



NECAN Update

BETH TURNER AND THE NECAN STEERING COMMITTEE

NROC MEETING, DECEMBER 16, 2019

NECAN Steering Committee

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NOAA/NOS/NCCOS

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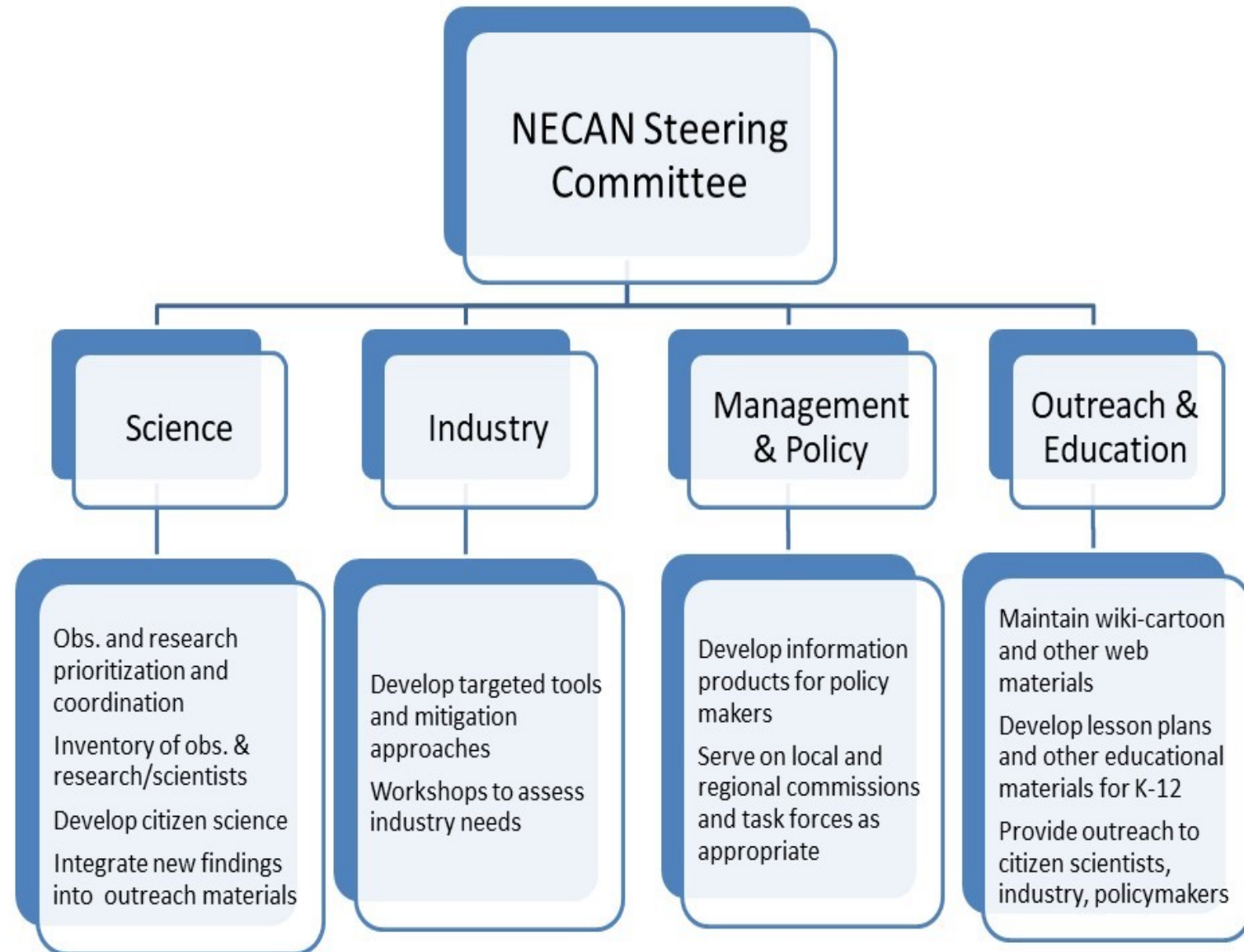
Steve Couture, NH DES

Kumiko Azetsu-Scott, DFO

Samantha Siedlecki, UCONN

Dana Morse, UME Coop. Ext.

