# Maine's Sustainability Science Initiative

## Year 1 Annual Report

**For EPSCoR award EPS-0904155**

**Covering the time period of:**
**July 1, 2009 to June 30, 2010**

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**Maine NSF EPSCoR EPS-09-04155**
**"Maine's Sustainability Science Initiative"**

## YEAR 1 ANNUAL REPORT for the period July 1, 2009 to June 30, 2010

## A) EXECUTIVE SUMMARY

### 1) General Information & RII vision:

The mission of the Maine EPSCoR Sustainability Solutions Initiative (SSI) is to connect knowledge with action in ways that promote strong economies, vibrant communities and healthy ecosystems in and beyond Maine. The vision is that this will lead to the creation of the Center for Sustainability Solutions (CSS) at the University of Maine, a national and international center of excellence in sustainability science. The overall research goal is to focus on the dynamics of social-ecological systems (SES) with an understanding and strengthening of connections between knowledge and action. During YR1 of this NSF EPSCoR RII project, significant progress was made in establishing a strong research and education infrastructure for Maine in this sustainability area, which has positioned the project to solidify and strengthen the enterprise in YR2 and have a major impact in the state.

### 2) Overview of Project Efforts:

#### a) Research:

The overarching goal of the Sustainability Solutions Initiative (SSI) is to advance the theory and practice of sustainability science. A central premise of SSI is that natural science and engineering are necessary but not sufficient for understanding and solving pressing sustainable development problems, which by definition have intersecting ecological, social, and economic dimensions. Using Maine as a laboratory, SSI examines both the coupled dynamics of social-ecological systems (SES) and the connections between SES knowledge and societal actions (K↔A). SSI's focus on landscape dynamics reflects a broad consensus that land change science is a critical research frontier as well as a pressing challenge for sustainable development.

During YR1, we began the process of creating an integrative portfolio of sustainability science research projects focused on landscape dynamics. The goal of this portfolio strategy is to compare and contrast different sub-problems in land change science, thereby facilitating the development of more robust models to explain how SES and K↔A vary as a function of biophysical conditions, socioeconomic characteristics, and stakeholder attributes. We are using three strategies to strengthen integration across the SSI research portfolio: 1) all the landscape dynamics projects involve interdisciplinary research approaches that reflect their interconnected ecological, social, and economic dimensions; 2) the projects are examining how SES and K↔A vary and interact among three major landscape contexts or *arenas* (i.e., urbanization, forest ecosystem management, and climate and energy futures); 3) the SSI interdisciplinary teams are themselves being studied to identify and implement practices for strengthening collaborative research.

A total of 23 closely related sub-projects were started in this first year to address the landscape change "model system" that was selected as our initial model for addressing Sustainability Science. These projects each address aspects of the landscape change problem in ways that integrate diverse disciplines (87 faculty from over 17 different academic departments), institutions (10 colleges & universities), students (17 graduate and more than 36 undergraduate students directly supported), and stakeholders (>100 unique entities involved). Stakeholders,

students and faculty are involved in different projects in ways that promote interdisciplinarity and effective knowledge sharing.

**b) Diversity:**

Maine EPSCoR continues to develop strategies for improvement, including a targeted effort to engage the Native American population through research that targets the emerald ash borer threat (affecting traditional basketmaking), and the Wabanaki Center's Native Scholar Educational Outreach program for students. In YR1, of the total number of individuals directly supported by this project, 47% were female and 5% were from underrepresented groups. Of indirectly supported participants, 58% were female and 8% were from underrepresented groups. Diversity partnerships included: the National Girls Collaborative Project; Expanding Your Horizons program; the Wabanaki Center Native Scholar Educational Outreach Program and tribal communities; the Institute for Broadening Participation; UMaine Center for Community Inclusion and Disability Studies; and Project EAST at USM.

This RII project was an important step for Maine EPSCoR, in that it represented the first opportunity to begin to really reach out statewide in a research theme that resonated will all institutions of higher education (the University of Maine is the state's only PhD-granting institution in STEM, and its flagship research institution). This enabled six SSP partner institutions to receive YR1 project funding from Maine EPSCoR and includes: Bates College, Bowdoin College, Colby College, College of the Atlantic, Unity College, and University of New England. Two other institutions have received planning grants from Maine EPSCoR to being the process of developing an SSP project and include: University of Maine Presque Isle, University of Maine Farmington. A planning grant to the University of Maine Fort Kent is pending. In addition, Maine EPSCoR has been working with University of Maine Augusta and University of Maine Machias to assist them in developing an SSP project. It is anticipated that all five of these latter institutions will be fully participating in YR2, and that 1-2 community colleges will be added as planned.

Since the SSI research focus is strongly dependent on collaborations with stakeholders, SSI/SSP researchers also engaged in 79 other collaborations during YR1, and Maine EPSCoR collaborated with 30 additional partners in workforce development, education outreach and communication, and human resource development. (This is in addition to the SSI and SSP partner institutions.)

**c) Workforce Development:**

Maine EPSCoR's SSI Strategic Plan outlines a holistic approach to workforce development – education, employment, and economic development are all important components of the process of creating a STEM workforce to ensure Maine's future. Strategies occur at many different levels of the RII project, and encompass: 1) K-12 outreach for students and teachers to develop the "pipeline"; 2) employment opportunities and professional development for faculty, postdocs, graduate and undergraduate students, and professional/technical staff; and 3) entrepreneurial training and support to assist in economic development. Workforce development activities over the grant period resulted in 157 new positions created and supported, and included two postdoctoral associate positions. Integrated research and education activities included: 40 graduate student internships, 81 undergraduate student internships, and 21 high school student internships. New courses were developed, conferences and workshops were offered, and related educational outreach programs targeted students at all levels.

**d) Cyberinfrastructure (CI):**

During YR1 of the SSI project, and in alignment with the 5-year Cyberinfrastructure strategy for the state, Maine EPSCoR implemented some basic, but essential, infrastructure activities that addressed the communication, collaboration, visualization, and data needs of the Maine EPSCoR/SSI research and education teams. This included: 1) communication cyberinfrastructure (videoconferencing equipment, ethernet switches, Multipoint Control Units, webcams); 2) visualization cyberinfrastructure (proto-type visualization walls); and 3) data management planning (SSI server on UMaine supercomputer, user systems).

**e) Outreach and Communication:**

Understanding and strengthening connections between knowledge and action is a key component of the SSI project. As such, SSI/SSP teams at the 10 participating institutions have developed partnerships with 79 collaborators, including academic, government, private sector and NGOs. In addition, the Maine EPSCoR team is collaborating with an additional 30 other partners in workforce development, educational outreach and communication, and human resource development (in addition to the SSI and SSP partner institutions). Multiple levels of communication activities, which are integral to both the research and education focus, involved numerous exhibits, presentations, film and video productions, printed materials, websites, conferences and workshops, and a new collaboration with Maine Public Broadcasting Network.

**f) Evaluation and Assessment:**

The Management Team has a five-pronged approach to project evaluation and assessment that includes formative evaluation processes to improve the project's effectiveness, and summative evaluation processes to assess its impact in relation to its goals. All evaluations will determine: 1) the appropriateness of the investment relative to accomplishments; 2) if the investment strategy yields substantial improvement in research and competitiveness; 3) if linkages between the project's research, education, and innovation efforts are effective; 4) if strategies increase participation. Findings will enhance efficacy, identify obstacles, assist in developing corrective action plans as needed, and help plan improvements. The levels of evaluation include: 1) external evaluation by two independent evaluators; 2) AAAS assessment; 3) SSI Advisory Board reviews; 4) NSF EPSCoR Reverse Site Visits and Site Visits; and 5) internal project evaluation and assessment.

**g) Sustainability:**

The Maine EPSCoR RII project achieved the majority of its output benchmarks for YR1, (see Appendix 2) including direct support of 263 individuals at 10 institutions throughout the state; 3,524 participants indirectly supported through various outreach, workforce development, and collaborative activities; 18 related scientific journal articles and six websites; 19 grant proposals submitted with 9 awards so far.

During YR1, SSI developed the research and education infrastructure to support a large project of this size, and also engaged in several other steps that will begin the process of building long-term sustainability for the project and enhancing research competitiveness. These included: 1) creation of an incentive program for faculty seeking external funding; 2) development of a Request for Proposals for integration projects; 3) refinement of the Sustainability Solutions Partners (SSP) program; 4) establishment of the Economic Development Committee.

Seed funding mechanisms were utilized to support SSI teams to collaborate in an emerging opportunity in offshore wind and tidal energy projects, and for travel scholarships for state faculty and students to participate in key conferences, workshops, and collaborative activities.

**h) RII Project Management & Structure:**

The Maine EPSCoR Office at UMaine has been formally established under a Memorandum of Understanding with the Maine Office of Innovation, and acts as the fiscal agent/proposing organization for the state's NSF EPSCoR programs; coordinates responses to NSF EPSCoR funding solicitations; is responsible for the implementation, administration, and evaluation of funded projects; and is the liaison to the NSF EPSCoR Office.

In recognition that a successful project of this magnitude and scope depends on a strong management team and sufficient staff and expertise to develop, implement, and oversee it, a strong project management structure has been put into place during YR1. The Maine EPSCoR office and the SSI research office at the Senator George J. Mitchell Center are both based at UMaine and operate under the aegis of the VP for Research (RII PI/PD), which provides a strong, synergistic foundation for success. The addition of a multi-level, parallel organizational structure for this RII project also provides effective programmatic and administrative oversight and successful implementation. The Maine EPSCoR office is responsible for overall management and all non-research components, while the SSI research office is responsible for all research-related components. Both offices are staffed and coordinate with each other fully. The Maine Innovation Economy Advisory Board serves as the State EPSCoR committee, and several other committees and advisory boards help to guide the project.

## 3) Overview of Key Accomplishments:

### a) Project highlights:

- 23 research teams with 87 faculty at 10 institutions of higher learning in Maine make up the SSI research portfolio
- direct support of 264 individuals in YR1 included 157 new positions and 142 students participating in research internships with SSI/SSP faculty
- programs to increase diversity resulted in increased participation, and programs involving Maine's Native American tribes actively engaged them in relevant research and education

### b) Intellectual Merit:

SSI is advancing the emerging field of sustainability science in three important and integrative ways: 1) examining interactions between social and ecological systems (SES) as landscapes change in response to urbanization, forest management, and climate variability, with a goal of expanding our understanding of SES thresholds, feedbacks, and resilience; 2) investigating how such SES knowledge affects, and is influenced by, the actions and decisions of diverse stakeholders, with a goal of strengthening connections between knowledge and action; 3) evaluating the factors that facilitate and impede interdisciplinary collaboration, with a goal of identifying and implementing individual and institutional best practices that are needed to support successful interdisciplinary research programs in sustainability science. We believe that all three of these components are required to support the investment priority identified in NSF's strategic plan of fostering "…research that improves our ability to live sustainably on earth."

### c) Broader Impacts:

This RII project is a fully integrated research and education program that advances discovery and understanding while promoting teaching, training, and learning. All aspects seek to broaden the participation of women and underrepresented groups, and includes a geographically and institutionally-diverse portfolio of projects.

SSI has begun to generate a diverse set of broader impacts due to its innovative approach and integrative goals, including: 1) creating a research portfolio that includes teams with remarkably diverse interdisciplinarity (87 researchers representing 17 fields of natural science, social science, and engineering); 2) engaging with over a hundred stakeholders from across the state

(including members of Maine's tribal communities) to identify pressing problems for the state, define research needs, and develop effective solutions; 3) recruiting new faculty, postdoctoral fellows, and graduate students to enhance our culture of interdisciplinary research and practice; 4) launching a statewide collaboration of colleges and universities focused on the theory and practice of sustainability science that currently includes 10 different institutions; 5) initiating new courses and partnerships designed to advance workforce and economic development and help grow Maine's green innovation economy. Collectively, these activities are helping to increase Maine's research capacity and competitiveness at the same time as they enhance our ability to link scientific knowledge with improved actions and decision.

## 4) Actions Taken in Response to Recommendations:

Two evaluation and assessment components have taken place in YR1: a survey by our external evaluators, and a site review by the SSI Advisory Board. Recommendations included the following, followed by the proposed actions that will be taken by Maine EPSCoR SSI:

*1) Address issues raised by cultural and institutional barriers to cross-institutional collaboration, and increase interdisciplinary capacity development*. Response: Since this survey was done, many pro-active efforts have been successfully implemented to engage academic institutions in an integrated, statewide manner, and YR2 plans will expand this area further. Strategies for YR2 have already been put into action to create a stronger integration across disciplines and teams.

