



Ocean and Coastal Acidification Monitoring Plan for the Northeast:

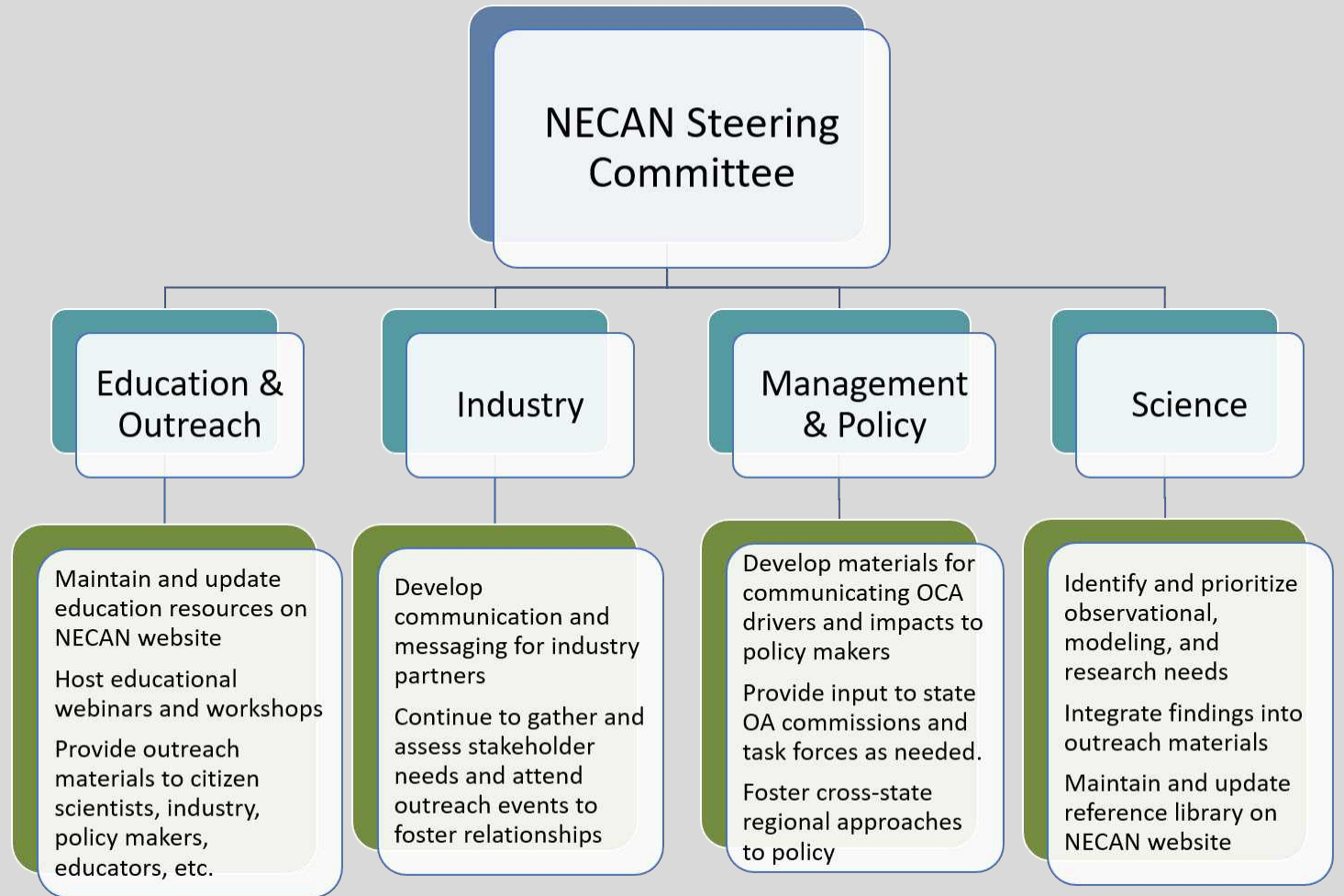
Regional insights on current assessments, monitoring priorities, and gaps.

