

Great Bay

MATTERS



*Promoting research, education
and stewardship throughout
the Great Bay Estuary*

GET TO KNOW GREAT BAY



**NINETY-EIGHT
FEET**

A natural buffer of this width
can remove pollutants,
provide habitat for
aquatic insects, and
influence water temperature

29

RESERVES
AROUND THE COUNTRY MONITORING
**COASTAL
PLANTS**

197

volunteer hours
helping with
Reserve field research
in 2019

12,000

stems of
saltmarsh
grass per m²
in the
high marsh



800

stems of
saltmarsh
grass per m²
in the
low marsh

BLUE CARBON:

Carbon captured by the world's oceans and coastal ecosystems



CARBON SINK:

Salt marshes "capture and hold" carbon below ground



GREAT BAY
NATIONAL
ESTUARINE
RESEARCH
RESERVE

Great Bay National Estuarine Research Reserve (GBNERR) is an estuary comprised of 7,300 acres of tidal waters and 2,935 acres of coastal land. Acquired through land purchases and conservation easements, GBNERR was designated on October 3, 1989 to be preserved for the purposes of education, research, and resource protection.

GBNERR

Manager: Cory Riley

GREAT BAY DISCOVERY CENTER

Education Coordinator:
Kelle Loughlin

GREAT BAY STEWARDS

Chair: Deb Alberts



89 Depot Road,
Greenland, NH 03840
603-778-0015

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manager's corner



Saving Saltmarshes

Reflecting on 2020, I am grateful for the comprehensive nature of the National Estuarine Research Reserve System. Our education programs paused, the Discovery Center closed to visitors, and our Coastal Training workshops went online. But, because we are a place-based system that also engages in stewardship and research, some of our work could continue uninterrupted. We remain a place for people to visit and find peace and we continue to serve as a platform for relevant science. This issue of Great Bay Matters highlights two research efforts led by Great Bay NERR staff that look into the fate of saltmarshes here and around the country. The saltmarsh just

behind the Discovery Center serves us all- its beauty calms the early morning walkers enjoying the boardwalk; the marsh grasses provide perfect cover for juvenile fish and birds; the dense biomass slows down floodwaters and acts as a "sink" for carbon. Saltmarshes have evolved to handle change- they thrive in an environment where the level of water and salt swing every day. But even our hearty saltmarshes are in danger of drowning as sea level rises. As the climate impacts on NH's coast become clearer, it is increasingly important for us to study what is happening now and what could happen in the future to save this critical piece of our coastal landscape. Being a part of a national network allows GBNERR to collaborate with coastal habitat experts from around the country to create transferable monitoring protocols and science products that help us both locally and nationally. Here in NH, these studies can directly inform restoration and conservation efforts in the Seacoast. Nationally, these efforts can help prioritize where and how to conduct national surveys of saltmarsh health and direct federal protection efforts. This year has demonstrated that our health and our future is interdependent on the people and places that surround us.

Cory Riley, Reserve Manager, GBNERR

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RISING TIDES



A Geospatial Screening Tool to Protect Marshes from Sea Level Rise

Saltmarshes provide all of us with important benefits like fisheries habitat, water filtration, flood control and carbon sequestration. They are one of the most valuable habitat types and unfortunately, they are also the one that is most threatened by climate impacts. Over the past fifteen years, the National Estuarine Research Reserve System (NERRS) has been studying tidal wetlands across the country. From the mangroves of Jobos Bay in Puerto Rico to the extensive saltmarshes of Sapelo Island Georgia- the Reserves have been mapping where the wetlands are, and monitoring their condition. One of the strengths of the NERRS is that our science is done at multiple scales; field biologists use similar protocols across the country to monitor vegetation at sampling sites and scientists also use remote sensing to map habitats from the landscape scale. Both types of data can answer local questions about how things are changing over time, and both types are now being used to understand national patterns and predict what might happen in the future.