*3) Address issues raised by low interest in using cybertechnology.* Response: YR2 strategies include sponsoring small-group training workshops for all SSI/SSP faculty that deal with several modes of communication technologies (videoconferencing, webcams, etc.).

*4) Establish incentives to encourage outreach to stakeholders, and increase the level of interaction and integration among research teams and stakeholders*. Response: SSI has established an SSI-wide Knowledge to Action research team that includes experts in stakeholder engagement processes and university–community partnerships. This team is in the process of developing strategies to identify and track new stakeholders and stakeholder concerns that are not already reflected in the SSI research portfolio.

*5) Continue to develop data management systems*. Response: Maine EPSCoR worked with their consultant in March to expand an existing on-line reporting database that is used at UMaine. This allowed all SSI core faculty, SSP faculty, and graduate students to enter data on-line that will be used for current and on-going evaluation purposes. The SSI management team is also working on expanding a database for stakeholder information.

*6) Articulate how individual projects fit within a Maine-futures framework, how they can be scaled up, and which projects can be conceptually merged.* Response: The SSI Management team has issued a request for proposals (June 2010) to focus on strategies that support new integrative research and related activities efforts that create synergies across the current portfolio of SSI projects.

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## B) FINAL REPORT DETAIL

### 1) RII Project Participants

This RII project for Maine EPSCoR is designed to have a large impact for the state through the enhancement of research and education in sustainability science. In order to accomplish this, there also needs to be a corresponding investment in human resource infrastructure, workforce development, outreach and communication, and diversity and broadened participation. Therefore, in YR1 of this RII project, 157 new positions were created and an additional 107 existing personnel were also supported, for a total of 264 individuals directly supported. This includes: 53 core faculty, 34 collaborative faculty, 2 postdocs, 40 graduate students, 81 undergraduate students, 21 high school students, and 33 technicians/professional/administrative staff on the SSI core project and at the SSP collaborating institutions (a total of 10 institutions). (These personnel have been reported in NSF Fastlane as participants.)

An additional 3,524 participants were indirectly supported through various outreach, workforce development, and collaborative activities and included: 353 faculty at academic research institutions, 84 faculty at primarily undergraduate institutions, 270 graduate students, 122 undergraduate students at academic research institutions, 310 undergraduate students at primarily undergraduate institutions, 131 technical/ professional/administrative staff, 257 K-12 teachers/pre-service teachers, 107 high school students, 1,025 middle school students, 150 elementary school students, 94 business/industry representatives, 315 NGO/government representatives, and 306 members of the general public through conferences and workshops.

### 2) RII Project Description

#### a) Research Accomplishments and Plans:

In this first year 53 SSI core faculty from the University of Maine and University of Southern Maine and 34 SSP faculty from other partner undergraduate institutions throughout the state participated in SSI activities. Faculty expertise is represented in 17 different disciplines, which are integrated throughout 23 multi-disciplinary teams that are addressing specific aspects of the overall research focus. Those disciplines are (in rank order): Biological Sciences; Forestry; Economics; Physical Sciences; Engineering; Anthropology; Geography; Communications; Public Policy and Planning; History; Cooperative Extension; Education; Psychology; Native American Research; Mathematics; Business; and Law.

Sustainability science is a new, solutions-driven interdisciplinary research field. As explained below, successful research in sustainability science rests on three critical components (i.e., social-ecological systems research, knowledge-to-action research, and research on interdisciplinary integration) that can be thought of as a three-legged stool. All three legs are essential to achieve major advances in the field of sustainability science. Progress in sustainability science also requires that researchers select a specific model system in which to investigate these "three legs of the stool." The single central research focus of this NSF RII project is on advancing the emerging field of sustainability science, and we chose to initially focus on the problem of landscape change.

The nested components of this sustainability science research focus include:

1) Successful research in sustainability science requires research on three sub-problems:

- Understanding the dynamics of coupled social-ecological systems (SES research) [Note that NSF often refers to these as "coupled natural-human systems" or CNH]
- Understanding and strengthening links between knowledge and action (K-A research)
- Overcoming barriers to interdisciplinary integration (we refer to this as "Research on the Research")

2) In addition, SSI uses Maine as a laboratory for sustainability science research and focuses on three interacting drivers of landscape change (urbanization, forest ecosystem management, and climate and energy futures) as a promising "model system" for advancing the field of sustainability science.

The overarching goal of the Sustainability Solutions Initiative (SSI) is to advance the theory and practice of sustainability science. A central premise of SSI is that natural science and engineering are necessary but not sufficient for understanding and solving pressing sustainable development problems, which by definition have intersecting ecological, social, and economic dimensions. Using Maine as a laboratory, SSI examines both the coupled dynamics of social-ecological systems (SES) and the connections between SES knowledge and societal actions (K↔A). SSI's focus on landscape dynamics reflects a broad consensus that land change science is a critical research frontier as well as a pressing challenge for sustainable development.

As described in our strategic plan, the work completed in YR1 began the process of creating an integrative portfolio of sustainability science research projects focused on landscape dynamics. This portfolio addressed research to be conducted by SSI core faculty (at UMaine and USM) and Sustainability Solutions Partner (SSP) faculty (at primarily undergraduate institutions) in ways that were collaborative, complementary, and integrative.

In order to ensure that the information on the proposed research, team members, and resources needed was current, we issued a request for proposals to the SSI core faculty and SSP faculty that included a common focus on SES and K↔A but explored different sub -regions of SSI's conceptual domain. Following an extensive peer-review process, SSI launched 23 different projects for YR1 that explored substantial components of themes within SES. A central and overarching goal was to help direct projects towards full integration of SSI principles to grow the portfolio into a seamless entity. For YR1, this SSI portfolio included projects at ten institutions of higher education in Maine. Our portfolio strategy is specifically intended to overcome one of the greatest challenges in sustainability science: determining how the ecological, social, and economic *context* of particular sustainability problems affects SES dynamics, K↔A interactions, and the ability to implement improved solutions. In essence, this strategy makes it possible to compare and contrast different kinds of problems, thereby facilitating the development of models that examine how SES and K↔A vary as a function of biophysical conditions, soci oeconomic characteristics, and stakeholder attributes.

One of the integrative frameworks used to guide the creation of SSI's research portfolio is the Venn diagram commonly used to describe the conceptual domain of sustainability science (Fig 1). Traditionally, pressing societal problems have usually been studied from a dominant intellectual perspective such as the natural or social sciences. Unfortunately, such approaches have often failed to produce an adequate understanding of the multifaceted and intertwined nature of these complex problems, which has in turn reduced the effectiveness of the strategies developed to solve them. Thus, all the landscape change

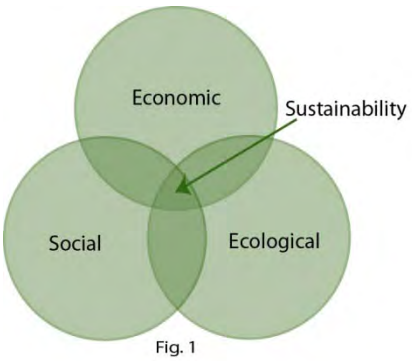

Fig. 1

projects in SSI's portfolio are designed to include interdisciplinary research that reflects the interconnected ecological, social, and economic dimensions of the problem.

Another integrative strategy central to the organization of SSI's research portfolio is related to the concept of *arenas* of landscape change. We view landscape change as a complex, interactive system in which potentially important *causes* of landscape change such as urbanization are themselves affected by changes in landscape processes and patterns. Thus, the term arena refers to a particular context in which interacting causes and consequences of landscape change can be examined. Rather than focus on these reciprocal interactions for a single arena, however, SSI seeks to examine how landscape dynamics vary and interact among three major arenas (i.e., urbanization, forest ecosystem management, and climate and energy futures) of particular importance in and beyond Maine (Fig 2). Although the projects in SSI's portfolio vary in the degree to which they focus on some arenas more than others, the strategy for YR2 will be to work on strengthening within- and among-project integration to investigate how SES dynamics and ~~K~~A connections are shaped by interactions among arenas.

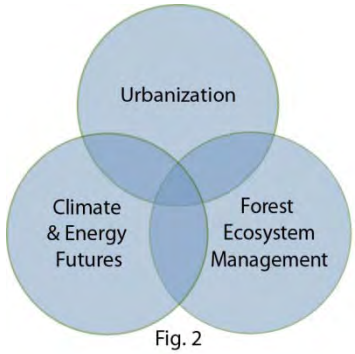

Fig. 2

The ultimate success of efforts to strengthen the theory and practice of sustainability science is critically dependent on the ability to overcome disciplinary barriers and harness the extraordinary but seldom realized potential of interdisciplinary research teams. Given the well known difficulties of fostering interdisciplinary research in a wide range of institutional settings, SSI has adopted a third integrative strategy that we call the *Research on the Research* (RoR). Specifically, the RoR is designed to identify the factors that facilitate and impede interdisciplinary collaboration, using SSI as a model system. A team of researchers with expertise in such diverse fields as social psychology, behavioral economics, organizational development, and collaborative management are using mixed methods to examine the individual and institutional barriers to improved interdisciplinary collaboration. As with other SSI's other components, RoR not only seeks to advance our understanding of collaborative processes in the context of interdisciplinary research, but also to identify and implement improved individual and institutional practices that can foster more effective collaboration in research universities.

The overall research strategy during YR1 sought to balance our goal of creating a portfolio of sustainability science sub-projects focused on landscape dynamics with our goal of strengthening the level of integration across SSI's research portfolio. The goal of this portfolio strategy is to compare and contrast different sub-problems in land change science, thereby facilitating the development of more robust models to explain how SES and ~~and~~ AK vary as a function of biophysical conditions, socioeconomic characteristics, and stakeholder attributes.

We are using three strategies to strengthen integration across the SSI research portfolio: 1) all the landscape dynamics projects involve interdisciplinary research approaches that reflect their interconnected ecological, social, and economic dimensions; 2) the projects are examining how SES and ~~K~~A vary and interact among three major landscape contexts or *arenas* (i.e., urbanization, forest ecosystem management, and climate and energy futures); 3) the SSI interdisciplinary teams are themselves being studied to identify and implement practices for strengthening collaborative research. Several of the projects supported in YR1 were broadly

integrative and already work across multiple projects, i.e. the Knowledge to Action and RoR projects.

In YR2, funding has been allocated expressly to work with integrating across the whole project with YR1 teams (including SSP partner institutions). Also, the planned Maine EPSCoR conference is being designed to serve as a venue to help further the integration of research throughout the overall project.

During YR2, we intend to support greatly expanded integration efforts. Specifically, we have issued a request for proposals to address a series of integration-related challenges: 1) supporting modeling and analyses of interactions among the research arenas (urbanization, forest ecosystem management, and climate and energy futures); 2) extending the capacity for cross-project comparisons and/or synthesizing discoveries across multiple projects in the research portfolio; 3) developing integrative decision or research communication tools applicable to multiple research projects; 4) filling computational or data management systems gaps in an integrative fashion to advance multiple research projects ; 5) producing an inventory of sustainability science needs to place the research portfolio in context; 6) developing metrics and indicators to measure progress toward and away from sustainability, through an explicit consideration of the nonlinearities, system thresholds, and emergent states stemming from a collective consideration of biophysical and social phenomena.

Any large undertaking requires the creation of specific infrastructure to guide and support the project. Therefore, in YR1, a considerable amount of effort was dedicated to building a project and management structure to engage and support researchers and students. At the same time leadership developed efficient processes to produce guidance for projects, organize committees, provide feedback, and administer oversight.

The following research projects were implemented in the YR1 start-up phase, and all but one will continue in the YR2 integration phase**.** All teams are multi-disciplinary, with many members on multiple teams and crossing the 10 current partner institutions. Additional information on outreach to stakeholders can be found in the f. Outreach and Communication section.

## University of Maine & University of Southern Maine: SSI Core Research Teams:

**Project #1:** ***Protecting Natural Resources at the Community Scale: Using population persistence of vernal pool fauna as a model system***

**Team Members:** Leader - Aram Calhoun (UM Wildlife Ecology). Faculty - Kathleen Bell (UM School of Economics), Mac Hunter (UM Wildlife Ecology), Rob Lilieholm (UM Forest Res.), Laura Lindenfeld (UM Comm. & Journalism, Smith Center), Cindy Loftin (USGS Wildlife Coop. Unit), Linda Silka (UM Smith Center), Charles Colgan (USM Muskie School), David Hiebeler (UM Math.). Graduate Students (UM) - Stan Hutchens, Brittany Cline, Vanessa Levesque, Jessica Jansujwicz, Kevin Ryan. Undergraduate Students (UM) - Lee Hecker, Cody Kennedy, Vance Brown, Erynn Call, Jonathan Grant, Scott Helmke.

