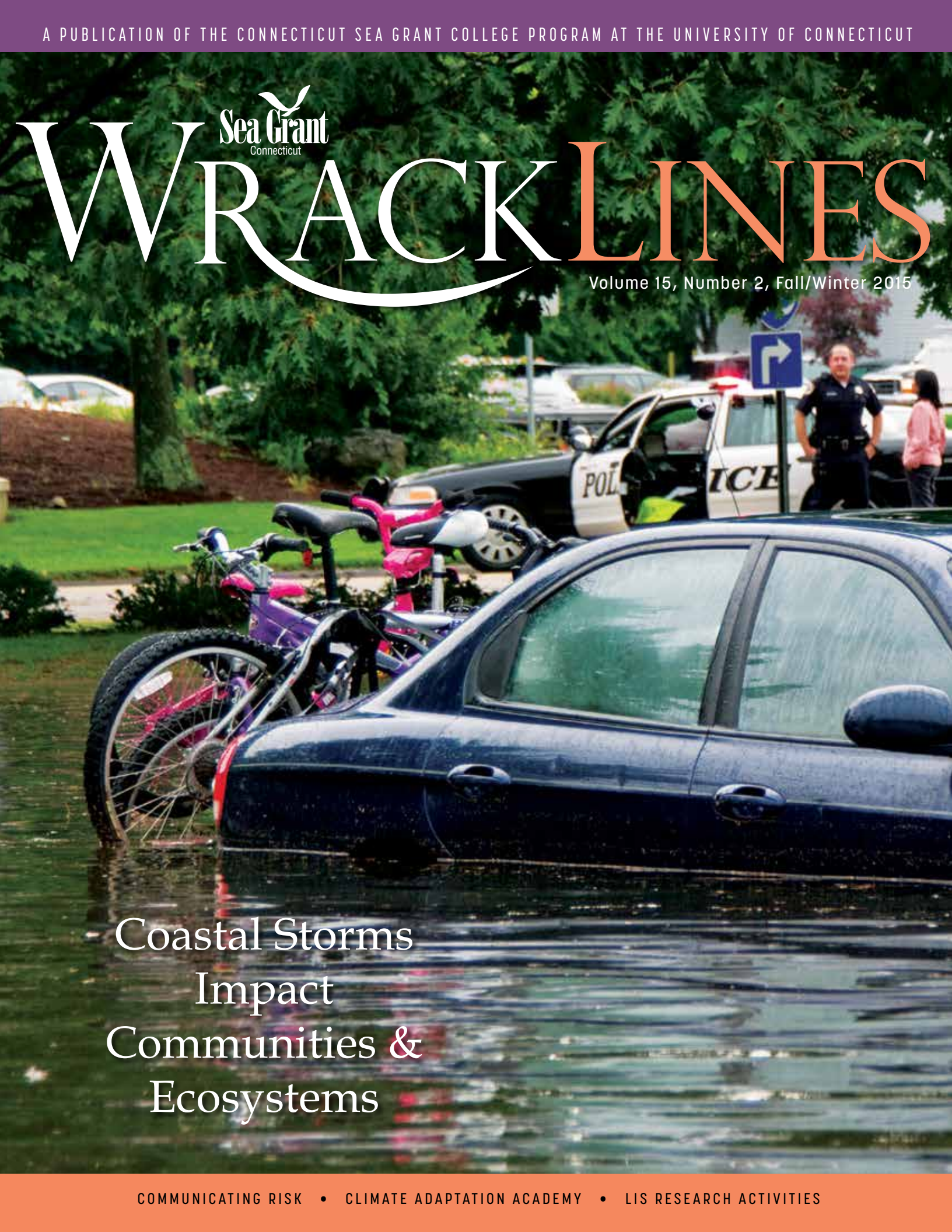




WRACKLINES

Volume 15, Number 2, Fall/Winter 2015



Coastal Storms
Impact
Communities &
Ecosystems

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TOUGH TIMES DON'T LAST BUT TOUGH PEOPLE DO

That's a great motto for these times of changing weather, extreme events, and for many, hard economic situations. Sometimes, though, you need even more than the capacity to become strong and tough (if you can). You need quick thinking, common sense, timely, accurate information, and above all, a plan. (Hope is not a plan!) A plan to gather family members, pets, and supplies, a plan to evacuate if needed, a plan to shelter in place. A plan to help others in our communities. So our new motto is:

"Don't be Scared, be Prepared!"

—or the U.S. Coast Guard motto, *Semper Paratus* (always ready.) There are plenty of places online to find preparation advice, such as Ready.gov or NOAA's Weather Ready Nation, to help individuals and families work out a thorough plan for extreme natural disasters as well as those less severe, but annoying, bouts of power outage or flooding. Please take the time to check and discuss with your family, neighbors, and friends. That's how humans can cope with coastal storm events and more. Communities also need to prepare. They must adapt and at times rebuild to survive. Animal and plant communities also need to succeed at adapting and coping as their habitats change. Restoring and protecting these habitats will increase estuarine and shoreline resilience too.

You'll find some great examples in this issue.

NOAA and Sea Grant researchers learned a lot from people who spoke up during our Coastal Storm Awareness Program surveys and meetings, and you can read about that research here. Researchers who spoke with people in the Sandy-affected region heard stories like the one about the disabled lady who evacuated to a shelter in her wheelchair-equipped van in the pouring rain, only to find the door at the end of the handicap ramp locked. We learned about individuals whose pets, family issues, and lack of transportation kept them from leaving when they should have. We learned that most Connecticut coastal residents didn't even know that they live in a flood zone, never mind where to go. A summary of these research findings is presented here for our readers. There is also a playlist of short video messages from each of the research projects on our YouTube channel (<http://s.uconn.edu/csapvideos>).

If I can include one more motto in our montage, it might be **"Tough Times Call for Effective Solutions."** We hope you'll enjoy this issue and please feel free to send us your ideas.

Peg Van Patten

Peg Van Patten, *Wrack Lines* editor

About our cover:

Visitors to Mystic Aquarium exited to find their cars submerged in flood waters following a coastal rainstorm in 2009. One of the regional effects of climate change in the Northeast is increased precipitation. Photo from The_Parasite Flickr feed.

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New social science research can help convey the right messages in extreme weather.

