Dramatically reducing carbon dioxide emissions is the most important action to mitigate ocean acidification.

- Support policies, plans and commitments that seek to reduce anthropogenic carbon emissions and greenhouse gas emissions.

- Support policies that mandate 100% clean electricity, improve efficiency of buildings, and advance electrification of the transportation sector from cars to marine shipping.

- Support commitments and investments in renewable energy sources from solar to offshore wind.

- Implement and advocate for initiatives creating climate smart communities (using greener power, waste reduction, and increased recycling, etc.).

- Engage leaders and policy makers to act as ambassadors to elevate urgency and ambition for climate action by highlighting impacts to ocean resources, ecosystems and communities.

- Integrate ocean into climate commitments, policies and multi-governmental frameworks.

- Work with international, national, regional and local partners to advocate for a comprehensive strategy to reduce anthropogenic carbon emissions and greenhouse gas emissions.
EXAMPLES FROM MEMBERS:

- State of New York has passed the most ambitions climate commitment in the country to achieve carbon-free electricity by 2040 and a net-zero carbon economy by 2050. They have also created a state task force looking at the impacts of OA on local water bodies.

- The City of Vancouver has adopted the Greenest City 2020 Action Plan, which sets out targets and strategies to reduce carbon emissions through our energy supply, building codes, transportation sectors and even through nature-based solutions like increasing canopy cover.

- Port of Seattle is incorporating blue carbon pilot project as part of their mitigation strategy to achieve their goal of becoming carbon neutral by 2050.

- The State of Maine has formed a Climate Council that will take up OA recommendations and actions within it’s “Coastal and Marine Working Group.” The Climate Council is charged with producing a final report that will outline strategies to meet the state’s greenhouse gas emissions reduction targets, including a gross 45% greenhouse gas emissions reduction below 1990 levels by 2030 and at least 80% by 2050.

- The Swedish Agency for Marine and Water Management has prepared a report examining, “Swedish efforts to address ocean acidification, including links to climate change,” which states that substantial emissions reductions in line with the Paris agreement will benefit the mitigation of both climate change and ocean acidification and calls for an upscaling of ambition in line with the Paris agreement and SDG 13.
ACTION #2
ADVANCE SCIENTIFIC UNDERSTANDING OF CLIMATE-OCEAN IMPACTS, LOCALLY AND GLOBALLY

Join, launch or expand nearshore and deep ocean monitoring networks that help determine where and at what rate regions are experiencing acidification and changing conditions. Establish baseline monitoring necessary to capture natural variability in ocean carbon chemistry and understand long-term trends.

- Ensure data compatibility in monitoring by adopting and adhering to the common indicators and methodology developed for UN Sustainable Development Goal 14.3.
- Inventory regional monitoring and observing efforts and analyze for gaps to improve efficacy.
- Support partnerships with local experts, fisheries, industry, traditional leaders, chiefs, universities and NGOs to participate in inclusive and sustained data collection. Develop and participate in a sustained national or regional citizen science programs that includes water sampling, pH monitoring and observations. This should include long term support for education, technical training and equipment.
- Identify “hot spots” or areas that might be highly vulnerable to OA. Explore opportunities for monitoring, research and adaption.
- Identify existing protected areas, like Marine Protected Areas or Locally Managed Marine Areas, and explore opportunities for OA monitoring and research.
- Develop funding mechanisms to support research and monitoring. This will help ensure baseline data is available to better inform adaptation and policy decisions at a local level.

Conduct research to understand biological OA impacts. Assess vulnerability and risk to ecosystems and species locally.

- Commission regional or national vulnerability assessments with an emphasis on social, economic and cultural vulnerability.
- Inventory existing case studies that examine ecological or biological species vulnerability thresholds and responses to OA. Identify additional studies that must be prioritized and commission reports.
- Support laboratory (ex situ) studies to assess the direct effects of OA, and other stressors, on local species and ecosystems.
Support field (in situ) studies to characterize the effects of OA, alone or in combination with other stressors, on local species and ecosystems.

Establish a regional or national clearing house for OA data, information and synthesis that can be accessed by governments and stakeholders with the goal of informing local decision making and actions.

**Develop predictive and forecast models to inform responsive decision-making and management.**

Invest and support the development models for short-term and long-term forecasting of corrosive conditions (predictive relationships for indicators of OA, such as pH and aragonite saturation state.)