**SSI Strategic Plan Goals addressed:** 1.1→1.3, 1.5, 2.1→2.5, 3.1→3.4, 4.1, 4.2

**Project Focus:** The conservation of natural resources (using vernal pools as a model system) is possible using a collaborative, multidisciplinary approach to maintaining critical wildlife habitat in human-dominated landscapes. Our goal is to demonstrate that Maine communities can have

both sustainable wildlife populations and economic growth and stability. The team is working on four themes related to natural resource conservation on private lands and providing ecological knowledge to practitioners: 1) amphibian ecology as it relates to geographic context and management issues; 2) conserving natural resources through collaborative management including private landowners and citizen groups; 3) the economy of conservation- what are the costs and benefits to communities and how can those costs and benefits be balanced? and 4) using vernal pool fauna as model socio-ecological system (SES) through which knowledge can be brought to action (K↔A).

**Year 1 Accomplishments and Progress:**

- Producing *Pools of Life*, an hour-long documentary targeted to the general public. The film will integrate our research, community outreach work, and feature footage from our town and state stakeholders, the forestry community, and private landowners.
- Three SSI Ph.D. graduate students recruited: Brittany Cline, Stan Hutchens, Vanessa Levesque.
- Initiated interdisciplinary an SSI Graduate Student Group to explore interdisciplinary research in academia and to build a sense of SSI community within the graduate community.
- SSI Graduate Student Group: Collaborative project with Dept. of Education to develop a research protocol (quantitative social science) to assess the evolution of the interdisciplinary process within the 1) SSI graduate fellow community; and 2) research and teaching faculty at UMaine.
- Collaborative SSI Project with Dept. of Mathematics and Statistics to develop a model of amphibian movement and population dynamics in a theoretical forested/wetland landscape (cellular automata).
- Expanding Gap Silvicultural System (Vernal Pool Habitat Management Guidelines). Met with 50 researchers and stakeholders in the forestry community to plan how to integrate with forestry guidelines developed to enhance/preserve vernal pool habitat.
- Held thirteen landowner and citizen scientist workshops in 10 towns for the municipal vernal pool mapping and assessment project (VPMP).
- Analyzed VPMP using semi-structured interviews with two managers, seven planners, one GIS specialist, and one conservation commission member in eight towns currently participating in the VPMP and two planners in towns that chose not to participate.
- Continuing empirical analysis of landowner decision-making with eight landowner focus groups conducted in four of the Maine towns involved in the VPMP.
- Vernal pool field assessments in ten towns.
- Created a common database structure to organize the information collected from communities.
- Presentation to (International Tax Assessors Organization) tax assessors and code enforcement officers (80 people representing 40 towns).
- Fourteen meetings with town partners to collect preliminary tax data and property value information.
- Developed partnership with Maine State Planning Office, USM, and focal towns.

**Plans for Year 2:** Continue to work with 10 towns and expand work to help with proactive vernal pool conservation plans elsewhere. Conduct follow-up survey to focus group towns regarding landowner responses and concerns regarding natural resources management on private lands. Analyze quantitative data from mail surveys to landowners (1200 surveys). Seek reactions from stakeholders to the results of our initial economics research. Continue development of preliminary

analyses based on collaborative exchanges with stakeholders. Conduct another tax assessor workshop.

**Project #2:** ***Developing Urban Landscape Models and Studies of their Use and Effects on Decision Making***

**Team Members:** Leader - Charles Colgan (USM Muskie School). Faculty - Kathleen Bell (UM School of Economics), Rob Lilieholm (UM Forest Res.), Bruce Segee (UM Computer Science), James Wilson (UM School of Marine Science), Jack Kartez (USM Muskie School), David Briggs (USM Computer Science). Graduate Students (UM) - Jennifer Plowden, Anne Hayden. Graduate Students (USM) - Sandra Goff, Thea Youngs, Slawomir Bojarski. Undergraduate Student (UM) - Karen Purinton.

**SSI Strategic Plan Goals addressed:** 1.1→1.5, 2.1→2.5, 3.1→3.5, 4.1→ 4.2

**Project Focus**: This project is developing large-scale computational simulation models of landscapes in Maine to investigate alternatives for achieving sustainable urban form. Such simulation models are essential to the investigation of changes in human and ecological systems resulting from the driving forces that frame SSI research and thus will be an essential tool for research in its own right and to help integrate research under other SSI projects. Critical decisions regarding land use, transportation, and environmental protection are based on understandings of how landscapes may change through time. Regional simulation models allow the development of much more systematic understandings of the interaction among the forces affecting landscapes which can form the basis for more effective actions to achieve sustainable landscapes. Testing how systematic understanding of landscape changes affects perceptions and decision making is an important element of the project.

**Year 1 Accomplishments and Progress:**

- Developed an on-line bibliographic resource with 4,000+ citations covering coupled systems modeling, landscape modeling, urban simulation, and related fields.
- Completed geographic scoping activities based on assessments of data availability (model urban regions are the Portland and Bangor metropolitan areas).
- Participated in a landscape-transportation planning project in the Portland region with affiliate Maine Center for Business and Economic Research (MCBER) in cooperation with the Maine Department of Transportation (DOT), Maine Turnpike Authority, and several private research firms. The results of this work are informing ongoing modeling and knowledge-action research activities.
- Acquired the Open Source Urban Simulation (OPUS) framework and Urban SIM software. A representative of the team attended the Urban Simulation Annual Conference at Berkeley in May 2010.
- Met with Eastern Maine Community and Economic Development staff, Maine Department of Environmental Protection and Maine Health and Human Services staff, Town of Orono Planner, and Maine Coast Heritage Trust staff.
- Briefings provided to: Maine DOT; Maine Turnpike Authority; Town planners in Orono, Gorham, Westbrook, South Portland, Portland, Scarborough, Windham, and Standish; and Greater Portland Council of Governments

**Plans for Year 2:** The addition of new faculty, postdoctoral researchers, and graduate students at USM and UM and the completion of the infrastructure development undertaken in year 1 will allow a transition to active development of modeling. The goals for the second year will be to:

Complete data acquisition; Develop prototype models for the Portland and Bangor region within the Urban Sim Models; Integrate the state transportation model with Urban Sim; Conduct at least one model simulation for stakeholders in each region; Submit at least 1 proposal to seek external funding for modeling research; Publish at least 3 articles/reports summarizing the project work to date; Present research in diverse settings: 1 international conference, 1 national conference, and 2 regional conferences.

**Project #3:** ***Decision tools to support water resources sustainability of managed lake systems***

**Team Members:** Leaders - Shaleen Jain (UM Civil & Env. Eng.), Andrew Reeve (UM Earth Sciences). Faculty - Jean MacRae (UM Civil & Env. Eng.), John Peckenham (UM Mitchell Center), Mike Scott (UM New Media), Firooza Pavri (USM Geo/Anthro.). Postdoc- Jong-Suk Kim (UM Civil & Env. Eng.). Undergraduate Students - Matthew Legere (UM), Abraham Dailey (USM), Cole Sanford (USM).

**SSI Strategic Plan Goals addressed:** 1.1→1.5, 2.1→2.5, 3.1→3.5, 4.1→ 4.2

**Project Focus:** This project focuses on the co-evolving nature of human and natural systems variability and changes in Maine's lake-watershed systems. The current focus is on the Sebago Lake, the second largest lake in Maine and source of drinking water for 170,000 citizens in the Portland area. It has been identified as the most vulnerable source watershed in the northeast region. The project addresses the need for a scientific analysis and visualization tool that can focus and facilitate shared vision planning and deliberation of lake-level management strategies within the on-going Utility – Water District – Stakeholder conversation.

**Year 1 Accomplishments and Progress:**

- Broadened stakeholder participation by engaging the National Weather Service (Gray, Maine) forecasters to evaluate short-term hydrologic forecasts methods to support flood warning and reservoir operations.
- Conducted six regional meetings with key stakeholders to coordinate project activities and protocols.
- Developed strong collaborative relationship with the Portland Water District in order to support management and decision-making based on project results.
- Assessed the sensitivity of wintertime hydroclimate to persistent wintertime climate anomalies and tropical sea surface temperatures. Results show the potential for amplification of hydrologic extreme-events in years when warmer and wetter winters associated with tropical North American anomalies overprint decadal warming trends.
- Analyzed Sebago Lake water quality, lake level, precipitation and temperature records to understand the seasonal co-evolution of the hydrology and water quality to explain the observed trends in lake turbidity.
- Developed a simple watershed model for the Crooked River (major inflow to lake) based on a lumped hydrologic formulation (GR4J) to develop a coupled hydroclimatic model for the lake-watershed system.
- Analyzed land-use classification and changes based on the remotely sensed dataset for the Sebago watershed.
- Developed online data visualization and modeling tools to improve the understanding of weather/climate-related uncertainties in Sebago lake level.
- Initiated research to integrate lake usage surveys with water quality and quantity perceptions by stakeholders

**Plans for Year 2:** Continued development and testing of the hydrologic model for the watersheds and lake system using historical climatic variability and lake level fluctuations. Collaborative scoping and scenario selection exercise to develop a set of scenarios for lake-level management models. Continued development of relationships with stakeholders in the watershed to clarify broad areas of concern regarding source protection. Test new hypotheses and experimental designs (field and laboratory scale) to explore apparent correlations between hydrologic, land use and water quality parameters from the ongoing data analysis.

**Project #4:** ***Improving Small-Scale Forest Policy & Management through Social Learning and Modeling***

**Team Members:** Leader - Jessica Leahy (UM Forest Res.). Faculty - Aaron Weiskittel (UM Forest Res.), Jeremy Wilson (UM Forest Res.), Mario Teisl (UM Economics), Laura Lindenfeld (UM Comm. & Journalism/Smith Policy Center), Kathleen Bell (UM Economics). Graduate Students (UM) - Erika Gorzyca, Patrick Lyons, Vance Brown. Undergraduate Students (UM) - Sean Hutchinson, Mallory Bussell, Karl Buckley.

**SSI Strategic Plan Goals addressed:** 1.1→1.5, 2.1→2.5, 3.1→3.5, 4.1→ 4.2

**Project Focus:** In the northeastern United States, family forest landowners are significant suppliers of timber, non-timber forest products, outdoor recreation opportunities; stewards of almost 94 million acres of forests; and contributors to the local quality of life. Family forest landowner decisions impact ecological, economic, and social systems in dynamic and complex ways. Small-scale forestry operations are between 10 and 1,000 acres in size. The large number of landowners, and small parcel sizes, along with pressing urbanization and forest ecosystem management issues, create sustainability problems that stakeholder-driven research can solve. This project applies a modeling technique to understand family forest landowner decision-making, reactions to forest policy, impacts to ecological systems, and emergent unintended consequences. Our research objectives are to: 1) Identify data needs for agent-based models (ABM) in family forests and explore approaches to resolve data needs; 2) Compare and contrast different methods of building agent rules and developing parameters; 3) Create and evaluate a learning tool that is rooted in agent-based modeling of family forests; and 4) Demonstrate and test boundaries of ABM applications to family forests.

**Year 1 Accomplishments and Progress:**

- Developed GIS Landscape Analysis for the Learning Tool using Lincoln, Maine as the study area.
- Compiled forest inventory data for the Learning Tool.
- Devised agent representation framework for the model. This framework uses a relational database with programmatic linkages that allows adding custom variables to address new problems.
- Developed tools for generating agents that can be used to create simple scripts to generate thousands of agents with a high level of variability to better simulate actual human populations.
- Initiated stakeholder engagement with town officials in Lincoln to discuss community issues, landowner decision-making, and data needs.
- Started social learning activities with the thirteen participating stakeholders to shape model.
- Continued development of methods for generating agents.
- Developed the learning tool simulation model representing the world, and making the world

progress and function.
- Analyzed deed data as a component of the ABM.
- Applied social learning activities to develop family forest stakeholder relationships.
- Constructed a baseline social network of CRSF faculty and family forest stakeholders that will allow us to monitor aspects of stakeholder engagement over time.

