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SAVINGS INSIDE

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Faster than anywhere in the U.S., salt marshes in Rhode Island and Massachusetts are disintegrating. The scientist who has studied these wellsprings of life for 17 years says the loss 'is just stunning.'

Losing ground



Scientist Kenny Raposa uses a surface elevation table (SET) device to gauge growth at Nag Marsh on Prudence Island. His goal is to determine whether marshes are gaining altitude, key to survival against rising seas. [THE PROVIDENCE JOURNAL/BOB BREIDENBACH]

By Alex Kuffner
Journal Staff Writer

PRUDENCE ISLAND — Kenny Raposa never considered himself a climate-change guy.

It's not that he didn't believe that the planet was warming. It's just that as a scientist studying salt marshes on Prudence Island, it wasn't part of his research.

But that changed five years ago when he started going through a decade's worth of his data on two of the most common marsh plants and noticed an unmistakable trend in the numbers: the species that can withstand frequent flooding was thriving while the one that adapted only to intermittent inundation was dwindling.

It was the first definitive proof for Raposa that the increasing pace of sea-level rise was pushing more and more water onto the island's marshes, dramatically changing the composition of their vegetation in the near term and auguring their demise in the long term.

"I wasn't even looking for these changes. I just saw them in the data," says Raposa, research

SEE MARSHES, A11

R.I. marshes among most vulnerable in U.S.

Researchers have found salt marshes in New England to be the most endangered in the country due to rising sea levels.

- | | | |
|---|---------------------|---------------------------|
| Salt marshes at 16 sites were scored on their ability to resist sea level rise. Resilience is judged by these categories: | ● Marsh elevation | Overall resilience |
| | ● Marsh growth rate | |
| | ● Sediment supply | |
| | ● Tidal range | |
| | ● Sea level rise | |
| | ● High | |
| | ● Medium | |
| | ● Low | |
| | ● Very low | |



SOURCE: National Estuarine Research Reserve Association
THE PROVIDENCE JOURNAL

Online

- Compare a square-meter plot of Coggeshall Marsh in 2011 and 2016
- Explore an interactive graphic: One marsh grass thrives as another falters
- Watch a video of scientist Kenny Raposa at work on Prudence Island. Find these and more providencejournal.com

STATE HOUSE

Raimondo pitching ethics reforms

Seeks campaign-finance audits, line-item veto

By Patrick Anderson
Journal State House Bureau



Raimondo Fox

PROVIDENCE — Governor Gina Raimondo is putting past lawmaker misdeeds and the power of the legislature in the spotlight again with government-reform proposals to be introduced this week.

The governor proposes routine audits of campaign-finance accounts, disqualification of candidates who owe campaign fines, and arming the governor with line-item veto power over spending bills.

"The reason to do this is Rhode Islanders deserve confidence in their government," Raimondo told The Journal in an interview

Inside

The governor makes her case. **A15**

Friday. "I think the vast majority of public servants are honest and ethical.... So I say strengthen the rules and strengthen enforcement so that we can find these bad actors sooner and also deter bad

SEE RAIMONDO, A12

HIGH SCHOOL SPORTS

Ortiz to headline All-State banquet

PROVIDENCE — Three-time World Series champion, 10-time Major League Baseball All-Star and 2013 World Series MVP David "Big Papi" Ortiz will be the guest speaker at the second annual All-State Rhode Island High School Sports Awards banquet on June 21.

The event celebrates the accomplishments of The Providence Journal's All-State athletes, as well as names the overall male and female athletes of the year in each sport,



Ortiz



and coach of the year. The event will be held at the Rhode Island Convention Center on June 21 from 6-9 p.m. First- and second-team All-State athletes will receive a letter with instructions on how to claim their free

SEE ORTIZ, A2

PASSAGES

Hundreds celebrate twins' joyous lives

Service honors sisters who found happiness everywhere together

By Alisha A. Pina
Journal Staff Writer

PROVIDENCE — Qualitative, not quantitative.

The phrase used by the Rev. Rebecca L. Spencer on Saturday embodied the late Martha Williams and Jean

Haley's "live-life-to-the-fullest" style.

Remembered by hundreds in a memorial service at Central Congregational Church, the twins, daughters of the late Louise Gibbs Young and L. Douglas Young, didn't consider anyone a stranger and found joy in family, each another, dining out, adventures — and even everyday tasks and household chores.

