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Casco Bay Workshop on Land Trusts and Climate Change Adaptation

Casco Bay Estuary Partnership

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Casco Bay Workshop on Land Trusts and Climate Change Adaptation



November 18, 2010





Casco Bay Estuary Partnership Workshop Report

**November 18, 2010
Portland, Maine**

Prepared for U.S. Environmental Protection Agency by ICF International



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I. Workshop Overview

The workshop on land trusts and climate change adaptation was hosted by the Casco Bay Estuary Partnership (CBEP) for the Climate Ready Estuaries (CRE) Program on November 18, 2010, in Portland, Maine. Fourteen participants convened for this workshop, along with CBEP and ICF staff. Workshop participants represented land trusts from several different areas in Maine, as well as regional organizations such as Beginning with Habitat, Manomet Center for Conservation Sciences, Maine Geological Survey, Maine Coast Heritage Trust, and the Maine Land Trust Network. Land trusts present at the workshop included Portland Trails (Land Trust for Portland), Portland North Land Trust Collaborative, Western Foothills Land Trust, Loon Echo Land Trust, Harpswell Heritage Land Trust, and Brunswick Topsham Land Trust.

The workshop objectives included (1) examine the potential impacts of climate change on land trusts; (2) foster discussion that will assist land trusts in incorporating climate change considerations into the planning process; and (3) gather information from the meeting to support a report to the wider Maine land trust community with findings on climate adaptation issues of concern to land trusts, information needs to support land trust climate adaptation planning, and tools to support planning efforts (flow charts, critical questions, ecological goals). These objectives focused discussions during the workshop.

The first section of the workshop featured presentations from representatives of three organizations working on climate change impacts and adaptation in the region. Peter Slovinsky of the Maine Geological Survey provided an overview of sea level projections and impacts for the region, and described several tools that land trusts may use to help in planning for sea level changes. Steve Walker of Beginning with Habitat presented on the impacts of climate change on Maine habitat, as well of some of the activities underway at Beginning with Habitat related to climate change. Andy Whitman from Manomet Center for Conservation Sciences provided an overview of adaptation strategies for land conservation.

The second section of the workshop featured a presentation on adaptation frameworks that would serve as the basis for a “mock planning process” using Western Foothills Land Trust as a case study. The case study covered several topic areas, including stewardship, land conservation priorities, land trusts and the community, and organizational development. These topics were discussed in detail for the Western Foothills Land Trust, but were also considered for other land trusts present. Finally, the workshop concluded with a summary of lessons learned and next steps.

Participants came away from the workshop with an understanding that climate change issues need not be addressed in a vacuum. Rather, participants realized that many of the implications of projected climate effects (both direct – changes in timing and intensity of precipitation events – and indirect – changes in human migration patterns) are exacerbations of existing stressors or considerations. Moreover, the case study exercise demonstrated that planning for climate change can be folded in with existing prioritization and management efforts, perhaps refocusing or reprioritizing some of those efforts to reflect the timing and severity of projected climate effects. Participants noted the need to address climate implications through a combination of parcel and land trust-specific actions, as well as more coordinated regional efforts.



Section 2 of this report provides a synthesis of the presentations from the workshop. Section 3 summarizes the Western Foothills Land Trust case study exercise, and describes next steps for CBEP. Section 4 provides resources for land trusts on climate change and adaptation planning. Appendix A provides the agenda, list of participants, Western Foothills Land Trust case study, and handout on climate change impacts on trails. Presentations from the workshop are provided in Appendix B. Results of the Western Foothills Land Trust case study mapping exercise are provided in Appendix C.

2. Synthesis of Workshop Presentations

During the workshop, presenters highlighted key points concerning climate change impacts on land trusts, incorporating climate change into the planning processes, and potential resources for the Maine land trust community. These presentations are summarized below. Presentation materials can be found in Appendix B.

