# Priority Action Recommendations

Draft – August 8, 2012

# Note

- All recommendations are draft and subject to change
- Recommendations are presented by topic/ workgroup
- Workgroup order does not imply prioritization of one workgroup's recommendations over another's
- These recommendations are a subset of a larger body of recommendations that should be implemented
- Most descriptions were shortened for presentation.
- A few titles have been updated.

Workgroup 1

# RESEARCH AND MONITORING

# Priority Research and Monitoring Actions

Action 1.1 - Measure trends in local conditions at high spatial and temporal resolution using established best practices. Collect high-resolution time series of physical, chemical, and biological data at a smaller number of sites.

Action 2.1 - Construct budgets for carbon and nitrogen to quantify key anthropogenic and natural processes contributing to acidification.

Action 3.1 - Understand the association between water chemistry variables and shellfish production and survival in hatcheries and in the natural environment, promoting collaborations between scientists, managers, and shellfish growers.

Action 4.1 - Conduct laboratory studies to assess the direct effects of OA on Washington species.

Action 5.1 - Establish ability to make short-term forecasts of corrosive conditions for application to shellfish hatcheries and growing areas and other areas of concern.

*Strategy 1, Action 1.1*

**Measure trends in local conditions** at high spatial and temporal resolution **using established best practices.** Collect high-resolution time series of physical, chemical, and biological data at a smaller number of sites.

***Description** (shortened)**:***
Conduct measurements at high spatial and temporal resolution to detect trends in local conditions and to characterize:

- The pH and carbonate chemistry of marine waters in Washington;
- The variation in chemistry over space and time;
- How the watershed, ocean and atmosphere affect the status and trends;
- How biological processes affect the chemical conditions.

**Implementation Time Frame:**
Can proceed immediately, pending funding. Many parts of this action can be operational within one year; some parts exist currently but need sustained support.

**Implementation Cost:** Depends on scale

**Lead(s)/Partner(s):** UW and NOAA (co-leads); 15+ partners including academia, tribes, hatcheries, growers, state agencies, feds, non-profits

**Research and Monitoring**

*Strategy 2, Action 2.1*

**Construct budgets for carbon and nitrogen** to **quantify key anthropogenic and natural processes** contributing to acidification.

***Description*** *(shortened)**:***

Use data from observations and models to construct budgets for carbon and nitrogen for coastal and inland waters. Quantify key processes including: the human contribution to OA state; specific focus should be given to quantifying the role of nutrient loading from human sources, NOx and SOx inputs from atmospheric and riverine sources, local atmospheric sources of CO2, and dissolved and particulate carbon loadings. This should be investigated on a spatial scale that is relevant to regulation and cover seasonal variation.

**Implementation Time Frame:**
In the best scenario, this is likely ~5yr undertaking. Some data already exist, but new data will be required for input to models. Existing models will benefit from further development and refinement. Time frame for implementation is dependent on the level of funding.

**Implementation Cost:** Variable, ~ $1 M

**Lead(s)/Partner(s):** Ecology (lead) UW, NOAA, PNNL

**Research and Monitoring**

*Strategy 3, Action 3.1*

**Understand the association between water chemistry variables and shellfish production and survival** in hatcheries and in the natural environment, **promoting collaborations** between scientists, managers, and shellfish growers.

***Description:***

Determine sensitivity of shellfish populations to ocean acidification via coordinated research in laboratory, hatchery, and field environments. Shellfish of importance in this context include oysters, mussels (native and Mediterranean), clams (geoduck, razor, littleneck, manila), Dungeness crab, spot prawns, pinto abalone, and urchins. Determine whether and where robust shellfish populations exist, due to favorable local environmental conditions or to the existence of strains or populations that are tolerant of ocean acidification conditions.

**Implementation Time Frame:** Near-term (1-2 years), Medium term (3-5 years)

**Implementation Cost:** Will scale with the number of species and factors studied.

**Lead(s)/Partner(s):** no lead identified; partners: WDFW, Pacific Shellfish Institute, Shellfish Restoration Fund, NOAA, WA Sea Grant, tribes

**Research and Monitoring**

*Strategy 4, Action 4.1*

**Conduct laboratory studies to assess the direct effects** of OA on Washington species.

***Description:***

Conduct laboratory studies to assess the direct effects of pH and carbonate variables on survival, growth, and reproduction of species occurring in Washington waters, prioritizing species of ecological, economic, and cultural significance, species of conservation concern, and species that can influence human health and well-being (e.g., species that cause harmful algal blooms). When possible, characterize variation in response to ocean acidification within species as a first step in assessing the scope for genetic adaptation to ocean acidification.

