

Muck Runs Amok

Algae are suffocating some of California's most popular lakes and streams. The culprits are nutrients from fertilizer and sewage.

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The clear, cooling waters of Solstice Creek, in the Santa Monica Mountains National Recreation Area near Malibu, evoke images of a different time, a different place.

Children chase tree-frog tadpoles and blue damselflies. Their parents slip off their shoes and wade into the water just to feel it between their toes. Fish dart through the water as long-legged water striders leave dimples on the surface. Orange newts climb on cobblestones, and mayfly nymphs, a plump meal for fish and frogs, burrow into the mud.

A few miles away, Malibu Creek presents a picture that is now far more common. Children who reach into the water pull out smelly masses of stringy neon-green algae. And if they step into the murky depths, they risk slipping on rocks coated with foamy brown scum.

These two contrasting streams illustrate one of California's most pervasive water pollution problems: Nutrients, which cause algae to grow more rapidly than nature ever intended, are spoiling what should — and still could — be some of California's most picturesque and popular waterways. Nitrogen and other nutrients from fertilizers, cow manure and human sewage are overloading virtually every waterway downstream from cities and farms.

Nutrients now impair more waterways in California than any other pollutant except bacteria. Nearly 300 — from Lake Tahoe, which has lost much of its clarity, to the Tijuana River — have been declared unfit for aquatic life or recreation because of excessive nutrients.

Excessive algae growth robs waters of oxygen, suffocating fish and other aquatic life. And although the algal blooms found in streams and lakes do not pose a human health threat, many people perceive the slimy waters as unsafe and unattractive.

"People enjoy being near streams and waterways that are clear and have no smell. You don't want to swim in pea soup — and smelly pea soup at that," said Rik Rasmussen of the State Water Resources Control Board.

In a deep channel of the San Joaquin River near Stockton, chinook salmon, one of the state's rarest fish, can't reach their spawning grounds because algae suck up so much oxygen the fish can't breathe.

At Riverside County's Canyon Lake, masses of algae clog the filters of a plant that delivers drinking water, sometimes forcing it to shut. Nearby, at Lake Elsinore, dead fish wash ashore as oxygen levels plummet.

At Las Virgenes Creek in Malibu Creek State Park, priests baptizing babies purify souls with greenish-brown water.

In Stemple Creek, which flows from Sonoma County into Bodega Bay, so much ammonia flows from cow and chicken manure that the water is poisonous to aquatic life.

For three decades, some areas of the country, especially around the Great Lakes, have been trying to rein in nitrogen, phosphorous and ammonia from farms and wastewater plants. But though some

waterways have improved, most, especially in California, are worse.

"Nutrient release is not regulated in this country right now," said Walter Dodds, a Kansas State University biologist who co-wrote an EPA document that is helping states set criteria for controlling nutrients. "There are exceptions, but mostly people are doing nothing."

California is just beginning to tackle its over-fertilized waters by developing standards for nutrients and setting individual limits for each body of water.

In the next few years, the battle could force changes in how farmers fertilize fields, how houses are built and how many millions of dollars the public spends to treat its sewage.

Some Southern California sewage plants are already building expensive new nutrient-removing facilities. Los Angeles is spending \$77 million at two plants to eliminate 90% of ammonia and 60% of nitrogen from effluent discharged into the Los Angeles River.

The upgrades will cost city residents, who spend an average of \$21 per month on residential sewer service, a "very small" amount, "pennies per household," said Joe Mundine of the city's sanitation department.

In tackling nutrients, California faces many complexities and uncertainties. Scientists and regulators know that although they can reduce the problem, they can't eliminate it. And because more people means more nutrients, the algae problem is likely to get worse before it gets better in many watersheds.

"The one general statement you can make about nutrients," said Ken Harris, chief of a department at the state water board that is coordinating plans for about 175 nutrient-loaded waterways, "is that where you find people, you will find streams that are impaired by them."

It's a case of too much of a good thing. Nitrogen, the most abundant element in the atmosphere, is a natural and essential ingredient in oceans, lakes, rivers and streams.

"These systems need a certain amount of nitrogen and phosphorus to sustain life. If you took it all out, all the plants would die," said John Warwick, director of hydrologic sciences at the Desert Research Institute in Reno.

Yet too much in a body of water — just like too much fertilizer on a rosebush — can ruin an aquatic ecosystem.

Humans today produce double the amount of nitrogen they did in the 1940s, exceeding all natural sources combined. Worldwide, about 200 million tons are produced per year, more than half of it as fertilizer. Phosphorous, another nutrient, comes mainly from soaps and detergents.

In a report issued in March, the director of the U.N. Environment Programme called the nutrient glut a gigantic global experiment." The World Resources Institute has ranked it as "one of the most serious threats to the aquatic environment today."

Many of the world's most famous bodies of water are highly contaminated with nutrients, including the mouth of the Mississippi River, a 7,700-square-mile "dead zone"; Chesapeake Bay, where crabs, fish and native sea grasses are smothered; and North Carolina's Pamlico Sound, where dead fish routinely wash up by the millions.

Nationally, 94% of the nitrogen comes from livestock and farms, although in urban watersheds,

wastewater plants are major contributors.

In the most extreme cases, nitrogen compounds, including ammonia, are so concentrated they can poison fish and other aquatic life. In most cases, however, they kill by stealing oxygen, a process called eutrophication.