2.1. Climate Change Impacts on Land Trusts

Impacts of Sea Level Rise and Adaptation Planning for Coastal Land Trusts – Peter Slovinsky, Maine Geological Survey

Peter Slovinsky of the Maine Geological Survey provided an overview of sea level rise impacts on land trusts, and implications for land trust planning. Coastal land trusts already face a number of issues, including funding in a tight economic climate, development standards and pressures, high pressures for other uses, coastal sprawl, and high property values and competition for other uses. In response to a changing climate and sea level rise, coastal land trusts may need to think about some key questions, including (but not limited to):

- What sea level rise or flood scenario might a land trust address?
- What municipal and state regulations might help land trusts plan for future sea level rise and future floodplains?
- What specific additional information is available to a land trust to help inform decisions?
- How might property acquisition and management opportunities and priorities arise or change?

Maine has experienced a sea level rise of approximately 1.8 millimeters (mm) per year over the last century, measured by tide gauges in Portland. This is approximately the same amount of global sea level rise that was reported by the Intergovernmental Panel on Climate Change (IPCC) in its Fourth Assessment Report.¹ Satellite altimetry measured approximately 1.9 mm/year of sea level rise in Portland from 1992-2010. Global sea level rise estimates range from 0.09 to 0.88 meters (m) with a central value of 0.48 m (1.6 feet) by 2100.² The State of Maine has adopted a “middle of the road” prediction of 2 feet of sea level rise over the next 100 years.

Impacts of sea level rise for the coast of Maine include:

- Mudflat erosion and loss
- Coastal wetland loss

¹ IPCC, 2007: Climate Change 2007. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html

² IPCC, 2001: Climate Change 2001. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. http://www.grida.no/publications/other/ipcc_tar/

- Habitat changes
- Upland conversion
- Increased beach erosion and loss of public trust
- Water quality degradation
- Increasing flooding of coastal property
- Increased coastal structure damage and loss
- Increased bluff erosion and landslide hazards

Land trusts can use the increase in vulnerability to hazards caused by sea level rise as an opportunity to help focus and prioritize goals. Several state regulations and municipal ordinances in the region address sea level rise and adaptation planning. The Coastal Sand Dune Rules (Chapter 355 of the National Resources Protection Act) plans for a rise in sea level of 2 feet over the next 100 years.³ For future planning, it will be important for land trusts to pinpoint existing and “future” areas for land, including coastal wetlands and floodplains. State and municipal regulations, ordinances, and programs such as the Coastal Sand Dune Rules, Maine Floodplain Management Program, and the Maine Shoreland Zoning Program can be used to help support the acquisition of existing and potential future at-risk properties.

Land trusts in Maine can use several sources of information to incorporate sea level rise into planning, including:

- Municipal tax maps and parcel data
- National Wetland Inventory
- U.S. Geological Survey (USGS) maps
- Beginning with Habitat maps and data
- Shoreland zoning maps
- Aerial photographs
- Bluff stability maps
- Landslide hazard maps
- Light Detection and Ranging (LiDAR) data
- Marsh migration scenario maps
- Inundation (floodplain) scenario maps

The National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center provides sea level rise inundation tools online through Digital Coast that may be useful for land trusts. Free LiDAR data is available to download through Digital Coast, at <http://www.csc.noaa.gov/digitalcoast/data/coastallidar/index.html>. The Maine Geological Survey has worked with several communities to use this data to identify vulnerable areas and potential future properties.

Land trusts can begin to incorporate sea level rise into planning by considering the following suggestions:

- Use increased vulnerabilities to hazards as opportunities for acquisition

³ <http://www.maine.gov/sos/cec/rules/06/096/096c355.doc>

- Focus on undeveloped or partially developed uplands contiguous to existing coastal or freshwater wetlands or bay, stream, and river floodplains
- Focus on at-risk or flooded/damaged properties within your community (bluffs, shoreline, etc.)
- Be proactive in looking into the future; this is consistent with land trust goals
- Use existing state regulations and municipal ordinances to help guide opportunities and priorities and to support your long-term acquisition plans
- Use newly available data (i.e., LIDAR, digital products, bluff maps, etc.) in addition to traditional techniques to pinpoint parcels
- Educate local decision makers on forward-thinking methodologies for pinpointing and acquiring parcels
- Consider future flooding and sea level rise in management of properties that have been or will be acquired
- Consider impacts of increased salinity on vegetation in low-lying uplands or freshwater wetlands
- Consider tidal flow management, as needed, with the use of tide gates and culverts for increased flow

Climate Change Impacts on Habitat and Conservation Planning for Land Trusts – Steve Walker, Beginning with Habitat

Steve Walker from Beginning with Habitat provided an overview of climate change impacts on Maine wildlife and habitat, and provided some resources available to land trusts for incorporating climate change into planning. Beginning with Habitat recently conducted a vulnerability assessment to examine potential climate change impacts on species and communities targeted for conservation within Maine. The assessment found that species on the northern edge of their range (e.g., chestnut oak) had low vulnerability, while other species and communities—such as the piping plover and coastal spruce forests—had higher vulnerability.