**Implementation Time Frame:** Near term (1-2 years), Medium term (5-10 years)

**Implementation Cost:** Will scale with the number of species tested.

**Lead(s)/Partner(s):** no lead identified; partners: NOAA, WA Sea Grant, tribes, other research programs

**Research and Monitoring**

*Strategy 5, Action 5.1*

**Establish ability to make short-term forecasts of corrosive conditions** for application to shellfish hatcheries and growing areas and other areas of concern.

***Description:***

Develop and use real-time and model-based values of atmospheric and oceanographic variables to forecast risk of corrosive conditions. Provide on-line access to a suite of variables that forecast corrosive conditions.

**Implementation Time Frame:** 2 years

**Implementation Cost:** $500K

**Implementation Lead(s):** UW. Partners: growers, NOAA, JISAO (at UW)

Workgroup2

# LOCAL SOURCES REDUCTION

# Priority Actions

*(subject to change)*

**1. Strategy 1, Action 1 -** Limit nutrient discharges entering marine waters from wastewater treatment plants and other point source facilities….

**2. Strategy 1, Action 2** - Review and revise water quality standards for pH and other parameters based on results of modeling efforts quantifying human contributions to ocean acidification (see recommendation on research and monitoring).

**3. Strategy 2, Action 1** - Further assess the effects of nutrients from agricultural lands and practices on shellfish and other marine organisms and implement effective water quality best management practices using regulatory and voluntary incentive-based programs targeted to owners of small-acreage and working farms….

**4. Strategy 3, Action 1** -Manage and control pollution from small on-site sewage systems and large on-site sewage systems by expanding funding for on-site system maintenance repair and replacement and by providing incentives to homeowners to adopt new nitrogen-removal technologies.…

*Strategy 1, Action 1*

Limit nutrient discharges entering marine waters from wastewater treatment plants and other point source facilities based on the results of further scientific analysis (TMDLs) and monitoring determining the amount of nutrient loads that can be discharged and still to meet water quality standards. Removal of nitrogen and phosphorus may require new and improved technologies and reliable funding mechanisms.

***Description:*** (see above)

**Implementation Time Frame:**
Scientific analysis and monitoring can be implemented in the near term if staff resources are available; reduction of nutrients from wastewater treatment will be long-term.

**Implementation Cost:**
Cost for the scientific analysis and monitoring is moderate; cost for the reductions of nutrient will be very high.

**Lead(s)/Partner(s):** Ecology, wastewater treatment owners/operators, and possibly EPA

*Strategy 1, Action 2*

Review and revise water quality standards for pH and other parameters based on results of modeling efforts quantifying human contributions to ocean acidification (see recommendation on research and monitoring).

***Description:*** (see above)

**Implementation Time Frame:**
The review and revision will take place after the modeling is completed. It can be done within the timeframe set by the CWA (once every three years).

**Implementation Cost:**
This action will likely be done in conjunction with other water quality standards updates

**Lead(s)/Partner(s):**
Ecology or Tribes, and EPA with input from industry, environmental groups, and the public.

*Strategy 2, Action 1*

Further assess the effects of nutrients from agricultural lands and practices on shellfish and other marine organisms and implement effective water quality best management practices using regulatory and voluntary incentive-based programs targeted to owners of small-acreage and working farms. This action may require augmenting technical assistance, inspection and compliance capacity, and the use of new technologies. It could be implemented by expanding the use of Pollution Control Action teams, local or tribal Pollution Identification and Correction programs, or other pollution reduction efforts.

***Description:*** (see above)

**Implementation Time Frame:**
near term for assessment; near to long-term for implementation of best management practices and other programs.

**Implementation Cost:**
High; some funds may be available from federal and state agencies.

**Lead(s)/Partner(s):**
Departments of Ecology and Agriculture, State Conservation Commission, with participation from NRCS, conservation districts, tribes, counties and farmers.

*Strategy 3, Action 1*

Manage and control pollution from small on-site sewage systems and large on-site sewage systems by expanding funding for on-site system maintenance repair and replacement and by providing incentives to homeowners to adopt new nitrogen-removal technologies. The option to fund a unified, self-sustained, low-interest loan program should be explored. The Dept. of Health, with funding from Ecology, is field testing new technologies. If proven effective and reliable, appropriate steps should be taken to develop guidance for these nitrogen-removal technologies for use in Washington.

