Manomet Center for Conservation Sciences

Moving from Vulnerability to Resilience: Sustaining Ecosystem Services in the Face of Climate Change

Introduction

The Manomet Climate Change Adaptation Project is intended to identify and implement opportunities for adapting to climate change in New England. Emphasis is placed on adaptation measures that maintain or enhance ecosystem services. Critically important ecosystem services include food production, provision of clean water and climate regulation.

Manomet staff is working to develop adaptation plans at two different geographic scales. At the smaller scale, Manomet is working with individual landowners who are involved in a mix of forestry, agriculture, management of conservation lands and rural residential development. Our interactions with landowners have resulted in a tremendous and mutual learning opportunity. In many cases, conversations with landowners have confirmed that they are already experiencing changes to climate in New England, ranging from subtle to significant. From the Manomet perspective, the exchanges have been an opportunity to gain insight into a broad range of operational issues, concerns, and adaptation opportunities that we would not have access to otherwise.

At the larger geographical scale, Manomet staff is addressing climate change adaptation in the Taunton River watershed in Massachusetts, the Sebago Lake watershed in Maine and the Sagadahoc County region in Maine. A critical step for this task has been to engage the numerous stakeholders, many of whom are already working collaboratively on related conservation issues. The initial workshops held for each of the sites provided an opportunity for the audience to learn about climate change and adaptation and allowed Manomet staff to benefit from the broad perspective and expertise of a diverse set of stakeholders.

In addition to the adaptation planning process the project also includes an analysis of climate change adaptation policy and associated regulatory programs as well as an analysis of payment for ecosystem service opportunities to implement adaptation measures.

Research Activities and Preliminary Findings

Several aspects of the research and analysis associated with the project are by necessity generalized for all of New England. Examples include research on the history and projected future of climate change, evaluation of land use and population trends,

evaluation of natural systems and the vulnerability of ecosystem services to climate change. In addition the status and trends of the four landowner-scale sectors (agriculture, forestry, conservation efforts and residential development) are under review. This base of information has been augmented through the interactions with the landowners and stakeholders and forms the foundation for the various adaptation plans. Some of the key findings associated with this research thus far are:

- **Climate change is already having significant impacts on the sites and sectors being studied as part of this project:**
    - Forestry: Warmer winters are disrupting traditional winter timber harvest. Timber harvests have historically occurred in winter when the ground remains consistently frozen, important given that Maine in particular has a high prevalence of wetlands. Unusual and unpredictable warm periods in winter have created a situation where it is often impossible to get heavy equipment on site due to muddy conditions. This has led to significant increases in harvest cost and undermines the ability of small woodlot owners to reap benefits they expect to justify keeping land in timber management.
    - Agriculture: Changing precipitation patterns are creating difficulties for farmers. For example, Five Fields Farm in Maine includes an apple orchard. The farm owner reports an increase in extreme precipitation events that provide too much water in a short period of time, and an increase in overcast days in general. He has difficulty in timing the expected application of pesticides - essential to his operation - between storms. At the same time, the additional precipitation and increased warmth is also increasing the presence and persistence of temperature and moisture-related fungi, i.e., molds, rusts, and mildews - which then also require treatment. The high costs of these various treatments threaten his bottom line.
    - Conservation Lands: Warming temperatures are threatening the viability of cold water fish habitat in Massachusetts. Explicit steps will be taken in the restoration of the Red Brook site to limit water temperature rise. Sea level rise also threatens the existence of the extensive coastal marshes that have been protected from development in Maine.
    - Residential Development: Stormwater management is an increasing concern in the residential development sector. Extensive planning is underway at River Run and other development sites in Massachusetts to maximize stormwater infiltration. However, localities in Maine are currently unprepared to address increased stormwater impacts from climate change.

- **Much of the stormwater infrastructure in New England is inadequate:** Among the most problematic aspects is the pronounced increase in both the frequency and intensity of extreme precipitation events. This change is causing

infrastructure damage and adversely impacting water quality. The Taunton River watershed in eastern Massachusetts experienced unprecedented flooding in the spring of 2010 associated with a series of torrential rainfall events.

- **Many coastal communities in New England are experiencing increased storm surge flooding due to sea level rise:** Sections of the Sagadahoc County study area have both housing and road networks that are being adversely impacted and will eventually become dysfunctional due to sea level rise and associated flooding without significant modification.