This vulnerability assessment has many implications for land conservation. Land trusts should focus on maintaining low-lying undeveloped uplands adjacent to coastal wetlands (beaches, mudflats, salt marshes, etc.) and undeveloped areas that serve as landscape scale habitat connections (especially riparian areas) when looking at future land planning. Other factors are also important to consider, such as unusual soil types, geologic conditions, and a variety of topographic conditions. Preserving a variety of habitat features will be important in order to maintain a functional, interconnected landscape for the future.

Beginning with Habitat has data and maps that may be useful for land trusts; these are available on its website (<http://www.beginningwithhabitat.org>), including:

- Maine Department of Marine Resources shellfish data
- Fish habitat data
- Aquatic barrier data
- Active river data

Land trusts may also wish to consult the Land Trust Alliance guide, *Strategic Conservation Planning for Land Trusts along the Maine Coast*, available at <http://www.mltm.org/documents/Final%20Full%20Student%20Guide%20for%20Rally07.pdf>.

Regional efforts will be especially important in order to maintain habitat connectivity. Beginning with Habitat is currently working with the Maine Interagency Stream Connectivity Workgroup on habitat connectivity data, and has also been involved with the Sagadahoc County Regional Initiative and the Lake Region Greenprint.

Adaptation Strategies for Land Trusts – Andy Whitman, Manomet Center for Conservation Sciences

Andy Whitman of Manomet Center for Conservation Sciences provided an overview of adaptation strategies for land trusts. In planning for climate change, it will be important for land trusts to know what their goals are for open space, recreation, working farmland, and other conservation priorities. Land conservation goals will help determine vulnerability to climate change as well as adaptation strategies. Four major paradigm shifts in land planning come with consideration of climate change impacts: (1) understanding that current habitats will not occur in the future; (2) managing risks and opportunities; (3) shifting to new ways of conserving land; and (4) using old tools to solve new problems.

Current habitats may not look the same in the future: species will move independent of each other, rather than moving as a whole system. Climate change risks such as loss of species or loss of habitat types will need to be managed concurrent with climate change opportunities, such as greater productivity in working landscapes and a longer recreational season. New ways of conserving land to incorporate climate change considerations include purchase in fee, conservation easements, term easements for specific values, and new market tax credits to maintain working forests. Tools that have been used in the past will continue to be useful for climate change planning, such as capacity building, monitoring, research, vulnerability assessments, and emphasizing “no regrets” solutions (strategies that would be worth undertaking regardless of climate change). Vulnerability is a function of exposure, sensitivity, and adaptive capacity. Understanding the vulnerability of an ecosystem will enable better planning for the future.

Planning for climate change requires consideration of scale, timing, and anthro-ecosystems. In terms of scale, it will be important for land trusts to consider not only their properties, but also adjacent properties and adjacent regions. To maintain habitat connectivity, conserving key landscape elements at a higher scale is necessary (such as at the watershed level). Timing is also an important consideration to conserve key enduring features, such as representative and unique landforms and soils, native species, legacies, old forests, agricultural soils, and important social and cultural features.

Land managers will also need to examine the services provided by the land. This may require identifying both “working” and “non-working” landscapes. “Working” landscapes included managed forests, agricultural land, and urban forests. “Non-working” landscapes include wetlands, estuarine systems, and reserves. It is also important to understand the existing

stressors on the land. Managing and reducing the impact of stressors such as habitat degradation and pollution will ensure resilience of habitats.