***Description:*** (see above)

**Implementation Time Frame:** near to mid-term

**Implementation Cost:** moderate

**Lead(s)/Partner(s):** Dept. of Health, EPA, Ecology, Puget Sound Partnership, and counties.

Workgroup 3

# ADAPTATION AND REMEDIATION

# Priority Actions

Action 2.1 Continue water quality monitoring at six existing shellfish hatcheries and rearing areas.

Action 2.2 Investigate efficacy of water treatment strategies and/or hatchery design to protect larvae from corrosive seawater.

Action 2.3 Investigate potential to breed and/or select OA-tolerant strains of shellfish and other vulnerable marine species.

Action 3.1 Prioritize investment in adaptation & remediation actions that provide future shellfish habitat capable of enduring a full suite of anticipated environmental changes.

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*Strategy 2, Action 2.1*

Continue water quality monitoring at six existing shellfish hatcheries and rearing areas.

***Description** (shortened)**:***

…This action is a very focused request to extend monitoring at six critical sites in the existing Pacific Coast Shellfish Growers Association (PCSGA) Monitoring Program. These sites include Whiskey Creek Shellfish Hatchery in Netarts, OR, Taylor Shellfish Hatchery in Quilcene, WA, the Lummi Indian Nation Hatchery outside Bellingham, WA, and three sites in Willapa in Nahcotta, Bay Center, and Tokeland.…This action will provide support for three years of continued monitoring, and maintain the PCSGA Monitoring Program through 2015.

**Implementation Time Frame:** Near term (< 5 years). Implementation of this request in 6-12 months would provide tremendous benefits to growers throughout the region.

**Implementation Cost:** Medium ($250k-$1mil); $499,116 for three years of monitoring at 6 existing site locations ($166,372annually)

**Lead(s)/Partner(s):** PCSGA Monitoring Program (lead); Pacific Shellfish Institute (PSI), WA Dept. of Fish and Wildlife, University of Washington, Oregon State University

*Strategy 2, Action 2.2*

Investigate efficacy of commercial-scale water treatment strategies and/or hatchery design to protect larvae from corrosive seawater.

***Description** (shortened)**:***

The rapid encroachment of ocean acidification into Pacific Northwest waters poses a significant threat to hatchery production of shellfish larvae, and fundamental system design criteria must be identified to alleviate the impact of acidified seawater on these important facilities…Further development of these [seawater treatment technologies], and additional technologies, is necessary if the Pacific Northwest shellfish industry is to stand a chance in the increasingly acidified conditions to come.

**Implementation Time Frame:** Near term (< 5 years)

**Implementation Cost:** Low (< $250k)

**Lead(s)/Partner(s):** Benoit Eudeline, Taylor Shellfish (Lead). Partners: University of Washington, Oregon State University (COAS, Hatfileld Marine Science Center), NOAA NWFSC, Whiskey Creek Shellfish Hatchery, Taylor Shellfish Hatchery, Lummi Hatchery.

*Strategy 2, Action 2.3*

Investigate potential to breed and/or select OA-tolerant strains of shellfish and other vulnerable marine species.

***Description** (shortened)**:***

We need to quantify the survival, growth and function (tolerance) of species vulnerable to ocean acidification and use these strains/species as broodstock (parents) to produce (select) more tolerant seed, fry, and other life stages for use in aquaculture and species restoration…. Marine species have some natural ability (genetic potential) to adapt to stressors; this potential may vary among species…. This potential should be explored, and if possible, harnessed to breed strains with greater resistance to OA conditions.

**Implementation Time Frame:** Near term (< 5 years)

**Implementation Cost:** Examples of current funding amounts include funding to UW at ~$200K per year for 2 years; annual operating costs of Oregon State University's (OSU) Molluscan Broodstock Program are ~$150K (but program is in the process of shutting down). A combination of public and private funding is warranted.

**Lead(s)/Partner(s):** Leads would vary among participants. Partners: 12 identified; includes feds, academia, growers, NOGs, state agencies

*Strategy 3, Action 3.1*

Prioritize investment in adaptation & remediation actions that provide future shellfish habitat capable of enduring a full suite of anticipated environmental changes.

***Description:***

Major interventions to reduce acidification impacts to shellfish habitat or production should be designed to withstand multiple concurrent stresses that are reliably projected to increase for decades or centuries to come... These changing environmental conditions are likely to influence the success or failure of actions intended to protect habitat and production of shellfish. However, a systematic approach to assessment of sites and potential interventions can improve the chances of success.