**Plans for Year 2:** Continue agent-based modeling research by completing the learning tool and social learning activities. Continue stakeholder engagement research by completing the: Qualitative study of external stakeholders (n=~30); Social network analysis of researcher-stakeholder relationships (n=~50); and mail survey of family forest landowners in Maine (n=1,000) about engagement preferences and research needs.

**Project #5:** ***Researching Knowledge-to-Action Linkages to Promote Stakeholder and Community Engagement***

**Team Members:** Leaders - Laura Lindenfeld (UM Comm. & Journalism/Smith Policy Center), Linda Silka (Smith Policy Center). Faculty - Jessica Leahy (UM Forest Res.), Kathleen Bell (UM Economics), Bill Kuykendall (UM New Media). Graduate Student (UM) - Karen Hutchins. Undergraduate Students (UM) - Sean Hutchinson, Mallory Bussell, Karl Buckley, Vance Brown.

**SSI Strategic Plan Goals addressed:** 1.1, 1.2, 1.5, 2.6, 3.1→3.5, 4.1, 4.2

**Project Focus:** The Knowledge to Action (K↔A) Engagement Team collaborates with other research teams on the SSI by testing theories on the ways in which both individual- and group-level processes link individual stakeholders and community actions and how the sustainability science research process influences and is influenced by these collaborations. The K↔A Team studies social, economic, and cultural issues relevant to SES by supporting the establishment of a "problem inventory" of Maine's sustainability threats. This team is currently partnered with the *Protecting Natural Resources at the Community Scale*, the *Managed Lake Systems*, and the *Urban Streams* project teams. The aim is to build a replicable model for studying collaboration and engagement through sequential exploratory design that draws on quantitative and qualitative analyses and participant observation methodologies.

**Year 1 Accomplishments and Progress:**
- Co-directed Conference on Communication and the Environment (COCE) with Travis Wagner (USM).
- Developed panel on Integrating Communication Studies into Issue-Driven Interdisciplinary Research: Maine's Sustainability Solutions Initiative as a Model at COCE (participants: Silka, Lindenfeld, Leahy, Colgan, Bell, Porter, Jain, Lilieholm).
- Organized International Environmental Communication Symposium (May 2010).
- Co-developed Energy survey with lead PIs Teisl and McCoy (Hutchins).
- Organized and facilitated monthly K↔A meetings for SSI team.
- Developed town manager survey.
- Developed interview protocol for team leaders' K↔A approaches.
- Established working relationships with *Impaired Urban Streams* and *Vernal Pool* teams.
- Increased collaboration with other K↔A researchers (Teisl, McCoy, Ranco, Johnson).
- Conducted stakeholder meetings with agencies, Maine legislature, and businesses.

**Plans for Year 2:** Complete surveys, analysis of data, and development of publications. Identify partner towns and communities in Maine. Establish a quasi-experimental method to study the impact of different kinds of collaboration over time. Develop trusting relationships with

stakeholders in key study towns and communities. Facilitate broader degrees of integration with SSI partner projects and new partnerships with SSI teams. Develop research plans to apply insights from town-scale survey and partnerships at other stakeholder scales (e.g., individual and institutional). Continue support and assessment of K↔A strategies across the SSI.

**Project #6:** ***Analysis of Alternative Futures in the Maine Landscape using Spatial Models of Coupled Social and Ecological Systems***

**Team Members:** Leader - Robert Lilieholm (UM Forest Res.). Faculty - Chris Cronan (UM Biology & Ecol.), Richard Judd (UM History); Jeremy Wilson (UM Forest Res.); Eric Gallandt (UM Plant, Soil, & Env. Sci.); Stephen Hornsby (UM Canadian-American Center). Undergraduate Student (UM) - Andrew Tomes, Jill Tremblay (technician after graduation).

**SSI Strategic Plan Goals addressed:** 1.1→1.5, 2.1→2.5, 3.1→3.5, 4.1→ 4.2

**Project Focus:** Recent state-wide assessments have highlighted the need for a more strategic, coordinated approach to land conservation in Maine – one that is based on inputs from a range of stakeholders and professionals across various disciplines and interests. Alternative futures modeling examines how changing land use demands, socio-economic conditions, regulatory climates, policy decisions, and environmental drivers are likely to influence the future distribution and balance of developed and undeveloped land in Maine. Spatial analysis and alternative futures modeling are applied to develop a decision-support system for strategic regional land use planning aimed at identifying prime targets for future conservation, human development activities, and working forest and agricultural lands. Our objectives are: 1) Develop a set of stakeholder-derived biophysical and socio-economic metrics to identify and map state-wide high-value lands suited for future conservation; 2) At the watershed level, identify where high-value conservation lands intersect with productive forest and agricultural lands important in sustaining traditional resource production; and 3) At the watershed level, identify areas of likely future development to anticipate land conversion pressures and better utilize limited conservation resources.

**Year 1 Accomplishments and Progress:**

- Acquired computing capacity to gather, store and analyze remote sensing data (ERDAS software for analyzing remote sensing data and Netica software for developing Baysian Belief Network (BBN) models of land suitability).
- Integrated GIS data and ERDAS to develop urban/developed clusters within the Lower Penobscot River Watershed (LPRW) study area.
- Continued development of BBN land suitability models for: 1) ecosystem protection; 2) working forest protection; 3) agricultural working lands protection; and 4) development.
- Initiated a process to engage stakeholders within each land suitability focus area.
- Contributed to revisions of the Maine Historical Atlas.
- Worked with the New England Governors' Conference's Working Group on Innovative Land Conservation Models to help develop NEGC's Great Maine Forest Initiative.
- Key stakeholders meetings started.

**Plans for Year 2:** Add two new project-specific PhD. students, as well as new SSI-wide post-docs and faculty at UMaine and USM. Continued development of the BBN land suitability models and engagement with a range of stakeholder groups. The focus groups and workshop will serve to test our initial expert-based models. Begin working with stakeholders to see how model

results can assist with on-the-ground planning among various stakeholders, including communities within our LPRW study area.

**Project #7:** ***Sustaining and Restoring Urban Stream Resources in Maine***

**Team Members:** Leader - David Owen (USM School of Law). Faculty - Chris Cronan (UM Biology & Ecol.), Laura Lindenfeld (UM Comm. & Journalism/Smith Policy Center), Linda Silka (UM Smith Policy Center), Kevin Simon (UM Biology & Ecol.), Peter Vaux (UM Mitchell Center). Graduate Students - Karen Hutchins (UM), Richard Wood (USM), Shannon Carroll (USM), Meghan Ogren (USM).

**SSI Strategic Plan Goals addressed:** 1.1→1.5, 2.1→2.5, 3.1→3.5, 4.1→ 4.2

**Project Focus:** Maine has become increasingly concerned with the health of streams in urban and urbanizing areas. Urbanization leads to water quality degradation driven mainly by changes in stormwater runoff. Water quality in urban streams is directly and inversely related to the amount of connected impervious cover in a watershed, and that degradation can start even at low levels of urbanization. While the adverse relationship between the magnitude of urbanization and stream integrity is well known, less is known about the proper methods for translating that knowledge into preventive or restorative action. Traditional legal mechanisms are widely seen as cumbersome or inadequate, and educational or social-marketing strategies, while successful in some contexts, involve significant challenges. Engineers and watershed scientists also are unsure about the optimal biophysical fixes. Nevertheless, in response to existing legal requirements, some communities and businesses in Maine are already making significant investments in restoration, or are about to start doing so. This research seeks to improve both knowledge of the biophysical mechanisms of degradation and recovery in urban streams and of the legal and non-legal methods for translating that knowledge into action. The ultimate goal is to support more sustainable management of urban and urbanizing watersheds.

**Year 1 Accomplishments and Progress:**

- Completed analysis of the applicable legal regime.
- Analyzed historic water quality data relative to land cover data.
- Initiated exploration of community values using a mail survey to all communities in Maine to better understand the pressing issues in those towns and influences on their preferences for engagement with the researchers.
- Met with stakeholders, including Maine Dept. of Environmental Protection and consultants working for the City of Portland, who already are involved in gathering community preference information, or who have identified the need for such information (or both) and are interested in coordinating research efforts.
- Obtained other data sets, including current land use data for upstream watershed areas and land use changes over the 1992-2002 period, that are relevant to urban streams management issues.
- Developed a website that serves information about this project and provides access to relevant documents and data sets from the focal urban regions of the State.
- Started work on an interactive mapping interface that allows users to simultaneously view multiple data sets from one or more urban regions.

**Plans for Year 2:** Continue analyzing the legal regime, with particular attention to mechanisms for triaging effort among different watersheds and mechanisms for integrating urban stream protection with efforts to protect other environmental values affected by urbanization. Use K↔A survey data to assess the relative importance communities/local governments place on urban

stream protection and restoration. Continue using monitoring and land cover data to refine understanding of relationship between development patterns and water quality. Continue developing web tools to facilitate communication and learning about urban watersheds. Continue developing multi-metric decision-support tools to help support community and governmental decision-making about urban watersheds.

**Project #8:** ***Spatial Forest Planning to Meet Multiple Natural Resource Goals: Developing geospatial tools to forecast management outcomes across a diverse landscape of ownership types and stakeholder interests***

**Team Members:** Leader - Jeremy Wilson (UM Forest Res.). Faculty - Steven Sader (UM Forest Res.), Jessica Leahy (UM Forest Res.). Technicians - Kasey Legaard (UM Forest Res.), Erin Simons (UM Forest Res.). Graduate Student (UM) - Jacquelyn Zimmerman.

**SSI Strategic Plan Goals addressed:** 1.1→1.5, 2.1→2.5, 3.1→3.5, 4.1→ 4.2

**Project Focus:** Forest management practices and natural disturbance are drivers of landscape and policy change in Maine. Past infestations of spruce budworm – the foremost natural disturbance agent of Maine's spruce/fir forest – have strongly influenced current ecological conditions, forest policy, and social attitudes about forest management. The integration of geospatial data with spatial forest planning software and advanced decision support systems will provide a process to evaluate current forest conditions and potential outcomes of future resource management strategies, including effects on wood supply, wildlife habitat, and budworm vulnerability. This research evaluates the costs, benefits, and tradeoffs involved when managing forestland to meet multiple natural resource goals across a diverse landscape of ownership types and stakeholder interests. Moreover, because Maine's citizens hold the "social contract" on forest management practices, and because the outcomes of past budworm outbreaks have strongly influenced social attitudes and forest policy, this research also evaluates the relationship between environmental values and reactions to communications about forest planning and the potential outcomes of alternative management strategies and budworm mitigation efforts.

**Year 1 Accomplishments and Progress:**

- Developed automated satellite image processing steps to map forest disturbance (ca. 1973-2009) and forest composition across 10 million acres of commercial forestland using Landsat satellite imagery.
- Entered Memorandum of Understanding with the U.S. Forest Service Northern Research Station Forest Inventory and Analysis (FIA) Program, releasing confidential plot location data for use in forest composition and vulnerability mapping.
- Started vulnerability mapping using regression algorithms to estimate budworm host species abundance from satellite imagery and reference data from FIA field plots.
- Devised models to compare ecological and economic tradeoffs (wood supply, wildlife habitat, and budworm vulnerability) associated with alternative forest management scenarios across a diverse landscape.
- Designed a mail survey instrument for the public attitude survey that will be able to address our three social science sub-objectives: 1) Evaluate the process of how attitudes toward Maine's forests and forest disturbances are formed, 2) Understand the public's value of forest resources and how it might relate to forest resource decisions and behavior related to disturbance (especially spruce budworm outbreaks), and 3) Identify how environmental values and beliefs affect public understanding and acceptance of risk communication.

- Designed a method to engage practicing foresters and loggers and to study intended future behavior in response to next spruce budworm outbreak.

**Plans for Year 2:** Expand this project to include modeling additional environmental service characteristics of the forest, i.e., biodiversity indicators and carbon sequestration. Implement LANDIS, a landscape dynamic model developed in the Midwest, to model spatial forest dynamics across the 10 million acre study area. Explore the development of forest decision support tools designed to help island communities grapple with dynamic changes and disturbances. Islands are ideal self-contained systems to pursue coupled social-ecological modeling.