GBNERR's Stewardship Program has been leading an effort to create a science-based tool to assess tidal wetland resilience and recommend appropriate actions to ensure that they persist in the face of sea level rise and coastal storm surge. A national effort has used landscape-scale information that is publicly available to create a consistent system for defining individual marsh boundaries and evaluating each marsh for

current condition, vulnerability to sea level rise, and adaptation potential. Taken together, these three elements give each marsh a resiliency ranking based on an index of metrics that are ingested into a geospatial model.

- A Marsh Unit is an area of tidal wetland with broadly similar land use / land cover and hydrology. At the national scale the boundary is typically drawn based on major waterways, roads or breaks in the marsh due to other built infrastructure and range in size from 1,384 acres in southern California to one in Texas that is over 2 million acres.
- Current marsh conditions includes measures of a marsh's core area compared to its exposed and un-vegetated

edges and the surrounding impervious, agricultural, and natural land cover. More edges, especially if not vegetated, expose more of the marsh to potential erosion. Impervious and agricultural cover can contribute to runoff and pollutants that degrade marsh conditions, while increased natural cover mitigates those effects.

- Vulnerability to sea level rise is based on soil erodability, total tidal range, and the percentage of marsh below mean high water and mean sea level. Marshes are more vulnerable to sea level rise when more of their vegetation is lower in the tidal frame, especially when that frame is not large. Erosion of marsh soils could increase with more frequent inundation.

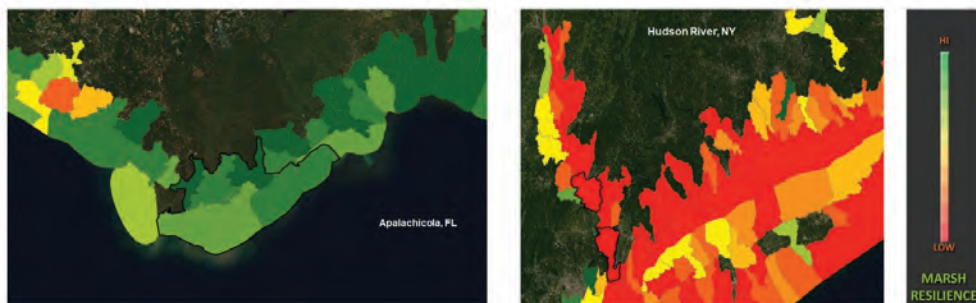


Figure 1: Comparing resiliency across the country: The most resilient Reserve in the contiguous US is Apalachicola in Florida. The least resilient is Hudson River in New York. The steep sided valley it is located in is a major driving factor as there is little room for marshes to migrate inland as sea level rises (graphic credit: NOAA).

- Adaptive capacity includes shoreline sinuosity (a measure of how curved it is which is an index of biodiversity) and armoring (hardening); the amount of space available into which the marsh might move (migrate) into in the future, given sea level rise; and future marsh connectedness.

The results of the national assessment offer a way to compare the resilience of marshes around the country. This type of information sets NERRS up to do comparative studies with like marshes, offers suggestions on where to focus protected areas or new monitoring sites, and may help focus large restoration investments made at the regional or federal level. (fig.1)

While understanding resilience at the watershed scale is useful nationally, a “down scaled” closer look at New Hampshire marshes has offered more specific guidance to prioritizing restoration and land protection projects. Working with partners at the National Oceanic and Atmospheric Administration, detailed habitat maps with finer resolution data have been developed to create much smaller “marsh units” for New Hampshire. The marsh units were reviewed with colleagues at The Nature Conservancy, NH Coastal Program and UNH to make edits based on local knowledge. This process resulted in a network of 224 marsh units that range in size from a 0.3 acre fringing marsh along the Piscataqua River to a 212 acre unit in the Hampton-Seabrook estuarine system. (fig.2)

GBNERR received a grant from the NH Coastal Program to customize the national landscape scale assessment model using additional, finer scale geospatial data and created resiliency metrics for all of New Hampshire’s saltmarshes. Next, a team of restoration practitioners, land use policy experts, scientists and land protection professionals worked to match the resiliency scores with appropriate management actions based on the combination of current condition, vulnerability, and adaptation potential.

