Stone Living Lab

Quarterly Summary
Research, Monitoring & Education Projects

Winter 2024

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About the Stone Living Lab

The Stone Living Lab (SLL) partnership is an innovative and collaborative initiative focused on testing and scaling up nature-based approaches to climate adaptation in Boston Harbor and beyond. We are a unique partnership between government agencies and nonprofits: UMass Boston School for the Environment, Boston Harbor Now, the City of Boston, the Massachusetts Department of Conservation and Recreation, the Massachusetts Executive Office of Energy & Environmental Affairs, and the National Park Service.

As a "Living Lab," we bring research into the real world by engaging scientists and the community in collaborative design and exploration. Our work brings us not only along the coastline of Boston Harbor, but into the water itself and out among the Boston Harbor Islands and other locations. Our areas of focus are research and monitoring, education and engagement, policy innovation, and climate preparedness.

From the Directors

Happy New Year! We are excited to share our second *Quarterly Summary of Research, Monitoring, and Education Projects*, which covers the period of September 1, 2023 through December 31, 2023.

Our featured project this quarter is Real-Time Monitoring in Boston Harbor, a project that we launched recently in collaboration with our partners at Woods Hole Group and the City of Boston. To learn more about this project, please see the coverage beginning on page 4.

In addition to this project, we are also sharing highlights for a range of projects that our team members are leading across the Lab's four areas of focus: research and monitoring, education and engagement, policy innovation, and climate preparedness.

We would love to hear your feedback! Please share recommendations with us about how to make this summary most useful to our network of municipal and community leaders, practitioners in the field of climate resilience, fellow researchers, and the general public.

Sincerely,
Joe Christo, Managing Director
Paul Kirshen, Research Director

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Featured Project
Core Research and Monitoring Projects - Real-Time Monitoring in Boston Harbor

Project Overview

This project - launched in the fall of 2023 in partnership with Woods Hole Group and the City of Boston - provides real-time monitoring of waves, water level, and meteorological parameters in and along Boston Harbor. The project is the next phase of work that the Lab has conducted since 2021, and provides a continuous time series of metocean data to evaluate normal conditions, changing climate, and storm conditions in Boston Harbor. All systems are real-time, and as such, will provide preliminary data to the web that can be viewed by the public as well as our researchers.

Updates

Boston Harbor Metocean Monitoring
In December, researchers redeployed the offshore wave buoy at the entrance to Boston Harbor following instrument service and mooring rebuild. The wave buoy is located northeast of Lovells Island, outside of the main navigation channel entering Boston Harbor. The buoy is equipped with a wave sensor, measuring wave parameters such as wave height, period, and direction; and a meteorological sensor, measuring wind speed and direction, air temperature, pressure and humidity.

With the nearshore wave buoy located off the northeast shore of Rainsford Island, we now have two metocean buoys in Boston Harbor actively measuring wave height, period, and direction.

During the December 28th storm, wave heights of up to 2 feet were recorded at the Rainsford Island Buoy and up to 4 feet at the Boston Harbor Entrance Buoy. At the same time, the NOAA NDBC Wave Buoy *(Boston Approach Station #44013)* located nearly 14 miles offshore of the Boston Harbor Entrance Buoy, recorded wave heights of 8 feet, illustrating the importance of having real-time data to capture changes in wave energy as storms approach Boston Harbor.

Wave Buoy at the entrance to Boston Harbor.

We continue to monitor tides in real-time at Gallops Island. A microwave radar tide gauge is installed on the Park Service Pier on Gallops Island, and has been recording water level near-continuously for over 20 months.

The Rainsford Island Meteorological Station is recording wind speed, wind direction, air temperature and pressure, among other meteorological parameters. The station was installed in January 2021 and has recorded

near-continuously since. During the December 18th storm, the station recorded sustained wind speeds of over 27 mph with gusts up to 50 mph.

We are in the early stages of developing a comprehensive public data dashboard to provide easily-accessible metocean data and visualization products to the public and decision makers.

