

Delta changes could prove irreversible

Mike Taugher, Bay Area News Group, 9-19-10

The toxic blue-green algae floating in the scientist's jar is a symptom of a disturbing shift in the West Coast's biggest estuary.

Common in lakes and reservoirs around the world, this kind of algae is less likely to be found in estuaries where rivers and ocean tides tangle in a restless ebb and flow.

But the slime has spread in an increasingly stagnant Delta.

After five years of studies, scientists are coalescing around the idea that diverting fresh water to farms and cities has led to a fundamental change in the Delta by slowing flows for most of the year.

Other factors are also at play, especially the dramatic conversion of a once vast tidal marsh into a network of deep channels and "islands" first built for farming.

In short, the Delta is becoming more like a lake or a lagoon, researchers say.

As a result, transplanted species -- such as largemouth bass -- that thrive in more stable, lake-like environments are outpacing native species, including salmon and smelt.

"You have this really important ecosystem and California is about ready to lose it if we're not careful," said Zeke Grader, a lawyer and head of the Pacific Coast Federation of Fishermen's Associations, a commercial salmon trade group. "We'll lose the estuary and end up with an inland sea."

It is an ecosystem Contra Costans depend on for drinking water, widely enjoy as a recreation area and perhaps could host the return of wild California salmon.

Consider this: As the state's salmon fishers braced last spring for a third consecutive dismal year -- a plight many of them blamed on water diversions -- professional largemouth bass fishermen came to the Delta for 2010's first Bassmaster Elite fishing tournament, during which 93 anglers caught more than 1 ton of bass over four days.

The tour then moved on to Clear Lake in Lake County and to other lakes across the nation, mostly in the South.

The new Delta "resembles a weedy lake," said Anke Mueller-Solger, lead scientist for the Interagency Ecological Program, a 40-year-old state and federal research project in the bay and Delta.

On a recent trip aboard the research vessel *Questuary*, researcher Lindsay Sullivan was looking for tiny jellyfish, not the toxic algae she collected.

The postdoctoral researcher from Rhode Island and her team lowered over the stern a high-tech device that transmits to an onboard computer measurements of salinity, temperature and the depth of the water.

A plankton net, similar to the butterfly net that cartoon character *SpongeBob SquarePants* uses to go "jellyfishing," trailed behind the boat, collecting samples.

The estuary, which includes the bay, the Delta and adjacent waterways, is reputed to be the world's most invaded by alien species. They come on ship ballasts and ship bottoms, by deliberate fish planting and even from dumped aquarium plants.

So it was not much of a surprise when Sullivan held up a jar with hundreds of zooplankton native to China's Yangtze River and a few tiny jellyfish from the Black Sea.

Or toxic algae, for that matter.

The algae, *Microcystis*, was first found here in 1999 and has spread aggressively in recent years. Its presence in the Delta, a significant source of drinking water, is a concern because it produces a powerful liver toxin.

Though increased ammonium discharges from Sacramento's sewer treatment plant may have boosted it, *Microcystis* probably was able to take hold because of the central Delta's unnaturally slow-moving water, according to a 2008 report.

But Sullivan, a jellyfish expert, was here for the jellies.

She wants to know whether they are undermining the food web by eating organisms that estuary fish such as Delta smelt need to thrive.

One of the theories about the decline of smelt, the Delta fish most in danger of extinction, is that the plankton it eats are no longer available, possibly because clams, jellyfish or something else is eating them.

Sullivan wants to examine whether the jellyfish invaders are eating enough plankton to affect the smelt.

When biologists discovered in 2005 that the Delta's fish were in sharp decline, they began focusing on three areas: pollution, changes in water management and invasive species.

Over the next several years, they looked at culprits within those categories -- Delta pumps, invasive clams, ammonium pollution, pesticides and others -- but found no single suspect to blame for the ecological free fall.

Now, scientists have given up searching for a single cause and have turned to a more complex examination of how a dynamic environment has stabilized.

"It's more of an ecosystem approach. Before it was more of a fish-centric approach," said Mueller-Solger, the ecological group's lead scientist.

The intense biological productivity typical of estuaries and the Delta's immense size -- 738,000 acres, or about the size of Yosemite National Park -- make it one of the state's most valuable ecosystems.

Its watershed covers 40 percent of the state, and the estuary is an important stop on migratory birds' Pacific Flyway and a critical nursery and migration route for California's king salmon runs. It is home to about 50 species of fish and 300 mammals, birds and reptiles.

About 500,000 people live in the Delta -- a triangle with corners roughly at Antioch, Sacramento and Tracy -- and more than 23 million people around the state get at least some of their drinking water from it.

In an estuary, salinity levels naturally vary as the run of rivers and the tides push back and forth.