Emily Silva, NECAN and NERACOOS
MACAN Coastal and Ocean Acidification Workshop
September 11 – 12, 2023



Who is NECAN?

- State and federal employees
- Researchers
- Academics
- Industry Members
- NGO's
- Regional Partnerships



Summary of OA Actions in the NECAN Region



Summary of 2019-2020 OA Actions in the NECAN Region
Developed by the NECAN Management and Policy Working Group
March 2021

The NECAN MPWG works to help inform and promote collaborations across states relative to Ocean and Coastal Acidification. We recognize that OA is a regional issue and will be best addressed with local and state-based efforts integrated into a regional approach.

The years of 2019 and 2020 were rich in activities at the state level to address ocean acidification (OA) and its impacts. Several states released reports related to OA specifically, or OA was included in more general state climate action plans. The Northeast Coastal Acidification Network's Management and Policy Working Group developed this summary to document recommendations related to OA and highlight commonalities among state reports.

***** MAINE *****

Maine's original OA Commission report in 2014-2015 resulted in six overarching goals:

1. Invest in Maine's capacity to monitor and investigate the effects of ocean acidification and determine impacts of ocean acidification on commercially important species and the mechanisms behind the impacts.
2. Reduce emissions of carbon dioxide.
3. Identify and reduce local land-based nutrients and organic carbon that contribute to ocean acidification by strengthening and augmenting existing pollution reduction efforts.
4. Increase Maine's capacity to mitigate, remediate, and adapt to the impacts of ocean acidification.
5. Inform stakeholders, the public, and decision-makers about ocean acidification in Maine and empower them to take action.
6. Maintain a sustained and coordinated focus on ocean acidification.

The original Commission recommendations were unable to be implemented during the previous state administration. After a change in governorship in 2018, the [Maine Climate Council](#) was formed and wrapped up its work with a comprehensive report in December 2020. One working group created a [report specific to climate impacts in Maine](#). Relative to OA, the climate plan's goals and initiatives are built on the original OA commission report recommendations.

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- Several states in the NECAN region released reports related to OA specifically, or OA was included in more general state climate action plans.
- The M&PWG developed a summary to document recommendations related to OA and highlight commonalities among state reports.

Commonalities:



Monitoring is necessary, both to understand current conditions and evaluate trends over time



Interest in Blue Carbon initiatives to sequester carbon.



Interactions of OA with other variables such as nutrient management, freshwater runoff, and habitat restoration



Increased research on impacts of OA on commercially important species



Continued engagement and outreach around OA and climate impacts in general

Missing Context and Next Steps:



- What kind of monitoring?
 - When, where, how often?
 - Methods, technology?
-

- How can NECAN address these questions?

Webinar Series → Workshop → Regional Monitoring Plan

2023 Webinar Series – Community Outreach



- What is the theme of this series?
 - Priorities in our region.
- Who is the audience?
 - The NECAN Steering Committee

2023 Webinar Series: Topics and Voices

Theme Areas

- Current Assessments
- OA and Climate
- Modeling
- Biological Impacts
- Current and New Technology, Sensors, and Methods
- User Needs and Products
- Indigenous Interests, Concerns, and Perspectives
- Rapid Response

Presenters

- Federal Agencies
- State Agencies
- Indigenous Groups
- Universities
- Research Institutes
- Non-Profits
- NGO's
- Canadian Federal Agency
- Industry

2023 Webinar Series: Topics and Voices

- What is the most important decision / use/ application for monitoring within each theme?
- What needs to be monitored to support this theme?
 - Does this approach require additional coupled monitoring?
- Where is the most important area / region / habitat / water mass to monitor to support each theme?
- How often does each theme require observations / monitoring?
 - Are there seasons that are critical?
 - What is the minimum useful frequency of observations?
 - What level of uncertainty is tolerated?
- Can each theme augment existing monitoring efforts or is new monitoring needed?
 - What implications and problems are inherited by augmenting existing monitoring?
- Does the theme require new methods / approaches to be developed or do we have the right capabilities now?