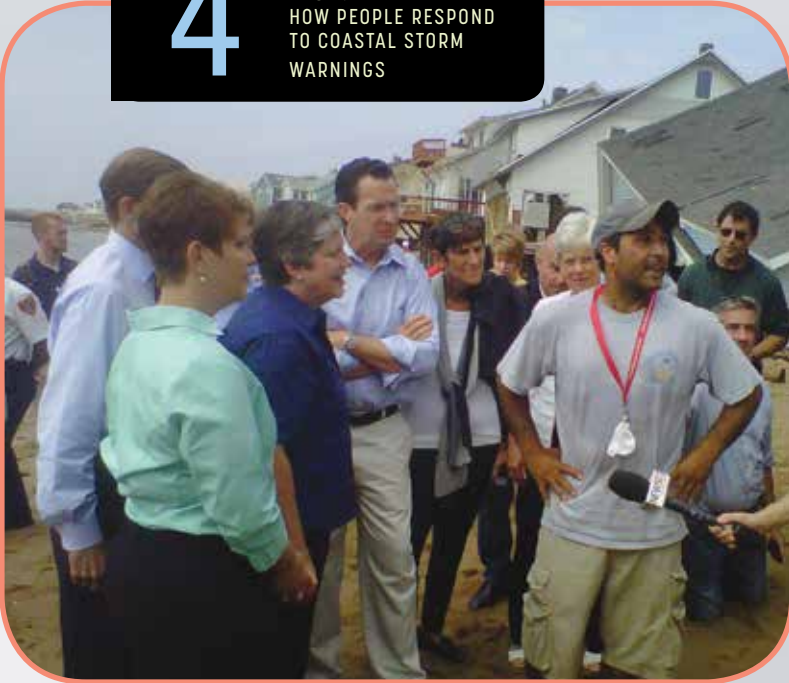
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A project underway in Stratford seeks to restore long-lost ecosystem services with help from a living shoreline.



Communicating Risk: how people respond to coastal storm warnings

by Nancy Balcom

Some people are diehards...as in fans of some team or another, that is. Actor Bruce Willis starred in a series of “Diehard” films which tested his limits in surviving various evil machinations. Still others are diehards when it comes to facing severe coastal storms. They prepare to shelter in place, protect their property, and, hopefully, survive. Not all people are diehards when it comes to storms, but how people react to storm warnings and make the decision to stay or to go was the focus of a two-year social science research effort supported by the Connecticut, New York, and New Jersey Sea Grant programs.

In late October 2012, “Superstorm” Sandy traveled up the Atlantic coast and came ashore in the tri-state region. In her wake, she left 117 people dead, billions of dollars in property and business losses, and thousands of lives shattered. While evacuation orders were in place, there was still significant loss of life in flooded homes. Why didn’t or couldn’t people leave for safe shelter?

“We were not expecting the worst...Hurricane Irene didn’t really do much damage at all...we were told to evacuate at our door and we chose to stay...”
(from interviews conducted by S. Moran *et al.*, 2015, SUNY-CESF.)

In 2013, the three Sea Grant programs, through NOAA National Sea Grant, were awarded Sandy Supplemental funds appropriated by Congress under the Disaster Relief Appropriations Act of 2013. The funds were used to mount a collaborative, jointly-managed social science research effort to investigate how people obtain storm warning reports and information, what factors influence decisions to heed or not heed the warnings, and how storm warnings can be made more effective. Ten research projects were competitively funded at institutions from Yale University to Mississippi State University as part of the Coastal Storm Awareness Program (CSAP) (*For more information see <http://nyseagrant.org/csap>*).

A Program Steering Committee was established that enabled both the researchers and Sea Grant staff to benefit from the expertise and feedback of individuals working for the NOAA National Weather Service, local and state emergency management, and environmental protection. Two “all hands” meetings were held, one to acquaint all of the PIs and foster potential inter-project collaborations and one to share and discuss the collective results.

“Know your audience” is important to successful messaging, yet this can be complicated when the same message is perceived differently by groups of individuals. Based on an analysis of risk perception



One strong message from Sharon Moran and William Peace’s research project was that the rights of disabled persons and service animals need to be addressed in evacuation planning. Photo credit: Peg Van Patten.



Governor Malloy and others survey damage from Tropical Storm Irene in 2011. Photo credit: Office of Gov. Dannel P. Malloy.

and other factors, Jennifer Marlon and her colleagues at Yale grouped people into five categories. The “First Out” are anxious and eager to leave if a hurricane is forecast, while on the other end of the spectrum the “Diehards” feel confident they are prepared to ride the storm out at home and typically will not evacuate. In the middle are the “Constrained”, the “Optimists” and the “Reluctant”. Those who are constrained recognize the risks and are willing to leave, but face barriers such as health issues or pets that limit their options on where they can go. Optimists doubt the storm will actually materialize or be as bad as predicted but are willing to evacuate, while the Reluctant prefer to remain at home but will leave if ordered to evacuate. Each of these groups has a different reaction to storm warnings. Recognize yourself?

People used a broad array of communication platforms to obtain reports and information on Sandy. Television and Internet were primary sources, but social

media like Twitter and Facebook were also important, as were radio and cell phone apps. John Edwards and his team at Mississippi State documented shifts in how people obtained information throughout storm Sandy, moving away from television and the Internet towards radio and face-to-face conversations as power outages increased. This underscores the need for official storm messages to be issued through many media platforms to ensure that before, during, and after a storm people have the means to get current, accurate, and relevant information.

No matter how people followed the progress of Sandy, the researchers identified several factors that strongly influenced the decisions people made with respect to the storm and evacuation. The factors included both the source and format of the warnings, previous

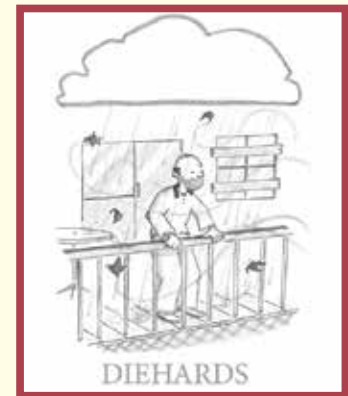
experience with coastal storms, and demographics. People seem to trust different sources of storm information—they recognized the NOAA National Weather Service as the authoritative source of weather information but expected and preferred to receive its information from more local sources. Local or state officials, television news reports, and family, friends, and neighbors were all key sources of information.

The Marlon study clearly indicates that if you want people to listen to evacuation orders, then have local fire fighters or police issue them, since they have the greatest likelihood of being listened to by all five population groups. Christa Farmer and her team at Hofstra University found that actions taken by local

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HURRICANE ATTITUDE SEGMENTS

First Out 21%	Anxious and eager to leave if a hurricane is in the forecast
Constrained 14%	Aware of risks & willing to evacuate but face barriers
Optimists 16%	Doubt that a hurricane will occur but willing to evacuate
Reluctant 27%	Reluctant to evacuate but will leave if ordered to
Diehards 22%	Confident they can safely ride out hurricanes at home



Jen Marlon from Yale used a survey analysis to group respondents from the Connecticut coastal flood zone in five groups of attitudes and behaviors.

Illustration Credit:
©Chris Cater.

From J. Marlon et al., 2015, Yale University

fire departments or police, such as going door to door or evacuating their own families, can have a greater influence on residents than just the evacuation order itself. In addition, emergency managers interviewed by Cara Cuite and her colleagues at Rutgers indicated they may use scare tactics or guilt to drive home the message that at some point during the storm, it may become too dangerous for first responders to rescue someone who fails to evacuate as advised.

In contrast, Ricardo Daziano and his colleagues at Cornell and Edwards both determined that family, friends, neighbors, local TV news, or The Weather Channel played major roles in influencing evacuation decisions, more so than government agencies or officials.