**Project #9:** ***Linking Knowledge with Action: Refining Maine's Mercury Fish Consumption Advisory***

**Team Members:** Leader - Aria Amirbahman (UM Civil & Env. Eng.). Faculty - Kathleen Bell (UM School of Economics), Stephen Norton (UM Earth Sciences), Kevin Simon (UM Biology), William Halteman (UM Math.), Ivan Fernandez (UM Plant, Soil, & Env. Sci.). Graduate Student - Linda Bacon (UM and Maine Department of Environmental Protection). Undergraduate Student (UM) - Jessica Baughman.

**SSI Strategic Plan Goals addressed:** 1.1→1.3, 1.5, 2.1→2.5, 3.1→3.4, 4.1, 4.2

**Project Focus:** Maine has had a blanket, uniform fish consumption advisory for mercury that applies to all inland waters since 1994. Maine's Department of Environmental Protection is interested in research to support an updated assessment of fish tissue contamination in Maine lakes and a rigorous analysis of linkages between lake trophic status, mercury burden in freshwater fish, and other relevant watershed characteristics. Complementary research contrasts the mercury fish consumption advisory of Maine with those of other states and explores the performance of fish consumption advisories that will lead to potential advisory revisions.

**Year 1 Accomplishments and Progress:**

- Identified 306 lakes that have had more than 1750 fish samples analyzed for mercury content. Water chemistry data are available for 188 lakes.
- Conducted initial statistical and spatial (GIS) analyses of these data to evaluate the representativeness of target variables among the lakes in the dataset and the spatial distribution of those lakes.
- Completed GIS coding of targeted lakes and watershed attributes (306 watersheds).
- Identified key organizations to represent diverse stakeholder views of the mercury fish consumption advisory.
- Compilation of secondary chemistry data for single events (date) from diverse sources.
- Evaluating alternative statistical approaches to investigate the variability of spatial data.
- Identification of data gaps.
- Developing a spatial dataset of lakes to be shared with researchers and relevant stakeholders.
- Stakeholder interactions- qualitative research interviews in progress (25 entities).

**Plans for Year 2:** Acquire additional data from targeted lakes to better control variability of biophysical parameters. Collect fish for mercury analysis to target fish of the same species and similar size. Selected lakes will be chosen regionally to avoid mercury 'hot spots' downwind of local waste-to-energy plants; impoundments with extreme water-level fluctuations will be avoided as they typically have unusually high fish tissue mercury concentrations. In addition to fish tissue, water and sediment samples will be obtained for analyses.

**Project #10:** ***Development of a Spatial Landscape Simulation Suite***

**Team Members:** Leader - David Hiebeler (UM Math.). Faculty - Frank Drummond (UM Biology & Ecol.), James Wilson (UM Marine Sci.), Charlene Donahue (State of Maine Insect & Disease Lab). Graduate Student (UM) - Jack Hill.

**SSI Strategic Plan Goals addressed:** 1.3→1.5, 2.2→2.5, 3.1→3.4, 4.1, 4.2

**Project Focus:** The central goal of the project is to improve awareness of SSI-related issues among the general population, primarily by targeting K-12 students and teachers and engaging them in hands-on exploration of these issues via computer simulation models. Specific topics that the models will facilitate exploration of are: 1) How do various local rules scale up to produce different emergent global patterns? 2) How do the spatial scales of behaviors or interactions affect dynamics of these systems? 3) What happens when two models of this type are coupled, e.g. a model of a population on a heterogeneous landscape, together with a model of how strategies for management of that population's habitat spread through the human population? 4) How successful would fixed management regulations be, versus adaptive strategies in response to dynamics of a population that is being managed? Using two competing populations on heterogeneous landscapes the user can manipulate parameters including the amount of suitable habitat, spatial clustering of suitable habitat, birth and death rates of the populations, and the spatial scale of dispersal. A model similar to the one above, where the habitat type is dynamic would represent e.g. pesticide application or other control measures applied at a spatial scale that can be specified by the user, or gap creation in a forest ecosystem. The amount of time for the pesticide to dissipate (or forest canopy to regenerate) can also be specified, allow for control of both spatial and temporal correlations in habitat type. Another variant includes dormancy as a strategy for some of its offspring. This allows for exploration of control strategies for agricultural crop pests that include some dormancy, such as blueberry maggot flies. Another model is a landscape model where the habitat is affected by public opinion in the local region (regarding management strategies), and where that public opinion is governed by a model of the spread of ideas. This may include a "top-down" regulatory/policy component governing management strategies.

**Year 1 Accomplishments and Progress:**

- Presented models during a half-day session to K-12 students and teachers (11 students and two teachers) at the UM Presque Isle campus.
- Assessed activities using a survey. Results indicated that models were helpful in understanding biology and natural world problems and as such can help guide management decisions.

**Plans for Year 2:** The models will be made available to SSI/SSP teams and on the Internet. No other additional work on this project is planned.

**Project #11 :** ***Adaptation Strategies in a Changing Climate: Maine's Coastal Communities and the Statewide Stakeholder Process***

**Team Members:** Leaders - Shaleen Jain (UM Civil & Env. Eng.), Esperanza Stancioff (UM Coop. Ext./Sea Grant). Faculty - Jasmine Saros (UM School of Biology/Climate Change Inst.), Judy Hakola (UM English), Kirk Maasch (UM Earth Sci./Climate Change Inst.). Graduate Student (UM) - Alex Gray.

**SSI Strategic Plan Goals addressed:** 1.1→1.5, 2.1→2.5, 3.1→3.5, 4.1→ 4.2

**Project Focus:** Adaptation in a changing climate requires a sound knowledge of the location-specific contexts, challenges across various sectors of the society and economy, and the nature of

interconnectedness between natural and human systems. Efforts to elucidate place-based climate information needs and vulnerabilities are often stymied by lack of community-scale networks. The research team is pursuing a community-based research and outreach approach, as well as detailed analyses of historical and projected climate scenarios and weather forecast products to address two research questions: a) What are the knowledge gaps and information entry points for weather and climate information that directly relate to the climate-related vulnerabilities of the coastal communities in Maine? and b) What are the recent changes in weather and climate variability on time scales most relevant towards support of decision-making and planning needs in the select communities? Furthermore, what is the utility of medium-range ensemble weather forecasts for decision-making?

**Year 1 Accomplishments and Progress:**

- Reviewed the existing data and body of knowledge regarding coastal adaptation in Maine.
- Selected two city/towns for a detailed analysis of climate-related vulnerability and decision-making issues.
- Met with municipal decision makers regarding vulnerabilities and assets in the target communities addressing the needs of coastal communities
- Conducted Portland focus group meeting and discussions (10 members including lead municipal planners, stormwater managers, emergency management director, Casco Bay Estuary Project Director).
- Worked with focus group of municipal officials for the City of Portland to develop a questionnaire regarding climate adaptation considerations and strategies.
- Assessed use of medium-range weather forecasts for decision-making.
- Initiated stakeholder engagement (Lincolnville).

**Plans for Year 2:** Complete a comprehensive survey and focus groups to characterize the adaptation issues facing Maine's coastal communities. Analyze and synthesize information based on the survey instrument to identify, develop, and prioritize the delivery of scientific assessment and information to support adaptation-related decision-making and planning. Prepare an assessment report of the climatic aspects of three recent extreme events that have impacted Maine coastal communities. Complete qualitative and quantitative analysis of vulnerabilities for a representative group of coastal communities.

**Project #12:** ***A Complexity-based Approach to Research- on-Research and Enhanced Systems Outcomes (RoR)***

**Team Members:** Leader - Terry Porter (UM Business). Faculty - Susan Gardner (UM Educ. & Human Dev.), Shannon McCoy (UM Psychology), Linda Silka (UM Smith Policy Center). Graduate Students (UM) - Brandon Cosley, Sam Truesdell.

**SSI Strategic Plan Goals addressed:** 1.1, 1.5, 2.6, 3.1→3.5, 4.1, 4.2

**Project Focus:** The optimizing of organizations and systems to improve sustainability practices and outcomes in complex organizations is in itself an important field of research. The SSI provides an experimental system in which to study key questions that include: 1) how to best design organizational structures; 2) empower and support interdisciplinary research groups; 3) coordinate and communicate group or organizational learning; and 4) deliver serviceable knowledge to stakeholders. The purpose of this project within the Research on the Research group (RoR) is to analyze survey and social network research that was conducted early in the SSI (in 2008 and 2009), thus providing baseline information about attitudes and social structures amongst the core faculty group of SSI researchers at the University of Maine.

**Year 1 Accomplishments and Progress:**

- Analyzed pre-project surveys to interpret how teams were organized and interacted prior to SSI.
- Conducted a conjoint analysis of surveys and social network analysis to provide longitudinal information and determine how attitudes may be assessed over time, and in light of pre-existing social networks.
- The meaning of integration in the RoR context is somewhat unclear, but it involves dissemination and feedback of assessments network structure.

**Plans for Year 2:** Continue with longitudinal data collection and analysis. Develop and test hypotheses about the relationships amongst attitudes, social network structures, and outputs and outcomes of SSI. Continue with dissemination and feedback with core faculty and other stakeholders.

**Project #13 :** ***Mobilizing Diverse Interests to Address Invasive Species Threats to Coupled Natural/Human Systems: The Case of the Emerald Ash Borer in Maine***

**Team Members:** Leader - Darren Ranco (UM Anthropology/Mitchell Center). Faculty - Robert Lilieholm (UM Forest Res.), John Daigle (UM Forest Res.). Partners - Jennifer Neptune and Theresa Secord (Maine Indian Basketmakers Alliance).

**SSI Strategic Plan Goals addressed:** 1.1→1.5, 2.1→2.5, 3.1→3.5, 4.1→ 4.2

**Project Focus:** The goal of this project is to study *and* facilitate the ways that Wabanaki (translated, *the people of the dawn)* basketmakers, tribes, state and federal foresters, various university researchers, landowners and others come together to prevent, detect, and respond to the Emerald Ash Borer (EAB), a potentially devastating invasive threat to all three species of ash trees found in Maine. As a team of social science researchers and stakeholder experts, we have come together to study and facilitate the linkage of knowledge-to-action in Maine around this invasive threat. As such, our group is facilitating a process that we believe links knowledge and action while at the same time studying how different groups come together to address a common invasive species threat. Therefore, our approach pairs social science research methods with explicit knowledge-to-action integration. Moreover, as our knowledge-to-action work progresses beyond year one and we include more science stakeholders as partners in our research, we believe our work will develop into high integration methods linking social-ecological-systems (SES) with a clear knowledge-to-action orientation.

**Year 1 Accomplishments and Progress:**

- Completed analysis of the applicable legal regime.
- Developed a website/newsletter to serve as a clearing house for stakeholders regarding: 1) Brown Ash; 2) the Emerald Ash Borer; and 3) invasive species issues (www.umaine.edu/brownash/)
- Assembled a team of key stakeholders to identify research to support the management and monitoring of the Emerald Ash Borer.
- Sent a group of researchers/stakeholders to participate in Purdue University's Ash Symposium.
- Developed and applied methods to assess and monitor the quality and intensity of stakeholder engagement.
- Conducted interviews and focus groups with various stakeholders to learn about ash ecology, uses, management and values.
- Presented testimony in support of LD 1607, an Act to Regulate the Transportation of

Firewood, on January 20, 2010, to the Joint Standing Committee on Agriculture, Conservation, and Forestry. This bill was signed into law April 1, 2010.

**Plans for Year 2:** Continue our stakeholder network maintenance through our website, direct meetings, distribution of reports, and other means. Finalize some of our initial social science findings and have this help direct the ways in which we engage in more biophysical research with our partners. Continue efforts to fund parallel biophysical research with other partners. Continue to slowly expand our stakeholder groups, especially into the business, non-profit, and public education communities.

**Project #14:** ***Modeling Stakeholder Acceptance of Solutions to Environmental Problems***

**Team Members:** Leaders - Mario Teisl (UM Economics), Shannon McCoy (UM Psychology). Faculty - Caroline Noblet (UM Economics), Laura Lindenfeld (UM Comm. & Journalism/ Smith Policy Center), Linda Silka (UM Smith Policy Center), Mark Anderson (UM Economics), Jessica Leahy (UM Forest Res.), Kathleen Bell (UM Economics), Teresa Johnson (UM Marine Sci.). Graduate Students (UM) - Karen Hutchins, Joseph Wellman, Brandon Cosley, Danielle Letarte, Kate Hassett. Undergraduates (UM) - Megan Wibberly, Kevin Price, Chris Dunn, Caitlyn Lajoie.