2023 Webinar Series: Overview

- 12 webinars from March to September
- 8 theme areas
- 31 presenters
- Webinar synthesis papers

Webinar #1 - Current Assessments of Ocean and Coastal Acidification in Our Region - Part One

Presented by:
Holly Galavotti, *Environmental Protection Agency*
Katie Clayton-O'Brien, *Connecticut Department of Energy and Environmental Protection*
Ivy Frignoa, *Friends of Casco Bay*

March 15, 2023



The image shows a YouTube video player thumbnail. The title is "OCA Monitoring Priorities for the North...". Below the title, there is a "Watch later" and "Share" button. The main content of the thumbnail is a map of the Northeast United States with a circular diagram overlaid. The diagram consists of several colored circles (purple, blue, green) connected by lines, representing different theme areas. The text "NECAN The Northeast Coastal Acidification Network" is prominently displayed in the center of the diagram. A red play button icon is visible on the left side of the thumbnail. At the bottom left, there is a "Watch on YouTube" button.

Watch on  YouTube



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Science on the Coastal Margin



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Research Reserve

PMEL
Pacific Marine Environmental Laboratory



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OA Monitoring Priorities Workshop

- Workshop Goals:
 - Identify OA monitoring needs and uses of OA data
 - Explore new ways of monitoring or additions to existing monitoring to help meet those needs.
 - Foster collaboration across the region.
- Workshop Outcomes:
 - Workshop report
 - OA Monitoring Plan for the NECAN region



Outreach and Engagement: VOCAL

Visualizing Ocean and Coastal Acidification Locally: New England

WHAT'S DRIVING THE CHANGES IN NEW ENGLAND'S COASTAL CHEMISTRY?

2. PRECIPITATION

- rain + snow + snowmelt
- fresh water can't resist changes to pH

1. CARBON DIOXIDE (CO₂)

- gas produced by burning of fossil fuels
- dissolves in water & reacts to form acid

6. NIGHTLY SHIFTS

- no sun = less photosynthesis = buildup of CO₂
- no rain

5. RUNOFF

- fresh water pollution from land filled with excess fertilizer, sewage & waste
- causes eutrophication

4. CYCLE OF EUTROPHICATION

PHYTOPLANKTON BOOM (tiny water plants)

- sun + nutrient fuels growth

DEATH (phytoplankton die & sink)

- bacteria feed on dead material
- release CO₂ & consume oxygen
- consume

UPWELLING & OCEAN CURRENTS

- colder, more acidic water rising up from offshore
- mixes into coastal areas
- causes pH shifts

PHYTOPLANKTON BOOM

- removes CO₂ via photosynthesis
- releases oxygen
- pH rises

PHYTOPLANKTON BOOM

- animals & bacteria continue producing CO₂ & removing oxygen

UPWELLING & OCEAN CURRENTS

- eutrophication makes nightly shifts more extreme

UPWELLING & OCEAN CURRENTS

- sea floor community also consumes oxygen & releases CO₂

The White Mountains, bacteria, lobsters, and sunshine have something big in common. They're all influencing the acidity of New England's coastal waters. Carbon dioxide is a major contributor to the ocean's falling pH, but coastal acidification is complicated by factors like runoff flowing into estuaries, and too much algae.

TAKE A DEEP DIVE INTO THE FACTORS INFLUENCING COASTAL ACIDIFICATION IN NEW ENGLAND

pH SCALE

ACIDIC	NEUTRAL	BASIC/ALKALINE
0 Battery acid	7 Pure water	14 Drain cleaner
1 Lemon juice	8 Seawater (pH 8)	13 Bleach
2 Stomach acid	9 Butter	12 Soft soap
3 Cola	10 Acid rain	11 Drain cleaner
4 Vinegar	11 Pure water	10 Baking soda
5	12	9
6	13	8

The pH scale measures the acidity or alkalinity of water-based solutions.