2.2. Incorporating Climate Change into the Planning Process

Introduction to Adaptation Planning – Anne Choate, ICF International

Anne Choate of ICF International provided an overview of adaptation planning, including defining key concepts and frameworks for planning. Adaptation refers to a set of adjustments in response to expected changes in climate or their effects. Adaptive actions are intended to moderate harm and increase system resilience to climate variability and change. Adaptation is distinct from mitigation, which focuses on actions to reduce greenhouse gas emissions that exacerbate climate change. Another important concept for adaptation planning is resilience, which is the capacity of a system to absorb disturbance and still retain its basic functions and structure.

Many plans and frameworks exist for addressing climate impacts through adaptation planning. These frameworks may be useful to land conservation managers in understanding how to take steps toward incorporating climate change considerations into current and future efforts. A systematic approach to addressing climate change impacts that includes a screening step will help to focus activities on key resources of concern. This early screening of risk and vulnerability of resources will allow for more time to conduct a detailed assessment and focus on planning for the resources that are of most concern. An effective screening step can minimize wasted time and financial resources by narrowing the focus to the most pressing issues for management.

Despite uncertainties associated with climate change impacts, it is possible to start adaptation planning now. This can be done by considering several key questions:

- What matters to us?
- What's at risk?
- What's vulnerable?
- What should we do about it?

Defining what matters includes examining both the stated and implied objectives of the land trust. Risk can be determined by identifying the stressors that are currently being managed to ensure that the objectives are met, considering how climate change will exacerbate those stressors, and identifying what, if any, unique stressors climate change may introduce. Screening for vulnerability will involve assessing the extent to which specific objectives are exposed to climate threats, their sensitivity to climate threats, and their relative adaptive capacity. A more detailed assessment of risk can be done for the most important and most vulnerable objectives, and then managers can develop a plan to reduce vulnerability and/or add resilience to the system.

3. Western Foothills Land Trust Case Study Exercise

The case study exercise focused on the Western Foothills Land Trust (see Case Study in Appendix A). The exercise assessed how adaptation planning relates to key activities of land trusts through a participatory mapping exercise and facilitated discussion. The four key areas of focus included: (1) stewardship; (2) land conservation priorities; (3) land trusts and the community; and (4) organizational development. The participatory mapping exercise used several maps of the Western Foothills Land Trust area, including a map of the 150-acre parcel known as Robert's Farm Preserve (a key focus of the land trust).

The exercise began by outlining the stated priorities and implied goals of the Western Foothills Land Trust and a consideration of priorities and goals of other land trusts in Maine. Possible metrics for measuring these priorities and goals were then identified. Next, the group examined existing stressors, followed by a consideration of how climate changes would affect those stressors or create new ones. Finally, participants discussed the implications of climate change for the four focus areas of the Western Foothills Land Trust (and the wider Maine land trust community). The comments from participants are summarized below.

3.1. Stated Priorities, Implied Goals, and Metrics

The Western Foothills Land Trust mission statement indicates stated priorities of "the conservation and preservation of native ecosystems, watersheds, farm and forest lands, and scenic landscapes in Western Maine." Other implied goals include:

- Specific areas of concern:
 - 1,300-acre wetland
 - 350-acre easement on Crooked River (serves as a major riparian corridor)
- Working farmland (agricultural products)
- Habitats, such as:
 - Marshall Pond and wetlands—fish habitat
 - Cedar swamp (and its influence on water quality and species habitat)
 - Bird habitat
 - Riparian corridors
- Recreation (canoeing, skiing, mechanized recreation)
- Trails
- Education (including bird walks)
- Cultural history (including historic farmland)

Some of the specific areas where these goals apply were identified on the map of the Western Foothills Land Trust (see Appendix C). Several implied priorities and goals were also identified for the Robert's Farm Preserve, which include:

- Water protection, including management of runoff
- Cultural farming practices
- Recreation
- Forest and agricultural land

- Cultural history—historic sites (e.g., former dairy farm)
- Education (including opportunities for Community Supported Agriculture)
- Trails

Several opportunities for management of the Western Foothills Land Trust exist, including four farms that the land trust is currently trying to aggregate; a former golf course that may be converted to open space; drawing visitors from the Mt. Abrams ski resort and Carter’s cross-country skiing trails; and potential for promoting local hiking areas.

Participants also identified priorities and goals for the management of coastal land trusts, which include migratory bird stopovers, coastal access for people, marine water quality, working forests and shellfish, and aquifers.