The result is a GIS based screening tool. Each marsh in NH can be selected and the user can see the resiliency metrics and determine where land protection, restoration and land use policy changes could have the biggest impact

in protecting tidal wetlands and helping them sustain in the face of sea level rise. (fig.3)

This project demonstrates how the NERRS are working at the national scale and at the local scale to produce science that can be practically applied to decisions that are made on the

coast. Our monitoring data has shown that saltmarshes are threatened by sea level rise. As a NERR, we do not just use science to identify a problem; we use it to help solve it.

Cory Riley, Manager, GBNERR
Rachel Stevens, Stewardship Coordinator, GBNERR

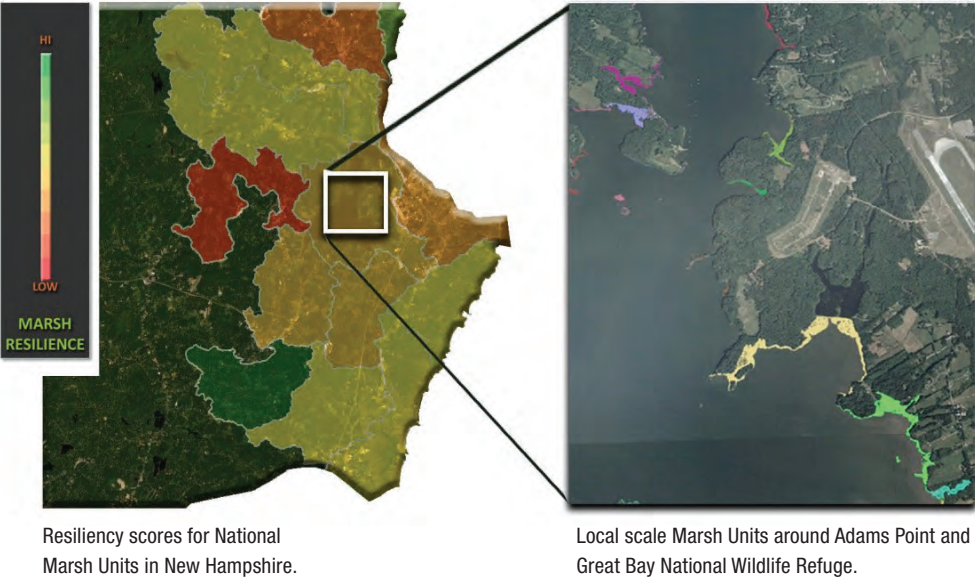


Figure 2: Marsh Units at different scales. Thirteen national scale marsh units cover New Hampshire. They have been subdivided into 224 marsh units based on NOAA high resolution tidal mapping data to create a framework for systematic study and decision support at the local scale.

