



August 13, 2014

RECEIVED AUG 14 2014

Dear coastal resident:

Many members of the public, specifically the fishing industry, have heard about and are concerned about Ocean Acidification (OA). At the Island Institute, we have heard this concern repeatedly during events we have hosted over the last several years, specifically during our annual “Fishermen’s Climate Roundtables”. Fishermen at these event have also reported to us that ocean acidification is not well understood by coastal stakeholders and the public in general. This packet was put together to help answer some questions about the process of OA and its impacts, as well as to provide information about how Maine is addressing the issue, including through the formation of the new legislative study commission on OA. Included in this packet are:

1. A fact sheet outlining what people in Maine are doing to confront the issue of OA and how you can become involved;
2. An “infographic” providing a basic overview of ocean acidification and the impacts on some of Maine’s marine organisms.

The Island Institute believes that communication between scientists and the public, particularly fishermen and other island and coastal residents, is vital to adapting to our changing environment. Another resource you may find helpful is a short, eight-minute documentary about ocean acidification from the perspective of Alaskan fishermen and scientists. See: www.islandinstitute.org/climateofchange to view the documentary.

Please feel free to share this information. We hope you find it helpful and that you are having a fun, safe, and productive summer!

Sincerely,

Susie Arnold & Julia Maine

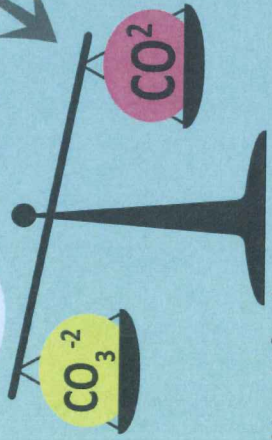
RECEIVED AUG 14 2014

Susie Arnold is a marine scientist at the Island Institute and an appointee to the Maine Ocean Acidification commission. She can be contacted at: sarnold@islandinstitute.org

Julia Maine is a resident of Chebeague Island and an undergraduate at Bowdoin College studying earth and ocean science and visual arts. This summer she participated in the Island Institute’s Island Scholars Internship Program. She can be contacted at: jmaine@bowdoin.edu

Ocean Acidification in the Gulf of Maine

CO₂ is being released into the atmosphere by human activities at historic rates.



More CO₂ in the atmosphere means more CO₂ is absorbed by the ocean, offsetting the balance of carbon molecules. This leads to an increase in the concentration of hydrogen ions (H⁺) and a decrease in the concentration of carbonate (CO₃²⁻) (an important component of shell building).

↑ H⁺ ↓ pH ↑ Acidity

Ocean Acidification (OA) is a term used to describe this changing chemistry. The pH scale is a measure of H⁺ in water. More H⁺ causes a drop in pH and an increase in acidity.

↑ Acidity
of seawater

↓ Shell Growth ↓ CO₃²⁻

The shells of marine organisms like clams and oysters are made out of calcium carbonate (CaCO₃). These organisms take up carbonate (CO₃²⁻) and dissolved calcium (Ca²⁺) to build their shells. A decrease in the concentration of carbonate decreases the amount of available shell-building material, making it more difficult for many organisms to build their shells.



Coastal Acidification

Polluted runoff from human activities causes coastal waters to acidify more rapidly.



Shell Damage

Increased acidity can even cause some calcium carbonate shells to dissolve like a piece of chalk (calcium carbonate) dissolves in vinegar (mild acid).

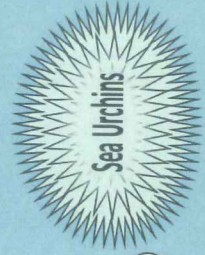
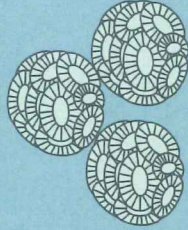
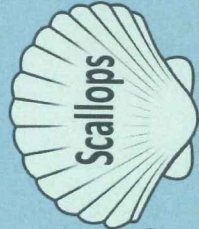
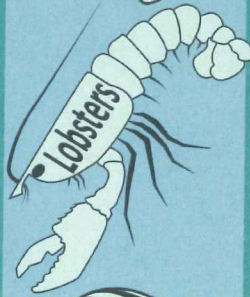
Vulnerable Organisms

Clams: OA has been found to increase mortality, delay the onset of metamorphosis, slow growth, and depress calcium uptake (the shell building process) in hard clams.

Plankton: Some plankton, which make up the base of the food chain, contain calcium carbonate and are impacted by OA. This could cause problems for organisms higher up the food chain like fish and lobsters.

Finfish: Early work on the response of finfish indicates that some species undergo behavioral changes when exposed to OA conditions predicted for the next century.

Lobsters: The impacts of OA on lobsters are not yet understood.





What's Happening with Ocean Acidification in Maine?