A second factor influencing evacuation decisions is the warning format. The key take-home message here is that the word “voluntary,” used in combination with evacuation orders, was determined to be completely ineffective by both Cuite and Daziano. Very few people seriously consider evacuating when it is promoted as a voluntary measure. In contrast, using the word “mandatory” with evacuation orders gets people’s attention. “We would advise against using the word ‘voluntary’ in any evacuation messaging,” Cuite said. Daziano found that compliance was likely to be 24X greater when “mandatory evacuation” was used. He also found that the majority of those interviewed were less likely to evacuate under a voluntary evacuation order, compared to having no evacuation order

in effect at all. Other format-related findings included providing precise “what-to-do” instructions linked to the community level and emphasizing practical reality such as “the shower and toilet won’t work” (from researchers Hogan Carr at Nurture Nature Center and Farmer).

Laura Hoven and her research team at Columbia University documented a shift from what people surveyed actually did during Sandy (27% ignored a mandatory evacuation order) to what they predicted doing in the future (83% would evacuate under voluntary orders and 100% under mandatory orders). Marlon found that one in five coastal residents living in Evacuation Zone A (closest to the water) and facing a Category 2 hurricane would evacuate without an official notice, whereas six in ten said they would evacuate if officially ordered.

Evacuation orders or flood warnings are rather meaningless if people don’t know where they live, relative to the scope of those orders or warnings. Some may leave their homes unnecessarily, while others who need to leave remain at home. And do people actually know where those evacuation signs lead? In 2013, New York City revised its hurricane evacuation zones and initiated a “Know Your Zone” campaign with maps to help familiarize residents with these changes. Connecticut coastal communities need something similar, given that Marlon determined that 70% of coastal Connecticut residents surveyed don’t know if they live in an evacuation zone and 74% have never seen a local evacuation map.

The New Jersey shore suffered the most severe winds and surf from Hurricane Sandy and the most damage from the storm, estimated at 30 billion.



Hurricane Sandy: Atlantic City, NJ, 2012: Tom Mihalek, Reuters

The terminology used in storm warnings plays an important role in determining whether the risk conveyed is understood by the general populace to whom the warning is directed. Hoven found that few people had any concept of what the term “storm surge” means; some envisioned a tsunami. The NOAA National Weather Service has recently begun to characterize storm surge as “height of the water above ground level” which will hopefully help people visualize and understand what is meant by future storm surge warnings.

A third factor, previous experience with coastal storms, also had a strong influence on how people reacted to storm warnings for Sandy. Hoven found that while the most important factor in a decision TO evacuate during Sandy was the family’s personal safety, the most important factor in a decision NOT to evacuate was previous experience.

Sharon Moran and her SUNY team

also found that people who evacuated during Irene in 2011, when it turned out not to be necessary, made the decision not to evacuate for Sandy. This decision had tragic consequences for some families. *No storm is ever the same as previous ones.* Cliff Scherer and his team at Cornell and Gabrielle Wong-Parodi and her team at Carnegie Mellon both found that previous experience also hinders or colors a person’s ability to conceptualize just how bad a storm can be. People can only imagine the worst storm they have ever experienced.

Previous experience also affected people’s ability to feel comfortable leaving their homes. Moran documented experiences of disabled residents from Sandy-affected areas, finding that key factors in decisions to shelter in place included concerns about accessibility to a new location, transportation, lack of confidence that a shelter could accommodate their specific needs, and a lack of real-time updates on shelter status. The Americans with Disabilities Act addresses a civil rights issue and communi-

ties need to include the disabled in conversations on local storm preparation. In New York City, a 2011 federal class action lawsuit resulted in a deal that calls for upgrading disaster centers to accommodate 120,000 disabled people by September 2017. Another significant barrier is that people will not leave their pets behind, underscoring the need for more pet-friendly shelters in communities.

An interesting question arising from research by Scherer, Marlon, and Farmer is, how will future evacuation behavior be affected by new requirements that homes in vulnerable coastal areas be flood compliant? Will compliance make people more, or less, inclined to evacuate? Scherer’s team found that some people felt that if their financial risk was minimized with safer, flood compliant homes, they would be more likely to leave, while others indicated if their homes were safer, they would be less likely to leave



(from interviews by Wong-Parodi)

“When they said it was going to be a really bad storm, I envisioned the worst I had experienced. I didn’t have a vision for worse than what I experienced...I don’t know what kind of information they could have shared that would have said ‘beyond your imagination level!’”

This storm-damaged house in the Fenwick community of Old Saybrook CT is being raised with a flow-through foundation for better storm resilience. Photo Credit: Nancy Balcom.

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Aerial views of the damage caused by Hurricane Sandy to Casino Pier on the New Jersey coast, taken during a search and rescue mission by 1-150 Assault Helicopter Battalion, New Jersey Army National Guard, Oct. 30, 2012. Photo credit: U.S. Air Force, Master Sgt. Mark C. Olsen

during future storms. Definitely a conundrum.

The last framing question for CSAP focused on ways to improve future warnings to make them more actionable. Hogan Carr analyzed how emergency personnel, broadcast meteorologists, and the public responded to and interpreted National Weather Service briefing materials and coastal storm surge forecast and warning products. Based on the feedback they received, the research team recommended ways to improve the verbal and graphic clarity of these materials and shared best practices for the use of the briefing materials. These recommendations were shared with the three NOAA National Weather Service meteorologists serving on the CSAP Program Steering Committee.

New tools and websites were generated by the CSAP effort. The Edwards team filtered and geocoded images shared by Twitter users during Hurricane Sandy, and verified their locations with Google Street View. They then

developed a software application that facilitates two-way communication between emergency managers and the public. The researchers envision its usefulness in helping local emergency managers identify priority response areas in their communities through Twitter images in near real-time. They did point out that they were not encouraging people to deliberately put themselves in danger to take pictures during storms.

Sandy Supplemental funding provided Sea Grant with the opportunity to improve our understanding of people's perceptions of, and responses to, coastal storm risk communications. Storm-related communications should be issued over many media platforms to maximize accessibility to critical information before, during, and after severe storms. Evacuation decisions are influenced by factors including source and format of any warnings, previous experience, demographics, and possibly going forward, by how safe or flood compliant a home is. Storm warnings and

related information can be made more understandable and actionable by improving their visual and graphic clarity, using simple terms, and including community-specific instructions. Coastal residents need to be firmly aware of the location of their homes relative to flood and evacuation zones in their community.

The collective results of the Coastal Storm Awareness Program social science research will be integrated into Sea Grant outreach programs for relevant audiences, including the Diehards among you. Hopefully, what has been learned can be put to use to influence future storm communications and response behaviors, with the ultimate goal of saving lives during severe weather events.

ABOUT THE AUTHOR

Nancy Balcom is Associate Director of Connecticut Sea Grant.



Connecticut's Climate Adaptation Academy

by Juliana Barrett and Bruce Hyde

Clean up from Sandy storm damage in Old Saybrook. Photo credit: Juliana Barrett.