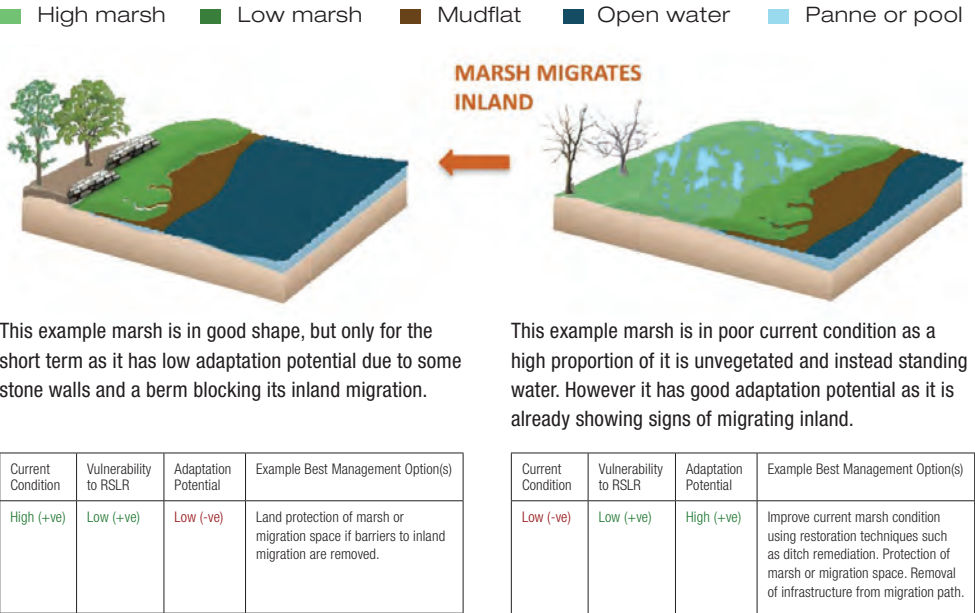


Figure 3: Matching management options to resiliency characteristics. Different marsh resiliency conditions determine what the best management options are for each marsh unit in a strategic and cost effective way (Graphic credit: GBNERR)

ARE NEW ENGLAND MARSHES DROWNING?



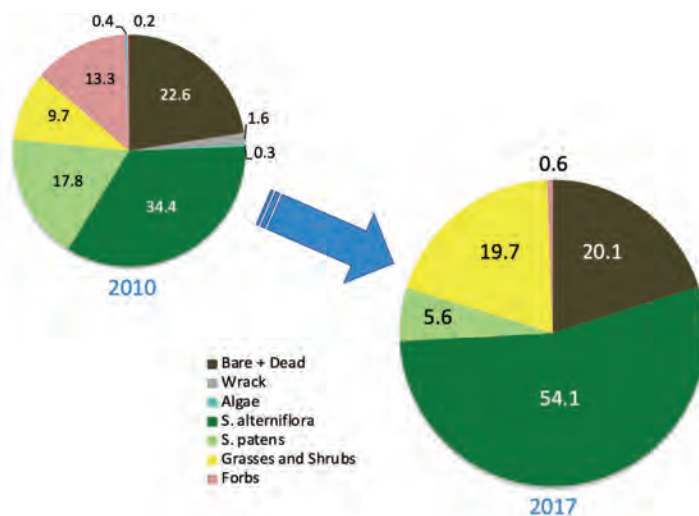
Oceans are rising at an alarming rate with future predictions almost impossible to comprehend. Rising seas will impact coastal communities in multiple ways, including flooding of homes and businesses and infiltration into drinking water. Saltmarshes, in particular, are at great risk of 'drowning' from sea-level-rise. These saline grasslands naturally build with rising seas by trapping sediments from the tides and by adding a matrix of roots and rhizomes to the soil, or peat – but they may not be able to keep pace. Coincidentally, the building of peat is also the main mechanism of carbon storage in marshes, which along with other coastal wetlands (mangroves and seagrasses) account for more carbon sequestration than

any other ecosystem in the world. Losing coastal marshes will amplify carbon dioxide levels in our atmosphere, further warming the planet

and increasing sea levels.

Over the past decade, scientists have been tracking the effects of rapidly rising oceans on saltmarshes. Great Bay Reserve (GBNERR), along with other Reserves around the country, began monitoring impacts to saltmarshes in 2010. This wealth of data led the GBNERR and UNH professor, David Burdick, to ponder what the data was showing. Have saltmarshes throughout New England been able to keep pace with rising seas?

