



Underwater eelgrass and rockweed (left) as captured from a DJI P4 Multispectral Drone over Great Bay (right).
Photos by Michael Routhier and Taylor Goddard, UNH

Eyes in the Sky

Utilizing New Technologies to Help Monitor Eelgrass

Knowing the acreage of eelgrass in the Great Bay Estuary during a given year and being able to track how its distribution changes over time is important in determining the health of our estuary. As far back as 1981, this monitoring has primarily been done in New Hampshire by capturing and deciphering photographs taken from a small plane. This method can be a challenging endeavor, as water clarity, weather, and tides all need to line up nicely, and coordinating a flight can be tricky and expensive.

For the 2021 field season, PREP partnered with local UNH scientists, including Michael Routhier, director of the Geospatial Science Center, to employ some cutting-edge approaches to estuary-wide

eelgrass monitoring. Satellite imagery was first collected and used to assess the locations of eelgrass beds. Michael's team then acquired very high-resolution imagery (2-6cm) using a low-altitude, DJI P4 quadcopter drone (pictured above) carrying a multispectral camera. The drone captured images every two seconds for a grand total of 82,615 multispectral shots!

Along with being quite impressive, these high-definition images allow for better interpretation of seagrass density and more accurate distinctions between different submerged vegetation types such as eelgrass and rock weed. This effort is a great example of how PREP is using novel technologies for the benefit of our estuaries.

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EELGRASS

Growing Grass in Great Bay

Here at PREP, we love eelgrass! A corner stone species of healthy estuaries, eelgrass provides numerous water quality and resilience functions like stabilizing sediments, capturing and storing carbon, and providing habitat for fish, crabs, lobsters, and more! Unfortunately, our Great Bay Estuary has lost over half its eelgrass acreage over the last few decades due to stressors including poor water quality. But with over \$200 million recently invested in wastewater treatment facility upgrades across the watershed, and promising trends in water quality and eelgrass abundance, now may be the time to start actively helping our favorite aquatic perennial on the road to recovery.

In 2021, PREP partnered with local eelgrass scientists and practitioners – Dr. David Burdick from the University of

New Hampshire and Dr. Alyssa Novak from Boston University, staff from the Great Bay National Estuarine Research Reserve and The Nature Conservancy (TNC), and the Great Bay-Piscataqua Waterkeeper – to plant experimental eelgrass beds around the Estuary.

Last summer, the project team and a host of volunteers transplanted eelgrass at five sites in the Great Bay Estuary specifically selected using results from an updated suitability model identifying locations of high potential for eelgrass recovery. A total of 8,000 eelgrass shoots were harvested from two donor beds and transplanted using two different techniques: planting individual shoots by hand (just like working in the garden!) and tying multiple shoots to weighted wire frames known as TERFS. After



In 2021, PREP and partners started our new eelgrass “Tier 2” monitoring program, collecting measurements including coverage, density, and biomass throughout the estuary. This will greatly refine our understanding of eelgrass health in Great Bay.

waiting several weeks to allow the eelgrass to get established, TERFs were carefully removed. With the help of student volunteers, these sites were periodically monitored using snorkel and video equipment throughout the summer and fall of 2021.

Results from this first pilot-scale restoration effort are providing crucial data to inform subsequent eelgrass restoration projects over the next few years, with a goal of larger scale restoration activities in the near future. Funded by the Great Bay 2020 Collaborative and TNC, this work represents an important step forward on our mission for healthier, more abundant eelgrass and a more resilient Great Bay Estuary.



Divers harvest eelgrass shoots from the Piscataqua River. *Photo by Grant Milne*

SHELLFISH

Designing a Plan for Oysters

Defining the 'Where' and 'How' of Oyster Restoration in New Hampshire

To those who know estuaries, an oyster is a sign of resilience. Each homely bivalve is a veritable workhorse, filtering tens of gallons of seawater daily and keeping our estuarine waters clear. And when they build themselves up into reefs, these subtidal structures stabilize sediment and become ideal habitat for an abundance of fish and benthic critters. With populations in Great Bay having plunged since the 1990s due to disease, The Nature Conservancy (TNC) has worked with the University of New Hampshire on restoring oysters since 2009. However, with the need for more strategic restoration efforts, TNC initiated "Restoration by Design" in 2017, a Natural Resources Conservation Service funded project that culminated with a near-term, spatially explicit plan for where and how to restore oysters in the estuary.