They called each other

"womb mates" and made international news when they died together March 4 after a Friday night sisters' date to the Lobster Pot in Bristol. One fell, the other came to help and fell herself and the frigid cold took them both in the night. Haley's Barrington neighbor found them in the morning.

The two were 97 years, four months and one day old, calculated Haley's grandson

Nathan Haley.

The surviving sibling, younger sister Mary Jacobs, 89, who went out with them that night, was silent at the service. The three were often called "the girls."

"They were 'the girls,' and they were a fixture in many local establishments — an institution well known and loved by so many," said

SEE MEMORIAL, A6



Family members prepare for Saturday's memorial service at Central Congregational Church in Providence honoring 97-year-old twins Jean Haley, pictured at left, and Martha Williams, right, who died two weekends ago when both fell outside Jean's home in Barrington. [THE PROVIDENCE JOURNAL/GLENN OSMUNDSON]

TODAY MON TUE



41°/28° 50°/33° 51°/30°

Complete forecast, B8



More than a fly in this ointment

Mark Patinkin is caught in the middle when his high-deductible health plan runs into pharmaceutical price-gouging. **A4**

Arts Calendar ...F5
Books.....F3
Business.....B1
Classified. D11, E5
Crossword.....E3
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Lotteries.....C6
Movies.....C6
Obituaries.....B5
Television.....E4



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Sunday

Color-coded guide to a habitat under siege

By Alex Kuffner
Journal Staff Writer

PRUDENCE ISLAND — The image on Robin Weber's computer screen is divided into two panels.

On the left side is a high-resolution aerial photograph of Nag Pond and surrounding marshland on Prudence Island. And on the right is something that looks like abstract art — a splotch of blue here and a dab of red there.

It's the result after the aerial photo has been run through a computer program that color-codes the different types of plant communities that grow on the marsh. The variety form of smooth cordgrass is shaded purple. The long variety is tan. Freshwater phragmites are green.

"And these are dieback areas," says Weber, stewardship coordinator for the Narragansett Bay National Estuarine Research Reserve, pointing to mudflats in yellow.

The reserve has generated these maps for the entire coastline of Rhode Island to better understand how the mixture of plants in salt marshes is changing as sea levels rise.

The mapping program differentiates between plant species based on how they reflect light. It then categorizes them based on these unique spectral signatures. The technology isn't new, but the reserve is the first to use it for mapping marshes.

The effort is being directed by Kenneth B. Raposa, research coordinator at the reserve, and Weber.

She has just finished the set of maps using photos taken in 2012 that will serve as a baseline to track future changes. And she hopes this year to finish maps using photos from 2016 so researchers can start making comparisons. New sets would follow every three or four years.

By shedding light on how different species of plants fare as conditions shift, the maps

could be an important tool in determining which marshes are degrading fastest and which stand the best chance of surviving higher seas. The maps will also help identify areas where marshes could endure by moving inland.

Weber zooms the map out and points out an area of low, undeveloped ground on the east side of Prudence Island. She has been eyeing it as a place that could convert to marshland with some human intervention.

If a culvert were installed under a road that separates the land from the Bay, it would allow saltwater to move in and out and potentially create a marsh of up to a dozen acres.

It sounds promising, but then Weber taps her finger on the photo of the 30-plus-acre marsh around Nag Pond.

"It certainly doesn't replace this," she says.

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The Narragansett Bay National Estuarine Research Reserve is using a computer program to map the entire coastline of Rhode Island to assess how the mixture of plants in salt marshes is changing as sea levels rise. [THE PROVIDENCE JOURNAL/BOB BREIDENBACH]

WASHINGTON, D.C.

Cherry blossoms ravaged by weather



Cherry blossoms peek out along the Tidal Basin in Washington, D.C., on Friday. Wild weather has claimed about half the blossoms in the city, though trees along the Tidal Basin are still expected to put on a good show. [THE WASHINGTON POST/BONNIE JO MOUNT]

Nearly half are killed after cold and snow follow warmth

By Perry Stein
The Washington Post

WASHINGTON — Persistent frigid temperatures and the sloppy storm that blanketed much of the East Coast on Tuesday ravaged about half of the city's cherry blossoms, leaving them unable to bloom this year. Most of the remaining buds are expected to fully bloom by the end of next week, according to officials at the National Park Service.

Mike Litterst, a spokesman for the Park Service, described the scenario as venturing into "uncharted waters" for the city. But, he said, it could have been worse.

Because the cherry blossoms are lush and dense along the Tidal Basin, those

hoping to see them can still expect a spectacular showing.