A team of scientists from Rhode Island to Maine set out to answer the question of how saltmarshes have responded to rising seas over the past decade. Using graphical visualizations, univariate and multivariate statistics, and inundation modeling,



*Plant community data shown from low to high marsh transition plots in Great Bay, NH showing an increase of the flood tolerant *S. alterniflora* at the expense of less flood tolerant *S. patens*.*



Time-series tracking a single plot in the low marsh at Narragansett Bay, RI showing a drastic loss of plants in only 5 years.

significant trends found that marshes are shifting throughout New England, indicating greater flooding and overall, a wetter environment.

Shifts in plant communities become clearer when analyzed by marsh zone. In the low marsh, where tides typically flood twice daily, the dominant plant (*Spartina alterniflora*) is dying off, leaving bare soils and standing water. The time series photo below shows how one monitoring location in Narragansett Bay Rhode Island went from completely dominated by *S. alterniflora* to almost entirely barren in just five years. Immediately upslope in the high marsh, flooded only a handful of times monthly, grasses such as *S. patens* are giving way to the more flood tolerant *S. alterniflora*. "Essentially, the entire marsh is migrating upslope to find

refuge from rising oceans", said Christopher Peter – GBNERR's Research Coordinator.

Southern New England marshes in Rhode Island and Cape Cod, have experienced the most dramatic changes. The team suspects southern marshes are more sensitive to rising seas, not because of their latitude, but because of their relatively small tidal ranges. If a marsh has only a couple feet of tidal water fluctuation, then an increase in water levels is proportionally much larger compared to marshes with over 10 feet of tidal range. Northern marshes with their large tidal ranges, support this hypothesis by showing less dramatic changes to the plant communities.

This first of its kind New England study shows the vulnerability of saltmarshes to sea

level rise in both microtidal (more vulnerable) and mesotidal (less vulnerable) estuaries. Results serve as a call to action for those who might be uncertain whether marshes are truly at risk. Managers should consider assisting systems to cope with unprecedented increases in sea levels. Tools at their disposal include experimental marsh restoration, reducing historical ditching sites, and allowing marshes to migrate into terrestrial areas, by removing barriers and protecting habitat. The results highlight how saltmarshes are being transformed and lost, and provide a strong case for continued monitoring, research, and management to prevent further loss.

Chris Peter, Research Coordinator, GBNERR

Estuary Almanac

Common Glasswort - (*Salicornia depressa*)

Take a walk in the saltmarsh along Great Bay and you will find an interesting looking plant called Glasswort (*Salicornia depressa*). Glasswort is a succulent herb also known as 'Pickle weed' or 'Marsh samphire'. It can be found around beaches and in saltmarshes like Great Bay. Living within a saltmarsh is not something most plants can do. Glassworts however, thrive in a salty environment due to their specialized adaptations. These unique marsh plants are called halophytes. This means, that they are a salt tolerant plant species able to grow in a habitat with high salinity. As halophytes, they are able to accumulate and store salt within their leaves and stems which allows them to survive in this type of habitat.

Glasswort is among the most common saltmarsh plants found in New Hampshire, and are distributed worldwide. In Great Bay, they are considered to be a pioneer

species. This means that they are typically the first plants to grow in disturbed areas and their presence helps establish surrounding species. These particular pioneer plants send oxygen down into the mud through their roots. This oxygenates the soil, which roots need to survive and reduces toxic substances like sulfides, which allows other plants like sea lavender, to grow.

Glasswort plants are relatively small and have jointed, bright green stems. During the fall, these asparagus looking plants turn red or purple. Their leaves are small and scale-like, and they produce fleshy fruits that contain a single seed. The stems of Glasswort are edible and can be eaten raw or pickled. One unique use of the Glasswort plant results from the fact that their dried ashes contain potash. Potash is potassium oxide which is used in soaps and glassmaking. This property is what gave the resilient saltmarsh plant its name – the Glasswort!