**SSI Strategic Plan Goals addressed:** 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 2.6, 3.1→3.5, 4.1, 4.2

**Project Focus:** This project seeks to understand how a broad array of factors may influence a person's evaluation of sustainability issues and solutions targeting these issues. The core effort is on the expansion and testing of current economic and psychological models of stakeholder choice. One aim of this research is to combine choice and technology adoption models into a more unified social science framework. Many environmental solutions are developed or enhanced through the use of new technologies/approaches/methods, but people are skeptical or resistant to accepting these. Further, Maine has passed legislation supporting wind power development as an environmental and economic development tool for the state. Thus, alternative energy development provides an excellent context to study people's reactions to alternative environmental solutions while also providing an application that has economic development ramifications. Ultimately, this research will create a means of evaluating the effectiveness of communication and decision-making processes, thereby leading to improvements in translating scientific knowledge into individual and collective actions.

**Year 1 Accomplishments and Progress:**

- Strong integration of various social science researchers with an understanding of each discipline's conceptual foundations and nomenclature.
- Identification of key stakeholders engaged in wind power activities around the state.
- Development of a survey instrument with five variations, allowing for cross-disciplinary modeling. The five survey variations allow for an information experiment aimed at obtaining information on citizens' perceptions and trust of various sources of information about wind power, and a messaging experiment aimed at determining how various informational framings impact individuals' perceptions.
- Started an analysis and modeling of currently available biofuels data.
- Working with a team of economic researchers in France on a web-based survey of French citizens to examine how people evaluate across various environmental problems that differ by media.
- Identified stakeholders contacted by phone and/or email and invited to discuss the project,

and comment on a draft of the survey.
- Provided information to Maine Senator Lisa Marrache, as she considered legislative statutes regarding E-10 (Ethanol fuel additives).
- Project of interest to other stakeholders, such as Gloria Helfand (OTAQ, U.S. EPA) as the methods we use and the results we develop have both policy and research implications for EPA.

**Plans for Year 2:** Expand current energy work that focuses on public values and attitudes concerning energy generation to encompass transmission and distribution and end-use issues of a transformative electrification program. Use psychological experiments within the wind power survey to develop initial models of attitudes toward wind power and the role of message framing in translating knowledge to action. Increase our research connections to a number of behavioral economists and environmental psychologists. Develop a series of seminars/workshops aimed at further developing the team's quantitative skills in an interdisciplinary framework. Expand the scope of our research team to include engineers and biophysical scientists engaged in energy- and other-related technologies. New faculty collaborations for Year 2: Gary Hunt (UM Economics), Leslie Forstadt (UM Economics/ Coop. Ext.), James Acheson (UM Marine Sci./Anthropology).

**Project #15:** ***The Individual and the Disciplinary System (RoR)***

**Team Members:** Leader - Susan Gardner (UM Educ. & Human Dev.). Faculty - Shannon McCoy (UM Psychology), Linda Silka (UM Smith Policy Center). Graduate Students (UM) - Andrea Nadine West, Amanda Mullen, Joseph Wellman, Ellen Newell.

**SSI Strategic Plan Goals addressed:** 1.1, 1.5, 2.6, 3.1→3.5, 4.1, 4.2

**Project Focus:** A focus on interdisciplinarity and interdisciplinary scholarship, in particular, has become a prominent feature of the landscape of higher education. Calls for interdisciplinary scholarship and doctoral training in interdisciplinary programs are frequent from the NSF and other organizations. However, interdisciplinarity is often misunderstood and not easily accomplished. Scholars have documented several issues inherent to interdisciplinary research: 1) true interdisciplinary research is rarely conducted as it is not often understood; 2) multiple obstacles exist to interdisciplinary research including departmental and university structures, promotion and tenure expectations, and even teaching assignments; and 3) education and socialization of students to interdisciplinarity is also difficult given all the above issues. Given the nascent status of interdisciplinarity in this country, however, relatively little is known about how the interdisciplinary research process operates or how researchers engage in it. Specifically, more research must be conducted to understand how interdisciplinarity occurs and what structures facilitate or impede the process. The scope of SSI has afforded a unique opportunity to analyze interdisciplinarity in action. The purpose of this study is to investigate the beliefs, attitudes, and assumptions that UMaine faculty involved with the SSI and UMaine administrators have about interdisciplinarity and the process of interdisciplinary scholarship. The focus of these investigations is to better understand the interplay of the individual within the larger disciplinary and institutional systems.

**Year 1 Accomplishments and Progress:**
- A total of 27 faculty deeply involved in the SSI were interviewed regarding their thoughts about interdisciplinary scholarship and their specific role in the SSI project.
- Four top-level UMaine administrators were interviewed to determine their perceptions of

interdisciplinary scholarship in regard to the existing structures on campus, such as tenure and promotion guidelines.

- Additional interviews are being conducted with newly admitted graduate students who join SSI teams in order to understand how they grapple with conflicting paradigms and perceptions.
- Transcription and analysis of all interviews is ongoing. Preliminary findings were presented to the larger SSI team to lead discussion on these findings related to future steps for integration among and within teams.

**Plans for Year 2:** Early analysis from the current study prompted a meeting with current SSI graduate students, which will result in an additional study beginning in fall 2010. This study will seek to understand the socialization process by which newly admitted graduate students come to understand interdisciplinarity. These data will then be combined with data from the current study to compare and contrast faculty and student understandings. We plan to observe student interactions with their research teams to understand the cognitive and relational processes inherent in interdisciplinary collaboration as well as proposing further longitudinal studies that measure cognitive and personality constructs that correlate with interdisciplinary success.

**Project #16:** ***Perceptions of the System and Interdisciplinary Success (RoR)***

**Team Members:** Leader - Shannon McCoy (UM Psychology). Faculty - Susan Gardner (UM Educ. & Human Dev.), Linda Silka (UM Smith Policy Center). Graduate Students (UM) - Brandon Cosley, Ryan Pickering, Ellen Newell, Joseph Wellman.

**SSI Strategic Plan Goals addressed:** 1.1, 1.5, 2.6, 3.1→3.5, 4.1, 4.2

**Project Focus:** Interdisciplinary work is often a significant stressor for the researchers involved. Uncertainty, and the resulting stress, can impede participation in, and successful completion of, interdisciplinary research. The SSI has the potential to serve as a resource to manage this uncertainty. The goal of the current work is to apply key social psychological theories to understand how perceptions of the SSI system impact the success of interdisciplinary work and K↔A. Research has shown that social systems that are perceived to be 1) legitimate, 2) predictable, and 3) relevant to their members are most successful in reducing uncertainty and anxiety. In the current research, the role of the SSI system in the success of individual members and research teams will be examined via survey methods collected over time. The specific aims of this work are to facilitate the success of SSI researchers by: 1) Measuring SSI members perceptions of the SSI system (e.g., Do members perceive SSI to be legitimate, predictable, and personally relevant?); 2) Examining predictors of these perceptions (e.g., How can we increase the legitimacy, predictability and relevance of SSI for its members?); and 3) Examining the consequences of these perceptions for researcher satisfaction, research team collaborations, K↔A and outputs/outcomes (e.g., Do these perceptions indeed have measurable consequences for team productivity and success?).

**Year 1 Accomplishments and Progress:**

- Coordinated evaluation process; the RoR team (Gardner, Silka, McCoy) held a telephone conference with the NSF EPSCoR external evaluators in order to identify and overcome any issues regarding the overlap between the research efforts and goals of the RoR research team and those of the external evaluation.
- Developed a survey instrument to assess the research goals of RoR sub-projects.
- Coordinated survey content and execution with the K-A research team to reduce participant burden.

- Survey results are still be evaluated. We are conducting preliminary analyses. McCoy is developing a presentation of those results of most immediate use to SSI team members for the upcoming SSI retreat.
- Added expertise in social network analysis.

**Plans for Year 2:** Complete survey data analysis and prepare a manuscript for scholarly publication. Develop Year 2 survey instrument to include social network analysis. The goal is to conduct two surveys in year two, one in the Fall and one in the Spring to further our understanding of how aspects of the SSI system can facilitate the work of individual researchers and teams.

**Project #17:** ***Developing a Framework for Linking Researcher and Stakeholder Values with Knowledge to Action Effectiveness (RoR)***

**Team Members:** Leader - Mark Anderson (UM Economics). Faculty - Mario Teisl (UM Economics).

**SSI Strategic Plan Goals addressed:** 1.1, 1.5, 2.6, 3.1→3.5, 4.1, 4.2

**Project Focus:** The purpose of this planning grant is to develop a comprehensive framework for understanding value or world view differences and changes both within the SSI study team and between the team and stakeholders. This project is designed to develop a comprehensive approach to understanding the effects of differences in environmental world views on the effectiveness of Sustainable Solutions Initiative (SSI) efforts in enhancing Knowledge to Action. Environmental or ecological values vary significantly across populations and these values may change over time. Extensive research with different metrics, particularly the New Ecological Paradigm (NEP), shows there are valid and reliable measures of such values and of some of their determinants.

**Year 1 Accomplishments and Progress:**

- Completed a comprehensive literature review to find alternative metrics to the NEP for measuring environmental world views and to uncover pre-existing research on the impacts of researcher and stakeholder values.
- Developed an instrument based on the core faculty interviews to measure environmental values and the research enterprise.
- Coordinated with the related SSI project “Modeling Stakeholder Acceptance of Solutions to Environmental Problems". A subset of the instrument developed for this project (an augmented NEP) was used in one of the wind power surveys in that project.
- Completed survey of the full SSI Core Faculty.
- Developed an instrument and overall intellectual framework specific to the SSI to be used for identifying and comparing the world views of the study team and stakeholders.
- Designed a comprehensive research strategy to link world view differences and changes to effectiveness of knowledge to action programs in SSI.

**Plans for Year 2:** Establish ongoing survey of SSI project stakeholders, post docs, and graduate students using the instrument developed to build models of the ways in which environmental world view differences among researchers and stakeholders affect knowledge to action effectiveness. In addition, at the end of the project, survey core faculty again to measure changes in the world views of researchers that may be attributable to engagement in SSI.

**Project #18:** ***Tidal Energy Development: Integrated SES and K↔A research***

**Team Members:** Leaders - Theresa Johnson (UM Marine Sci.), Gayle Zydlewski (UM Marine

Sci.). Faculty - Christopher Bartlett (Sea Grant/Coop. Ext.).

**SSI Strategic Plan Goals addressed:** 1.1→1.5, 2.3→2.6, 3.1→3.5, 4.1→ 4.2

**Project Focus:** The role of ocean-energy development in the context of global climate change and local interests intersects social, economic, environmental, and technological disciplines. This involves assessing how biophysical and human-initiated changes occur, understanding the implications of these interactions, and how decisions can be made in response these challenges. This project focuses on the global, regional, and local social and economic characteristics of tidal-power development, in which Maine is an international leader. The aim is to identify the best course forward for community stakeholders interested in developing this alternative energy source in and beyond Maine. The project's primary goal is to make vital connections between the technical (engineering, biological, and physical resource evaluations) research of tidal power with social science and K↔A research to improve the sustainable development of this promising alternative energy resource.

**Year 1 Accomplishments and Progress:**

- Integrated social science research into the Maine Tidal Power Initiative (MTPI) research team (initially composed of biologists, oceanographers, and engineers).
- Identified and engaged community stakeholders and scientists.
- Partnered with the Cobscook Bay Resource Center (CBRC) and Maine Sea Grant/Cooperative Extension to identify stakeholders in Eastport, ME, relevant to tidal power development.
- Initiated discussions with the University of Maine Wabanaki Center as the Passamaquoddy Tribe has been identified as a potential stakeholder. Additional stakeholders have been identified through a review of documents and media sources.
- Started preliminary social science research on tidal power in Maine.
- Tested an interview protocol to assess attitudes about tidal power in Eastport Maine, including perceptions of potential benefits and impacts.

**Plans for Year 2:** Continue development of stakeholder relationships related to tidal power development at Eastport and other sites in Maine (e.g. Coast Guard, Eastport Port Authority, City of Eastport, Cobscook Bay Fishermen's Association (CBFA), fishermen not CBFA members, Tidewalker Associates, Boat School - Washington County Community College, Marine Technology Center, Sunrise County Economic Council, Passamaquoddy Tribe at Pleasant Point, ORPC employees (new hires in tidal power industry), state and federal regulatory agencies, local/state environmental organizations, local residents, businesses, and teachers, etc., harbor pilots). Further integrate social science/K↔A research into broader MTPI research team based on findings from preliminary research (interviews and stakeholder interactions). Complete a case study manuscript based on scoping interviews and preliminary research.