"It's a glass half-full, glass half-empty situation," he said.

There are about 3,800 cherry blossom trees in the city, the bulk of which are located along the Tidal Basin. There also are several different varieties of cherry blossom trees in the District, though 70 percent of them are Yoshino trees.

Litterst said the assessments of damages and predictions of bloom dates are based on examinations of the Yoshino trees.

The cold temperatures killed the cherry blossoms that were in their final stage before they fully bloomed, know as the puffy stage. About 50 percent of the cherry blossoms were in this stage.

Experts studied the buds in the fourth stage of the blooming process, called peduncle elongation, and

determined there was no serious damage to these, according to Litterst.

The loss of 50 percent of the buds pushes the peak bloom date to probably late next week. "Peak bloom" refers to the point when 70 percent of the cherry blossoms along the Tidal Basin are in bloom.

The Park Service had predicted that peak bloom would fall between March 19 and 22.

Litterst explained the delay in peak bloom is not because the remaining buds are now blooming more slowly but because the buds that had been expected to bloom on the earlier end will no longer bloom. Without these early bloomers, the calculation for when 70 percent are considered in full bloom is pushed back.

"We've lost half our data points that we intended to use," he said.

These unfavorable conditions for the city's

beloved cherry blossoms was caused by unseasonably warm weather, quickly followed by unseasonably cold weather. When the cold snap hit last week, the freezing temperatures killed the cherry blossoms that were almost fully bloomed.

Diana Mayhew, president of the National Cherry Blossom Festival, has said that the month-long event that began March 15 would go on no matter what happens to the cherry blossoms.

The programming, she said, attracts tourists on its own. It features a Japanese street festival, musical performances, a kite festival and a fireworks show. The flagship parade is scheduled for April 8 along Constitution Avenue before the festival wraps up April 16.

"We still have the events as scheduled," Mayhew said. "It's still nature's kickoff of spring, not only in Washington but across the country."

TRUMP BUDGET PROPOSAL

NOAA's satellites left untouched

Budget plan maintains funding because they collect 'critical weather data'

By Brian K. Sullivan
Bloomberg

President Donald Trump may want to kill \$250 million in funding for the National Oceanic and Atmospheric Administration's coastal and marine programs, but there's one area of the massive data-collecting agency he seems keen on sparing: its satellite fleet.

A sprawling agency under the Department of Commerce with 12,000 employees, NOAA's charge is watching the oceans, the climate, the sun and the weather. Satellites are its eyes — gathering data on everything from gravity waves in the atmosphere to lightning strikes. There's even one parked 1 million miles from home watching the sun.

Without them, the National Weather Service's forecasting would be set back decades. So Trump's plan to maintain funding for the satellite systems came as welcome news on Thursday.

"I am heartened those facilities aren't being cut," said Bob Henson, a meteorologist with Weather Underground based in Boulder, Colorado. "What goes into forecast models is satellite data, and it would be a significant impact not to have those."

Not to mention they're big business. Raytheon Co. has estimated that weather satellites, instruments and data-collection products could be a \$15-billion market over the next five years. Lockheed Martin Corp. had a hand in designing the equipment that locates lightning strikes on the GOES-16 launched earlier this year.

IN BRIEF

MARYLAND

Governor seeks ban on fracking

ANNAPOLIS, Md. — Maryland Gov. Larry Hogan called Friday for a ban on hydraulic fracturing in the state, adding a new twist to a debate in the legislature over whether to forbid the controversial drilling method or extend a

(Lightning is a good indicator of a hurricane's future intensity.)

The GOES-16 satellite floating 22,300 miles above Earth is the first of four new ones being deployed as part of a \$10.8-billion program that's based in Wallops Island, Virginia. GOES stands for Geostationary Operational Environmental Satellites. Trump proposed in his budget Thursday to maintain funding for the program, so they keep relaying "critical weather data to help protect life and property."

There's another type of satellite in polar orbit. These sweep the entire planet, according to Henson. Together, these two kinds of satellites form the backbone of modern weather prediction. The data they collect informs models that, in turn, move natural-gas markets daily by projecting how demand there might be for the heating fuel. Retailers plan store inventories based on those weather forecasts, airlines plot routes and avoid turbulence, and governors and mayors decide evacuations ahead of storms and floods.