Overland Flood Real-Time Monitoring

This fall, we launched a new monitoring effort to collect flooding data in the Boston area. Ultrasonic, acoustic sensors typically deployed over water to measure tides (as 'tide gauges'), were installed in low-lying overland locations. This is a unique application of these instruments to observe episodic water level information to help provide critical data about the residence time and depth of flooding in areas that are normally dry.

The Hohonu overland flood monitoring station at Long Wharf in Downtown Boston

From October to December, we installed the four Hohonu overland flood monitoring stations throughout Greater Boston: Long Wharf in downtown, along the inner harbor in East Boston, on the eastern side of Morrissey Boulevard, and at Tenean Beach, both located in Dorchester. We selected the station locations based on previously observed nuisance or 'sunny day' flooding during large spring tide events, and prioritized environmental justice neighborhoods.

These sensors measure the flood depth over the ground, and the data are transmitted in real-time. At present, data can be viewed here. The overland flood data will also be incorporated into the comprehensive public data dashboard.

As one example, approximately 1.5 feet of flooding was observed at the Tenean Beach walkway during the spring tide event on October 30th.

Core Research and Monitoring Projects - Cobble Berms

<u>Project Overview</u>

This project is evaluating the performance, morphology, and ecological impacts of recently constructed cobble berms (also called dynamic revetments) throughout coastal areas of Massachusetts using robust monitoring protocols. Additionally, the project is also providing education and outreach focused on coastal community planners, municipal staff, community advocates, restoration professionals, and engineers and designers who are working in the coastal zone.

<u>Updates</u>

Fall Sampling
In October and November of 2023, we resampled the cobble berm and control sites for sessile species cover and small mobile species abundance.

Fish-specific Autonomous Reef Monitoring Structures (FARMS) that had been installed in July from the Bayside cobble berm and control sites were removed for the season. Coughlin removal will be at a later date due to late tides and early sunset.

Broadly, FARMS at the berm were full of rock gunnels, green crabs, shrimp, and a few cunner. Control FARMS had mainly shrimp and crabs, with few fish.

Education
The Education team for the cobble berm project have also begun designing our Year 2 programming, including designing a series of factsheets and educational videos. Our 2024 field courses will include informational panels hosted by experts and municipal staff, to discuss the process of considering, designing, and implementing cobble berms in real-world scenarios. In addition, we will host a virtual "Permitting 101" program to help guide staff through the permitting process, and connect professionals with regulatory agencies and staff.

Core Research and Monitoring Projects - Living Seawalls

Project Overview

In 2021, the Sydney Institute of Marine Science's (SIMS) Living Seawalls Program was named a finalist in the Reviving Our Oceans category of the prestigious Earthshot Prize. In 2022, Earthshot organizers invited the Stone Living Lab to partner with the Living Seawalls team on groundbreaking research in Boston Harbor, which will build upon pilot research carried out by the Lab from 2020 to 2021. For this mutually beneficial eco-engineering approach to reach its full potential, we must understand how its benefits vary across a range of environmental settings. This project will establish the first installation of Living Seawalls' habitat-mimicking concrete tiles in North America and investigate ecological and other impacts of this nature-based approach on built structures in Boston Harbor.

Updates

Panel Construction
Stone Living Lab researchers collaborated with the Living Seawalls group to create a novel experimental design to look at the efficacy of five different panel designs.Panel construction is underway with an estimated delivery at the end of February 2024 for a March 2024 installation.

Fish Sampling
To assess the impact of Living Seawalls on fish, this fall we devised a novel method of sampling fish off of seawalls during high tide. With our fish-camera pipes, we observed a small number of small fish using current seawall habitat. We will perform the same sampling next summer after installation to assess changes in fish abundance and habitat use.