The plan established site suitability criteria for restoration by integrating ecological and physical data, including current and historic reef assessments, eelgrass distribution, and oyster population dynamics, with social interests, such as permitting requirements and aquaculture lease areas. An

OYSTER FACT:
On average, one adult oyster can filter up to 30 gallons of water per day, removing excess nutrients and suspended particles from the water.



Photo by Ray Grizzle, UNH

inclusive process of public engagement and feedback, developed through a collaboration between PREP and TNC, was used to review criteria and inform the final plan. Along with recommending multiple methodologies of oyster restoration across seven specific locations, the final report also advocates for different management actions such as temporary closures to recreational harvest at specific reefs, as well as suggesting further research in areas including integrated oyster-eelgrass restoration.

The completion of this comprehensive plan is an exciting step forward for oyster restoration in NH and sets the stage for robust, strategic action and investment in our estuary. For more information, email Brianna Group at Brianna.Group@tnc.org or read the report and more at www.nature.org/nhoysters.

An Oyster Restoration Retrospective

With population losses of nearly 90% of our wild oysters since the early 1990s, restoring oyster reefs is an integral part to promoting a more resilient Great Bay Estuary. But how successful are our efforts and what have we learned? A recent article published in the Dec. 2021 issue of *Ecological Restoration*, "Oyster Reef Restoration in New Hampshire, USA: Lessons Learned During Two Decades of Practice," details the findings from three assessments of over 20 projects in the estuary since 2000. Along with valuable reflections and data, the study highlights two significant factors to restoration. First, with much higher recruitment and spat densities on sites less than 1km from natural reefs, site selection is critical to restoration success. And second, burial of restored reefs is a major challenge in our estuary, so construction of reef bases to minimize sedimentation is equally important. Lessons like these are crucial as we continue to support our local oysters.

FISH

What's Great Bay Worth to a Fish?

Determining the Value of Estuarine Habitat for Rainbow Smelt

Estuaries, like our Great Bay, are extremely important for many types of fish. They provide critical hunting, spawning, and nursery habitat, and many commercially significant species will spend time in them at some point in their lifecycle. However, the specifics of how, where, and when certain species use the estuary are not always well understood, often resulting in conservation or management challenges.

The rainbow smelt (*Osmerus mordax*) is an important diadromous fish (meaning it migrates between fresh water and the ocean during its life) that supports popular recreational sport and ice fisheries in northern New England. Unfortunately, migratory populations have declined in recent decades and rainbow smelt are now listed by NH and federally as a species of concern. To help reverse this

negative trend, stock enhancement and habitat restoration projects, such as dam removal, are often prescribed to boost natural productivity, but there are no assessments of how long rainbow smelt stay in different habitat types, particularly in estuaries. To fill this gap and strengthen the impacts of these conservation efforts, Dr. Nathan Furey and Dr. David Berlinsky from the University of New Hampshire and Dr. Benjamin Walther from Texas A&M Corpus Christi are leading a project to detail the migratory behavior of rainbow smelt and how they value different estuarine habitats throughout their development.

By collaborating closely with NH Fish & Game and NH Sea Grant, and engaging citizen scientists and the recreational fishing community, project



Photo by Tim Briggs, NH Sea Grant

researchers are determining the time smelt spend in specific habitats over different life stages using otolith microchemistry and tracking tagged adult smelt migrations with acoustic telemetry. Results from these research techniques will be used in tandem to provide a comprehensive view of estuarine use by rainbow smelt, improving future management efforts by helping managers identify optimal stocking sites and prioritize locations for restoration. For more information, email Dr. Nathan Furey at Nathan.Furey@unh.edu or follow on Twitter @NBFurey.



Rainbow smelt support important fisheries like recreational ice fishing, seen here along the Squamscott River in Exeter, NH

SALT MARSH

Prioritizing Marsh Management for Saltmarsh Sparrows



Photo by Mike Kilpatrick

An undeniably cute bird, the saltmarsh sparrow (*Ammodramus caudatus*) spends its entire life in salt marshes along the Atlantic Coast and nests exclusively in less frequently flooded "high marsh" areas from Virginia to Maine. Sadly, the population of this adorable, coastal songbird has seen a staggering 80% decline across its range over the last 15 years,

primarily due to nest loss caused by sea-level rise, more frequent flooding, and habitat degradation and loss. To sustain the populations of these birds, organizations and partnerships, such as the Atlantic Coast Joint Venture (ACJV), look to identify, protect, and restore salt marshes that act as valuable breeding habitat for the sparrows.