In fact, about one-third of U.S. gross domestic product comes from industries vulnerable to changes in the weather, according to John Dutton, president of Prescient Weather Ltd. Crunching data from NOAA and predicting it are companies ranging from AccuWeather Inc. in State College, Pennsylvania, to International Business Machines Corp., which recently started using its Watson artificial-intelligence platform to make better predictions.

The National Weather Service, an arm of NOAA, referred all questions about the budget to the Commerce Department.

moratorium on it for another two years.

The first-term Republican in the past said he would support fracking in western Maryland if he believed it could be done safely. At a hastily called news conference Friday, he said he did not think there was a way to frack safely, and therefore would support a ban.

— *The Washington Post*

MASSACHUSETTS BRIEFS

Officials warn of heroin circulating

LOWELL — Law enforcement officials in a Massachusetts city are warning about a dangerous batch of heroin circulating there.

Lowell officials say they've responded to six near-fatal overdoses since Thursday night. The victims survived after they were administered the overdose reversal drug Narcan and sent to area hospitals for treatment.

The local district attorney, police superintendent and fire chief are warning

residents to be particularly careful this St. Patrick's Day weekend.

Group warns about problem gambling

BOSTON — A local group wants to make sure March Madness doesn't turn into a year-round gambling habit for some people.

The Massachusetts Council on Compulsive Gambling says now is a good time to talk to friends and family members — particularly children — about the consequences of problem

gambling.

The group cites estimates of more than \$12 billion being spent on sports gambling during the current NCAA basketball tournament, making March the largest month for individual bets.

Man blamed for deaths asks Maine governor for clemency

CHARLESTON, Maine — A man blamed for the deaths of six people in four states and serving a life prison sentence is trying to persuade

Gov. Paul LePage to give him another chance.

Richard Steeves, 75, told the Governor's Board on Executive Clemency last month that he's rehabilitated himself, conquered his demons and performed good works that include providing hospice care to inmates, caring for neglected dogs and giving piano lessons.

No attorney, friend or family member provided support during Steeves' presentation, the Boston Globe reported.

— *The Associated Press*

MARSHES

From Page A1

coordinator at the Narragansett Bay National Estuarine Research Reserve.

Now, Raposa is almost exclusively studying the effects of rising seas on salt marshes. In his most recent paper, he collaborated with counterparts at 15 other research reserves around the country to compare regional differences in marsh health and create a first-of-its-kind index to assess their resilience to sea-level rise.

The most vulnerable marshes were found to be in Rhode Island and Massachusetts.

How bad is it? Another study that Raposa co-authored estimates that Southern New England is losing a greater percentage of marsh vegetation every year than even the fast-eroding Mississippi Delta.

“We’re basically the hotspot for this,” Raposa says.

Tidal marshes play a vital role in the natural world, matched only by rainforests in their ability to support living organisms. They serve as nurseries for commercial and recreational fish species, feeding grounds for wading birds and nesting areas for migratory birds.

They filter water from contaminants and the nutrients that can cause harmful algae blooms. And they act as natural sponges that soak up floodwaters from heavy rains and barriers that protect inland areas from coastal storms and wind-driven surges.

Marshes have lined the Rhode Island coast for thousands of years, but they exist only in a narrow set of conditions. If the elevation of a marsh relative to the sea is too low, water pools on the surface, plants drown, and the marsh washes away. If the elevation is too high, the marsh dries out and becomes a meadow or woodland.

A marsh will naturally grow higher as tides deposit sand and silt, and plants die back to build up an underlying layer of peat, but Raposa has found that in Rhode Island the rate of growth averages less than a tenth of an inch a year. Since 1999, seas have risen in the state at about three times that rate.

While a cadre of scientists are documenting this change and working to respond, perhaps nobody is as responsible as Raposa for proving the connection between sea level rise and the degradation of marshes.

“In Rhode Island, people didn’t realize the wetlands were disappearing until he drew their attention to it,” says Elizabeth Watson, a wetlands ecologist at Drexel University in Philadelphia who has studied the state’s marshes and worked with Raposa.

Joanna Carey, a salt-marsh ecologist at Babson College in Boston who has also done research with Raposa, describes his work as “critical in determining what is going on.”

“Rhode Island is very lucky to have him working on this topic,” she says.