Kelsey Hanson, Naturalist, GBNERR



Common glasswort



Glasswort in autumn



NERRS NEWS



Program News and Events From GBNERR

OSPREY BANDING AT GREAT BAY DISCOVERY CENTER

The Great Bay Discovery Center has been enjoying a pair of ospreys on the edge of the property for close to a decade now. For several years the pair successfully nested on a platform installed on a tall white pine rimming the edge of the saltmarsh. A pair of ospreys once again returned to the nest and under the guidance of ornithologist, Robert S. Kennedy, Ph.D (Bob), both the adults and one juvenile were banded during the summer to begin monitoring the pair and its offspring.

According to Bob, this is his 50th year working with osprey after an impressive career researching raptors all over the world including 20 years working in the Philippines with the Philippine Eagle.

How do you catch a bird with a six foot wingspan? First, as humans approach a nest, the female flies off leaving the nest empty. A screen with a series of micro-thin loops is then laid upon the nest. With humans out of sight, the female returns to resume incubation and her talons are quickly ensnared. The osprey is gently carried down the ladder where a small leather hood is placed over its head to calm the bird. Banding the leg is done quickly and the female osprey is held until the male, with similarly strong instincts to incubate, returns and is caught in the

same fashion. The female is then released to return to incubation. At the time of this writing, a new camera (replacing a damaged one) has been installed on the nest and will be ready for the pair's return in the spring of 2021.



© NANCY ECKERSON

NATIONAL SALTMARSH STUDY MOVES FORWARD

Great Bay NERR continues to be a leader in saltmarsh science. A proposal led by GBNERR's Research Coordinator, Chris Peter, was recently recommended for funding in a national research competition to further study the impacts from rising seas on saltmarshes. This new project builds off the recently completed New England saltmarsh study, which found drastic changes to saltmarshes occurring in 4-8 years from rapidly rising seas, by using data from on-the-ground monitoring stations. More detail on the regional study is found in the feature article (pg 4). The future project will widen the scope to examine the impact

of rising oceans on tidal marshes across the entire country, including all 3 U.S. coasts and even Alaska. This 3-year grant is funded by the NERRS Science Collaborative, a partnership

between the University of Michigan and the National Oceanic and Atmospheric Administration.

The work is slated to begin early next year and involves scientists and managers from 21 different Reserves as well as researchers from the University of New Hampshire and Clemson University. "We are excited to work with so many other Reserves to advance

the science on marshes that can help inform regional and national management," said Peter.





Educational Offerings



SIT A SPELL IN YOUR SIT SPOT

In your life, is there one constant that can always be relied upon to bring you comfort, particularly in times of stress? For me, that is nature. For so many who have found their daily routines completely, unexpectedly altered, when you are really finding yourself needing a break, can I suggest hitting pause on all the pressing things that might need to be done, and ask you to just step outside? Find a quiet spot in the forest, your backyard, or on your front porch, to sit for a moment and just breathe. Is there a strong earthy scent as the dirt and leaves are baking in the early autumn sun? How many birds can you see or hear? Are there any insects crawling or flying about? Any leaves beginning to turn? Any blades of grass beginning to wither or signs that animals are beginning to prepare for the long winter ahead? Do you feel the breeze on your face as you tilt it up to the sky to soak up the final days of true

warmth? Take a couple more deep breaths and enjoy before you have to go back. Feel better?

If you have kids, of any age, I would encourage them to do the same. Have you ever heard of a sit spot challenge? I challenge/invite you to do this every day for 30 days. Find a special spot that you can visit for at least 15 minutes every day. Start a journal to keep track of what you notice each day and what changes over the course of 30 days. Vary the time of day you visit and see how the activity level changes. Venture out

