

The following pages present a variety of climate change adaptation strategies and actions suggested for and in use in coastal and marine areas.

Adaptation Terminology:

Adaptation goal: General characterization of what an adaptation activity is attempting to achieve.

Adaptation strategy: General statements of how to reduce climate vulnerabilities or increase resilience within a given goal.

Adaptation action: Specific activity that facilitate progress towards achieving an adaptation strategy.

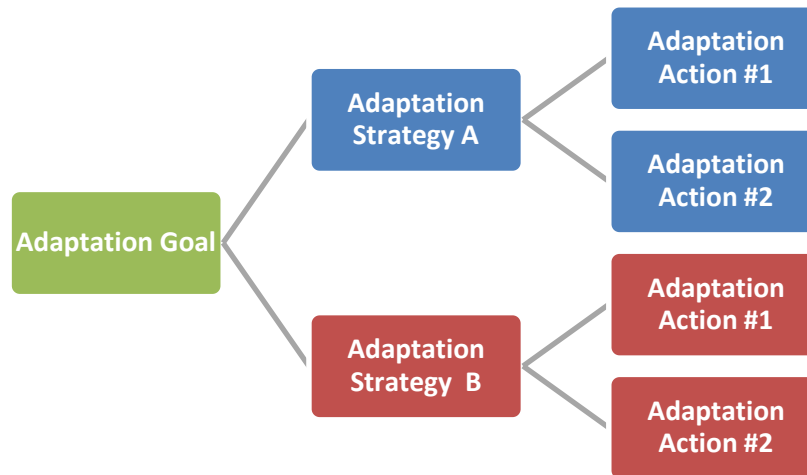


Figure 1. Visual representation of relationship between adaptation goals, strategies, and actions.

Most adaptation activities fall into the following five categories:

1. **Enhance Resistance.** Implementation of these strategies can help to prevent the effects of climate change from reaching or affecting a resource. One common type of resistance actions are activities designed to reduce non-climate stressors.
2. **Promote Resilience.** These strategies can help a resource weather the impacts of climate change by avoiding the effects of or recovering from changes.
3. **Facilitate Transition (or Response).** Transition or response strategies intentionally accommodate change and enable resources to adaptively respond to changing and new conditions.
4. **Increase Knowledge.** These strategies are aimed at gathering more information about climate changes, impacts, and/or the effectiveness of management actions in addressing the challenges of climate change.
5. **Enhance Coordination.** Coordination strategies help organize adaptation efforts across various groups (e.g., sectors, governments, project teams). They may help align budgets and priorities for a program of work across lands, or establish or expand collaborative monitoring efforts or projects, among others.

Resilient management requires implementing a variety of adaptation options!



Goal	Adaptation Strategy	Specific Adaptation Action	Examples and Case Studies
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Facilitate Transition/Respond (continued)</p>	<p>Anticipate and facilitate migration (continued)</p>	<p>Maintain and/or increase habitat connectivity to facilitate species migrations^{LU1}</p>	<ul style="list-style-type: none"> - Estero de Limantour Coastal Watershed Restoration Project, California: dam removal to increase saltwater/freshwater connectivity and enhance anadromous fish habitat - Pacifica State Beach, California: enhanced tidal wetlands and restored creek banks, enhancing steelhead habitat connectivity - High Divide Project, Idaho and Montana: developing and implementing conservation tools to maintain wildlife habitat connectivity corridors - Washington Wildlife Habitat Connectivity Working Group: using GIS to identify key future habitat connectivity areas and incorporating into a master plan - Chicago Wilderness Climate Action Plan, Illinois: climate action plan promotes landscape connectivity - Climate Change Action Plan for the Florida Reef Tract: updating marine zoning plan to ensure reef connectivity - Mesoamerican Biological Corridor Project, Mexico: planning for and implementing landscape connectivity of priority habitats
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Increase Knowledge</p>	<p>Enhance understanding of vulnerability</p>	<p>Continue to gather and integrate data for refinement of vulnerability assessment and adaptation plans^{U1}</p>	<ul style="list-style-type: none"> - Delaware Sea Level Rise Initiative: conducting research and gathering data to inform vulnerability assessments - ClimAID, New York: incorporating new climate projections into climate action plan as new science becomes available
	<p>Assess vulnerability of state, regional, and local infrastructure^l</p>	<p>Assess vulnerability of state, regional, and local infrastructure^l</p>	<ul style="list-style-type: none"> - East Bay Municipal Utility District, California: evaluating reliability of water supply infrastructure in face of sea level rise and examining adaptation options - King County, Washington: identifying infrastructure and facility vulnerability to climate change impacts and developing adaptation options - Water Utility Climate Alliance: coalition helping wastewater and water utilities adapt to climate change - RAND Corporation, Southern California: utilizing a decision-making tool to compare various utility water management plans under different climate scenarios to inform long-term planning
	<p>Gather non-habitat baseline data and/or conduct studies/modeling to better understand non-climate stressor distribution and potential synergistic or cumulative impactsⁱ ^U</p>	<p>Gather non-habitat baseline data and/or conduct studies/modeling to better understand non-climate stressor distribution and potential synergistic or cumulative impactsⁱ ^U</p>	<ul style="list-style-type: none"> - Mission-Aransas National Estuarine Research Reserve, Texas: investigating linkages between coastal land use changes and coastal/marine ecosystem impacts
	<p>Gather and integrate traditional ecological knowledge into adaptation plans and projectsⁱ</p>	<p>Gather and integrate traditional ecological knowledge into adaptation plans and projectsⁱ</p>	<ul style="list-style-type: none"> - Kotzebue, Alaska: conducted a study to gather traditional ecological knowledge from Qikiktagrugmiut members to serve as reference point for monitoring future changes