Metrics for measuring the success of these priorities and goals were not as well defined. A few metrics that were mentioned by the participants included:

- Nests (coastal bird habitat)
- Number of acres protected (of parcels of land in trust)
- How well community is meeting Comprehensive Plan
- Access points to water bodies
- USDA Forest Inventory
- USDA Agriculture Inventory

3.2. Existing Stressors and Climate Change Implications

Many existing stressors affect the management of the Western Foothills Land Trust as well as other land trusts throughout Maine. Climate changes may exacerbate these stressors or cause new ones. Participants identified a number of existing stressors and described the potential implications of climate change for these stressors. In some cases, the impact of climate change on an existing stressor is already known (e.g., it will increase or decrease that stressor). However, there is still uncertainty as to how climate change will affect many existing stressors, or what types of new stressors climate change will introduce. The stressors identified by participants are provided in Table I, along with potential implications of climate change identified for those stressors.

Participants identified some specific areas within the Western Foothills Land Trust where stressors are a concern, and indicated how these stressors may be influenced by climate changes. The results of this mapping exercise are provided in Appendix C.

The specific example of climate change impacts on trails was also discussed by participants (see Appendix A). Approximately 30 to 40% of trails in Maine have minor to insignificant water quality issues. When considering future climate changes, many managers worry that it will be very expensive to put new bridges in to meet higher water levels and potential for flooding.

Table I. Existing Stressors and Climate Change Implications Identified by Participants for Land Trusts

Existing Stressor	Climate Change Implications
Drought	Increased drought
Runoff	
Flooding	Increased flooding
Development	Increased development
Air pollution	
Trail erosion	Increased trail erosion
Subdivisions	
Road development	
Timber industry	
Downturn in timber markets	Changing timber markets: uncertainty as to what the change will be
Storm events	
Lack of zoning	
Invasive species (e.g., barberry, Japanese honeysuckle, insects, aquatic species)	Increased invasive species
All-terrain vehicle (ATV) damage	
Utility corridors (e.g., wind, electricity)	
Marine pollution (for coastal areas)	
Nutrient loading	Increased nutrient loading
Motorboat erosion (often due to lack of regulation)	
Changing land ownership	
Abutting easement violations	
Upholding the easement (nature of the easement)	
Economy—selling of parcels	Changing economy: uncertainty as to what the change will be

3.3. Implications for Land Trusts

Following the identification of stressors and climate impacts, participants discussed the possible implications of climate change for land conservation planning. This discussion focused on the four key areas of: (1) stewardship; (2) land conservation priorities; (3) land trusts and the community; and (4) organizational development.

Stewardship

Participants identified trail planning as a focus for stewardship that should incorporate climate change considerations. This may include better planning of trails in advance: examining whether an area may be vulnerable to flooding, erosion, etc. and determining appropriate trail locations when considering these impacts. Trail planning should also tie in priorities, which may require identifying the major purposes for a trail (e.g., hiking, skiing, motorized recreational vehicles).

As invasive species are currently a major stressor for many ecosystems, managing invasive species will become increasingly important as climate changes occur. Maintaining and improving current invasive species management programs will help to address the impacts of these species. It may also be necessary to differentiate between what the land trust will define as an invasive species versus a species whose range has shifted into the region. Range shifts may become more common with climate changes and may be more difficult to control.

As with invasive species, managing current stressors will help land trusts improve their adaptive capacity. Managing human uses (such as recreation and development) will help mitigate negative effects. Land managers may also improve adaptive capacity by managing easements: examples include changing justifications for easements (e.g., to protect rare plants) or writing climate-resilient easements.

Participants also noted several other stewardship implications of climate change, including disaster response, planning, and cleanup; using different means of harvesting; managing coastal erosion; and allowing for flexibility with fee lands.