Are your lilacs blooming earlier? Could be climate change.

By now, you've heard about climate change and likely seen for yourself some changes over time. Maybe your lilacs are blooming earlier each spring or you've noticed that bird migration patterns are changing. You've probably heard discussions about climate change and the polar ice caps on TV news shows. Have you wondered what's going on in Connecticut to deal with our changing climate?

Connecticut Sea Grant and UConn Center for Land Use Education and Research (CLEAR) have teamed up to create the Climate Adaptation Academy. This unique forum is an opportunity to exchange ideas and information about climate change adaptation throughout Connecticut and with neighboring states.

Climate adaptation is another one of those terms that we often hear, but what does it mean? The U.S. Environmental Protection Agency offers a concise definition

of adaptation: Adaptation is the adjustment that society or ecosystems make to prepare for, or adjust to climate change. So, adaptation includes everything from migration of a salt marsh further inland, to movement of fish species further north as ocean waters warm, to a town installing larger culverts in stormwater systems to deal with changing precipitation patterns. Whether you live on the coast or further inland there are ongoing climate change impacts. Inland communities are experiencing higher air temperatures in summer. The precipitation patterns are changing, with more rain falling during short intervals followed by periods of little to no precipitation. Coastal communities are seeing the impacts of accelerated sea level rise with road flooding now occurring in areas not just during storm events but during particularly high tides.

With funding from NOAA/National Sea Grant, the Climate Adaptation Academy (CAA) began holding workshops and forums in 2014 on a number of climate adaptation



1980



2012

Compare the melting of polar sea ice in these two photos taken 32 years apart. – Photo credit: NASA/Goddard Scientific Visualization Studio.



pertaining to climate adaptation that you think would be a good workshop topic, please contact Juliana Barrett (Juliana.barrett@uconn.edu) or Bruce Hyde (bruce.hyde@uconn.edu).

ABOUT THE AUTHOR

Juliana Barrett and Bruce Hyde are Sea Grant Extension staff and affiliated with UConn CLEAR.

Coastal communities are experiencing floods as a result of warm temperatures with increased precipitation, sea level rise and high tides. Photo credit: Peg Van Patten.

issues including a general overview of climate change in Connecticut, flooding issues for inland communities, living shorelines, and legal issues that are arising due to climate change impacts. These workshops not only bring in experts to provide the best and most up to date information for Connecticut’s municipal officials, consultants and other citizens, but also provide a forum for the exchange of ideas, solutions and opportunities.

very complex issues. The discussions of alternative approaches, resilient landscapes and native plants, and thinking outside the usual ‘box’ has enabled me to explore different courses of action to help solve some very difficult issues on several coastal properties.”



Sandy’s damage to a seawall in Old Saybrook is seen here before and after repair. Photo credit: Juliana Barrett.

“The Climate Adaptation Academy has provided timely and relevant information on climate adaptation for my community in the work we are doing re: climate adaptation.” said Meg Parulis, Westbrook Town Planner. “ I enjoyed the variety of topic and speakers as well as the opportunity to provide input, and I’m looking forward to the next session on legal issues.”

Many of our speakers have been municipal officials and consultants with stories to share and lessons learned. We continue to collect ideas for new CAA sessions and welcome your thoughts and input. If you have a particular topic

Beth Sullivan, Avalonia Land Conservancy, agrees. “The workshops greatly broadened and deepened my base of knowledge in many areas.” she said. “Working as land trust stewards on coastal properties, we are faced with unusual and



Quite a crowd turned out for the Climate Adaptation Academy’s first Living Shoreline meeting despite the falling snow in January 2015. Photo credit: Kara Bonsack

A scenic view of a rocky coastline. The foreground is dominated by large, dark grey and brown rocks with visible cracks and textures. The water is a deep blue, with patches of green seaweed and kelp floating on the surface. The sky is a pale, clear blue.

Connecticut Seeks to Join National Estuarine Research Reserve System

by Kevin O'Brien

A healthy and productive Long Island Sound is our greatest natural resource and also contributes an estimated 7 billion dollars annually to the regional economy...

continued on next page



Photo credit: CT Audubon/Paul Fusco

Plovers are among the wildlife that benefit from healthy coastal ecosystems.

The Sound, like other estuaries around the country, is constantly threatened by development, pollution, invasive species, and the effects of climate change—to name just a few. These and other threats make it more important than ever to have the information needed to make critical management decisions affecting our coastal resources. One such source of information is the National Oceanic and Atmospheric Administration’s (NOAA) National Estuarine Research Reserve (NERR) System.

The NERR System is a network of 28 coastal areas designated to protect and study estuarine systems. Created by the Coastal Zone Management Act, the reserves are a partnership between the National Oceanic and Atmospheric Administration (NOAA) and coastal states. NOAA provides funding, guidance, and technical assistance. Each reserve is managed by a lead state agency or university, with input from local partners. The reserves cover 1.3 million acres of estuaries and focus on:

- **Stewardship:** Each site undertakes the initiatives needed to keep the estuary healthy.
- **Research:** Reserve-based research and monitoring data are used to aid conservation and management efforts on local and national levels.
- **Training:** Local and state officials are better equipped to introduce local data into the decision-making process as a result of reserve training efforts.
- **Education:** Thousands of children and adults are served through hands-on laboratory and field-based experiences. School curriculums are provided online.

The national Reserve system is a vital, important program from which no coastal state should be omitted. Connecticut, however, is one of only two salt-water coastal states without a reserve. A Connecticut-based NERR would complement and extend existing activities of programs like the EPA National Estuary Program, the Connecticut Coastal Management Program, the Connecticut Sea Grant office, Project Oceanology, and various academic institutions through the addition of funding, resources, and expertise. Additionally, it would enable new directions and initiatives by leveraging national system programs. The health of the Sound’s ecosystem and the state economy can only benefit from establishing a NERR.

While earlier attempts to designate a reserve in Connecticut stalled, recent efforts have enabled a formal designation process to proceed through the Department of Energy and Environmental Protection’s Office of Long Island Sound Programs (OLISP). Accordingly, OLISP has been working closely with NOAA to develop a process to identify and nominate a NERR

using nationally proven standards with added criteria unique to Connecticut.

Here are some frequently asked questions (and answers!) about the NERR system and how it applies to Connecticut:

Q: What programs and benefits do research reserves offer?

A: They apply science and education to improve the management of estuaries. Reserve staff work with local communities to address natural resource management issues, such as non-point source pollution, habitat restoration and invasive species.

- Reserves provide adult audiences with locally relevant training on estuarine issues of concern to better inform coastal management decisions.
- Reserves offer field classes for K-12 students and support teachers through professional development programs in marine education.
- Reserves are considered “living laboratories” providing for long-term water quality and habitat monitoring as well as opportunities for both scientists and graduate students to conduct research on our nation’s estuaries.
- Reserves are eligible for federal funding programs that are only available to a NERR site.

Q: Will the state have to purchase land for a Connecticut research reserve?