However, the sprawling network of dams and pumps that water managers use to supply farms and cities through the Delta are run to optimize water delivery without violating salinity standards meant to protect drinking water and habitat.

The result is that the Delta's salinity today is both higher and less variable than it was historically, researchers say.

For 800 years, the water in Suisun Marsh and Suisun Bay -- between Benicia and Pittsburg -- was mostly fresh.

Beginning in about 1915, when rice farmers moved into the Sacramento Valley, the drain on the Delta's fresh water allowed salt water to pour in from San Francisco Bay.

Salinity increased dramatically as water development continued in the 1920s.

"The other thing we found was that the nature of salinity intrusion changed," said Greg Gartrell, assistant general manager at the Contra Costa Water District, which closely tracks Delta salinity.

Before the levees were built and the waterways were channelized, the Delta remained full of fresher water even in long droughts, when Suisun Bay was salty.

"That means it (salinity) is exacerbated not just by the diversions but also the draining of the marshes and channelization of the Delta that allowed the tides to accelerate intrusion," Gartrell said.

As California's thirst grew, draining more fresh water from the Delta, salty water pushed farther into it.

By the end of the 1990s, new reservoirs such as a complex of underground water banks in Kern County and Diamond Valley Lake in Southern California were in place.

Then, even in wet months and wet years, when the demand for Delta water was low, water managers could store excess Delta water that otherwise would have flowed out to sea, further interfering with the natural variations of healthy estuaries, according to Bruce Herbold, fisheries biologist at the U.S. Environmental Protection Agency.

In recent years, the state and federal water projects supplying millions of acres of farmland and two of every three Californians have taken record amounts of water -- as much as 6 million acre-feet. That is enough to irrigate about 2 million acres or supply all of California's residents.

And it is about 1 million acre-feet more than the Bay and the Delta together can hold at any one time, Herbold said.

So, in other words, if the impossible happened and no water flowed in from rivers or the ocean, the amount of pumping from the Delta in recent years has been more than enough to run the estuary dry.

In early 2005, annual surveys showed an alarming three-year drop in several populations of fish that could not be explained by weather patterns.

It was a mystery with lots at stake -- namely, the health of an important estuary and the availability of water from the state's most important water source.

Mueller-Solger, the ecology program's lead scientist, in 2008 began prodding a team of researchers to consider whether the Delta's changes showed it becoming more like a lake.

About the same time, two leading experts at University of California, Davis, were coming to similar conclusions about the Delta's plight. In August 2008, Peter Moyle and Bill Bennett published their thoughts in a little noticed appendix to a report on Delta water policy.

"This shift presumably occurred as a result of the long-term (slow) process of steadily increasing pumping rates over time, which required the maintenance of freshwater conditions in the Delta during summer, as well as the relatively rapid invasion by Brazilian waterweed and other factors that favored (lake fish)," they wrote.

The meaning: An assortment of species more at home in stable environments -- largemouth bass and the Brazilian waterweed they like to hide in, jellyfish, overbite clams and even a zooplankton called *Limnoithona* -- are driving out and replacing the Delta smelt, longfin smelt, striped bass and the plankton on which they prey.

The new way of looking at the Delta does not lead to easy answers.

For example, if *Microcystis* is blooming more now because of the ammonium from the Sacramento sewage treatment plant, is the solution to reduce the pollution or to increase flows to dilute it and wash the toxic algae downstream? Or are both necessary?

The answer, in this and many other cases, could be both -- the flow of water and what is in it are each important.

"In an aquatic system, it does come down to water to some degree," Mueller-Solger said. "On the other hand, all the other threats are real, too."

Last month, the State Water Resources Control Board adopted a report that found California's farms and cities are using far more Delta water than is good for the estuary -- roughly twice as much.

That report has no regulatory teeth and officials of some water agencies have said it should be effectively ignored while the separate Bay Delta Conservation Plan being pushed by Gov. Arnold Schwarzenegger is written.

There is no way to restore the estuary to pre-Gold Rush conditions; the shallow marsh spreading through the Central Valley is gone forever.

The invaders feel quite at home. Voracious filter feeding clams carpet parts of the Delta bottom. Bass tournaments produce better fishing than native salmon runs.

Increasing the flow of water, while controversial and costly, may be one of the most effective ways to improve conditions, if only because restoring the landscape or eradicating invaders are next to impossible.

"There are a whole bunch of problems and they are linked together somehow, and there are only some we can work on," said Wim Kimmerer, research professor at San Francisco State's Romberg Tiburon Center for Environmental Studies and Sullivan's faculty adviser. "I'm skeptical flow (increases) will do what we're hoping."

Others are more confident, though.

"We can make it better habitat," Herbold said. "Right now, we're making it just ideal for the introduced species. It would behoove us to do what we can."