- **Changing land ownership and land use patterns are significantly impacting ecosystem services:** Continued fragmentation of the landscape in New England is among the most important additive stressors to be considered in conjunction with climate change. For example, the three towns surrounding the River Run and Red Brook adaptation sites have experienced a substantial decrease in ecological integrity during the last 40 years, mostly due to extensive residential development. Maine's relatively undeveloped landscape lacks zoning to achieve landscape outcomes that leave space for vital habitat. The success of many adaptation strategies in limiting ecosystem service degradation will depend upon limiting the extent of future landscape fragmentation.

In addition to the analysis of trends and projections for New England and the direct work with landowners, Manomet is engaged with local government staff in Maine to stimulate local actions that can maintain resiliency given projected climate change. We are working directly with town managers and staff to comprehensively assess their local land use ordinances and planning efforts, including infrastructure planning. These assessments will culminate in a report back to each town, as well as a public presentation to any elected or appointed committee that makes a request. Each town will see where their existing stormwater, development planning, habitat conservation, and other measures rank as compared to other towns in the region. The assessment report will include suggestions for changes using other localities as models, as well as information about costs and benefits for implementing local ordinance and planning approaches that can maintain ecological systems and ecosystem services.

Landowner Scale Site Descriptions

Manomet is working with a broad range of landowners in Maine and Massachusetts to develop a solid understanding of the challenges and opportunities for climate change adaptation.

- Massachusetts Landowner Sites and Associated Land Uses

    - **River Run, Plymouth, MA.** Land uses include development, agriculture, and conservation. River Run is a proposed mixed-use development site

which is owned by A.D. Makepeace, the world's largest cranberry grower and largest private landowner in eastern Massachusetts. The site currently is a mix of forest, grasslands and cranberry bogs. The development plans include keeping the majority of the cranberry bogs in production.

- **Red Brook, Wareham and Plymouth MA**. Land uses include conservation and agriculture. The Red Brook site, also known as Century Bog, is currently in cranberry production but the planning and design work is underway to restore the site to cold water fish habitat. Manomet staff is assisting the State in the restoration effort through an analysis of likely climate change impacts and the subsequent development of an adaptation plan for the site. An integral part of this process is engaging a diverse group of stakeholders, from local, state and federal agencies to non-profit organizations and citizens associations.
- **Tidmarsh Farms, Plymouth, MA**. Land uses include conservation and development. The Tidmarsh Farms property encompasses the headwaters of Beaver Dam Brook. The planning and design work is under way for a major environmental restoration that will feature the conversion of cranberry bogs to wetlands, removal of a dam and stream corridor restoration. The plans for the site also include the possibility of limited residential development.

- Maine Landowner Sites and Associated Land Uses

  - **Maquoit Bay, Freeport and Brunswick, ME.** Land uses include conservation, residential development, commercial fish harvest (marine agriculture) and forestry. Maquoit Bay is located within the Sagadahoc landscape area, and is part of a state-identified Focus Area of Statewide Ecological Significance. The Bay holds extremely clean and productive mudflats, rare natural community types, wading bird and waterfowl habitat, and provides numerous important ecosystem services. The focus of concerted efforts over several years has been to conserve undeveloped land adjacent to the Bay, but it is also at significant risk of losing much of its mudflats and fringing marshes due to sea level rise. Manomet is working to identify how sea level rise will change the Bay, where there may be opportunities to restore tidal flow and allow upland areas to convert to salt marsh, and creating resiliency in the face of climate change along the Bay's coast.
  - **Five Fields Farm, Bridgton, ME.** Land uses include agriculture and forestry. Five Fields Farm, part of the Sebago Lake watershed, is in its third generation of ownership and operation as an orchard. The Farm sells apples at its farm stand during the apple season, then converts to a cross country ski facility in the winter. The Farm sits high over a

watershed prized for its drinking water, and several streams noted for their cold water fish habitats flow over the property. The owner has noted several weather shifts which he attributes to climate change, resulting in both the increased presence of harmful fungi in spring and earlier harvests in recent years. Managing future impacts of climate change is the focus of our work there.

- **Allen-Whitney Forest, Manchester, ME.** Land use is forestry. The Allen-Whitney forest is one of the demonstration forests operated by the New England Forest Foundation (NEFF). Manomet enjoys a collaborative relationship with NEFF, and has completed a climate change adaptation plan based on the landowner management goals for the site. The existing plan will be modified to address the broader questions of ecosystem service delivery associated with the Manomet Climate Change Adaptation Project.
- **Haynes Property, Waterford, ME.** Land uses include forestry and conservation. The Haynes property is approximately 900 acres of land located in the Sebago Lake watershed. The property is privately owned and primarily used for forest management. It also has a working sawmill on site. A small portion of acreage is managed for haying. The property is not currently vigorously managed for tree harvest, but the property owner is looking for advice about how climate change will affect the site over time. The owner's son is also concerned about ensuring that the acreage is maintained in forest management, rather than converting to development.