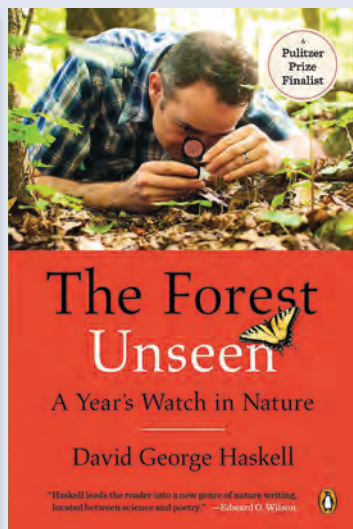
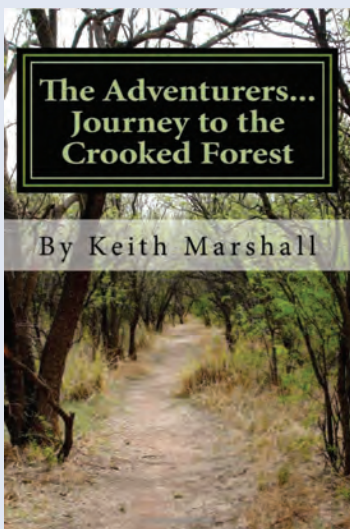


© JAY SULLIVAN

to visit your spot at night so you can also listen for owls or watch the stars come out.

In the hectic, stressful pace of our daily lives, it is easy to get overwhelmed or lose perspective. For me, taking the time to go outside, listen and just be, grounds me. It makes me feel reconnected and, indeed, a part of everything around me. It is a good reminder that sometimes, the small things can really be huge.

If you are someone that loves a good book, I have two great suggestions. *The Forest Unseen: A Year's Watch in Nature* is a Pulitzer Prize finalist by David George Haskell. While sharing his experience of visiting a patch of old growth forest in Tennessee for a year, he weaves a great story about ecology and science, while including his personal reflections on life. If you are looking for a great read aloud to share with the whole family, I can highly recommend, *The Adventurers... Journey to the Crooked Forest* by Keith Marshall. This one will bring back all the fond childhood memories of playing for hours in the woods. Happy Discovering.



Jay Sullivan, Staff Naturalist, GBNERR

A National Perspective: *Welcome Davidson Fellows!*

NOAA's Office for Coastal Management has announced the first cohort of the Margaret A. Davidson Graduate Fellowship program (2020-2022). This new program offers graduate students the opportunity to conduct estuarine research at a National Estuarine Research Reserve.

NOAA awarded one fellowship at each of the 29 Reserves. During their two-year projects, these fellows will employ collaborative research principles, including engaging end-users, incorporating multi-disciplinary perspectives, and ensuring outcomes are applicable to local management needs and decision-making.

Fellows will be mentored by

professionals working at the national and local levels and will have access to professional development opportunities that help build the skills that coastal professionals need. Due to COVID-19, the students and mentors will connect virtually, and each Reserve will work within the rules of their

Hampshire. Anna will be working on a project that models how nitrogen and light attenuation factors influence Great Bay's ecology.

Article reprinted in part from the National Estuarine Research Reserve Association website <https://www.nerra.org>.



© PHOTO COURTESY OF WELLS RESERVE

Davidson Fellows will have the opportunity to conduct collaborative research at every Reserve.

state to support their fellow.

"We are thrilled to administer this new program to honor Margaret Davidson's legacy, and to recognize the sustained and passionate effort of the many folks who worked so diligently to bring this new fellowship to reality," says Dr. Jeff Payne, director of NOAA's Office for Coastal Management (OCM).

Great Bay will be welcoming Anna Lowien from the University of New



Volunteer for Great Bay!



Volunteer opportunities are dependent on the Covid-19 situation, and may change to ensure the safety of volunteers, staff, visitors, and students.

- **Fall School Program:** Spend time outside and educate school groups about the cultural history of Great Bay! To be resumed in 2021.
- **Other Opportunities:** Like to garden? Handy by nature? Want to participate in field research? There is an opportunity that is right for you!

Interested in becoming a volunteer or have questions? Contact Melissa Brogle at melissa.brogle@wildlife.nh.gov or 603-778-0015. You can also learn more at <https://www.greatbay.org/get-involved/>.