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Increase Knowledge (continued)	Increase or enhance monitoring	Incorporate climate change considerations into current monitoring frameworks ²	<ul style="list-style-type: none"> - Marine Protected Area Monitoring Enterprise and EcoAdapt, California: held focus groups to identify what climate change impacts are currently being monitored in temperature marine ecosystems and how current monitoring might be adapted in context of climate change - Minnesota Department of Natural Resources: results from four year lake monitoring period will inform development of long-term monitoring plan that evaluates habitat, climate change impacts, and land use change impacts - Fond du Lac Reservation, Minnesota: incorporating climate change considerations into existing water quality monitoring program
		Identify and develop monitoring frameworks for critical climate-related data and extreme events ^{1,2}	<ul style="list-style-type: none"> - Gulf of the Farallones National Marine Sanctuary, California: developed a climate change monitoring inventory and plan for the North-Central California Coast - Coral Reef Ecosystem Studies Project, Florida: monitoring coral response to climate change and sea level rise - North Pacific Climate Regimes and Ecosystem Productivity Program: monitoring and observing marine ecosystems in Gulf of Alaska and Bering Sea to track ecosystem response to climate variability - The FLaSH Project, Florida: monitoring impacts of ocean acidification and climate change on ecosystems of the Florida Shelf
		Monitor baseline habitat and species conditions to monitor changes and inform adaptive management ^{1,2}	<ul style="list-style-type: none"> - Northwest Stream Temperature Project: organizing all stream temperature monitoring data gathered by various agencies to create maps and models and to inform restoration, conservation, and future stream monitoring activities - Fond du Lac Reservation, Minnesota: baseline water quality and flow data will be used to inform planning and management of key tribal resources
		Adjust fisheries monitoring to incorporate climate change ^{1,2,5}	<ul style="list-style-type: none"> - North Pacific Fisheries Management Council: preventing commercial fishing activity in some areas until monitoring and scientific studies indicate that fishing pressure will not exacerbate climate impacts and/or negatively affect fish stocks
		Design and implement citizen science monitoring projects ^{1,2}	<ul style="list-style-type: none"> - Mass Audubon Wellfleet Bay Wildlife Sanctuary, Massachusetts: using citizen science to monitor oyster reef restoration success - Sky Island Region, Arizona and New Mexico: using citizen science to conduct an inventory of local springs to improve landscape-wide, climate-informed management - What's Invasive Project, California: citizen monitoring to map invasive species locations - California King Tides Project: citizen photos document king tide flood risk, are used for comparison and validation of models, and help visualization and communication of future flood risk - Salmon Watcher, Washington: citizens document barriers to upstream salmon migration and conduct salmon species identification and population counts during breeding season to inform larger studies on salmon population fluctuations in response to environmental variability