Collaborating faculty for year 2 will include: Mick Petersen (UM Mech. Eng.), Xuijie Hue (UM Marine Sci.), James McCleave (UM Marine Sci.)

## Primarily Undergraduate Institutions: SSP Collaborating Research Teams

Maine EPSCoR SSI utilized a multi-phase mechanism to successfully bring the state's primarily undergraduate institutions into the overall project. Since the mission for these institutions is teaching, with faculty research primarily taking place during the summer months, a hands-on approach was taken to mentor the incorporation of these institutions. This included

SSP faculty travelling to UMaine to meet with Maine EPSCoR and SSI project personnel and to take part in workshops; videoconference meetings; and the Maine EPSCoR Director travelling to conduct site visits with all of the teams at their institutions. Several challenges were successfully worked through in the development of the SSP projects, such as variations in how research and grants were handled at each institution, and the fact that some institutions had very little experience dealing with research grants.

This enabled six SSP partner institutions to receive YR1 project funding from Maine EPSCoR and includes: Bates College, Bowdoin College, Colby College, College of the Atlantic, Unity College, and University of New England. Two other institutions have received planning grants from Maine EPSCoR to being the process of developing an SSP project and include: University of Maine Presque Isle, University of Maine Farmington. A planning grant to the University of Maine Fort Kent is pending. In addition, Maine EPSCoR has been working with University of Maine Augusta and University of Maine Machias to assist them in developing an SSP project. It is anticipated that all five of these latter institutions will be fully participating in YR2.

**Project #19:** ***Ecological and economic recovery and sustainability of the Kennebec and Androscoggin rivers and their common estuary and nearshore marine environment***

**Team Members:** Leader - John Lichter (Bowdoin Biology). Faculty - Guillermo Herrara (Bowdoin Economics), Eileen Johnson (Bowdoin Environmental Studies), Lynne Lewis (Bates Economics), Beverly Johnson (Bates Geology), Theodore Willis (USM Research Administration), Karen Wilson (USM Environmental Science & Policy). Undergraduate Students - Shannon Shuttle (USM), Zach Ross (Bates), Dava Wool (Bates), Jen Lindelof (Bates), Holly Jacobson (Bowdoin), Henry Berghoff (Bowdoin), Catherine Johnston (Bowdoin), Andy Bell (Bowdoin), Cory Elowe (Bowdoin), Ben Towne (Bowdoin), Paul Hinman (Bowdoin).

**SSI Strategic Plan Goals addressed:** 1.1→1.3, 1.5, 2.1→2.5, 3.1→3.4, 4.1→ 4.2

**Project Focus:** Over the past three centuries in Maine, increasing human population and exploitation led to more or less permanent changes in the ecology of the Kennebec and Androscoggin Rivers. The goal is to identify key ecosystem variables that summarize the ecological status of the river-estuary nearshore complex and provide input variables that bridge economic and ecological models. Anadromous river herring are an appropriate vehicle to bridge the social and ecological contexts surrounding restoration since they integrate freshwater and marine environments and form the forage base for economically important marine predators. The specific objectives are to: 1) assess the current quantity and quality of river herring spawning habitat, nursery habitat, and resident populations in the Kennebec and Androscoggin watersheds; 2) evaluate the economic evolution of communities on the Sebasticook River after the 2008 Fort Halifax dam removal; 3) estimate the potential for river herring production under different scenarios of river restoration and the affects on groundfish populations associated the traditional fishing grounds proximal to the lower Kennebec River estuary; and 4) disseminate results.

**Year 1 Accomplishments and Progress:**

- Planned surveys of aquatic vegetation and important food web components in target watershed estuaries.
- Initiated survey of juvenile river herring and groundfish abundance.
- Initiated paleoecological study at Damariscotta Lake to track past alewive population

dynamics.

- Started selecting other lakes for paleoecological analysis.
- Implemented a river restoration model for a meta-analysis of existing benefit-cost analyses.
- Taught related courses - Community and Ecosystem Ecology, Ecology and Environmental History of Merrymeeting Bay, Perspectives in Environmental Science, Environment and Culture in North American History, Building Healthy Communities, Environmental Geochemistry.
- Conducted five team-stakeholder meetings (16 entities identified).

**Plans for Year 2:** Develop ecological models of catastrophic regime shifts in ecosystems to explicitly include human disturbances observed in the Kennebec-Androscoggin watershed over the past three centuries. Continue work on model to evaluate linkages between human activities and ecosystem responses and integrating socioeconomic and ecological drivers and feedbacks in our system. Reach out to local stakeholders including fishermen, alewife harvesters, sports fishing guides, and others who make their living from the rivers, estuary, and nearshore marine environment. Prepare detailed chemical analyses of sediments and fish tissue. Continue effort to educate students, reach out to underrepresented groups, and identify potential stakeholder/collaborators.

**Project #20:** ***Modeling Resilience and Adaptation in the Belgrade Lakes Watershed***

**Team Members:** Leader - Whitney King (Colby Chemistry). Faculty - Russel Cole (Colby Biology), Philip Nyhus (Colby Environmental Studies), James Fleming, (Colby Science, Technology, and Society), Herbert Wilson (Colby Biology), Catherine Bevier (Colby Biology), Lauren Lessing Mirken (Colby Museum of Art), Peter Kallin (Belgrade Lakes Conservation Alliance), Wendy Harper (UM-Farmington Business Economics), Matthew McCourt (UM-Farmington Social Sciences and Business). Undergraduate Students (Colby) - Ian McCullough, Kim Bittler, Sharonda Bradley, Jasmine Bruno, Anne Chang, Eleanor Hoyt, Corey Martin, Erin Shnettler, Danielle Sheppard, Alexandra Todd, James Westhafer.

**SSI Strategic Plan Goals addressed:** 1.1→1.3, 1.5, 2.1→2.5, 3.1→3.4, 4.1→ 4.2

**Project Focus:** This multi-institution project addresses how landscape and lake ecosystem change in the development of central Maine. The Belgrade Lakes region typifies the complex dynamics between environmental, biogeochemical, and socio-economic systems. This 180 square mile region is comprised of seven major lakes within 13 municipalities and is an important engine for the local economy. The region has evolved from having clear lakes and a few small summer camps with relatively low human-population pressure to eutrophic lakes, year-round residences, and relatively high human-population densities. Water quality is declining and the economic value of the local housing inventory is tied to lake water quality. Resource managers and policy makers have a limited understanding of how demographic and economic changes driving modifications of land-use patterns are affecting the physical and biological systems within this lake system. The Belgrade Lakes region is a complex adaptive system where change is not predictable or linear. Disturbance at smaller spatial scales (e.g., home lots) and temporal scales (e.g, months, seasons, years) are having impacts on larger spatial scales (e.g., the larger Belgrade Lakes watershed and downstream) and temporal scales (e.g., decades, centuries) in unpredictable ways. We are interested in exploring how “resilient” (i.e., “sustainable”) the Belgrade Lakes system is to disturbance and change. Data will be gathered and used to develop models to improve understanding, prediction, and management of past, present and future

changes in this and other lake regions of Maine. Results will raise awareness and communicate these results through detailed classroom curricula and hands-on student activities.

**Year 1 Accomplishments and Progress:**

- Formed a working group to examine local Belgrade history and apply professional standards of social, technological, and environmental history.
- Networked with local stakeholders and experts.
- Surveyed the region and the existing literature and resources.
- Developed framework and protocols for a GIS database and collected data - historical Secchi, oxygen, and temperature data for each of the seven lakes from state databases and assorted gray literature.
- Completed the thermohaline modeling for East and North Ponds.
- Developed site forms and voucher data cards for the damselfly survey. This survey will be a citizen-based project.
- Helped develop concepts and programs for a collaborative lakes education center *Docks to Doorways* that will focus on providing education to watershed residents to protect water quality.

**Plans for Year 2:** Conduct fieldwork including collection of odonates and butterflies and survey of bird distribution and abundance around the margins of the Belgrade Lakes. Digitize the NPS surveys of the remaining lakes in the watershed. Continue to integrate lake and watershed data into GIS-amenable databases and develop a bibliography of watershed datasets. Complete the thermohaline modeling of the remaining five Belgrade lakes. Continue to recruit and train volunteers from the various lake associations for the field measurement and validation tasks. Work with Maine COLA to complete final conference logistics.

**Project #21:** ***Sustaining Quality of Place in the Saco River Estuary through Community Based Ecosystem Management***

**Team Members:** Leaders - Pamela Morgan (UNE Environmental Studies), Christine Feurt (UNE Environmental Studies). Faculty - James Sulikowski (UNE Marine Sciences), Stephen Zeeman (UNE Marine Sciences), Gregory Zogg (UNE History & Politics), Michele Dionne (Wells National Estuarine Research Reserve). Undergraduate students (UNE) - William Almeida, Chelsea Amaio, Jessica Bergeron, Amy Carlson, Marissa Hammond, Samantha Johnson, Lindsay Kelly, Gale Loesher, Justine Madore, Deidra Sargent, Derek Wright.

**SSI Strategic Plan Goals addressed:** 1.1→1.3, 1.5, 2.1→2.5, 3.1→3.4, 4.1→ 4.2

**Project Focus:** This project is studying how increasing coastal development relates to the health of the Saco River Estuary and on ways to manage these effects. Methods apply social sciences to understand management and policy challenges and to examine gaps in scientific knowledge required to address these challenges. This is coupled with biophysical research to develop ecological indicators that reflect the extent and effects of coastal development. This project is a first step towards sustaining the structure and function of the Saco River Estuary. The 1,500 square mile Saco River watershed is the largest watershed in southern Maine. The team includes researchers from Wells Reserve, home to the Coastal Training Program (CTP), which engages coastal communities, resource managers, federal and state environmental agencies and NGOs in collaborative dialogues aimed at sustaining coastal ecosystems through shared effort. Researchers, land use decision-makers and interested citizens use a collaborative learning process to: 1) Identify the important qualities of place related to the Saco River Estuary; 2)

Identify values held by stakeholders related to the Saco River Estuary; 3) Discover current management and policy challenges; 4) Explore the status of current scientific knowledge and research in the estuary; and 5) Locate scientific knowledge gaps required to answer management and policy questions. Mapping of existing land use along the Saco River will assess the Shoreland Zone for conversion of undeveloped land to impervious surface, maintenance of vegetated buffers, and lawn care practices. Another objective is the identification of ecological metrics that bridge the gap between ecosystem health, community values, and land use policies and practices in the Shoreland Zone along the Saco River, such as: 1) Salt marsh fish diversity and health; 2) Salt marsh plant diversity; 3) Nitrogen levels in salt marsh plants (which are a proxy for nitrogen inputs to the marsh); and 4) Other aspects to be determined using stakeholder input. Ultimately, we will develop communication strategies that connect the quality of place attributes with improvements in land use policies and practices with the goal of sustaining estuarine health.

**Year 1 Accomplishments and Progress:**

- Identified stakeholders, their values and concerns as they relate to the Saco River estuary.
- Selected and obtained permission to study the ecology of ten study sites along the river.
- Started bird fish and plant studies, including larval fish sampling.
- Completed two UNE courses, Ecosystem Management and Environmental Communications with 35 students.
- Planned scope of the economic analysis to be conducted.
- Stakeholders have been identified and have participated in three workshops to date.

**Plans for Year 2:** Continue work to identify the important qualities of place related to the Saco River Estuary and identify values held by stakeholders related to the Saco River Estuary. Examine gaps in scientific knowledge required to answer management and policy questions. Continue fieldwork to determine existing land use along the Saco River, specifically in the Shoreland Zone. Complete fieldwork to identify salt marsh ecological metrics: fish diversity and health; plant diversity; nitrogen levels in salt marsh plants. Develop communication strategies that connect the quality of place attributes with improvements in land use policies and practices with the goal of sustaining estuarine health.

**Project #22:** ***Understanding the relationships among biodiversity, forest management, and invasive species disturbance in a forested New England landscape***

**Team Members:** Leader - Amy Arnett (Unity Ecology). Faculty - Erika Latty (Unity Botany), Alysa Remsburg (Unity Biology), Kathleen Dunckel (Unity Computers & Geographic Information Systems). Undergraduate Students (Unity) - Arielle Arsenault, Kelly Barber, Nils Bell, Jasmine Greer, Thomas Lamppa, Ari Leach, Andrea Miller, Cayce Salvino, Alison Zukas.