1. CARBON DIOXIDE (CO₂)

The ocean absorbs a quarter of the carbon dioxide (CO₂) we produce, leading to complex chemical reactions, including the formation of carbonic acid (the same chemical that makes soda fizzy and corrosive) and the release of hydrogen ions. The more hydrogen ions, the more acidic, and the lower the pH value. (← Take a look at the pH scale on the left.)

Some hydrogen ions go on to bond with and destroy carbonate ions, which are a vital ingredient in the recipe to build shells and hard structures for scallops and mollusks. As a result, ocean and coastal acidification can lead to too few carbonate ions and too much carbonic acid that can dissolve shells or make them difficult to build.

2. PRECIPITATION

Snowmelt and rainfall impact coastal chemistry because unlike ocean water, fresh water can't resist changes in pH when acids or bases are present. When fresh water enters estuaries, it contributes to swings in acidification that decrease carbonate minerals shellfish like scallops and lobsters need to grow. During spring when more fresh water enters the Gulf of Maine, the influx can lead to local acidification, especially near the mouths of rivers.

3. RUNOFF

As freshwater streams and rivers travel through land, they pick up and carry contaminants downstream like pesticides, excess nutrient-rich fertilizer, food waste and sewage; when the rivers eventually dump into coastal waters, the nutrients cause naturally-occurring algae populations to spike, a process called "eutrophication" (see 4). Reducing runoff may help ease acidic conditions on the coast.

4. CYCLE OF EUTROPHICATION

Like terrestrial plants, algae and phytoplankton grow by taking in CO₂, sunlight, and nutrients, and they produce oxygen as a byproduct. If more nutrients are added, phytoplankton grow faster, using up additional CO₂ and raising the pH of the water, especially at the sunlight-rich surface.

PHYTOPLANKTON POPULATION BOOM

When the algae's growth outpaces animals' ability to eat it, the excess dies and sinks to the bottom, where it becomes food for decomposing bacteria. As they break down the algae, the bacteria release CO₂ and use up oxygen, worsening coastal acidification and creating "hypoxic," or oxygen-poor bottom water. This low-pH/low oxygen pattern is repeated seasonally, peaking in summer with warm water and plentiful sunlight.

5. UPWELLING & OCEAN CURRENTS

Oceanic waters can also contribute to coastal acidification. Deep ocean water is separated from the surface where plants produce oxygen and CO₂ is absorbed. During the spring and summer, deep ocean water enters coastal areas through a process called "upwelling." Low oxygen, high-CO₂ upwelled water mixes with coastal water, contributing to variations in coastal acidification conditions.