A: No. Connecticut will select a site from existing publicly owned lands consisting of state owned property and adjacent public trust waters. Municipal and non-profit property may be considered as well and could be part of a reserve through a cooperative agreement with the State.

Q: Does a reserve restrict existing commercial, recreational, or cultural activities?

A: The designation of a NERR site does not preclude existing uses/activities, and does not result in the total preservation of the area. As part of the NERR designation process, the Code

of Federal Regulations (15 CFR 921) that set the requirements for NERR sites requires development of a management plan. The management plan must articulate how the public will interact with the site and its resources and describe uses that will require a permit. States are allowed to develop management plans in a manner that respects human as well as natural resource needs. For example, the San Francisco Bay NERR Management Plan acknowledges: "Recreational and commercial fishing, hiking, horseback riding, bicycling, camping, and boating are all traditional uses within the boundaries of the Reserve sites. Some of these activities are subject to state regulation and require licenses and/or permits. Traditional use access will continue according to local and state laws." Development of a management plan for a Connecticut NERR site will require the State to work with stakeholders to determine an approach that best serves Connecticut's resources and people.

Q: Does the designation of a reserve bring more rules?

A: No. Reserve designation does not add any new regulations. As part of the site designation process, NOAA will examine whether a proposed site is adequately protected for long-term research and education by existing state authorities. There are no federal regulations imposed as a result of reserve designation.

Q: Are there certain criteria that a site must meet to be eligible to become a research reserve site?

A: Yes. Reserves reflect regional ecosystem types called "biogeographic regions," and unique estuarine habitat features within them. NOAA gives priority consideration to designation proposals that establish a reserve in a biogeographic region or sub-region that is not currently represented by the system or that incorporates unique habitat

types that are not represented by the system. Connecticut lies within a biogeographic region encompassing the coastal areas from Cape Cod, Massachusetts to Chesapeake Bay, Virginia, and specifically within the Southern New England sub-region ranging from Cape Cod to Sandy Hook, New Jersey. Since the Southern New England sub-region already contains three reserves (Waquoit Bay, MA, Narragansett Bay, RI, and Hudson River, NY) it will be imperative for Connecticut to evaluate and identify a site with unique habitat elements that are currently not represented in order to potentially designate a research reserve.

Q: What is the process to establish a potential site as a research reserve?

A: The Office of Long Island Sound Programs of the Connecticut Department of Energy & Environmental Protection is coordinating the reserve designation process. Having sent a formal letter of intent and received a notice to proceed, the State and NOAA worked together to develop a site selection process to inventory and evaluate potential sites. The site selection process will require the involvement of a variety of stakeholders including academic institutions, state and federal agencies, private industries, environmental groups, municipal officials and staff, local land owners, as well as other parties that have interests in the coastal area. Several public information meetings will be held to present information and solicit input from the public. The process itself will apply an expansive suite of environmental and organizational criteria to evaluate and score various options that will culminate in a formal report documenting the process and nominating a site. Following an approval from NOAA, the State, with assistance from NOAA, will then work to develop and submit a management plan for NOAA review. At the same time NOAA,

with the State's assistance, will develop Draft and Final Environmental Impact Statements for the designation. When the reserve is approved by NOAA, the State and NOAA will sign a Memorandum of Understanding addressing operation of the new reserve and a ceremony will be held to present the certificate of designation to state officials and reserve partners.

Q: If we have a potential reserve site in mind, is it necessary to use the formal selection process?

A: Yes. The state is responsible for developing a site selection process that examines potential sites and then strategically narrows down the options to the best location. The site-selection process has been proven valuable in clarifying issues and priorities and in engaging interested parties.

For more information on the CT NERR effort, please contact:

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For more information on the NERR system, please visit <http://www.nerrs.noaa.gov/>



Aerial view of the Dodge Paddock and Beal Preserve. Photo credit: Roger Wolfe, CT DEEP.

The Restoration of Dodge Paddock and Beal Preserve – Uniting a Community in Achieving Climate Resiliency

by MaryEllen Mateleska

Nestled between the tree-lined streets of Stonington Borough and the rolling waves of the Sound lies the Dodge Paddock and Beal Preserve; a tract of land with a rich history and an even richer biodiversity. On any given day, visitors walking the path along the edge of the Preserve may see elementary school students participating in a lesson on Long Island Sound while searching for crabs and snails along the rocky shore, artists with their easels painting the breathtaking views of the historic homes among the backdrop of the salt marsh, or hear a chorus of song birds flying through the grassland hunting for their afternoon meal. Over the last few decades, the introduction of invasive plant species and the aftermath damage of strong storms have left the Preserve in need of some work to restore native plants and prepare this area for future climate related challenges. In January 2015, Mystic Aquarium and Avalonia Land Conservancy, under the guidance of the CT Department of Energy and Environmental Protection, began a collaboration to restore the 2.6 acres of coastal marsh and grassland habitats by engaging volunteers in on the ground stewardship activities.

Located in the Stonington Borough section of Stonington, Connecticut, the Dodge Paddock and Beal Preserve, owned by Avalonia Land Conservancy, is the last publicly accessible green space in this popular coastal tourism destination. The eastern boundary of the Preserve faces Little Narragansett Bay and overlooks Sandy Point Preserve and is comprised of several habitat zones including dunes, coastal grasslands, and a tidal wetland area. In addition to boasting precious resources of significance to the health of Long Island Sound, the site's former role as a stoneware kiln in the 1800s makes it an important historic preservation site. Pieces of pottery can still be found strewn around the area and finer works are preserved at a nearby museum. Today, the Dodge Paddock and Beal Preserve is open to the public for passive recreational activities (motor vehicles, bicycles, horses, and hunting prohibited). A dedicated corps of Avalonia volunteers work year-round to ensure that boundary signage is in place and that hiking trails are maintained.

As with many sites in the Long Island Sound watershed, the Preserve has faced natural and anthropogenic challenges to its health. These threats are most evident in tidal areas of the Preserve, which encompasses grassy marsh habitat, tidal pools, gravel and sand pockets, and rock outcrops. This area provides critical feeding and roosting areas for migratory birds including cormorants, geese and ducks, shorebirds, egrets, and herons. Despite past projects to allow upland storm water drainage and to restore tidal exchange in the marsh, surface water failed to drain from the marsh and the highest tides did not fully recede. What was intended to be a tidal system with some level of tidal exchange turned into a system with intermittent depressions of stagnant water. This restriction of tidal circulation promoted *Phragmites* growth which dominated much of the marsh. The loss of regular tidal flow and stagnant conditions also produce



A group of students from the Marine Science Magnet School in Groton, CT work to remove *Phragmites* debris in preparation for planting. Photo credit: MaryEllen Mateleska.



This photo was taken immediately following the first planting stewardship event, which included the creation of a new walking path to minimize human impact on the marsh. Photo credit: Emily Bodell.