Meeting Challenges

On a cool weekend in April earlier this year, we sincerely missed our artists and friends at what would have been our 16th annual Art of Great Bay. We still hope to hold the event at a later date though the presentation may be slightly different from our shows in previous years. In exchange for visitors to the buildings of the Discovery Center, it has been gratifying to see so many people out on the grounds and

enjoying nature during these complicated and changing times. The staff has spent many hours improving the gardens and pathways, so please stop by and enjoy the grounds.

For my part, I've been gardening, planting vegetables and new beds of pollinators, coneflowers, hostas, and sedum, as well as walking and kayaking along the Oyster River near my home. At the Discovery Center, visitors have been putting in kayaks, strolling the boardwalk to view the osprey nesting on the new platform on the right of the boardwalk, and enjoying viewing the yearly migration of the horseshoe crabs, all while responsibly socially distancing and

with many wearing masks.

We are so grateful this year for your overwhelming response to our annual appeal, especially in these challenging times. Thanks to your support, we will be able to meet many of the goals we set to support our friends at the Reserve.

This year's project list includes: enabling online access to the camera overlooking the Discovery Center osprey nest; bringing students from socio-economically disadvantaged schools on Discovery Center field trips; completing a new exhibit on horseshoe crabs at the Discovery Center; and providing time and supplies toward research projects in the estuary, including continued DNA monitoring of invasive species as well as understanding the role of invasive crabs in the region. We're so grateful to the amazing Reserve staff for all they have continued to accomplish during this time, and to you, our supporters, for helping make it possible. We could not do this work without you.

As I write this, we are still hoping to have the Great Bay 5K this fall. We hope to see you there, if not sooner. In the meantime, please stay safe and be well.

It's a great time to make a difference.

Deb Alberts, Chair, Great Bay Stewards

Get Your Boots Wet!

On a gorgeous September morning last fall, a group of scientists and volunteers could be found parked along a road in Newington, N.H., then making their way down a thin trail into the marsh. We were there to collect data on the plant species that call our region's saltmarshes home. Information collected through this research has shown a plant community shift throughout New England saltmarshes that is indicative of accelerated rising seas, creating more flooding on the marsh. Volunteering with the research being done by Reserve staff was a wonderful chance to



interact with other Stewards, University of New Hampshire scientists, and staff from the state Department of Environmental Services. While this volunteer only got out there for one morning's worth of research, a total of 170 hours of volunteer time went into collecting data last season. We're grateful for our ability to serve as a fiscal agent on grants focused on saltmarshes, as well as the opportunity to occasionally get our boots wet.

Allison Knab, Executive Director



PLEASE JOIN US!

All interested parties are cordially invited to become Great Bay Stewards. Members receive Great Bay Matters and other pertinent mailings.

Annual dues may be paid by check made payable to the **Great Bay Stewards** and sent to: GBS Membership Committee, 89 Depot Road, Greenland, NH 03840

- ☐ Guardian \$150 ☐ Protector \$75
☐ Steward/Family \$35 ☐ Student \$20 ☐ Other \$ _____

name _____

address _____

town _____

state _____ zip _____

email _____



GREAT BAY 5K & 55k Challenge! October 1-24

To ensure the safety of our participants and volunteers, the *Great Bay 5K | Race for a Healthy Estuary* will be going virtual this year! Complete a 5K any time between October 1 to 24 and receive a long-sleeve race t-shirt, as well as a race bib redeemable for complimentary beer, cider, and oysters.

And new this year ...

The Great Bay 55K Challenge

Run or walk this virtual (or real) circuit of Great Bay - New Hampshire's largest estuary! Track your distance completed along the way and you'll reach special "milestones," with information on interesting land or water features at each location. Participants will receive a special racing hat as well as a race bib redeemable for complimentary beer, cider, and oysters.

Sign up now at greatbay5k.org