Invest and support the development of models to project ecological responses to OA and other climate stressors (e.g. how will coral reef or seagrass ecosystems respond to changing ocean conditions?) Undertake biological responses of key species (e.g. oysters, shrimp, lobster, fish) to predicted OA conditions and warming trends.
EXAMPLES FROM MEMBERS:

• New Zealand’s National Institute of Water and Atmospheric Research supports a national monitoring network including 15 sites. The Royal Netherlands Institute for Sea Research commissioned the report, “Causes and Consequences of OA- with special emphasis on Dutch territorial waters” and is working with the Convention for the Protection of the Marine Environment of the North-East Atlantic or, OSPAR Convention, and the Global Ocean Acidification Observing Network’s NE Atlantic HUB to further identify monitoring gaps and priorities.

• Tsleil-Waututh Nation is helping to lead the Cumulative Effects Monitoring Initiative (CEMI) which is developing a holistic monitoring program to establish current baseline conditions, monitor and assess trends over time, predict future development and climate change effects, and identify and prioritize opportunities for environmental protection.

• The Latin American Ocean Acidification Network (LAOCA) consists of 36 members from 8 Latin American countries and is part of the Global Ocean Acidification Observing Network (GOA-ON.) Researchers involved in the LAOCA network are working on four main lines of research that will ultimately help impacted industry, communities and decision makers better understand how ocean acidification and other stressors are impacting the region. LAOCA helped produce a Regional Action Plan on OA for Latin America and the Caribbean.

• The State of California is conducting a gaps analysis of California’s ocean acidification and hypoxia monitoring inventory assets, evaluating how existing and proposed future assets could be integrated and managed to fulfill decision-making needs.
The New Zealand Pacific Partnership on OA (PPOA), administered through the Secretariat of the Pacific Regional Environment Programme, conducted an ocean acidification vulnerability assessment for the Pacific region. The PPOA is also supporting OA monitoring sites in the region.

State of Oregon’s OAH Plan recommends co-locating oceanographic monitoring alongside existing biological sampling in Marine Reserves. This will help leverage and improve the state’s existing research.

State of Washington and the University of Washington OA Center are developing predictive forecasting models and performing monitoring and research to understand vulnerability of and impacts to key species in the region to ocean acidification. The State Legislature has invested nearly $10 million — mostly in significant actionable research — since 2012. This investment has, in turn, spurred $14.5 million in federal and private funding.
ACTION #3
REDUCE LOCAL POLLUTIONS THAT EXACERBATE OA

Implement actions that reduce local inputs of land-based pollutants (e.g., nutrient loading, storm water, and wastewater) that make conditions worse. Local actions to reduce these exacerbating stressors can increase the resilience of our marine species and ecosystems. Local actions to reduce impacts of OA also have multiple co-beneficial outcomes.

- Support research and modeling to help characterize and determine the impact of local contributions to OA from land-based sources of pollution (e.g. nutrients, organic carbon, other) from sewage systems and wastewater.

- Implement strategies to limit the flow of nutrients and sediments from rivers and coastal catchments onto coral reefs, or into bays or estuaries. This could include vegetation-based remediation systems, for use in upland habitats and in vulnerable areas.

- Where pollution sources are identified, amend allowed land or water uses, update wastewater and storm water treatment requirements, and regulate land use actions to prevent and reduce run-off and water quality issues exacerbating coastal acidification.

- Ensure coastal development plans and land-use changes are managed in a way that considers local hydrology changes to water movement that could further exacerbate impacts of coastal acidification.

- Determine whether existing water quality criteria are adequate for tracking OA. Include OA as a potential point of concern and review in local water quality policies and permitting decisions.

- Eliminate destructive fishing activities, mining of coral rock, unregulated sand and gravel mining from streams and coasts and damage from boating and tourist operations.
EXAMPLES FROM MEMBERS:

- California Coastkeeper Alliance outlines strategies for preventing wastewater discharges from causing ocean acidification and hypoxia hot-posts and for preventing agricultural nutrient inputs from causing harmful algal blooms which can exacerbate existing conditions.

- State of Washington is working on a model that will help characterize how nutrients from wastewater sources may contribute to OA locally and regionally.

- Seattle 2030 District is working to promote effective management of non-point source pollutions, including stormwater run-off with the goal of limiting the amount of pollution that ends up in local water channels or bodies. Through their Green Stormwater Initiative, they are promoting use of rooftop gardens, on-site vegetation, bio-swales, rainwater collection, permeable pavement, and other stormwater mitigation best practices.

- Coral Reef Alliance is helping to restore natural filtration processes within watersheds to prevent land-based water pollution from degrading reefs and further exacerbating negative stressors like warming and ocean acidification.