NECAN Working Groups



NECAN Approach

Review and assess

Communicate

Respond

Set priorities

Webinars

Synthesis

Translation

Stakeholder
Input

Implementation
Plan



**Webinars
2013 - 2014**

**State of the
Science
Workshop
Apr 2014**

**Summary
Article
June 2015**

**Stakeholder
Engagement
Workshops
2014 - 2016**

**Implementation
Plan
2017 and 2019
(revisit annually)**

2013

2019

Gaps identified at 2014 SoS workshop

- ▶ Prioritize work on species of economic importance
 - ▶ lobster, scallop, cod
 - ▶ Combined impacts of OA and other stresses
 - ▶ Integrate lab
 - ▶ This resp
 - ▶ Multi experiments to exa
 - ▶ Benthic habitats as well as pelagic
 - ▶ Maintaining experimental life cycle of organic
 - ▶ Met
 - ▶ Instead
 - ▶ history
 - ▶ when/where will OA impact these?
 - ▶ Geographic distribution of species
 - ▶ where are they at the edge of their distributions?
 - ▶ What are realistic CO₂ levels and variability in environment?
- Regional SG-OAP call for proposals 2016
 - State SG funding
 - OAP-NCCOS competitions 2015 and 2018



Dec 2017
NECAN
NROC

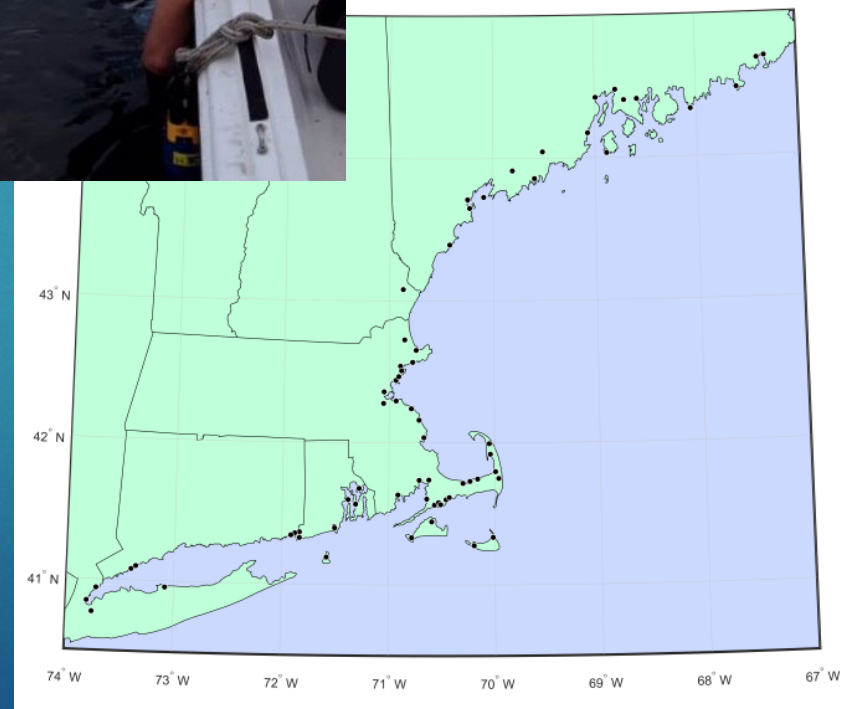
Monitoring Coastal Acidification: *Why, What, How?*



- ▶ *Goal: Help to create a coordinated monitoring strategy that can incorporate current observations as well as include emerging efforts to measure OCA parameters in order to best meet the needs of coastal managers.*
 - ▶ Develop **ways to share data** for integration, analysis, and interpretation for management (coordination with ISMN)
 - ▶ Create **narrative standards for management** with numerical interpretations
 - ▶ Better **communications strategy** with an emphasis on who is communicating to which audiences
 - ▶ Engage **citizen science** groups

Citizen Science Monitoring Workshops and Shell Day

- ▶ **April-May 2018:** 3 Day-long workshops in CT, MA and ME
- ▶ **Aug 22, 2019:** Shell Day monitoring blitz for TA and Salinity
 - ▶ **500** samples collected
 - ▶ **100** unique sampling sites
 - ▶ **57** water quality monitoring organizations
 - ▶ **8** laboratories analyzing samples