Meta-Analysis & Cross-Project Synthesis
We also began analysis and review of all extant seawall modifications to enhance marine life that has been published. The analysis focuses on changes in sessile and mobile species diversity and abundance. The work is ongoing into winter 2024, with a database of approximately 35 papers with multiple experiments per paper to re-analyze.

The Stone Living Lab Living Seawalls project team has also initiated conversations with a team in San Francisco Bay building a different version of living seawalls, as well as a similar group in Seattle. The three plan to come together to discuss results, lessons learned, and best practices in the United States.

Core Research and Monitoring Projects - Camp Harbor View Partnership Project

<u>Project Overview</u>

Camp Harbor View (CHV) is a summer camp for Boston middle and high schoolers located on the northeastern end of Long Island in Boston Harbor. The western and eastern sides of the camp have erosion issues and may have flooding that could increase over time due to climate change-associated sea level rise (SLR), as well as increases in tropical storm intensities. The Lab is partnering with CHV to document the nature of onshore and offshore physical processes (e.g. ocean waves, tidal currents, and sediment transport) and biological habitats for baseline assessment purposes; determine, based on those data, the causes and impacts of any erosion or flooding at the sites in question; and support the educational program of CHV.

<u>Updates</u>

Onshore Surveys

On October 5, 2023, a drone was used to collect topographic data in the study area. The aerial surveys were conducted at low tide to maximize the coverage of the terrestrial system. The resulting datasets - a high-resolution, orthorectified photomosaic, and a 3D digital surface (topographic) model - will provide a much needed high-resolution, high accuracy baseline inventory of current conditions that can also be used to measure both short-term (storm and seasonal), and long-term change (annual and decadal). Analysis of these datasets are ongoing, and final results will be provided in March 2024.

ADCP Deployment

On October 26, 2023, staff from UMass Boston deployed two Acoustic Doppler Current Profilers (ADCP) on either side of Long Island. These instruments were lowered to the seafloor and will collect data on waves, tides, and currents throughout the water column for approximately 3 months. In late January of 2024, researchers will retrieve the instruments, and then process and analyze the data from both locations. This will help quantitatively characterize the nearshore energy regime of the island through the bulk of the winter and capture any events with elevated water levels and/or high waves from either side of the island. These data will prove invaluable to help better understand change throughout the study period.

Education and Engagement Projects - Wicked High Tides

Project Overview

Each fall, SLL presents public programming centered on the perigean spring sides, also known as king tides. These "wicked high tides'', as we refer to them here in Boston, can cause "sunny day" flooding at a number of Boston landmarks like the New England Aquarium, and are particularly dramatic at Long Wharf and the Fort Point Channel.

Updates

Stone Living Lab Education and Engagement Program Manager Rebecca Shoer talks to a group of students during a wicked high tide event at Long Wharf. (Robin Lubbock/WBUR)

This year, Lab staff and our partners at Boston Children's Museum hosted two high tide events, with an additional trip to Long Wharf for the Norfolk Agricultural High School's sophomore climate change course.

Stone Living Lab, Boston Harbor Now, and Boston Children's Museum staff engaged with visitors and residents, as well as local press, and educated them about sea level rise and coastal flooding. For many attendees, this event is the first time they are confronted face-to-face with rising ocean levels, and the impacts it's already having on the city. It also provides an opportunity for attendees to ask questions and engage with staff in an open and non-judgemental forum.

In addition to engaging with over 100 members of the public, imagery from our wicked high tide programs was featured in WBUR's photographic year in review, "The photos that helped us tell the stories of 2023"!

Education and Engagement Projects - Youth Engagement

<u>Project Overview</u>

The Lab regularly partners with organizations serving youth (typically high-school aged) via employment and development programming. Regular partners include National Parks of Boston *(PLACE fellows, Youth Conservation Corps, etc.)* and the Trustees *(Waterfront Ambassadors)*. Lab staff present single or multi-day engagements with these programs, providing experience and exposure to field science and climate careers, while also hearing directly from youth about their concerns and interests. This year, staff also engaged with two new organizations, GreenRoots ECO and City Apprentice, and collaborated with a new NPS program: the Climate Conservation Corps.