- The State of Oregon is working to assess how clean water quality criteria could be amended to include biocriteria for pteropods and additional considerations of hypoxia and oxygen impairment when determining the health of marine waters.
**ACTION #4**

PROTECT THE ENVIRONMENT AND COASTAL COMMUNITIES FROM CLIMATE-OCEAN IMPACTS THROUGH ADAPTATION AND RESILIENCE BUILDING STRATEGIES.

- **Remediate or ameliorate the impacts of coastal acidification**
  - Conduct pilot projects to determine how submerged aquatic vegetation—like sea grass, kelp or mangroves—can absorb or sequester CO₂ in the water column and protect nearby calcifying organisms like coral reefs or shellfish.
  - Build local capacity to preserve, protect, and restore submerged aquatic vegetation like mangroves, seagrass, kelp and saltmarsh.
  - Identify and protect refuges for OA-vulnerable organisms.
  - Manage resources and human activities to reduce co-occurring stressors that exacerbate ecosystem vulnerability. This could include precautionary fisheries policies and catch limits or establishing and enforcing Marine Protected Areas or Locally Managed Marine Areas.

- **Increase adaptation capacity and enhance species biological resilience**
  - Support techniques to adapt to OA impacts at shellfish hatcheries, such as buffering seawater, applying aeration strategies, or adding shell to marine waters.
  - Maintain and enhance genetic diversity of native species including conservation hatchery techniques or selective breeding for tolerance and resilience.
  - Develop hatchery and grow-out systems of freshwater pond aquaculture.
  - Diversify catches of coastal demersal fisheries to match changes in species composition due to a) local increases in abundance due to changes in distribution; b) increase in herbivorous species.
  - Pursue and support projects for coastal restoration in partnership with Tribal leaders, village chiefs, NGOs, local universities and other researchers.
Practice adaptive management to enhance community and economic resilience

- Develop methods to incorporate OA and ocean warming into existing short- and long-term resource management plans and adaptive management actions for species at varying scales.

- Support fisheries stock assessments designed to alert managers of climate related changing ocean conditions and resulting impacts. As applicable, transfer some fishing effort from coral reefs to oceanic species by installing fish aggregating devices close to the coast that will increase access for some communities.

- Develop alternative income options for fishing and other ocean resource dependent jobs and provide direct support for affected industries and communities. Establish funding sources and regional networks of financial aid for this purpose.
EXAMPLES FROM MEMBERS:

• California’s Ocean Science Trust (OST) has been researching the potential co-benefits of restoring and conserving seagrass beds and kelp forests, including examining the role seagrass plays in remediating impacts of coastal acidification near shore.

• Members of Maine’s Ocean and Coastal Acidification Partnership are investing in pilots that explore kelp farming as a strategy for remediating OA and improving shellfish cultivation.

• Seychelles’ Conservation and Climate Adaptation Trust (SeyCCAT) is working with Oxford University, Pew Trusts and the University of Seychelles to map the seagrass ecosystems within Seychelles and use existing guidance to assess their carbon value and potentially help remediate impacts of coastal acidification.

• Mook Sea Farm and Taylor Shellfish Farms are exploring several adaptation strategies including buffering of seawater to ensure that the oysters and shellfish they grow are able to withstand impacts of ocean acidification.

• New Zealand’s Ministry of Business Innovation and Employment (MBIE) also commissioned CARIM, the Coastal Acidification—Rates, Impact and Management project which was charged with providing new knowledge on ocean acidification to enhance protection and management of New Zealand coastal ecosystems.

• Through the New Zealand Pacific Partnership, Secretariat of the Pacific Regional Environment Programme, works with communities across the Pacific region to identify and implement stakeholder priorities for practical adaptation actions to enhance community and ecosystem resilience to ocean acidification including: mangrove and seagrass restoration to locally buffer pH, Locally Managed Marine Areas to reduce reef stressors and alternative livelihood opportunities to reduce reef fishing pressure and enhance food security.
**ACTION #5**

**EXPAND PUBLIC AWARENESS**

Engage policy makers, industry, scientists and the public on the growing threat posed by OA, as well as local actions that may be taken to address OA.

- **Increase visibility of OA as an issue and facilitate understanding of impacts and actions across government agencies and intergovernmental bodies**

  - Engage heads of state, governors, chiefs, ambassadors, ministers and mayors to act as ambassadors on ocean acidification and put them on panels, commissions and other platforms to help elevate the issue.