**Implementation Time Frame:** Near term (<5 years) through Long term (10 + years)

**Implementation Cost:** High (> $1 million) over 10 years.

**Lead(s)/Partner(s):** Washington Department of Natural Resources, Ecology, treaty Indian tribes, NOAA and EPA (leads). Partners: 14+, including feds, state agencies, academia, tribes, NGOs, growers

**Adaptation and Remediation**

Workgroup 4

# PUBLIC EDUCATION AND OUTREACH

# Priority Actions (also sequenced)

Action 2.3 Conduct public opinion research. Use results to develop an effective communication and outreach strategy about ocean acidification.

Action 2.1 Conduct personal outreach to key influencers and stakeholder groups to educate them about current and projected ocean acidification impacts that require some level of response at the local and state level.

Action 2.2 Develop outreach strategy and materials consistent with policy recommendations.

Action 2.4 Reinforce/reinvigorate actions that help address OA through existing planning efforts and programs

*Strategy 2, Action 2.3*

Conduct public opinion research. Use results to develop an effective communication and outreach strategy about ocean acidification.

***Description:***

The entity in charge of developing the outreach and education strategy for the Ocean Acidification Panel's policy recommendations should begin with the first step of conducting public opinion research to measure the level of the public's understanding of ocean acidification in Washington. Besides helping identify the level of public understanding, the findings of this research will inform decisions about the needed messages and tools to deliver them. Conduct public opinion polling at the start of the communication work and again in two years. The second poll will help measure if this work has increased public awareness of ocean acidification in Washington.

**Implementation Time Frame:** Near term (< 5 years)

**Implementation Cost:** Low (< $250k)
Estimate this work can be accomplished for $200,000 ($100,000 per public opinion poll)

**Lead(s)/Partner(s):** Washington Sea Grant (lead). Partners: Washington Department of Ecology, NOAA, EPA, shellfish growers, Ocean Conservancy

*Strategy 2, Action 2.1*

Conduct personal outreach to key influencers and stakeholder groups to educate them about current and projected ocean acidification impacts that require some level of response at the local and state level.

***Description** (shortened):*

Selected ambassadors will carry the ocean acidification message to identified individuals and stakeholders no later than January 2013. The aim is to establish two-way communication between the ocean acidification panel and specific industries, environmental organizations and communities who are either impacted by ocean acidification or in a strong position to help implement the panel's recommendations. Information from these meetings will be used to develop ocean acidification materials…The ultimate goal of these contacts is to invite longer-term collaboration from key stakeholders and to enlist their aid in developing solutions for specific industries and audiences.

**Implementation Time Frame:** 3-6 months

**Implementation Cost:** Low (<$250k)

**Lead(s)/Partner(s):** Governor's Blue Ribbon Panel on Ocean Acidification (lead)

*Strategy 2, Action 2.2*

Develop outreach strategy and materials consistent with policy recommendations.

***Description** (shortened)**:***

Designate an entity (preferably a person or team of people who can be associated with a non-profit agency, for example the Sea Grant Program) to develop the outreach and education strategy for the Ocean Acidification Panel's policy recommendations. The outreach strategy and materials should be based on public opinion research (See Strategy #2.1). This research will help identify the level of public understanding and the needed messages and tools to deliver them….The goal is to grow widespread understanding of the problem….It's recommended that this communication and outreach work continues for a period of two years in Washington state.

**Implementation Time Frame:** Near term (< 5 years)

**Implementation Cost:**
Low (< $250k); Estimate this work can be accomplished for $120,000 over two years.

**Lead(s)/Partner(s):** Washington Sea Grant (lead). Partners: Washington Department of Ecology, NOAA, EPA, shellfish growers, Ocean Conservancy

*Strategy 2, Action 2.4*

Reinforce/reinvigorate actions that help address OA through existing planning efforts and programs

***Description** (shortened)**:***

Ocean acidification is a new theme that can be seamlessly folded into existing planning and implementation efforts with a well coordinated and articulated strategy across Washington State….These community planning processes are well positioned to transfer acidification information within their group and within their circle of influence. These groups currently address Watershed Resource Inventory Action Plans, Shellfish Protection District plans, liquid and solid waste management, Total Maximum Daily Load plans, Lake Management Districts, groundwater management, stormwater plans, Shoreline Master Plans, transportation plans, air quality plans, emergency management plans, etc.

**Implementation Time Frame:** Near term (< 2 years)

**Implementation Cost:** Medium ($250k-$1mil total)

**Lead(s)/Partner(s):** Leads: A team of partners representing a diversity of programs and authorities that includes state agencies, tribes, business, local government, and universities to design the implementation and evaluation of this Action. Partners: many

Workgroup 5

# POST-PANEL NEEDS