During daytime, algae and other fast-growing plants suck up nutrients and produce oxygen, so the water is so saturated that oxygen bubbles drift to the surface. But at night, plants drain oxygen from the water without replenishing it. Oxygen levels in nutrient-loaded waters frequently plummet to half the normal amount, and in some cases drop to near zero.

Some species can tolerate low oxygen, but many, such as carp, are considered undesirable. Trout and salmon are particularly sensitive to low oxygen levels, which can suffocate their eggs and block their migration.

Near Stockton, in a channel of the San Joaquin River that was deepened to allow ships to navigate to and from San Francisco Bay, the oxygen level is extremely low when fall-run chinook salmon pass through en route to their spawning grounds. The salmon typically have to wait days or weeks for it to improve, and because their eggs are viable only a short amount of time, it reduces their chances of survival.

Insect larvae, important food for fish and amphibians, also cannot survive in areas matted with algae. Mayflies and stoneflies are one of the best indicators of a healthy stream.

People tend to find the mats of algae unattractive. Yet despite that, on hot summer weekends, several hundred people waded into the pools and streams at Malibu Creek State Park near Calabasas. Those creeks carry some of the highest nutrient levels in the region, yet they offer rare swimming holes.

On a 90-degree Sunday in August, just before noon, families gathered in the park along the algae-encrusted banks of Las Virgenes Creek, toting umbrellas, coolers and inflatable rafts. About 30 children and adults splashed in the green-hued water and tried not to slip on the brown slime—single-celled organisms called diatoms that grow on submerged algae.

Downstream, it's worse. "This is a mess," said Shelley Luce, science and policy director of the Santa Monica-based environmental group Heal the Bay, as she pulled up fistfuls of fluorescent-green plants, thick and tangled like dreadlocks. "Algae as far as the eye can see."

At Malibu's Surfrider Beach, one of Southern California's most famous beaches, the creek drains into a lagoon, where oxygen levels plummet to near zero at night, according to predawn tests conducted by Heal the Bay.

Because the watershed drains more than 100 square miles of communities and land in the Santa Monica Mountains and Simi Hills, the nutrients originate at a variety of sources. The single largest contributor is the Tapia wastewater plant, which discharges more than 9 million gallons of treated sewage into the creek every day except in summer, when discharge is prohibited. Nutrients also come from septic systems, horse ranches and runoff from lawns and golf courses.

Statewide, water boards are creating plans, called Total Maximum Daily Loads, for each waterway and each pollutant, including nutrients. They must calculate precisely how much each can tolerate and set specific allocations for each source.

Not only large rivers, but several hundred small creeks and tributaries, must be addressed individually. "Everything from huge rivers like the Klamath to something like Dairy Creek" along the

Central Coast, said Rasmussen, statewide coordinator of the program for the water quality board.

In addition, the EPA has ordered all states to adopt numeric standards for nutrients in waterways. California is in the process of doing so. Yet many uncertainties remain: What level of nutrients is too high? Where exactly are they coming from? And in an environment as altered as California's, can the problem ever really be resolved?

Under the Clean Water Act, all waterways must reach the point where beneficial uses are no longer impaired. But each is categorized by how valuable it is to society, which dictates how far states must go to restore them. Lake Tahoe, for example, is "appreciated like a work of art," Rasmussen said.

"The L.A. River is not going to be a High Sierra stream, and never could be, but what is the best it can be if you put reasonable controls on it?" Rasmussen said. "This is not designed to restore them to pristine condition. It's designed to restore them to what society would consider the minimal acceptable condition."

Tackling nutrients means changing the behavior of homeowners as they tend to their lawns and altering how farmers use fertilizer and dispose of manure. The state's regional water boards have the authority to require cities and farmers to reduce runoff, and that could mean regulations about how property is drained and how fertilizer is used.

"Getting people upstream to realize what they are doing downstream is not easy," said Dodds. "People don't need to fertilize their lawns as much as they do. Suburbanites think if one bag's good, two is better."

Water-quality experts say the efforts will get rid of some plants that are choking California's waterways. Orange County's Upper Newport Bay already has far less plankton after large nurseries upstream stopped washing fertilizer into its tributaries.

But most California rivers and lakes face such a plethora of problems — among them pesticides, bacteria, water diversions and damaged vegetation — that controlling nutrients alone will not protect them.

In the Central Valley, solutions are especially complicated because rivers have unnaturally low flows — their waters have been diverted to cities and farms. Even if all farmers were issued a zero-discharge mandate, the San Joaquin River's nutrient problem could remain. Stagnant, warm waters are especially prone to algae buildup.

Water-quality engineers say they have the technical know-how to improve the condition of most nutrient-loaded water bodies but they have questions for society: How much do you want to improve them and how much are you willing to pay?

"The public will bear this cost and it will be very large," said Warwick of the Desert Research Institute.

"Ultimately," Harris added, "society has to determine what it's worth."

There are stark differences between the reality and the potential of California's waterways. Yet most Californians have diminished expectations. They haven't been alive long enough to remember what lakes and rivers were like before they became clogged with algae.

"People don't know what a good stream looks like," said Don Sada of the Desert Research Institute. "We all get habituated to what we see all the time." What most people see, he said, is "very, very bad. I have spent weeks at a time sampling streams where my hands are so fetid from filthy water that I

can barely stand it."

Southern Californians, in particular, assume that in modern times, the murky pools of Las Virgenes Creek are the best that can be expected, and that slimy waterways like the Los Angeles and San Gabriel rivers aren't worth saving.

"If you give up and say places like these don't matter," said Luce, kneeling along the banks of Malibu Creek, "we're lost. There's not a creek worth saving."