  - Appoint positions within appropriate departments/ agencies/ ministries to focus on ocean acidification and ocean changes from a resource management and climate mitigation, adaptation and resilience perspective.

  - Help policy makers and resource managers understand how they might integrate OA science and current findings into mitigation and resilience planning.

  - Communicate OA issues and science developments to regulators. Support regulatory bodies in publicizing and communicating local ocean acidification impacts and potential responses.

- **Engage local academia, public, industry, stakeholders, villages and communities**

  - Leverage relationships with local academic institutions, Tribal governments, traditional leaders, chiefs, city leaders, and NGOs within the region to provide a platform and inclusive approach to learning more about the impacts of ocean acidification on local water bodies, including through shared data collection. This could be accomplished through panels, task forces, committees, and workshops to increase understanding and awareness.

  - Attend conferences, symposiums, workshops, and other events that include diverse audiences and impacted communities and share knowledge about OA impacts and responses.
Share information with OA vulnerable industries and professions by convening specialists and/or industry representatives. Engage the seafood industry, aquaria, NGOs and other private sector partners around ways to connect with their membership about what is at risk.

**Educate and facilitate understanding on the drivers and impacts of ocean acidification**

- Leverage existing education and outreach networks to inform stakeholders and the public about OA.
- Create public education curriculum to teach youth about climate change impacts felt in our oceans. Help educators develop and implement curricula on OA and associated climate issues for primary, secondary and higher education. Aid formal and informal OA education programs and teacher trainings.
- Facilitate community and village conversations and include facts and summaries of the issue. Share information with potentially vulnerable fisheries and industries through convening specialists and scientists within the region.
EXAMPLES FROM MEMBERS:

- State of Hawaii has appointed an Ocean Acidification Action Planner position to help convene government, stakeholder and community workshops and to draft OA recommendations and priorities for the state to consider. The State of Washington created the Marine Resources Advisory Council which is responsible for maintaining a sustainable coordinated focus on ocean acidification across state agencies, delivering recommendations to the Governor and state legislature and conducting public education activities regarding ocean acidification.

- State of Oregon is describing how relevant state agencies can integrate OA science and current findings into mitigation goals, resilience planning and management.

- Alaska OA Network has created several resources for educators and fisherman, including a 2-pager about the biological impacts of OA on Alaska’s Fish and Shellfish. The Alaska OA Network also runs an OA community sampling program, that includes communities across Alaska and is primary coordinated by Tribes in the region.

- The Nature Conservancy helped to create the Shellfish Growers Climate Coalition, which is working to highlight and educate about the impacts of climate change on marine species, ecosystems and economies and push for increasing climate mitigation ambition.

- Natural Resources Defense Council and Ocean Conservancy have helped to build infographics and one-pagers that describe the potential economic consequences of OA and engage state policy makers in local actions.

- Seattle Aquarium has helped to lead education and outreach efforts through blog posts and hosting events focused on local impacts of ocean acidification.

- The Suquamish Tribe and the Northwest Indian Fisheries Commission helped to produce a curated collection of free resources on ocean acidification (OA) for educators and communicators aimed at school aged children K-12.


ACTION #6

SUSTAIN INTERNATIONAL SUPPORT

Secure sustained support globally, regionally and locally for action taking.

- Join and participate in the International Alliance to Combat Ocean Acidification (OA Alliance.)
- Join and actively engage with international knowledge-exchange networks focused on OA, including Global Ocean Acidification Observing Network (GOA-ON), the International Ocean Acidification Coordinating Centre (OA-ICC), Ocean Acidification international Reference User Group (OAiRUG), or the UN’s IOC Sub-Commission for the Western Pacific (WESTPAC). the OA Information Exchange (OAIE.)
- Call for emissions reductions and ocean adaptation actions under international climate frameworks like the United Nations Framework Convention on Climate Change (UNFCCC.)
- Register voluntary commitments relevant to climate-ocean impacts to the UN Sustainable Development Goal Platform (SDG 13 and 14.)
- Include OA and other climate-ocean action plans within Nationally Determined Contributions and Convention on Biological Diversity Aichi Targets.
- Integrate OA into National Ocean Policies, National Action Plans and Joint National Action Plans by incorporating the most current science, vulnerability assessments and actions that support mitigation, adaptation and resilience planning.
- Include climate-ocean adaptation strategies, policies, and priorities across adaptation communications.
- Contribute ideas and plans to the Platform for Science-Based Ocean Solutions, created by the COP25 Presidency to bring together best practices, methodologies and tools to help national governments incorporate oceans into Nationally Determined Contributions.
- Enhance collaboration and coordination of OA efforts across a region and with other governments and organizations focused on ocean, climate and coastal issues. Ensure that OA is a permanent agenda item at regional meetings.
Convene stakeholders, decision makers and other target audiences to promote understanding of OA causes and consequences at regional and international symposiums, conferences, workshops and other events.