<u>Updates</u>

Lab staff are hard at work planning our spring and summer engagement programming.

Staff are currently developing a new sea-level rise climate cart activity, centered on designing ways to protect a coastal city - and discussing the many challenges that come along with it. We have piloted the cart with several youth groups, including the Climate Conservation Corps and Codman Academy interns. Winter is the perfect time to revamp and refresh activities, reviewing evaluations and experiences from visitors during the busy summer months.

Lab and NPS staff have also begun reviewing and preparing our 5th grade lesson plans for public release late this winter. Our two lesson series, piloted with 5th graders at the O'Donnell and Samuel Adams elementary schools in East Boston, center on the question "How do we know when something is changing?" We plan to release our first lesson series, focused on coastal erosion, in the next few months. The place-based lessons series are designed specifically for Boston public schools, though can be adapted to other schools beyond Boston.

Finally, we are beginning preparations for programming that will be launched in late winter, including Living Seawalls programming.

Education and Engagement Projects - Participatory Science

<u>Project Overview</u>

Through participatory science, the Lab is engaging a wide range of perspectives in contributing to our sustainable future. Focused specifically on storm surge, the Lab's current Coastal Storm Investigators (CSI) project involves collaboratively designing and deploying equipment to measure both the vertical rise of flooding as well as the horizontal extent of flooding. The day before a storm, volunteers deploy three vertical indicators as well as twelve horizontal indicators. Within 12 hours of the storm, volunteers collect the equipment and report their results to the Stone Living Lab. Our team of participatory science volunteers are helping us understand today's storm surges so that we can better prepare for those of the future.

<u>Updates</u>

The SLL team performed a test deployment at Morrissey Boulevard from September 15-17. The area did not experience any flooding, but the deployment provided helpful information to improve the design of the flood equipment.

We expanded our project to include measurement of flooding from perigean spring tides with a deployment from October 29-31 at Morrissey Boulevard, Tenean Beach, Carson Beach, and Long Wharf. Fifteen students from UMass Boston's Introductory Environmental Science Class also helped with this deployment and collection.

Throughout this process we have worked with the Boston Planning and Development Agency (BPDA), Department of Conservation and Recreation (DCR), and our community volunteers to select five sites for the CSI Project to focus on moving forward: Morrissey Boulevard, Tenean Beach, Carson Beach, Long Wharf, and the Umana Academy in East Boston.

The team will continue to improve on the design of the flood measurement equipment. In particular, we want to investigate other forms of water indication that have less impact from humidity, temperature, and other external factors.

Education and Engagement Projects - Summer Teacher Institute

<u>Project Overview</u>

This year the Lab hosted our second Summer Teacher Institute, in direct partnership with National Parks of Boston. We recruited 11 Boston-area teachers for a free, five-day workshop, during which participants explored climate change through the lens of place-based learning and citizen science. Guest presenters from 11 partner institutions joined us throughout the week, while participants developed their capstone lesson plans to be implemented in the 2023-2024 academic year. Final presentations of these capstone projects took place in September 2023.

<u>Updates</u>

This year's Summer Teacher Institute will run from July 22-26, and reflect the growth and development of the program with input from two years of program alumni. Applications will open in mid-February, and more information will be available soon on our [website](#). We are also hosting a mid-winter gathering for all of our participant alumni to come together, share updates, and enjoy an evening together.

In the meantime, SLL staff will be presenting about the program for the second time at the National Science Teaching Association conference in March. This annual conference brings together thousands of teachers and teaching experts from across the country, and is an invaluable opportunity for the Lab to share our own pedagogy, lessons learned, and network with other educators.