6. NIGHTLY SHIFTS

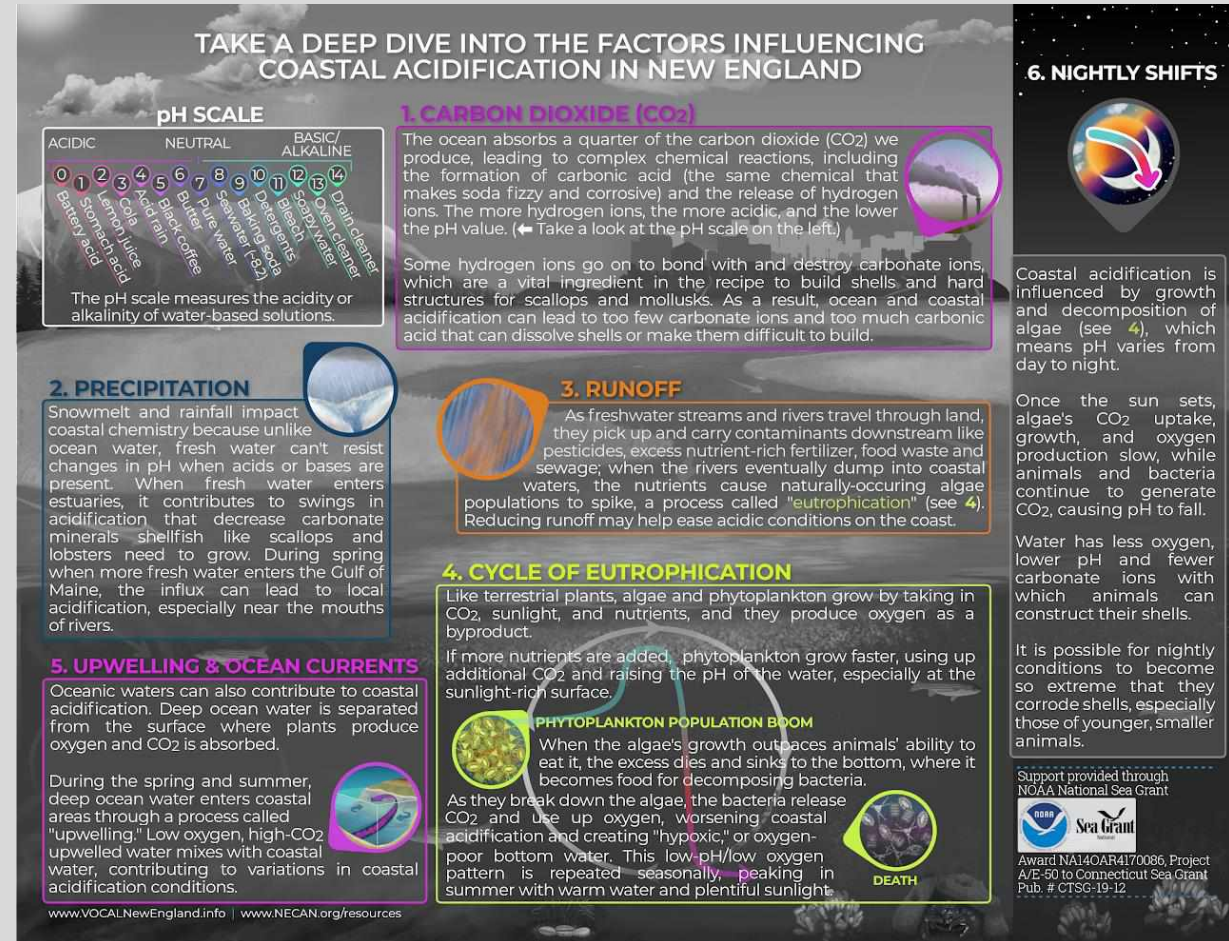
Coastal acidification is influenced by growth and decomposition of algae (see 4), which means pH varies from day to night. Once the sun sets, algae's CO₂ uptake, growth, and oxygen production slow, while animals and bacteria continue to generate CO₂, causing pH to fall. Water has less oxygen, lower pH and fewer carbonate ions with which animals can construct their shells. It is possible for nightly conditions to become so extreme that they corrode shells, especially those of younger, smaller animals.

Support provided through NOAA National Sea Grant
Award NA14OAR4170086, Project A/E-50 to Connecticut Sea Grant
Pub. # CTSG-19-12

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Outreach and Engagement: VOCAL

Visualizing Ocean and Coastal Acidification Locally: Mid-Atlantic



Outreach and Engagement: VOCAL

COASTAL ACIDIFICATION FOR INDUSTRY MEMBERS

Unlike ocean acidification, which is changing offshore water chemistry steadily over the course of years, the acidity of coastal waters fluctuates seasonally or even daily by as much as 1 unit of pH due to the many factors that converge at the coast.

This map shows general ocean and coastal acidification conditions in the Northeast based on the average minimum monthly amount of shell-building minerals (aragonite) available at the sea surface. The poorest conditions, usually seen during early spring, can be harmful to growing shellfish.