Leverage funding opportunities through framework conventions like CBD, UNFCCC and through programs such as UNEP to assist with implementation of measures related to science, monitoring, mitigation, adaptation and resilience building as relevant to OA impacts.
EXAMPLES FROM MEMBERS:

• The Government of Chile launched the Platform for Science-Based Ocean Solutions at COP25—a tool that will bring together examples, best practices and methodologies to help national governments incorporate ocean mitigation and adaptation strategies into their Nationally Determined Contributions. Chile is also a founder of the Because the Ocean Initiative, which urges UNFCCC Parties to consider submitting Nationally Determined Contributions that promote, as appropriate, ambitious climate action in order to minimize the adverse effects of climate change in the ocean and to contribute to its protection and conservation.

• The Government of Fiji helps lead and coordinate numerous activities and negotiations internationally and across Pacific Island Countries, finding the synergies and the gaps across the different UN bodies to address climate and ocean issues such as ocean acidification. The Republic of Fiji’s National Adaptation Plan was published in 2018 and includes ocean acidification.

• Governments of Sweden and Fiji co-chair Friends of Ocean Action, a coalition of over 50 ocean leaders who are fast-tracking solutions to the most pressing challenges facing the ocean. Its members come from business, civil society, international organizations, science and technology. Friends of Ocean Action helps to ensure ocean mitigation and adaptation strategies are elevated across the UNFCCC.

• The Government of New Zealand champion’s the Commonwealth Blue Charter Ocean Acidification Action Group and works to advance ocean acidification science, observation, action and education across Commonwealth governments.

• Ocean Conservancy, Nature Conservancy, World Wildlife Fund, National Resource Defense Council, Climate Advisors and other affiliate members are hosting workshops and supporting international events across climate and ocean platforms.

• The Ocean Foundation builds the capacity of scientists, policymakers, and communities to monitor, understand, and respond to ocean acidification both locally and collaboratively on a global scale through their leadership of the International Ocean Acidification Initiative.
7
HAVING AN IMPACT
COLLECTIVE IMPACT BY OA MEMBERS

Membership accounting for nearly 300 million people

OA Action Plans that will cover 366,414 kilometers of coastline

OA Action Plans are identifying economically important fisheries and aquaculture that are most at risk.
(For example: Spiny squid, sea urchin, tuna, blue crab, eastern oyster, salmon, and Dungeness crab)

The OA Alliance is an active member of UN SDG 14 Communities of Ocean Action through Voluntary Commitment # 15195 which is helping to implement SDG 14, to conserve and sustainably use the oceans, seas and marine resources for sustainable development.

OA Alliance has supported the creation of 15 OA Action Plans

The OA Alliance is a featured stakeholder of the Platform for Science-Based Ocean Solutions which was created by the COP25 Presidency and a contributor to the Ocean and Climate Change Dialogue created through the UNFCCC.
“Washington state has already experienced the ravages of climate change and it is impacting the health of our ocean, our economy, and our communities. Up and down the coast of our state, ocean acidification has damaged shellfish aquaculture production, while marine heat waves and harmful algal blooms threaten to cripple fisheries, tourism and wildlife. Our decisions matter and it is critical we act fast to reduce carbon pollution. In Washington, we aren’t waiting to act and harnessing the power of collective action and leadership through the OA Alliance. We are all in this together.”

Washington State Gov. Jay Inslee, a founding member of the OA Alliance.
PROMOTING SOLUTIONS AND ADVANCING KNOWLEDGE INTO ACTION
References:


Final Report of the commission to study the effects of coastal and ocean acidification and its existing and potential effects on species that are commercially harvested and grown on Maine’s coast (2015) http://www.maine.gov/legis/opla/Oceanacidificationreport.pdf


Credits:

Photography: Dr Julien Vignier (Cawthron Institute), Oregon Marine Reserves, Hoodh Ahmed, Vivaan Irivedii, Catrin Johnson, Daniel Oberg, Matt Hardy and Thomas Vimare on Unsplash, Dr. Paul Erftemeijer and Karl Fellenius for pictures related to Pacific Partnership on Ocean Acidification.

Design: Juliana Corrales | ju-la.com
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