Taken in May of 2014, this photo illustrates the extent of invasive species debris removal that was necessary prior to the first planting stewardship events. Photo credit: Beth Sullivan.

unbearable numbers of mosquitoes, which necessitates several pesticide applications per season. The mosquitoes created a nuisance and potential disease vector to the surrounding neighborhood and to preserve visitors, thereby lowering their quality of life and creating a public health hazard. Complicating the already challenging conditions at the Preserve, in 2012 Superstorm Sandy overtopped the dune, which pushed sand and gravel into the marsh. The sand covered marsh vegetation and partially filled a drainage channel, bringing with it flooding, debris deposits, erosion, and a decreased ability to serve as a buffer from land-based runoff. In summation, there was a great need to restore balance to this system.

In an effort to prepare the site for future restoration and mitigate the mosquito infestation, CT DEEP's Wetlands Habitat and Mosquito Management Program (WHAMM) worked to open a new drainage area, eradicate invasive *Phragmites*, and create channels for better flow of floodwaters. The result of this intensive work was a coastal wetland area that was primed for the replanting of native marsh plants.

Both Avalonia Land Conservancy and Mystic Aquarium share a mission to inspire the community to protect and conserve our natural resources through direct hands-on stewardship actions. This project was recognized by both organizations as an ideal opportunity to educate the community on coastal resiliency in light of rising sea levels due to climate change and the potential for increased storms. "Using a climate adaptive planting plan and engaging the community in a shared vision of coastal stewardship makes this project a model for how people can join us in fulfilling our conservation based missions" explained Beth Sullivan, Avalonia Land Conservancy Stonington Committee Chair. Using their breadth and depth of resources – including a robust education and conservation department – Mystic Aquarium is leading this charge with a goal of engaging up to 2,800 volunteer hours in the restoration of the Preserve. Beth Sullivan



Planted *Spartina alterniflora* plugs begin to grow and spread throughout the Dodge Paddock and Beal Preserve. Photo credit: MaryEllen Mateleska.

adds, "Community participation in the restoration of the Preserve will not only encourage the community to be part of something big but will also instill a greater sense of ownership of this local treasure."

Since its onset, there has been overwhelming support for this project. Stonington Borough neighbors offered water supplies to cultivate the growth of new plants and college students conducted soil tests to assist with the selection of appropriate plants for each habitat. As of September 2015, more than 170 volunteers participated in the first planting season. High school students from the Marine Science Magnet School of Southeastern Connecticut in Groton and college students from Mitchell and Connecticut Colleges in New London prepared the site by removing *Phragmites* and other debris while groups of volunteers participated in the planting of grass plugs and native shrubs. Although there is still much work scheduled to be accomplished the success of this community effort is evident with an increase in the presence of both native marsh flora and fauna.

By using a climate adaptive planting plan to accommodate for climate change effects including saltwater intrusion and extreme precipitation, while engaging the community through stewardship initiatives, this project could serve as a model for regional coastal communities. It seeks to "rebalance the system" by restoring and protecting habitats for the species that rely on this site, but also ensures optimal health and balance for the last public green space available in Stonington Borough. Public visitors can enjoy having access to the site as they learn about and gain a sense of appreciation for the Sound well into the future.

ABOUT THE AUTHOR

MaryEllen Mateleska, Director of Education & Conservation at Mystic Aquarium, serves as the project manager for the Dodge Paddock and Beal Preserve restoration project. Mateleska works with community members of all ages in immersive conservation programs designed to engage the next generation of environmental stewards.

After the Storm, Birds are Resilient but Habitats Change

by Milan G. Bull
Senior Director of Science and Conservation
Connecticut Audubon

Devastating coastal storms don't just wreak havoc on human communities but they also severely damage habitat for coastal bird communities.

Big storm events scatter birds just as they do people and we notice mortality events especially with migrating birds encountering severe weather. Birds that require low coastal areas such as marshes, dunes and beaches are displaced. This can result in long-term habitat effects. Barrier islands, beaches and bars are flattened and reshaped, impacting breeding habitat of coastal birds such as Piping Plovers and Least Terns.

The same storm event that eliminates coastal bird breeding habitat in one area may also improve habitat by sand deposition in another area, so in many cases, coastal birds are inconvenienced for a short time, but ride it out and discover new breeding areas.

Disturbance and coastal reshaping is part of the ecosystem process and birds have evolved to deal with it. However, the increasing impacts of sea level rise intensify the effects of coastal storms and may, in the end, have a much more destructive impact on our bird species.

.....

Birds sing after a storm; why shouldn't people feel as free to delight in whatever sunlight remains to them?

—Rose Kennedy

.....

This heron, normally a marsh wader on the ground, was spotted on an osprey platform after "Superstorm" Sandy. Photo credit: Juliana Barrett.



Does Urban Habitat Restoration Work?

A Tale of 19 Students and 5,148 Insects in a New Haven Harbor Refuge

By Taylor Pauls, Erik Lopez, Kathiana Torres, Sophia Ginnow, Georgia Basso and Corrie Folsom-O'Keefe



Urban Habitat Restoration by the Numbers

- 1 Urban Wildlife Refuge Partnership
- 6 habitat restoration study plots
- 19 Common Ground Green Job Corp Students
- 3 years of monitoring
- 13 pairs of tweezers
- 10 microscopes
- 100+ native species planted
- 5, 148 insects collected and identified



The lab classroom is silent as eight Green Jobs Corps students from Common Ground High School peer under microscopes, sorting and counting insects with a methodical intensity. They pause to jot down a few notes, make a quick sketch of an insect, or flip through the dichotomous key to double check the difference between flies and wasps. Occasionally a triumphant cry rings out from one of the tables, "I've finished counting the Homoptera! 15 different species, 213 individuals." Smiles and encouragement come from the other tables, "Yeh!" "Way to go!" There is a sense of comradery among this crew, with thousands of insects left to identify—we are all in this together.

Now and then an outsider wanders into the lab room. Upon seeing this strangely silent, extremely focused group, who occasionally speak to each other using Latin names—it's too much for them and the silence is broken, "What the heck are you guys doing?"

As part of the New Haven Harbor Urban Wildlife Refuge Partnership, Green Jobs Corps students from Common Ground are working side-by-side with Audubon and USFWS biologists to restore habitat in the city of New Haven. These students took on a multi-year challenge to scientifically document whether urban habitat restoration is working to increase biodiversity. Although it's generally known that habitat restoration increases

biodiversity, there are few studies that actually document this. This study is one of the first of its kind in New Haven.

Over the past three years, the students have collected invertebrate data at two habitat restoration sites in the city. The students hypothesized that by increasing the diversity of native plant species



Author Kathiana Torres works with Common Ground teacher Sharon Brostrom to sort Hymenoptera (bees, wasps, and ants) by their appearance. Photo credit: Joel Tolman, Common Ground

we will also increase invertebrate diversity and abundance and create better habitat for wildlife.

The experiment involved extensive habitat restoration. First, invasive shrubs, herbaceous plants, and cool-season grasses were removed. Then native plants were planted. Mulch was placed around the native plants to stop the spread of invasive weeds. Three ten by ten meter plots were set-up at the two sites—a control plot and two study plots. The percent of native plants, non-native plants, mulch, or bare ground was recorded each year in all study plots. Insects were collected by sweeping the ground with butterfly nets, killed in rubbing alcohol, identified to order using a dichotomous key, and then identified to species based on differences in their appearance.