Policy Innovation Projects - Robust Policies for NBA Implementation

<u>Project Overview</u>

The purpose of this project is to generate a better understanding of how to incorporate human values and community knowledge into adaptation planning, including the design and implementation of nature-based approaches. When thinking about successful climate change adaptation, it is important to apply a contextual lens as local community dynamics and decision-making processes often define people's access to resources and thus determine whether outcomes are equitable (See & Wilmsen 2020). Specifically, this research examines the influence and significance of human values in climate change adaptation planning by examining diverse human perceptions on climate change risks associated with sea-level rise (SLR) and proposed adaptation strategies for flood protection (i.e., nature-based approaches) in the coastal urban context and recommend potential policies to achieve transformative adaptation.

<u>Updates</u>

- September 2023: We assessed interview transcripts of conversation with 40 Boston stakeholders, including representatives from community-based organizations, foundations, City and State agencies, developers, and consultants.
- October 2023: SLL developed two cognitive maps based upon initial interview analysis and participant responses identifying:
  - The broad climate change adaptation challenges Boston faces, including those related to funding and investment, community consensus and engagement, and governance and management related to adaptation.
  - The broad adaptation priorities based upon these challenges as described by participants working for public and private organizations, community-based organizations, and local and regional government officials
- November 2023: SLL applied a Values-Focused Thinking (VFT) assessment to analyze stakeholder interview transcripts with the goal of creating fundamental objectives networks to outline objectives to minimize coastal flood impacts for the Boston community. Three VFT networks were developed to outline objectives defined by respondents working for public and private organizations, community-based organizations, and local andregional government officials
- November 2023: SLL conducted two focus groups with original interview participants to rank and discuss the coastal climate change adaptation strategy objectives identified from interview analysis.
- December 2023: SLL began assessing focus group transcripts, applying a VFT approach to create one integrated network of stakeholder objectives and potential decision actions that support coastal climate change adaptation strategies for the community.

Climate Preparedness Projects - Stone Living Lab Conference Monthly Seminar Series

<u>Project Overview</u>
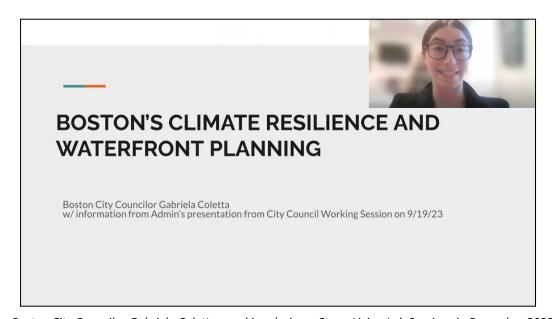
The Lab convenes [conferences](#) to formally discuss coastal research and climate resilience with researchers, practitioners, and other interested stakeholders doing work in Boston Harbor and around the globe. The conferences foster coordination and collaboration amongst individuals from a variety of fields. In addition to discussions about the research, conveners focus a special emphasis on place-based participatory science, education, policy, environmental justice, and community participation. The Lab also hosts a monthly seminar series to continue these efforts and conversations throughout the year.

<u>Updates</u>

This fall, we were fortunate to facilitate seminars with three fantastic local stakeholders on a variety of topics. In October, we were joined by Christian Krahforst, Director of Climate Adaptation & Conservation for the Town of Hull, for a discussion surrounding the potential for nourishment on Nantasket Beach, dune restoration work, a potential cobble-berm site, and a brief overview of developing an adaptation roadmap on the neighborhood scale (including the topic of planned retreat).

November's seminar speaker was Kannan Thiruvengadam, Director of Eastie Farm for conversation about the community nonprofit's work in climate justice, food security, and community resilience through urban agriculture, education, and the building of an equitable local food system.

We closed out the year with a presentation from Boston City Councilor Gabriela "Gigi" Coletta. Councilor Coletta serves District 1 (encompassing much of the city's waterfront communities, including Charlestown, East Boston, and the North End), and spoke about climate adaptation, environmental justice, and working towards a waterfront that is resilient, accessible, and inclusive.

Boston City Councilor Gabriela Coletta speaking during a Stone Living Lab Seminar in December 2023.