in La Jolla, says we are witnessing “the rise of slime.”

Even in modern times, when oil spills, chemical discharges and other industrial accidents heightened awareness of man’s capacity to injure sea life, the damage was often regarded as temporary.

But over time, the accumulation of environmental pressures has altered the basic chemistry of the seas.

The causes are varied, but collectively they have made the ocean more hospitable to primitive organisms by putting too much food into the water.

Industrial society is overdosing the oceans with basic nutrients — the nitrogen, carbon, iron and phosphorous compounds that curl out of smokestacks and tailpipes, wash into the sea from fertilized lawns and cropland, seep out of septic tanks and gush from sewer pipes.

Modern industry and agriculture produce more fixed nitrogen — fertilizer, essentially — than all natural processes on land. Millions of tons of carbon dioxide and nitrogen oxide, produced by burning fossil fuels, enter the ocean every day.

These pollutants feed excessive growth of harmful algae and bacteria.

At the same time, overfishing and destruction of wetlands have diminished the competing sea life and natural buffers that once held the microbes and weeds in check.

The consequences are evident worldwide.

Dr. Jackson uses a homespun analogy to illustrate what is happening. The world’s 6 billion inhabitants, he says, have failed to follow a homeowner’s rule of thumb: Be careful what you dump in the swimming pool, and make sure the filter is working.

“We’re pushing the oceans back to the dawn of evolution,” Jackson said, “a half-billion years ago when the oceans were ruled by jellyfish and bacteria.”

Jellyfish populations are growing because they can. The fish that used to compete with them for food have become scarce because of overfishing. The sea turtles that once preyed on them are nearly gone. And the plankton they love to eat are growing explosively.

As their traditional catch declines, fishermen around the world now haul in 450,000 tons of jellyfish per year, more than twice as much as a decade ago.

This is a logical step in a process that Daniel Pauly, a fisheries scientist at the University of British Columbia, calls “fishing down the food web.” Fishermen first went after the largest and most popular fish, such as tuna, swordfish, cod and grouper. When those stocks were depleted, they pursued other prey, often smaller and lower on the food chain.

“We are eating bait and moving on to jellyfish and plankton,” Dr. Pauly said.

In California waters, for instance, three of the top five commercial catches are not even fish. They are squid, crabs and sea urchins.

This is what remains of California's historic fishing industry, once known for the sardine fishery attached to Monterey's Cannery Row. And the world's largest tuna fleet, based in San Diego, which brought American kitchens StarKist, Bumble Bee and Chicken of the Sea is no longer active.

Overfishing began centuries ago but accelerated dramatically after World War II, when new technologies armed industrial fleets with sonar, satellite data and global positioning systems, allowing them to track schools of fish and find their most remote habitats.

The result is that the population of big fish has declined by 90% over the last 50 years.

It's reached the point that the world's fishermen, though more numerous, working harder and sailing farther than ever, are catching fewer fish. The global catch has been declining since the late 1980s.

Fish farming also exacts a toll. To feed the farmed stocks, menhaden, sardines and anchovies are harvested in great quantities, ground up and processed into pellets.

Dense schools of these small fish once swam the world's estuaries and coastal waters, inhaling plankton like swarming clouds of silvery vacuum cleaners.

In many places, bacteria and algae run wild in the absence of the many mouths that once ate them. As the depletion of fish allows the lowest forms of life to run rampant, it is transforming the oceans into a microbial soup.

Jellyfish are flourishing in the soup, demonstrating their ability to adapt to wholesale changes — including the growing human appetite for them. Jellyfish have been around, after all, at least 500 million years, longer than most marine animals.

The ancient seas contained large areas with little or no oxygen — anoxic and hypoxic zones that could never have supported sea life as we know it. It was a time when bacteria and jellyfish ruled.

Nancy Rabalais, executive director of the Louisiana Universities Marine Consortium, has spent most of her career peering into waters that resemble those of the distant past.

Years ago, Dr. Rabalais popularized a term for this broad area off the Louisiana coast: the "dead zone." In fact, dead zones aren't really dead. They are teeming with life — most of it bacteria and other ancient creatures that evolved in an ocean without oxygen and that need little to survive.

"There are tons and tons of bacteria that live in dead zones," Rabalais said. "You see this white snot-looking stuff all over the bottom."

Other primitive life thrives too. A few worms do well, and jellyfish feast on the banquet of algae and microbes.

The dead zone off Louisiana, is a testament to the unintended consequences of manufacturing nitrogen fertilizer on a giant scale to support American agriculture. The runoff from Midwestern farms is part of a slurry of wastewater that flows down the Mississippi, which drains 40% of the continental United States.

The same forces at work in the mouth of the Mississippi have helped create 150 dead zones around the world, including parts of the Chesapeake Bay and waters off the Oregon and Washington coasts.

About half of the Earth's landscape has been altered by deforestation, farming and development, which has increased the volume of runoff and nutrient-rich sediment.

Most of the planet's salt marshes and mangrove forests, which serve as a filter between land and sea, have vanished with coastal development. Half of the world's population lives in coastal regions, which add an average of 2,000 homes each day.

Global warming adds to the stress. A reduced snowpack from higher temperatures is accelerating river discharges and thus plankton blooms. The oceans have warmed slightly — 1 degree on average in the last century. Warmer waters speed microbial growth.

Robert Diaz, a professor at the Virginia Institute of Marine Science, has been tracking the spread of low-oxygen zones. He has determined that the number is nearly doubling every decade, fed by a worldwide cascade of nutrients — or as he puts it, energy. We stoke the ocean with energy streaming off the land, he said, and with no clear pathways up the food chain, this energy fuels an explosion of microbial growth.

These microbes have been barely noticeable for millions of years, tucked away like the pilot light on a gas stove.

"Now," Dr. Diaz said, "the stove has been turned on."

The full article is Part 1 of a five-part series on the crisis in the world's oceans published in July and August of 2006.

The series -- by reporters Kenneth R. Weiss and Usha Lee McFarling and photographer Rick Loomis -- won the 2007 Pulitzer Prize for explanatory reporting.