Communications strategy NECAN and MACAN SG – NART project

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

3. RUNOFF

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

4. CYCLE OF EUTROPHICATION

PHYTOPLANKTON POPULATION BOOM

- sun + runoff fuels growth

- removes CO₂ via photosynthesis
- releases oxygen
- pH rises

DEATH

- phytoplankton die & sink
- bacteria feed on dead material
- release CO₂ & consume oxygen
- pH falls

- sea floor community also consumes oxygen & releases CO₂

5. UPWELLING & OCEAN CURRENTS

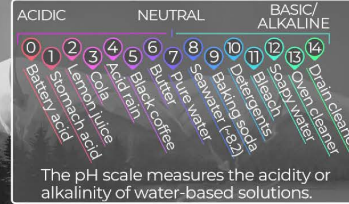
- colder, more acidic water rising up from offshore
- mixes into coastal areas
- causes pH shifts

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



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.

6. NIGHTLY SHIFTS

- no sun = less photosynthesis = buildup of CO₂
- pH falls

PRECIPITATION

It and rainfall impact chemistry because unlike water, fresh water can't resist in pH when acids or bases are added. When fresh water enters the ocean, it contributes to swings in pH that decrease carbonate ions, which are needed to grow. During spring and summer, when fresh water enters the Gulf of Maine, it can lead to local acidification, especially near the mouths of rivers.

UPWELLING & OCEAN CURRENTS

Deep ocean water is separated from the surface where plants produce and CO₂ is absorbed.

In the spring and summer, when fresh water enters coastal waters, it can lead to local acidification, especially near the mouths of rivers.

- less CO₂ removal by phytoplankton

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.

DEATH

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



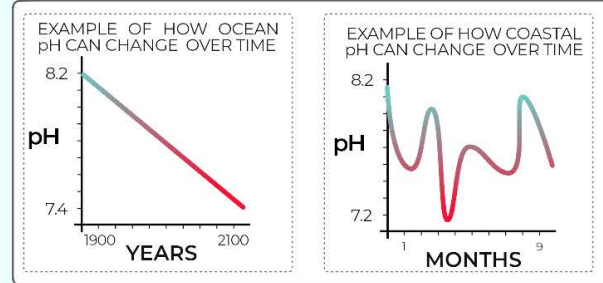
Award NA14OAR4170086, Project A/E-50 to Connecticut Sea Grant, Pub. # CTSG-19-12

Conceptual model to show OA drivers and impacts to stakeholders in industry & policy

Info Sheet for Shellfish Industry

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.

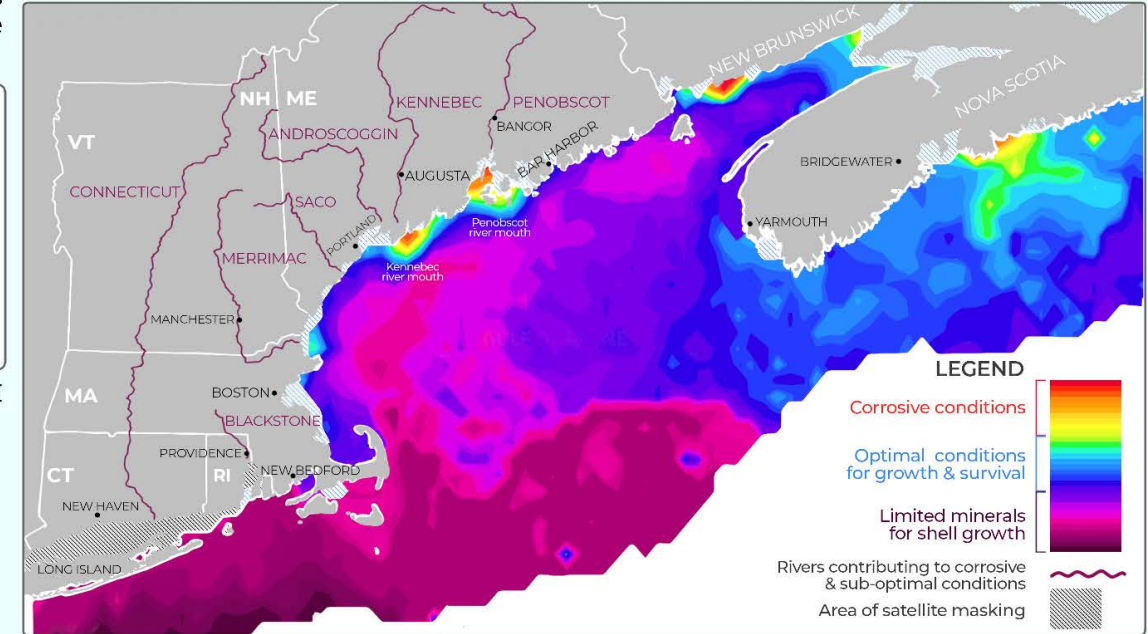


Unfortunately, we don't yet know the exact pH threshold at which shellfish will not grow or survive.