What we found out.

In analyzing the data, first we saw more vegetation diversity in 2015 than the previous two years in all the plots. Second, the increase in vegetation diversity is helping to increase invertebrate diversity and abundance.

On the next page, we highlight Beaver Pond Plot 3, one of the four study plots. Plot 3 is representative of what we see happening at the other study plots in that both vegetation diversity and insect diversity are increasing as we continue to restore these urban areas.

In the summer of 2014, we came up with a hypothesis that after a year ended up being supported. Our hypothesis was that the mulch that spread on Plots 3 and 4 at Beaver Pond reduced a lot of the insects

that were living in that area (*Figure 2*). We brought this information to our Urban Wildlife Refuge Partners and asked them to use less mulch and more native plants. It worked! This year we have more native plant species and the highest diversity of invertebrates of all the study years (*Figures 1 and 2*). The native herbaceous plants increased from 25 % to 56% in plot 3 (*Figure 1*) and 5% to 35% in Plot 4. Invertebrate abundance and diversity tripled at Plot 3 and doubled at Plot 4. Lastly, in the previous years the Beaver Pond control plot resembled a soccer field. The vegetation was very short. In 2015, the control was not mowed and it looked more like a meadow. We suspect that the tall grass increased the invertebrate population. We saw the abundance increase by six times and diversity by three times more than the previous year. Habitat restoration in New Haven is

Figure 1 - A Vegetation Change at Beaver Pond

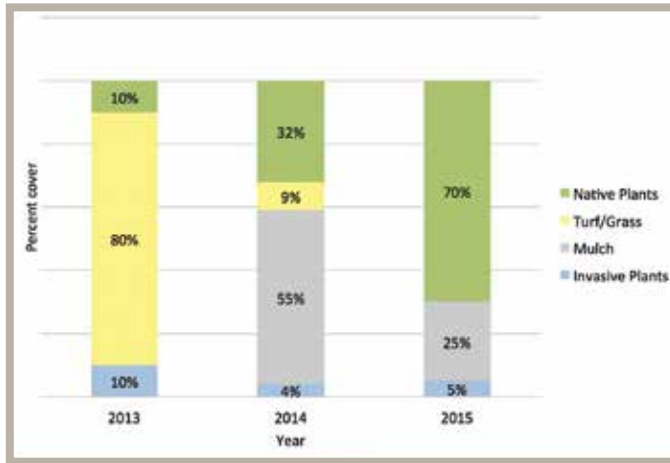
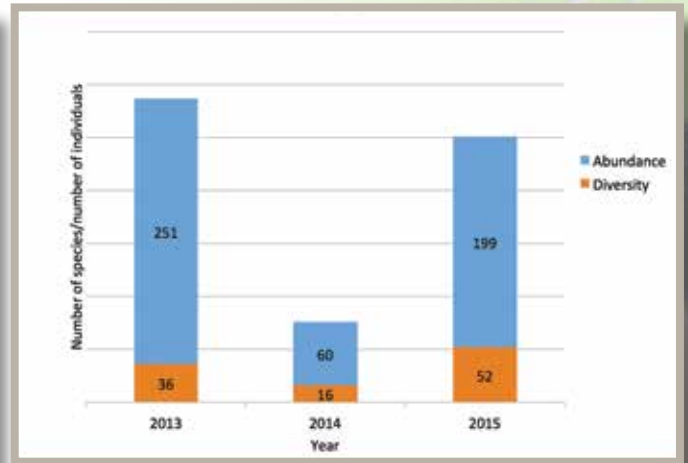


Figure 2- Invertebrate Abundance and Diversity at Beaver Pond



improving wildlife habitat and also benefiting the students involved in this project.

• Monitoring is important

Monitoring alerted us to problems with the habitat restoration (too much mulch, not enough native plants) and allowed us to change our restoration plan mid-course. This was very important to the study. Because it is still early in the study, we recommend monitoring for at least two more years in order to have a 5 year data set. This will also allow us to monitor after the plants have had more chance to grow.

• Designate low and no mow sites

Based on the past three years of data

we recommend that the study plots not be mowed at all because mowing can kill the young native plants trying to establish themselves. We also recommend that select areas across the city in parks and other public spaces be designated as low or no mow sites. Mowing certain areas less frequently could not only save the city money but also increase the amount of insects at these sites and the value of the areas for wildlife, particularly species that eat insects like birds, small mammals, and reptiles.

• Plant a diversity of native species

Based on the past three years of data we recommend continuing to add and care for a diverse suite of native plants in the study plots. Diversity in plants

and native plants in particular are helping to increase the diversity of insects, including beneficial insects like bees, ants, and wasps. We feel that with continued management including planting and watering native species and removing invasive species, vegetation diversity at the sites will continue to increase and have a positive effect on wildlife diversity.

Why this project has been important to us

This project is important to the Common Ground Green Jobs Corps students. It gives them meaningful summer employment and job skills like being responsible, showing up on time, and planning for the day ahead, while earning income to help support their families. We are learning life skills, discovering career interests, and seeing the results of the hard work and the real outcomes for the environment and our community.

Special thanks to:

The New Haven Urban Wildlife Refuge Partners who work to plant, protect and monitor the habitat restoration sites, especially the Urban Resources Initiative and their partners.

Common Ground students and instructors who have worked on this project- Students: Michael Bruno, Nyasia Mercer, Dimitri Lemonas, Grace Knudsen, Joaquin Davis, Lovell Davis, Sophia Ginnow, Tricia Johnson, Erik Lopez, Taylor Pauls, Kathiana Torres, Meisha Hennesey, Thomas Montez, Thomas Melendez, Eugenio Garcia, Loc Nguyen, Christopher Gonzalez, Anthony Duff, Lisandra Mendosa, and Linnette Mendoza.

Instructors: Joel Tolman, Sarah Tracy-Wanck, Karen Climis, Sharon Brostrom, and David Edgeworth



Butterflies are excellent pollinators.
Photo credit: ©Mel Morales.

Insight from the Authors:

“The coolest part about this project is seeing the results of the work that me and my coworkers did in planting and taking care of the habitat restoration sites. Realizing that the work we did is actually making an impact is really great.”

-Kathiana Torres

“My favorite part of this project was seeing the spiders under the microscope. For the first time ever I was able to see all the little parts of the body. The thing I will remember most about this project is the long hours looking into the scope and having to check carefully to see if the insects were the same or different.”

-Erik Lopez

“I loved looking at the insects under the microscope. It was as if they came alive and we could see all the detail in their body structure. The biggest lesson I will take away from this experience is learning all the orders of insects, like Homoptera, Hemiptera, Diptera, Hymenoptera. Being involved in this project made me even more passionate about working in a scientific field; I really enjoyed collecting and analyzing the data and discussing the results.”