Landscape Scale Sites and Associated Stakeholder Workshops

An initial stakeholder workshop has been held for each of the landscape scale sites. The Taunton River Watershed Workshop was held in November 2010, Sagadahoc Region, Maine, in May 2011 and Sebago Lake watershed, Maine, in June 2011. The format for each of the workshops was similar and included an overview of current and projected climate change, presentations on pertinent climate change related topics for the specific region and a work session for the participants. Despite the similarity in format, stakeholder types and priority issues varied among the three landscapes. The following is a brief description of each landscape scale site and the associated workshops.

The Taunton River watershed, Massachusetts. The Taunton River watershed, located in southeastern Massachusetts, is the most urban of the three sites and has been the subject of extensive study, planning and management efforts, including the federal designation of Wild and Scenic. The participants in the Taunton workshop included a large number of professionals working in planning and resource management. Given the expertise of the participants, it was not surprising that much of the discussion focused on infrastructure and regulatory issues.

The Sagadahoc County region, Maine. This area, located in the mid-coast region of Maine, is fairly rural, but does include several towns, the largest having a population of 21,000. The area has been the subject of both local planning initiatives and a natural resources regional planning effort, completed in 2010. The region hosts numerous Federal endangered species and several State Wildlife Focus Areas. The area expects to experience significant population growth regardless of the impact of climate change. Of our three sites, the Sagadahoc County region is the most vulnerable to sea level rise. Areas vulnerable to sea level rise include numerous coastal towns, the area adjacent to Merrymeeting Bay, and the very popular sandy beach areas in Phippsburg and Georgetown. Workshop participants identified future development patterns, increased precipitation, and sea level rise as their priority areas for adaptation planning, with one group also noting that likely future water scarcity outside of Maine should make water policy a priority as well.

The Sebago Lake watershed, Maine. This area, in the western lakes region, is very rural and forested to the north, then more developed in the southern part within commuting distance to Maine's largest urban area, Portland. The area has received considerable planning attention due to its pristine water that flows to Sebago Lake, then on to Portland and 11 other communities, and the recent sale by a lumber interest of numerous large lots of previously undeveloped forested land. Significant increases in development pressure – in some communities over 15% growth in the past decade - gave impetus to several initiatives to prioritize conservation opportunities, particularly where property is closely associated with drinking water quality. Unsurprisingly, water quality, storm intensity, and development pressure were identified as priorities, as well as planning for future demands and rural community rights and responsibilities for the Sebago drinking water supply.

Common themes identified in the workshops:

a. **Education is greatly needed and desired**: One of the consistent elements of the workshops has been an appreciation by participants for access to unbiased information about both climate change and the need for adaptation. In addition, the profound interest of participants to learn about the basics of climate change was remarkable.
b. **Advocates for climate change adaptation are available and willing to work for solutions**: Building a coalition at the local and regional level is entirely possible through a combination of education and leadership.
c. **Cost benefit analyses and the identification of no regret strategies are essential:** Motivating both those knowledgeable about climate change and those who are skeptical will require an honest assessment of the real costs and overall benefits of adaptation actions. Particularly at the local level, governments are making expenditures all of the time, but generally without any assessment of climate change risks or the costs associated with a failure to adapt. Cost avoidance information and risk assessment

are tools that can bear fruit in encouraging local governments to adopt common sense adaptation actions.

Regional Conference on Climate Change Adaptation:

On November 16, 2010, Manomet hosted a regional conference on Climate Change Adaptation. Over 140 individuals representing more than 90 organizations came together to learn more about adaptation, plan strategies to respond to climate change, and discuss how to best act to implement these strategies across northern New England. Breakout sessions on focal landscapes created opportunities for specific conversations on the challenges and opportunities associated with climate change in one of the seven focal areas. Conference Presentations included the following:

a. Economic Perspective on Climate Change by Bruce M. Kahn, Deutsche Bank
b. Northern New England's Climate Future by George Jacobson, Professor, University of Maine
c. Practical Adaptation Strategies for the Natural Resource Sectors by Hector Galbraith, Manomet Center for Conservation Sciences

In addition to the presentations climate vulnerability assessment workshops were held for the following locations:

a. Connecticut River
b. Downeast Maine
c. Penobscot Valley Maine
d. Sagadahoc Region, Maine
e. St. John/Allagash Rivers Region, Maine
f. White Mountains & Mahoosucs, Maine
g. Western Mountains, Maine & New Hampshire