Land Conservation Priorities

Many of the land conservation priorities for the Western Foothills Land Trust (as well as other Maine land trusts) were identified in the discussion of stated priorities and implied goals (see Section 3.1). Strategies for incorporating climate change considerations into some of these land conservation priorities may include:

- Keeping options open (e.g., allowing public access versus clamming for coastal areas)
- Buying slightly inland properties (that may become shorefront with sea level rise or flooding)
- Diversifying properties—maintaining a variety of habitat types
- Emphasizing habitat connectivity
- Focusing on larger parcels of land
- Protecting lands appropriate for development (i.e., smart growth)
- Non-traditional land protection
- Using different tools (e.g., LiDAR, habitat mapping)

Land Trusts and the Community

Land trusts often work with the community through a variety of outreach and education efforts to the public, property owners, and stakeholders. Maintaining and improving these relationships will be especially important to consider when planning for future climate changes. In terms of the Western Foothills Land Trust as well as other Maine land trusts, participants were interested in how to leverage partnerships with other groups such as towns, schools, historical preservation groups, as well as groups associated with the potential casino development. Partnerships with these types of groups can help leverage available resources and staff to tackle many issues that the land trust may not be able to address on its own.

Focused outreach to property owners is also a priority for land trusts. Outreach to property owners can help provide the appropriate information on climate change impacts and solutions for adaptive management to that key audience. Land trusts may choose to target owners that

meet a certain criterion, such as the number of acres held or the type of land, in order to focus their efforts. The media also provide an outlet through which land trusts can get attention for their areas and issues of concern.

Education and outreach efforts to the public are a major focus for many land trusts. Participants highlighted the need to communicate climate change concerns to the next generation (school children), as well as to their parents. Land trusts have opportunities to provide school curriculum or activities for schools. For example, Portland Trails has worked with schools to implement rain gardens and educate the public on invasive species. There is often grant money available for land trusts to undertake educational efforts. Efforts to improve and maintain signage represent another opportunity for land trust managers to provide climate change information.

Organizational Development

While it is uncertain exactly how climate change may affect the institutional aspects of a land trust, participants identified several organizational changes that may be spurred by climate change. Changes in climate may lead to increasing migration of people into Maine, which may increase potential new members of land trusts. Another observation was that more people may buy land as the economy improves, causing land prices to change and directly affecting land trusts.

To help prepare themselves for such possibilities, land trusts can begin to set aside money now to fund future stewardship activities. Land trusts can also try to identify future priority efforts to help them plan. Partnerships and grants can also be pursued by land trusts now. Financing is becoming increasingly available for climate change efforts, including both mitigation and adaptation activities.

3.4. Summary of Lessons Learned and Next Steps

Participants highlighted the lesson that while there is uncertainty inherent with planning for climate change, it is important to take action now to address adaptation. Planning for uncertainty is common for any manager, and planning for climate change is very similar to how current management is done. Participants noted that many of the implications for land trusts that were identified are activities that already are undertaken by land trusts. Many of the implications already serve as management priorities. This signifies that planning for climate change does not add onto the work that is currently being done by land trusts; rather, it allows for land trusts to examine largely familiar issues within a different context.

An important part of adaptation planning is monitoring and observation. Climate change monitoring does not necessarily require expensive measuring systems and new technologies. General observations by land owners, visitors, stakeholders, etc. can provide data and understanding of changes as they occur on the ground.

The case study mapping exercise will be useful to repeat for other land trusts and other audiences. The process helps people to come away with the understanding of what actions they need to take, where they need to focus priorities, and where they can maintain what they are already doing. This exercise will be repeated at the 2011 Maine Land Trust Conservation



Conference (to be held April 30, 2011). CBEP will work with the Maine Coast Heritage Trust and the Maine Land Trust Network to determine the material that will be covered during this exercise, as well as which land trust(s) will be used as a case study.

4. Resources for Adaptation Planning

4.1. Toolkit Resources

Climate Ready Estuaries Coastal Toolkit

Websites, reports, and other resources related to monitoring and climate change data, coastal vulnerability and adaptation tools, adaptation planning, smart growth, sustainable financing options, and communications and outreach materials: <http://www.epa.gov/cre/toolkit.html>

ICLEI-Local Governments for Sustainability Free Climate Adaptation Resources

Case studies, fact sheets, and guidebooks, as well as other free resources for local governments: http://www.icleiusa.org/programs/climate/Climate_Adaptation/free-climate-adaptation-resources

