York. By using the same testing protocols at each site, the study's leaders hope to provide the Sound's communities with the most comprehensive water quality data available.

"We've had some exceptional groups studying water quality in different bays," said Peter Linderoth, water quality program manager for Save the Sound. "Now we have standard testing procedures, and we can have comparable data that will allow us to make studies from bay to bay."

But all this work – and all the improvements in water quality in Norwalk Harbor and the Sound in general – will be put to the test by climate change.

Ammerman of the Long Island Sound Study said that as Connecticut's summers get hotter, so will the Sound's waters. That will mean more stratification of the water column, less mixing of water within the column, less oxygen in the overall mix and potentially more fish kills.

"We've done all this work to reduce nitrogen levels and now climate change is trying to undo it," he said.

Climate change will also mean changes in the harbor's ecology, as salt water moves further onshore.

"The marshes are moving inland," said Hudson of the Maritime Aquarium.

And that will mean changes in the fish populations and the lives of the people who harvest those fish and shellfish. Winter flounder may be leaving, Hudson said, but southern species like black sea bass are arriving. Lobsters have all but disappeared in the Sound. Blue crabs may take their place.

And none of this is hypothetical. Climate change is altering ecosystems – in Norwalk Harbor, in Long Island Sound, in our world – as we live and breathe.

"It's happening right before our eyes," Hudson said.

Oysters shells are piled near the Norm Bloom & Son docks in Norwalk. Photo: John Pirro

Goats that spent last summer feasting on invasive plants at a New Haven city park are just the latest actors in the story of how this urbanized coastal landscape is reducing its burden on Long Island Sound.

"We're trying to make Edgewood Park better for everybody," said Stephanie FitzGerald, president of the Friends of Edgewood Park.

By consuming thick stands of Japanese knotweed, bittersweet, multiflora rose and other non-native flora, the six goats, loaned from a farm in Rhinebeck, N.Y., are clearing the way for the return of native plants that will in turn benefit native insects, birds and other wildlife. That will lead to a healthier environment – and more food for the resident fish, turtles and frogs – along the West River, which flows through the park and ultimately into the Sound. It's one more piece of the complex puzzle of how this coastal city is connecting the dots between what happens on land and the health of its harbor, where productive shellfish beds and popular swimming

As New Haven takes a green-first approach, the harbor gains too

Story and photos by Judy Benson

One of six goats brought to Edgewood Park in New Haven grazes on invasive plants along the banks of the West River this fall.

Inset: David Hill and his daughter Makenna Hill, 3, enjoy the beach at Lighthouse Point Park in New Haven with Jackie Ruiz and her son Jaiden Fretyes, all of the Springfield, Mass., area, in July. "The water is excellent," David Hill said.

beaches share the waters with oil tankers and cargo ships. The busiest shipping port between New York and Boston, this city of 130,000 residents that's home to one of the nation's great universities prides itself on its environmental as well as its industrial and academic identities.

"I go to Lighthouse Point beach all the time, and there are very, very, very rarely beach closures," said FitzGerald. Also serving on the West River Watershed Coalition, she understands how the health of the river matters to the water quality downstream where she likes to swim, "so we're trying to make sure the river gets cleaner and cleaner."

The efforts by the Edgewood Park and West River watershed groups complement larger initiatives throughout the city – by municipal, nonprofit and academic groups working together and independently – to revamp the built environment to lessen its impact on rivers, marshes and the Sound, and at the same time reduce flood risk in residential and commercial areas. In recognition of its efforts, in July the city was named the 2018 recipient of the Roy Family Award for Environmental Partnerships from the Kennedy School of Government at Harvard University.

"It's become a green-first approach in all our departments," said Dawn Henning, project manager in the city's Engineering Department.

Starting in 2013, she said, the city began installing bioswales – recessed areas with soils and plantings

The self-regulating tide gates installed on the West River five years ago allow salt water to flow upstream, restoring a tidal marsh and reducing flooding in the surrounding area.

Families enjoy swimming on a hot July day at Lighthouse Point Park in New Haven.

Workers from Emerge Connecticut Inc. construct a bioswale near the intersection of Wall and Church streets in New Haven in October.

Gaboury Benoit, who teaches environmental chemistry at Yale University, walks past a completed bioswale in full bloom in July.

that capture and store stormwater. These trap road pollutants and excess nutrients from fertilizers and pet waste before they get into waterways. In the 600-acre downtown area alone, 40 bioswales have been built and 160 more are slated to be constructed by next summer. Founded in 1784, New Haven, like many cities in the Northeast, has aging infrastructure ill-equipped to handle the more frequent intense storms happening with climate change, nor was it designed with the health of the Sound in mind. The bioswales and other green infrastructure are, Henning said, "retrofits added on to the old infrastructure, so they're siphoning off the flows that would have been going into the sewer system" or flooding neighborhoods, and eventually emptying into the Sound.

For Henning, being part of projects that help keep the estuary clean is personal. She grew up in neighboring Milford, where she often enjoyed swimming in the Sound.

"That's what drives me to do what we do to work to improve it," she said.