Coastal and Marine Adaptation Strategies and Actions

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<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Increase Knowledge (continued)</p>	<p>Improve availability and use of spatial information</p>	<p>Update maps and spatial data sets to reflect most current available knowledge¹</p>	<ul style="list-style-type: none"> - EcoAdapt and the Geos Institute, Washington: collaborated to create climate-informed blueprint maps of western Washington that identify priority ecological areas and evaluate stability in face of climate change for use in decision-making - Northwest Stream Temperature Project: organizing all stream temperature monitoring data gathered by various agencies to create maps and models and to inform restoration, conservation, and stream monitoring activities
	<p>Practice climate-informed research</p>	<p>Conduct adaptive management studies^{1,2,5}</p>	<ul style="list-style-type: none"> - South Bay Salt Pond Restoration Project, California: adaptive management plan implements restoration efforts in multiple phases and uses lessons learned to determine future actions - Alligator River National Wildlife Refuge, North Carolina: utilizing adaptive management to increase shoreline resilience to sea level rise
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Enhance Coordination</p>	<p>Work across jurisdictions</p>	<p>Increase communication and idea sharing amongst local, regional, and state entities^{1,2}</p>	<ul style="list-style-type: none"> - Northwest Stream Temperature Project: organizing all stream temperature monitoring data gathered by various agencies to create maps and models and to inform restoration, conservation, and stream monitoring activities - Bald Head Island Conservancy, North Carolina: developing a knowledge sharing network amongst various barrier island communities
		<p>Increase collaboration amongst local, regional, and state entities^{1,2,5}</p>	<ul style="list-style-type: none"> - Wisconsin Initiative on Climate Change Impacts: unifies efforts of various stakeholders to identify climate change risks and adaptation options - Climate Change Action Plan for the Florida Reef Tract: organizes federal, state, and local government action to enhance resilience of Florida’s coral reefs - The Southeast Florida Regional Climate Change Compact: ensures coordination on mitigation and adaptation activities between four counties - Comprehensive Everglades Restoration Plan, Florida: joint effort between multiple agencies and groups to implement restoration projects and to develop and provide guidance on sea level rise
		<p>Identify opportunities where resources can be leveraged to benefit multiple parties¹</p>	<ul style="list-style-type: none"> - Hamilton City, California: establishing river setback levee to reduce community and agricultural flood risk while restoring river floodplain habitat - Nisqually Estuary, Washington: river delta restoration project to increase estuary resiliency by enhancing tidal wetlands and facilitate salmon recovery efforts by reconnecting floodplain and restoring juvenile salmon habitat - Estero de Limantour Coastal Watershed Restoration Project, California: removal of two flood- and sea level rise-vulnerable dams to minimize failure risk, enhance freshwater/saltwater habitat connectivity, and enhance anadromous fish habitat - Pacifica State Beach, California: managed beach retreat combined with wetland and stream bank restoration to improve habitat, reduce flood risk for adjacent residents, and enrich recreation



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Enhance Coordination (continued)	Engage the public	Practice education and outreach through a variety of platforms (e.g., technology, personal interactions, signage) to communicate climate risks and adaptation options and to garner public support ^{1,2,5}	<ul style="list-style-type: none"> - National Park Service: using national parks to communicate climate impacts and highlight adaptation options - Apostle Islands National Lakeshore, Wisconsin: developed a climate change exhibit that highlights impacts on local indigenous cultures and other residents; now working on translating this exhibit into a curriculum for school teachers - Channel Islands National Marine Sanctuary, California: identified a variety of public outreach methods to increase climate change communication (e.g., education programs, website updates, climate change issue of sanctuary publication, brochures, teacher workshops, public lectures) - Narragansett Bay, Rhode Island: developed guidebook for coastal property owners to encourage low impact development and natural shoreline management (e.g., install natural vegetative buffers) - Bald Head Island Conservancy, North Carolina: using graphics, lecture series, and turtle conservation program to educate and engage public in climate adaptation - Many Strong Voices Programme, Arctic Canada: Portraits of Resilience photography project to highlight climate change impacts and local responses - Baldwin County, Alabama: Grasses in Classes Program engages local schools to cultivate and plant native grasses for coastal habitat restoration

¹ California Natural Resource Agency. 2014. *Safeguarding California: Reducing Climate Risk*.

http://resources.ca.gov/docs/climate/Final_Safeguarding_CA_Plan_July_31_2014.pdf

² Gregg, R.M., L.J. Hansen, K.M. Fiefel, J.L. Hitt, J.M. Kershner, A. Score, and J.R. Hoffman. 2011. *The State of Marine and Coastal Adaptation in North America: A Synthesis of Emerging Ideas*. EcoAdapt. Bainbridge Island, WA.

http://ecoadapt.org/data/library-documents/EcoAdapt_Marine%20and%20Coastal%20Synthesis%20Report_2011_Final.pdf

³ California Coastal Commission. 2015. *California Coastal Commission Sea Level Rise Policy Guidance: Interpretive Guidelines for Addressing Sea Level Rise in Local Coastal Programs and Coastal Development Permits*.

http://documents.coastal.ca.gov/assets/slr/guidance/August2015/0_Full_Adopted_Sea_Level_Rise_Policy_Guidance.pdf

⁴ Georgetown Climate Center. 2011. *Adaptation Tool Kit: Sea-Level Rise and Coastal Land Use*.

http://www.georgetownclimate.org/sites/www.georgetownclimate.org/files/Adaptation_Tool_Kit_SLR.pdf

⁵ Boicourt, K. and Z.P. Johnson (eds.). 2010. *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change, Phase II: Building Societal, Economic, and Ecological Resilience*. Report of the Maryland Commission on Climate Change, Adaptation and Response and Scientific and Technical Working Groups. University of Maryland Center for Environmental Science, Cambridge, Maryland and Maryland Department of Natural Resources, Annapolis, Maryland.

http://www.dnr.state.md.us/climatechange/climatechange_phase2_adaptation_strategy.pdf

⁶ California Emergency Management Agency. 2012. *California Adaptation Planning Guide*.

http://resources.ca.gov/docs/climate/O1APG_Planning_for_Adaptive_Communities.pdf