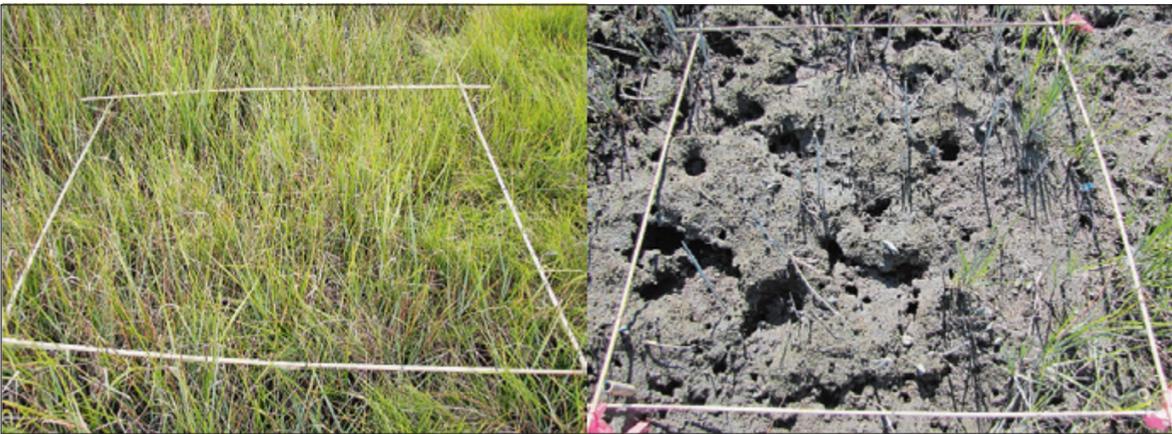
Kenneth Bryan Raposa is a boyish 46-year-old prone to wearing baseball caps and carrying a mug of lukewarm coffee. A native of the Riverside section of East Providence, he spent childhood days exploring the marshes around Bullock Cove with a cousin in search of crabs.

After getting his doctorate at the University of Rhode Island, where he focused on marsh restoration, he started working at the Narragansett Bay research reserve in 2000.

Founded in 1980, the reserve covers 4,400 acres of protected land on Prudence, Patience and Dyer islands, a mini-archipelago in the Bay nestled between Portsmouth and North Kingstown. It is part of a federal network of estuary research facilities



Kenneth Raposa, research coordinator at the Narragansett Bay National Estuarine Research Reserve, and reserve manager Bob Stankelis walk to Coggeshall Marsh, which, along with Nag Marsh, are Prudence Island “sentinel sites,” where benchmark studies are being conducted. [THE PROVIDENCE JOURNAL/BOB BREIDENBACH]



Then and now: A test plot at Coggeshall Marsh, Prudence Island, that Raposa monitors annually, shows smooth cordgrass (left) several years ago. A 2016 photo shows that as the plants die, there’s nothing to hold the mud and peat in place. [KENNETH RAPOSA PHOTOS]

Death of a salt marsh

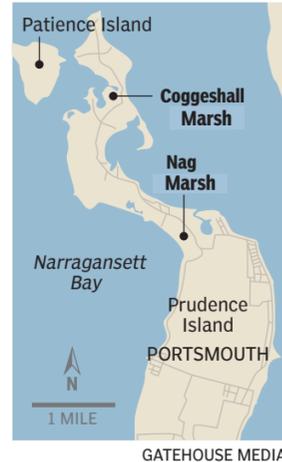
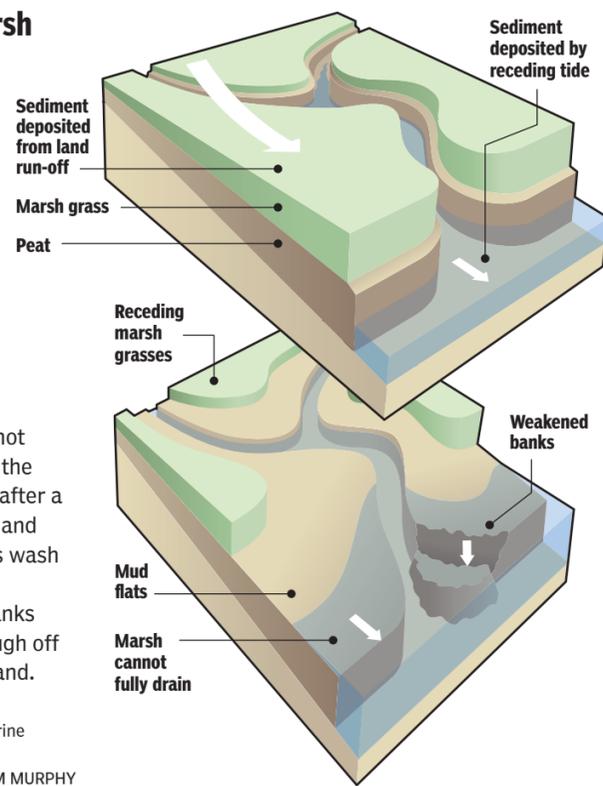
Healthy marsh

In a healthy salt marsh, some grasses are submerged twice a day at high tide. As the tide drains, it deposits sediments. This helps build up the marsh, allowing it to keep pace with rising sea levels.