Michael Dietz, associate extension educator with Connecticut Sea Grant and UConn Extension, works with cities and towns around the state on new approaches to stormwater management that help keep polluted runoff out of waterways. New state regulations that took effect in 2017 are a main motivator for urbanized communities to take this on, he said, but some have embraced it more than others.

"New Haven is a model and a leader," said Dietz, who also directs the Connecticut Institute of Water Resources.

Stormwater, he said, "has been called out as a major source of pollution into Long Island Sound," second only to sewage treatment plants. "But we've made leaps and bounds with stormwater over the last five years."

So, too, with sewage treatment plants, said Curt Johnson, president of the Connecticut Fund for the Environment/ Save the Sound, which has its offices in New Haven. Johnson grew up in the Fair Haven section of the city, and remembers the "worst hypoxic event" to happen in the Sound in modern times that came 30 years ago. Fish kills in the western Sound were a wake-up call, he said, prompting major investments in sewage treatment plants to remove more nitrogen from treated effluent before it was discharged. Excessive nitrogen was spurring algal blooms, which led to the oxygen-starved waters that killed marine life.

"We're removing 60 percent of the nitrogen now," he said. "Certainly challenges remain for New Haven Harbor and the Sound, but if we hadn't made the clean water investments in Long Island Sound starting in the 1990s after that huge hypoxia event, I'm convinced on a gut level that we would have lost the central and western Sound. Instead we're seeing it rebounding.

"For the last two summers," he continued, "we've had humpback whales in Long Island Sound. That's because now there's something for them to feed on. If you set the table, these animals will come back."

One of the most important New Haven projects Johnson's organization spearheaded focused on the West River downstream from Edgewood Park, along with the tidal marshes in between. About five years ago, CFE/Save the Sound received a federal grant to replace tide gates on the river that had been cutting off saltwater flows into upstream areas, effectively killing brackish marsh areas. New self-regulating gates that now allow marine waters into the marshes "restored the tidal flushing" and helped prevent

flooding of some nearby commercial streets and buildings. Once the new tide gates were installed, they were turned over to the city.

For Gaboury Benoit, Yale professor of environmental chemistry, the return of tidal flows into the West River marshes provided an ideal laboratory for documenting the value of restoration projects to the environment. Funded by Sea Grant, he is now researching how heavy-metal contaminants are captured in sediments of tributaries flowing into the Sound, keeping them out of the estuary.

"I'm looking at the hydrology and the chemistry of it," he said, while he and a graduate assistant collected water and sediment samples for the project one day last summer. "It's possible that now this system is acting as a trap, so it's providing ecosystem services."

The restored marsh areas are also providing spawning habitat for migratory herring, shad and alewives. The old tide gates, installed a century ago in a misguided attempt at flood and mosquito control, prevented fish passage.

"We're observing fish all the way up to Konolds Pond in Woodbridge," said Gwen MacDonald, director of Green Projects for CFE/Save the Sound. "There's a diverse wetland community there that didn't exist before."

The 2015 removal of a dam in another section of the West River, on a preserve owned by the New Haven Land Trust, has further improved water quality.

For retired coastal ecologist Ron Rozsa, seeing the condition of the West River and its marshes today compared to 30 years ago validates the many years of work he and others did to call attention to the need to restore coastal habitats for the health of Long Island Sound. Rozsa, who worked for the state Department of Energy and Environmental Protection, identified the West River and 14 other degraded tidal areas as restoration priorities in the early 1980s.

"We set up a series of restoration policies for coastal wetlands, tidal flats and tidal wetland restoration," he said.

Today, Robert Granfield, a commercial fisherman who raises clams and oysters in beds in New Haven and Milford harbors, is among the beneficiaries of these multiple efforts. The progress he's seen over the last 30 years he's been making a living on the water has allowed him to keep doing what he loves.

"Over the years the water quality has really improved," he said. "There are a lot more fish in the Sound, and the shellfish areas are very, very productive. Of course there are still things that need to be watched carefully."

The 26-acre Cranberry Meadow Farm in East Lyme is within the Niantic River watershed. Owners Tom and Nancy Kalal are local advocates for sustainable land use within the watershed.

It takes a watershed to save a bay

From its headwaters to the beach, Niantic Bay needs everyone's effort to safeguard it into the future

Story and photos by Judy Preston

Tom and Nancy Kalal live in the Niantic River watershed, in the town of East Lyme. Their driveway winds through fenced-in pasture, past rows of brightly painted beehive boxes. Surrounded by outbuildings, the house is nestled among flower and vegetable gardens and signs for local honey and beef, the products of Cranberry Meadow Farm.

Tom Kalal graduated from UConn with a degree in ornamental horticulture, while his wife grew up on a dairy farm just down the road. It's clear that they love their farm, but he said that it wasn't until he took the UConn Master Gardening program, and then the advanced Master Gardener Coastal Certificate program, that his thinking began to really change. In 2011, he sold his lawn-care business in Waterford, and the two of them have become advocates for sustainable land use within the watershed – be that farm, residential backyard or municipal property.

"I don't think people in the watershed are aware of the bay, except the people who can see it," Tom Kalal said, seated at their kitchen table.

Their awareness of what it means to live in a watershed has

McCook Point, overlooking Niantic Bay and Long Island Sound, is at the southern end of the Niantic River watershed.