EXAMPLE OF HOW OCEAN pH CAN CHANGE OVER TIME

EXAMPLE OF HOW COASTAL pH CAN CHANGE OVER TIME

Unfortunately, we don't yet know the exact pH threshold at which shellfish will not grow or survive. Understanding thresholds is even more difficult because coastal acidification is highly influenced by:

- daily & annual cycles of plant/algae production
- land-based fresh water & nutrient inputs
- mixing of ocean and coastal waters

NEGATIVE EFFECTS OF COASTAL ACIDIFICATION ON SHELLFISH

There have been some studies on the short and longer-term effects of increased acidity and low aragonite mineral levels on larval and juvenile shellfish (info on adults is scarce), but nearly all were conducted in controlled lab settings. Those studies seem to suggest that when pH is **-7.8 or below**, most species of shellfish found in New England start to show signs of stress. Generally, larvae are the most sensitive and more likely to be stressed or die than juveniles or adults.

FUNDAMENTALS OF COASTAL ACIDIFICATION

Scientists, resource managers, fishers, and aquaculturists need to work together to support projects that will monitor acidification conditions and effects on shellfish in real-world settings. Learning more about biological responses allows us to better predict how coastal communities and economies will be impacted, so we can prepare for the future.

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LOCAL POLICY ACTIONS TO COMBAT COASTAL ACIDIFICATION WILL MAKE A DIFFERENCE. HERE'S WHAT WE CAN DO:

Coastal acidification is a danger to our region's economy, food security, ecosystem, and culture— but local-level actions can and will make a difference in mitigating damage and preparing for the future. **It's time for elected officials to publicly acknowledge the threat coastal acidification poses, work locally to implement policy changes, and support educational initiatives that will empower the next generation of coastal champions.**

CONTRIBUTORS TO ACIDIFYING CONDITIONS	WHAT IT DOES	CAN WE DO ANYTHING ABOUT IT?	WHAT POLICY ACTIONS CAN WE TAKE?
Nutrient Pollution	<ul style="list-style-type: none"> • Creates harmful algal blooms that cause extreme pH swings • Closes shellfish areas to harvesting • Can cause massive fish & shellfish die-off • Closes beaches to swimming 	YES	<ul style="list-style-type: none"> • Point source pollution: refine the Clean Water Act's technology-based standards • Non-point source pollution: impose and enforce limits on total maximum daily load of pollution • Support local estuaries in the National Estuary Program and the National Estuarine Research Reserves that protect important habitats and serve as focal areas for place-based research • Support tertiary system sewage treatment plants
Habitat Destruction	<ul style="list-style-type: none"> • Estuaries and wetlands are important carbon mitigators; less habitat means less carbon mitigation • Loss of vital habitat/nurseries for shellfish and baby fish • Fewer wetlands & aquatic vegetation exacerbates low-oxygen "dead zones" and shore erosion 	YES	<ul style="list-style-type: none"> • Legislate a state version of the National Environmental Policy Act (NEPA) to ensure that projects requiring government action can be directed (CT, MD, MA, NJ, NY, VA & D.C. already have state-level NEPAs) • Continue to empower coastal management programs through the Coastal Zone Management Act, and encourage planning bodies to support habitat restoration projects • Require that environmental impact assessments include analysis of potential contributions to coastal acidification
CO₂ Emissions	<ul style="list-style-type: none"> • The ocean is the world's largest "sink" for CO₂, making seawater more acidic • Additional CO₂ in the atmosphere traps heat, causing climate change 	To a degree: local action helps, but must be part of a national & global effort	<ul style="list-style-type: none"> • Regulate local area CO₂ emissions through the Clean Air Act • Improve public transportation infrastructure to remove vehicles from the roads • Implement green building codes for new structures and provide incentives to improve the energy efficiency of older, less economical buildings • Invest in renewable energy
Upwelling	<ul style="list-style-type: none"> • Creates corrosive conditions as cold, acidic water rises up from deep offshore and mixes on the coast 	NO	<ul style="list-style-type: none"> • Upwelling is a natural process that happens on a global scale; the process is changing due to rising ocean temperatures and increased acidity, which can only be slowed by reducing CO₂ emissions
Fresh Water Inundation	<ul style="list-style-type: none"> • Floods the coastline with corrosive, mineral-poor water • Lowers the salinity in estuaries to the point where shellfish are biologically stressed 	NO	<ul style="list-style-type: none"> • Spring snow melt and rain are a natural part of the climate cycle, though climate change is causing unprecedented amounts of precipitation, which is worsening the effects of freshwater inundation. This cycle can't be slowed without significant reduction in CO₂ levels.