Threatened marsh

When marsh growth cannot keep up with rising seas, the marsh cannot fully drain after a high tide. Grasses drown and the underlying sediments wash away. Without grass to strengthen them, peat banks weaken and begin to slough off as the marsh recedes inland.

Source: Narragansett Bay Estuarine Research Reserve Association
THE PROVIDENCE JOURNAL/TOM MURPHY



One study estimates that Southern New England is losing a greater percentage of marsh vegetation every year than even the fast-eroding Mississippi Delta.

administration proposing a total elimination of funding for all the estuary reserves. Even if the cut were temporary and funding were to be restored under a future administration, the damage would be lasting.

“If you have a large data gap, you lose a lot of value,” Stankelis says.

Coit goes with Raposa, Stankelis and others to Coggeshall Marsh, which, along with Nag Marsh, is one of the island’s two “sentinel sites,” where benchmark studies are being conducted.

Raposa explains that this marsh at the north end of the island is showing barely any growth. The waters of Southern New England carry only small amounts of sand and soil, so marshes in the region tend to gain elevation at an excruciatingly slow pace.

He gestures to a small square of marshland that he coated in a thin layer of white feldspar to serve as a marker horizon, a baseline against which to measure marsh growth. In a healthy marsh, as time passes, the chalky clay should gradually be covered by dirt and peat.

In sediment core samples — cylinders of soil removed for testing — it stands out as a white line. The growth rate of a marsh can be calculated by measuring the material above the line.

Raposa put the feldspar here in 2012, but it is still visible on the marsh surface.

“Nothing’s being deposited,” he says.

And because the seas are rising faster in the Northeast than just about anywhere else on the planet — due in part to changes in Atlantic Ocean currents — this 62-acre marsh is gradually flooding. Pools of water stand on barren soil. Salt marsh hay is retreating and even smooth cordgrass, which is more water-tolerant, can’t survive these conditions. As the plants die, there’s nothing to hold the mud and peat in place, so the pools grow wider and deeper.

The rising waters wouldn’t

be as much of a threat if the marsh could migrate inland to higher ground. But, even in a place as lightly developed as Prudence Island, there are roads and house lots that act as barriers.

Raposa is conducting field studies on the best ways to encourage marsh migration. If woods are thinned or cleared, will the marsh be able to take their place? He is also monitoring projects elsewhere in Rhode Island that have raised marshes by spreading sand on top of them and then replanting areas.

“Just conserving the marshes now is not enough,” Coit says.

Raposa nods. Many of Rhode Island’s marshes won’t survive on their own. “We’re past that,” he says.

“Pin one: One fifty-three,” Raposa calls out. “Pin two: One fifty-six. Pin three: One fifty-three.”

He reads off six more numbers so Stankelis can write them down. Each number measures the height in millimeters of a rod threaded through the arm of a device called a surface elevation table, or SET, that’s used to gauge marsh growth.

On this overcast day in March, Raposa wears hip waders and a pair of ripped jeans that may have been blue once. He kneels on a wooden plank suspended across a pair of milk crates to keep him from disturbing this part of 37-acre Nag Marsh.

“One footstep would ruin your data forever,” he says.

This is the crux of his work. He has set up SETs at six locations in Nag Marsh, which stretches across the middle part of Prudence Island, and another six in Coggeshall Marsh. He takes measurements every year.

Raposa is not expecting to see any growth on this day. In fact, there are signs of the opposite. Edges of the marsh are denuded of plants and pockmarked with holes dug by purple marsh crabs, which are proliferating in the changing environment. Their burrows only weaken the marsh, and portions are sloughing off into the water channels.

Raposa crosses a road to where the marsh continues around Nag Pond.

As he nears the water’s edge, he stops mid-stride at the sight of a tiny island in the pond that is little more than a mudflat. As recently as last summer, it was covered in smooth cordgrass, but the plants have died off.

It’s the first time Raposa has seen it like this. He is nearly speechless.

“That is just stunning,” he says.

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