To help support the ACJV's sparrow population goal in New Hampshire, a working group of conservation partners, led by the Great Bay National Estuarine Research Reserve (GBNERR) utilized the latest data to classify salt marsh areas that are good candidates for restoration to provide persistent nesting habitat. Using a draft, high-resolution, GIS mapping tool of New Hampshire salt

marshes, currently being developed by GBNERR and other Federal and state agencies and organizations, local marsh complexes were assessed on a number of characteristics affecting their condition, vulnerability, and adaptability. This spatial analysis of marsh resilience was coupled with the local knowledge and expertise from the working group to produce a list of priority salt marshes with recommended management actions to maintain or restore high-quality saltmarsh sparrow habitat. This list will serve as a valuable resource for restoration practitioners looking to implement projects that would enhance the state's salt marshes and benefit this lovable little sparrow.

Developing Living Shorelines for New Hampshire

Science tells us that traditional "grey" shoreline erosion control techniques such as rip-rap revetments and seawalls are harmful to natural ecosystems such as salt marshes. Around the country, nature-based living shoreline techniques are beginning to replace traditional, grey infrastructure as the preferred best practice for shoreline stabilization. With a goal to support new living shoreline development here in New Hampshire, the NH Department of Environmental Services Coastal Program and its partners kicked off the Great Bay Living Shorelines Project in 2021. Through this initiative, the project team is working with community members and landowners to identify four new living shoreline project sites, develop conceptual designs, provide practical living shoreline design learning opportunities for professionals, and share recommendations for future living shoreline projects. To learn more, please visit:

www.nhcaw.org/greatbaylivingshorelineproject.



Project participants observing an eroding salt marsh.

Photo by Lynn Vaccaro, GBNERR

LAND CONSERVATION

A Turning Point for Conservation

Conserving undeveloped land is one of the best and most cost-effective ways of protecting the quality of our local waterbodies and habitat for our local wildlife. However, all parcels are not made equal, and since 2006, conservation groups in our region have used the Land Conservation Plan for New Hampshire's Coastal Watersheds – a plan based on the best available science at the time – as well as other supplemental resources, to help guide and prioritize their land protection investments. But just as the best available science becomes updated over time, so too must our management plans, and in the summer of 2021, The Nature Conservancy in NH, in partnership with the Great Bay Resource Protection Partnership and others, completed the 2021 update of the NH Coastal Watershed Conservation Plan. This updated

plan gathers and synthesizes the latest conservation science and resources to prioritize protection efforts in the Piscataqua Region watershed. These priorities represent a broad set of conservation targets and values including water quality, regionally important wildlife areas, migratory bird habitat, working landscapes, recreational and educational opportunities, climate resiliency, and landscape connectivity. The 2021 plan represents a turning point for conservation in our region, and recognizes that, while tremendous progress has been made over the last 15 years, considerably more conservation still needs to be done to protect our natural systems and the human communities they support. To learn more, visit www.greatbaypartnership.org/conservation-planning/conservation-planning-tools/.

OUR WORK CONTINUES

Although 2021 had its share of challenges, it was still a year full of new and exciting efforts and meaningful progress spearheaded by the passionate and committed people who live, work, and play in this watershed. It is always encouraging knowing that we have a community dedicated to the health and resilience of our natural resources and estuarine systems. To join that community or learn more, get in touch. And be sure to check out our State of Our Estuaries report later this year!

Questions or comments? Please contact:

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PREP Support for Habitat

Historic Totals (2006-2019)

Conservation or restoration acres supported: **16,950**

Total value: **\$15,764,882**

Past 2020/21 Year

Conservation or restoration acres supported: **1,607**

Total value: **\$6,996,388**

ACKNOWLEDGEMENTS

PREP thanks the following individuals for providing or reviewing content for this publication:

Dea Brickner-Wood
Great Bay Resource Protection Partnership

Nathan Furey
University of New Hampshire

Ray Grizzle
University of New Hampshire

Brianna Group
The Nature Conservancy

Kirsten Howard
New Hampshire Coastal Program

Chloe Pearson
University of New Hampshire

Michael Routhier
University of New Hampshire

Peter Steckler
The Nature Conservancy

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Great Bay National Estuarine Research Reserve

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This publication was produced by the Piscataqua Region Estuaries Partnership with funding from the U.S. Environmental Protection Agency through an agreement with the University of New Hampshire.