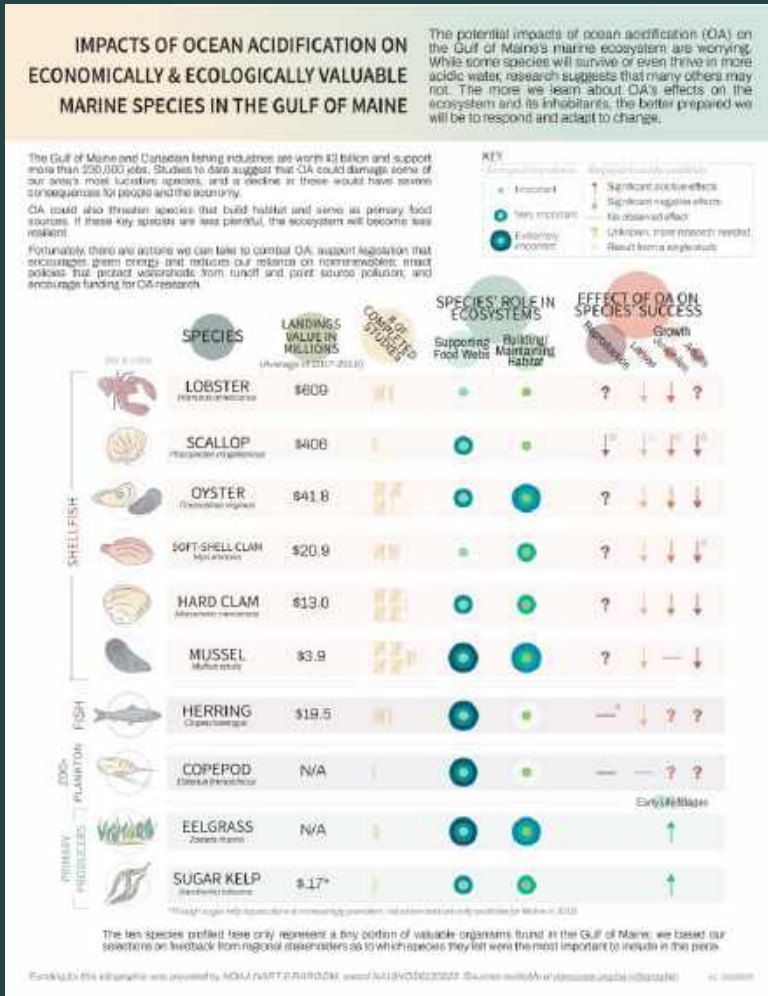
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Support provided through NOAA National Sea Grant award NA16OAR070006, Project A/E-50, to Connecticut Sea Grant, PI: HCTOC-19-10

Coastal acidification for industry members.

Local policy actions to combat coastal acidification.

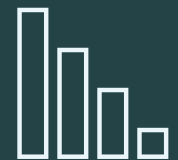
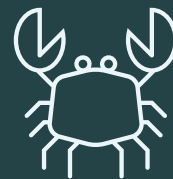
Outreach and Engagement: OA Impacts



Impacts of Ocean Acidification on Economically and Ecologically Valuable Marine Species in the Gulf of Maine

Species Value Studies

Role in Ecosystem Effects of OA on Species



Thank you!

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