Ongoing Efforts in Maine and the Region

Maine OA Legislative Study Commission- LD 1602, a bill to form a commission to address the impacts of OA on the state, introduced by Representative Mick Devin, became law this spring. The commission is reviewing what is known about OA and where there are critical knowledge gaps, prioritizing strategies for filling these gaps, and will suggest mitigation strategies, policies, and other tools to respond to OA in a report due in December. For more details see: www.maine.gov/legis/opla/oceanacidification.htm

Maine OA Working Group- This group consists of over 100 members who share a common concern for the environmental and socioeconomic impacts of OA in Maine. The purpose of the group is to share information about ocean acidification that will help build a stronger community around understanding and addressing OA's impacts on Maine's marine resources and coastal communities. If you're interested in joining, contact Susie Arnold at sarnold@islandinstitute.org

Northeast Coastal Acidification Network (NE-CAN)- A nexus of scientists, federal and state agency reps, resource managers, and affected industry partners that serves as an interface between research and industry interests, shares the state-of-the-science on OA, and guides regional observing, research, and modeling endeavors to better understand OA. NE-CAN is aiming to host a stakeholder meeting about OA in Maine in December. For more details see: www.neracoos.org/necan

First Meeting to Address Ocean Acidification in Maine held January 16

The Island Institute hosted a full-day meeting on confronting ocean acidification in Maine on January 16 in Augusta. We had nearly 70 participants, ranging from fishermen and aquaculturists to scientists and legislators, as well as others in fields impacted by ocean acidification (OA). The group heard presentations on the science of OA, concerns from stakeholders, national, regional, and state efforts underway to tackle OA, and some potential mitigation and adaptation strategies. A summary and copies of most of the presentations can be found at www.islandinstitute.org/OceanAcidification

Some key concerns, questions, and knowledge gaps identified at the meeting include:

- lack of knowledge about OA impacts on commercially important species, particularly lobster, and the potential socioeconomic consequences;
- impacts on the base of the food chain;
- the role of polluted runoff in exacerbating coastal acidification;
- how OA will interact with other changes like rising sea water temperatures;
- how we can raise visibility to an invisible problem

*****Upcoming Workshop on Coastal Community Vulnerability to OA- October 7 in Portland*** (Agenda will be posted at: www.islandinstitute.org/OceanAcidification)**

For More Information

Contact: Susie Arnold, Marine Scientist at the Island Institute, at sarnold@islandinstitute.org, 207-844-0050 or Nick Battista, Marine Programs Director, at nbattista@islandinstitute.org, 207-691-3554

Visit: www.islandinstitute.org/OceanAcidification and check out the video about OA and Alaskan fishing communities produced by the Island Institute at: www.islandinstitute.org/climateofchange

Key Points About Ocean Acidification:

- The absorption of carbon emissions by the ocean is changing the chemistry of seawater and lowering its pH, known as ocean acidification.
- While the pH of the ocean has held stable at 8.2 for over 600,000 years, in the last 200 years its pH has dropped to 8.1, representing a 30% increase in acidity. To add context, an equal drop in pH of human blood, 0.1 units, can cause seizures, heart arrhythmia or even coma. The rate of this increase is happening 100 times faster than anytime in the last 65 million years. Marine life may not be able to adapt at this rate of change.
- The Gulf of Maine has been identified as being uniquely susceptible to ocean acidification, with its cold temperatures and high amounts of freshwater input lowering its buffering capacity.
- Marine organisms that secrete shells or skeletons are most vulnerable to ocean acidification. Over 75% of Maine's fisheries (by landings value) are shell-producing species, including clams, oysters, scallops, urchins and lobsters. Lobster alone accounts for approximately 69% of the value of all fisheries landings in the state, with a value of over \$375 million in 2013 and an overall contribution of around \$1 billion to the state economy. About 7,500 active harvesters targeted shell-building species in 2012.
- Clams and oysters in Maine are already being negatively affected by ocean acidification.
- Other commercially important species may also be at risk. Early work on responses of finfish indicates that some species undergo behavioral changes when exposed to OA conditions predicted for next century.
- Important prey species at the base of the food chain, such as calcareous plankton are also negatively affected.
- While specific impacts on many species are yet to be determined, we do know that OA is happening now and is measurable.
- There is currently very little known about the impacts on lobsters. This uncertainty is part of the need for action. Research into the physiological, behavioral, and ecological reactions of lobster to OA should be a high priority for the state of Maine.
- Acidification is occurring along with other changes, such as warming sea temperatures, that could magnify stress on marine organisms.
- Given the high stakes associated with the changes in ocean chemistry, stakeholders, managers, conservation organizations, and scientists together must coordinate together to share current knowledge and identify critical data gaps.
- While the primary cause of OA is carbon emissions being absorbed by the ocean, there are local actions we can take to mitigate coastal acidification, such as reducing polluted runoff from farms, lawns, and septic systems that are causing coastal waters to acidify more rapidly, and preserving marine photosynthesizers, like eel grass, that may reduce local acidification.