-Taylor Pauls



ABOUT THE AUTHORS

Taylor Pauls (senior), Erik Lopez (junior), Kathiana Torres (senior), and Sophia Ginnow (sophomore, not pictured) are Common Ground students. Corrie Folsom O’Keefe is affiliated with Audubon CT, and Georgia Basso is affiliated with the U.S. Fish and Wildlife Service.

Butterfly nets were used to collect insect at the 10x10m study plots. The insects were bagged and then brought back to the school for identification.

Seas of Change: The Restoration of Ecosystem Services in Long Island Sound

by Jennifer H. Mattei, Ph.D.

When Adriaen Block entered Long Island Sound (LIS) from the East River for the first time in 1614, what he experienced would have been a feast for our tired urban eyes. Estuaries rimmed by shellfish reefs and beds, acres of eelgrass dotted with scallops, salt marsh grasses embedded with tenacious mussels, dunes and bluffs blanketed with grasses, and towering coastal forests behind them. These complex highly structured estuaries teeming with a diversity of invertebrates have come to be appreciated for their role as the nursery for the fry of hundreds of fish species.

By the end of the 19th century, the habitat structure had changed dramatically. Shellfish, particularly oysters, the ecological engineers of the intertidal zone, had been overharvested and mounds of shell removed resulting in a trampled structure and less habitat. Pollution, development, and nearly constant trawling had taken its toll. The big picture reveals Long Island Sound is similar to other urban estuarine and coastal habitats – some of the most heavily utilized and most threatened natural systems across the globe.

Today, the sea level of our now urban Sound is rising. Average annual water temperature is increasing, and seasonal hypoxic (i.e. low oxygen) events continue to occur in parts of the western Sound. Also in late summer, when nutrient loads, bacterial and algal counts are high, the pH of the water declines. These varied factors due to human activity can slow shellfish growth and disrupt other life processes within the estuarine food web.

People living by the sea have attempted to block rising waters and prevent subsequent coastal erosion by armoring the shoreline. One common method of armoring is the construction of seawalls, bulkheads, and ripped shorelines. This activity cuts the connectivity of the land to the sea, causing loss of sandy beaches and marsh grasses seaward of the wall, and still may not adequately protect homes and businesses behind the wall from flooding during large storm events like hurricanes and Nor'easters.

It was not until the back-to-back occurrence of Hurricane Irene (2011) and Superstorm Sandy (2012) that some coastal homeowners began to realize the structural importance of estuarine habitats such as shellfish beds and reefs, salt marshes, sandy beaches, dunes, grasslands, and coastal forests. What Adriaen Block never realized and only now we have begun to understand are the ecosystem



Map showing location of the Stratford living shoreline.
Credit: Trey Chabot.

services (i.e. benefits) of intact functioning estuaries. In our search for resiliency, stability, and renewable resources in the face of climate change, the answer comes from our long forgotten natural history, a fully functional estuarine ecosystem, a 'living shoreline'!

These various estuarine habitats do not exist in isolation. The coastal resources are ecologically and synergistically connected; that is, there are physical and biological interactions between them. It is difficult to restore a sand dune as a stand-alone habitat and expect it to be stable and resilient without the adjoining saltmarsh and reef in front of it and grassland, shrub, and forest mosaic behind it. At Stratford Point, the first stage of a long-term, collaborative living shoreline restoration project has begun. Partners in this effort include: Sacred Heart University, Audubon CT of the National Audubon Society, National Fish and Wildlife Foundation, and DuPont. The purpose of our study is to examine how to speed the recovery of the interconnected habitats of an estuary and examine the sequencing of the installment of each habitat. Thus, stop shoreline erosion, allow for sediment accretion, abate damaging waves, and allow the migration of the coastal habitats upland as sea levels rise. So far we have learned that the reef structure needs



to be in place first and is important for salt marsh grass establishment and dune protection. The upland coastal shrub/forest habitats are equally important as part of the structure of the coastal ecosystem that acts as a windbreak and shelter for wildlife. In addition, restoring pollinator meadows/grasslands and at least one freshwater pond will help to increase species diversity of the site.

The living shoreline restoration activity has already included a prescribed burn and some upland planting. In May 2014, with State, federal and local approval, we installed 64 cement Reef

Balls™ each 1m high by 1.2m wide (3ft X 4ft) in two equal length rows of 49m (~161ft). The reef was placed in the intertidal zone approximately 27 m (~90 ft) from the high tide line to abate wave energy, allow for sediment deposition and protect newly transplanted *Spartina alterniflora*. Milford Point, which harbors a dozen homes and a federal wildlife refuge, just across the Housatonic River from Stratford Point, is serving as the reference site for our management plan as well as historical records of the Sound. Both Stratford and Milford Points are subjected to natural and anthropogenic disturbances (e.g. flooding from hurricanes and sea level rise, fires, human activities, invasive species, etc.) but have very different land use histories with varying levels of intensity and duration of disturbances. The differences in disturbance regimes have led to ecological communities characterized by different flora and fauna. We intend to have this restoration project serve as a model for ecological restoration in other degraded coastal zones, both within and outside of Long Island Sound.

Due to its location, Stratford Point is an integral component of the fragmented matrix of coastal habitats located near the intersection of the Housatonic River and LIS. As the restored habitats mature, they will become increasingly important as a migratory stop-over site for

a variety of wildlife, including the monarch butterfly that has recently suffered from a dramatic population decline. It will also provide valuable shelter, stopover and wintering habitat for migratory birds, waterfowl and, most recently, snowy owls. The intertidal habitats including the reef structure and fringing saltmarsh will eventually become important nursery areas for fish, shellfish and crabs. If this area remains undisturbed by human activity, it would naturally supply recruits to harvestable stocks elsewhere in the Sound.

In April 2016, with the support from our partners, we will be restoring the upland vegetation and cutting back invasive plants. If you would like to get involved check the Audubon Connecticut website (<https://www.audubon.org/content/audubon-connecticut>) for dates when volunteers will be needed; tours of the site will be offered by the author in early June 2016, check www.projectlimulus.org for dates.

ABOUT THE AUTHOR Jennifer Mattei, Ph.D. is a professor, in the Department of Biology, at Sacred Heart University, Fairfield, CT. This work has been supported by the National Fish and Wildlife Foundation, DuPont, and the Undergraduate Research Initiative of Sacred Heart University.

To learn more about living shorelines, attend the **Living Shorelines Technology Transfer and Regional Workshop** in Hartford, CT on **Dec. 1 & 2.**

On Dec. 3rd, the author will lead a field trip to the Stratford living shoreline. The workshop is sponsored by the Connecticut Institute for Resilience and Climate Adaptation and Restore America's Estuaries.

For more information on the workshop contact jessica.leclair@uconn.edu or see <http://s.uconn.edu/shoreline>. For field trip information, contact matteij@sacredheart.edu.




One of the first living shorelines in Connecticut constructed with Reef Balls and newly planted (July 2015) salt marsh grass at Stratford Point (poles and flagging are part of the goose excluder fencing system). Photo credit: J. Mattei.

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