CAKE: Climate Adaptation Knowledge Exchange

Case studies, literature and tools on climate adaptation: <http://www.cakex.org>

Coastal Conservation Networking Toolbox of Techniques

Case studies, methods, resources, software, and trainings for coastal land trusts and their partners: <http://198.66.224.63/resources/coastal/content/toolbox.htm>

4.2. Education and Outreach Resources

Climate Change, Wildlife, and Wildlands Toolkit

Educational toolkit designed for classroom teachers and informal educators in parks, refuges, forest lands, nature centers, zoos, aquariums, science centers, etc., and is aimed at the middle school grade level: <http://epa.gov/climatechange/wycd/CCWKit.html>

Vital Signs

Gulf of Maine Research Institute effort to address invasive species through a science education program for middle school students: <http://vitalsignsme.org/>

National Conservation Training Center

The U.S. Fish and Wildlife Service offers webinars on climate change through its National Conservation Training Center: http://training.fws.gov/CSP/Resources/climate_change_webinars/safeguarding_wildlife_cc_archives.html

4.3. Reports

Climate Change in the Casco Bay Watershed (CBEP, 2009)

Describes how the climate of Casco Bay's watershed has changed over the past century and how the future climate of the region is likely to change: http://www.cascobay.usm.maine.edu/pdfs/Climate_Change_in_Casco_Bay.pdf

State of the Bay 2010 (CBEP, 2010)

Provides an assessment of the environmental conditions of the Casco Bay and its watershed, including how climate change will affect the region: http://www.cascobay.usm.maine.edu/pdfs/State_Bay_2010.pdf

Maine's Climate Future (University of Maine Climate Change Institute, 2009)

Considers past change over geologic time, recent evidence of accelerated rates of change, and the implications of continued climate change in Maine during the 21st century:

<http://climatechange.umaine.edu/research/publications/climate-future>

Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions

(Northeast Climate Impacts Assessment Synthesis Team, 2007)

Summarizes climate impacts research and provides policymakers, opinion leaders, and the public with the best available science upon which to base informed choices about climate change mitigation and adaptation:

<http://www.northeastclimateimpacts.org/pdf/confronting-climate-change-in-the-u-s-northeast.pdf>

Synthesis and Assessment Product 4.4: Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources (U.S. Climate Change Science Program, 2008)

Presents adaptation options for management of ecosystems and natural resources:

<http://www.globalchange.gov/publications/reports/scientific-assessments/saps/sap4-4>

Global Climate Change Impacts in the United States (U.S. Global Change Research Program, 2009)

Summarizes sectoral climate change impacts across the U.S., including a discussion of impacts on coastal areas and updated global sea level rise projections:

<http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts>

Western Forests Recommendations and Guidance for Addressing Climate Change

(Council of Western State Foresters, 2010)

Provides recommendations and guidance for addressing climate change for forest managers:

<http://www.landtrustalliance.org/policy/emerging-issues/climate-change/CWSF-CC-Forest-4-27-10.pdf>

Rising to the Urgent Challenge: Strategic Plan for Responding to Accelerating Climate Change (U.S. Fish and Wildlife Service, 2010)

U.S. Fish and Wildlife Service climate change strategy:

<http://www.fws.gov/home/climatechange/strategy.html>

National Park Service Climate Change Response Strategy (National Park Service, 2010)

National Park Service climate change strategy:

http://www.nature.nps.gov/climatechange/docs/NPS_CCRS.pdf

4.4. Data, Maps, and Other Technical Resources

NOAA Digital Coast Tools

Web-based and downloadable tools to support coastal decision making:

<http://www.csc.noaa.gov/digitalcoast/tools/index.html>

Habitat Priority Planner

Downloadable tool that aids in making decisions about habitat conservation, restoration, and land use planning: <http://www.csc.noaa.gov/digitalcoast/tools/hpp/index.html>



LiDAR Data

LiDAR data for all of the coastal states, which range from shoreline strips to full county coverage: <http://www.csc.noaa.gov/digitalcoast/data/coastallidar/index.html>

Beginning with Habitat Maps

A variety of habitat maps for Maine: http://www.beginningwithhabitat.org/the_maps/index.html

Northeast Climate Data

Northeast Climate Impacts Assessment database of projections for changes in temperature, precipitation, relative humidity, and snow cover for the U.S. Northeast:

<http://www.northeastclimatedata.org>