Understanding thresholds is even more difficult because coastal acidification is highly influenced by:

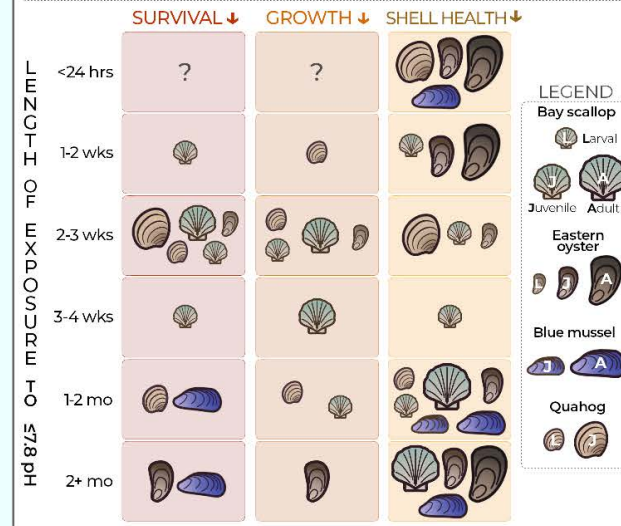
- daily & annual cycles of plant/algae production
- land-based fresh water & nutrient inputs
- mixing of ocean and coastal waters

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.



*Map adapted from Fig. 2, Gledhill et al. (2015). Ocean and coastal acidification off New England and Nova Scotia. *Oceanography*. <https://doi.org/10.5670/oceanog.2015.41>

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.

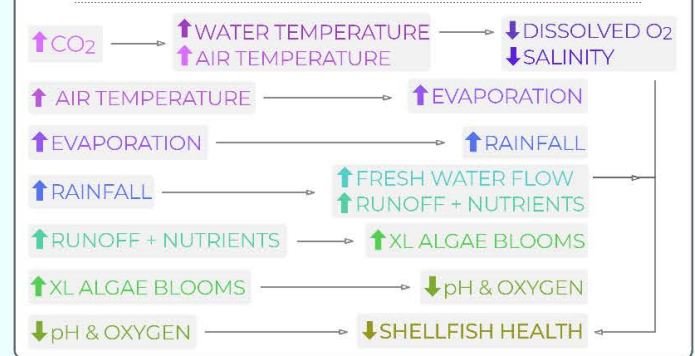
Those studies seem to suggest that when pH is ~7.8 or below, most species of shellfish found in New England start to show signs of stress. Generally, larvae are the most sensitive and more likely to be stressed or die than juveniles or adults.

*Table compiled from Gledhill et al. (ibid) & Gazeau et al. (2013) Impacts of ocean acidification on marine shelled molluscs. *Marine Biology*. DOI 10.1007/s00227-013-2219-3

Support provided through NOAA National Sea Grant award NA14OAR4170086, Project A/E-50, to Connecticut Sea Grant Pub. # CTSG-19-10



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.

Info Sheet for Policy

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"> <i>Point source pollution</i>: refine the Clean Water Act's technology-based standards <i>Non-point source pollution</i>: 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
CO ₂ 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.

Upcoming and ongoing NECAN activities

- ▶ Regional Modeling Project
 - ▶ NERACOOS lead, adding carbonate to NECOFS
 - ▶ Utility to water quality managers, shellfish industry and management
- ▶ Follow-up to Cit Sci Workshops
 - ▶ Analysis of samples
 - ▶ Outreach to sampling groups
- ▶ Continue webinar series
 - ▶ Industry webinars
 - ▶ SG projects from 2016 RFP

- Expanded info sheet re. impacts, including economic importance of resources
- Pursue monitoring strategy
- Potential Symposium?
 - Revisit state of science since 2014
 - Assess progress and continuing knowledge gaps
- OA Information Exchange
 - <https://www.oainfoexchange.org>