**SSI Strategic Plan Goals addressed:** 1.1→1.3, 1.5, 2.1→2.5, 3.1→3.4, 4.1→ 4.2

**Project Focus:** Forest resources are a key part of Maine's economy. Examining the relationship between plants, invertebrates, and woody debris loads will lead to an understanding of how manipulations of forest structure common to most management actions influence biodiversity patterns. A mechanistic understanding of the role of woody debris in determining plant and invertebrate biological diversity is key to understanding and managing long-term forest productivity. A changing climate is adding stress and allowing new invasive species to become established in the region. We propose to study biodiversity patterns of herbaceous plants and three primary invertebrate taxonomic groups (ants, ground beetles, and earthworms) associated

with three disturbance treatments (hemlock-removal and standing-dead hemlock associated with the presence of *Adelges tsugae*, and woody-debris reduction associated with current forestry practices). Developing an understanding of the collective response of species to changing environmental conditions can inform conservation practices that seek to maintain functional capabilities of ecosystems. The following ecological questions are central to this work: 1) What are the relationships of plant, ant, ground beetle, and earthworm diversity and community structure to environmental variables, such as soil type, leaf litter, existing woody debris levels and overstory characteristics? 2) How will plant, ant, ground beetle, and earthworm diversity and community structure change when a) hemlock is removed, mimicking the impact of the forestry management strategy for the invasive hemlock woolly adelgid (*Adelges tsugae)*; b) hemlock is killed, but left standing, mimicking the impact of *A. Tsugae* in natural, unmanaged forests; and c) the woody debris levels are reduced, mimicking the trend in current forestry practices of whole tree removal?

**Year 1 Accomplishments and Progress:**

- Developed a summer student research program (nine students).
- Designed survey methods for plant and invertebrate biodiversity studies.
- Compiled a Geographic Information System (GIS) database.
- Identified and started engagement with stakeholders (Bessey Forestry Company, the Waldo/Knox County Forester, a local land trust, and multiple local private land owners).
- Developed a survey to help understand stakeholder needs for management decisions.
- Created research and education activities that complement activities already being done in Maine.

**Plans for Year 2:** Initiate detailed fieldwork with student during the summer. Continue working with stakeholders to identify the important variables affecting their management decisions, particularly in how they respond to invasive species. Develop methods to share the scientific knowledge required to answer management and policy questions. Work with students to publish results of field studies.

**Project #23:** ***Developing our Energy Future: A Community-based Research Project***

**Team Members:** Leaders - J. Gray Cox (COA), Davis Taylor (COA). Faculty - Don Cass (COA), John Anderson (COA), Jay Friedlander (COA), Isabell Mancinelli (COA), Ken Cline (COA), Craig Ten Broeck (COA). Undergraduate Students (COA) - Matthew Dickenson, Marketa Doubnerova, Nick Haris, Matt Maiorana, Lindsey Nielsen, Brittany Slabach, Jake Wartell.

**SSI Strategic Plan Goals addressed:** 1.1→1.3, 1.5, 2.1→2.5, 3.1→3.4, 4.1→ 4.2

**Project Focus:** This project address three themes that relate to landscape change and Maine's energy future with an emphasis on aspects of sustainable energy for coastal/island areas of Maine: 1) An analysis of the Hancock County Woodshed; 2) Demand side management of residential energy consumption; and 3) Determining flight patterns of migratory birds to assist in the siting of offshore wind turbines. The planning effort will produce solutions that reduce fossil fuel energy consumption, assist in development of renewable energy, and mitigate climate change through reduction of the carbon footprint of Hancock County. In addition, COA students will develop collaborative K↔A activities to engage the community in developing sustainable energy solutions. The integrated theme of sustainable energy in a community context maximizes the established interdisciplinary, collaborative relationship among COA faculty, draws on the community engagement expertise of COA's Center for Applied Human Ecology (CAHE),

provides multiple research training opportunities in sustainability studies for COA students, and takes advantage of COA's coastal location and unique offshore research platforms.

**Year 1 Accomplishments and Progress:**

- Recruited research associate to manage fieldwork and data analysis for the avian research project and undergraduates to assist with initial data gathering and summer field work.
- Completed literature review to establish research methodology in all three sub-projects.
- Acquired necessary equipment to conduct remote avian surveys and evaluation of low energy indoor food production; feasibility study is underway.
- Established initial stakeholder contacts in the community.
- Initiated interviews and relationships with representatives of different types fuel producers, consumers, and equipment suppliers: nine separate stakeholders are participating to date.

**Plans for Year 2:** Future research will be conducted in two formats: a) research practica during the three academic semesters will be utilized to train undergraduates in research methodology and to engage them in supervised research; b) full time research will be conducted by undergraduate research assistants during the twelve week summer interval; this work will be supervised directly by PIs and Senior Staff. This work will lead to a broader integrated research proposal.

## b) Diversity and Broadening Participation:

### b.1 Broadening Participation:

While Maine fluctuates between the first or second least diverse state in the nation with minorities consisting of around 3% of the population, Maine EPSCoR has a demonstrated track record of being committed to programs and activities that will expand the participation of women and underrepresented groups in STEM fields. Maine EPSCoR continues to develop strategies for improvement, including a targeted effort to further engage the Native American population, which is the state's largest minority population.

In YR1 of this RII project, of the total number of individuals directly supported, 47% were female and 5% were from underrepresented groups. Of indirectly supported participants, 58% were female and 8% were from underrepresented groups. (see Appendix 4 and Template B. RII Participants)

It needs to be noted that Maine EPSCoR begins a totally new research focus each time it receives an RII award, and therefore the beginning baseline for each new RII project is technically zero, since all participants are new to the new research and education project (and not from the past project). However, the above YR1 diversity percentages compare favorably with those reported for the last year of Maine EPSCoR's Forest Bioproducts Research Initiative RII project (EPS-0554545) which ended September 30, 2009 and had 32% female and 4% diversity for directly supported participants, and 41% female and 4% diversity for indirectly supported participants.

Maine EPSCoR has formed strong partnerships throughout the years in order to continue efforts to increase the participation of women and underrepresented groups. Some of the activities supported during YR1 of this project targeted young women in particular and included:

**1) National Girls Collaborative Project:** As part of a match from Maine EPSCoR, the Maine Girls Collaborative Project (MGCP) at UMaine's Womens Resource Center was able to provide full funding to 6 additional mini-grant applicants. This allowed leveraging of their grant from the NSF National Girls Collaborative Project at the Puget Sound Center for Teaching, Learning and Technology (now the EdLab Group).

- University of Maine at Presque Isle's TRiO Upward Bound program, the Maine School of Science and Mathematics, and Aroostook Coalition for Women in Trades and Technology, "Engineering Your Future." This project was a one-day event for high school students intended to expose them to careers in engineering through engaging in interactive activities with women who are currently students or working professionals in a wide variety of engineering specialties. This program served 140 high school kids, 50% of whom were girls and 9% of whom were from underrepresented groups. Through participant surveys it was determined that this program successfully achieved its goals of participants having confidence that they can be successful as a practicing professional in a STEM career and were able to demonstrate their ability to perform a particular STEM-related skill or activity.
- Coastal Studies for Girls and Cornerstones of Science, "Helping Girls Dream Big in Science and Education." This project targeted girls in grades 6-12 and offered them an evening presentation designed to spotlight science writing as a career choice. Participants explored connections between science, nature, art and future career opportunities. Through this program, 37 middle and high school girls were introduced to science-related educational and career opportunities in Maine and specifically at Coastal Studies for Girls, Cornerstones of Science, and Maine Sea Grant. Opportunities explored related to coastal communities, ecosystem health, fisheries and aquaculture, as well as science writing. As a result of this event, attendee interests and needs were identified to assist in planning future guest lecture topics and speakers.
- St. John Valley Soil & Water Conservation District and University of Maine's Cooperative Extension, "2010 Earth Day: A Thirst for Conservation." Students in grades K-5 from the St. John Valley were invited to the University of Maine at Fort Kent to participate in water conservation activities and to meet local female professionals working in the natural resources field. This project is not yet completed, thus participant information is pending and will be reported in the YR2 annual report.
- Damariscotta Montessori School and Platform Shoes Forum, "Think Tank with STEM Professionals." Girls in grades 6-8 from the Damariscotta Montessori attended a full-day Think Tank event hosted by Zoey's Room. These girls will work together in teams with STEM professionals and Zoey's Room staff over 4 months to creatively brainstorm and develop STEM-related curriculum that appeals to their age group. This project is not yet completed, thus participant information is pending and will be reported in the YR2 annual report.
- Platform Shoes Forum and Maine Centers for Women, Work, and Community, "Enhancing Collaboration: CBOs and ME CTEs." These partners convened a half-day roundtable discussion of girl's organizations in Maine who have an interest in supporting increased participation of girls in STEM careers. The purpose being to develop strategies to share program resources and expertise with Maine Secondary Career and Technical Centers and Regions (CTEs) in an effort to increase CTE enrollment in STEM program areas. This project is not yet completed, thus participant information is pending and will be reported in the YR2 annual report.
- Math and Science Mentoring Alliance and the Portland Mentoring Alliance, "Math Mentoring Project Portland High School." This collaboration connected up to ten $10^{th}$ grade students from Portland High School interested in STEM careers with mentors. This project is not yet completed, thus participant information is pending and will be reported in the YR2 annual report.

**2) Expanding Your Horizons:** Maine EPSCoR provided its fourth year of support for the Expanding Your Horizons STEM conference on campus for 515 middle school girls in grades 6-8. This conference, sponsored by UMaine's Womens Resource Center, links the girls with women role models who are active in STEM and provides hands-on STEM activities, workforce development experiences, and career information. This program has provided young women with positive, hands-on, fun experiences in mathematics and science that provides a foundation for them to increase their interest in these areas. Students who attend the conference report that: 1) they have a better understanding of the relationship between math and science and possible career choices; 2) they believe that they could enter any career of their choice in these areas; 3) they were more aware of non-traditional and less publicized career choices; 4) they were more aware of the benefits of an education and its relevance to their lives, and would consider continuing their education beyond high school.

**3) NSF ADVANCE**: Maine EPSCoR has also partnered with the Provost's office at UMaine to submit a proposal that is pending the finalization of an award for the NSF ADVANCE program, which will focus on advancing women and leadership at the university.

**4) Native American programs**: Another area of special interest is increasing Native American participation in research and education. During YR1, Maine EPSCoR continued its partnership with the Wabanaki Native American Center at UMaine, and was assisted by the university's new Coordinator of Native American Research, Darren Ranco, who is also an SSI faculty member. YR1 activities included a targeted effort to engage the Native American population through research on the emerald ash borer threat (affecting traditional basketmaking), and the Wabanaki Center's Native Scholar Educational Outreach Program (NSEOP) for students. NSEOP activities included:

a) Defining and establishing the baseline population served: as outlined in the proposal, baseline figures across the state are not definitive, so Wabanaki staff began identifying the cohort of Native students that can be served statewide. They also explored the suitability and accessibility of other baseline data sets with partners such as the UMaine System Office and Maine Indian Education.
b) Partial support was provided for a week-long elder-in-residence by Native American Libra Professor Oren Lyons. Multiple activities were held throughout the week for elders to share their knowledge, concern and future visions for Wabanaki tribal communities with students, as a means to encourage students to learn and take action in STEM fields and to have a positive impact on their communities.
c) A Native STEM Student Center/Library at the Wabanaki Center was equipped with initial resources for students and faculty to utilize for Native American STEM academic support. This included computers with DVD's, CD's, software, books, journals, newsletters and textbooks.
d) Wabanaki staff participated in outreach visits and activities involving two high schools that serve Native populations, and the University of Maine at Presque Isle.
e) Native student orientation: Wabanaki Center staff, Native STEM students and other professionals led incoming and returning Native students in one day of orientation activities. Presentations by faculty from STEM departments, advanced undergraduates and graduate students, and other UMaine departments were included. Students had the opportunity to engage with other students and with Native mentors, to build connections that will serve them well throughout their college careers.

The main focus of this program in YR1 centered on continuing to forge relationships with the Wabanaki Center and the tribal communities, and to lay a foundation for future programming. The outcome of this effort was that an agreement was reached on how best to proceed to effectively engage this community, and a decision made to have the UMaine Coordinator of Native American Research, Darren Ranco (and SSI faculty researcher), oversee this effort.

The development of a database on Native students and alumni was another key outcome for YR1, as this finally identified the population that can be served with future programming (this information was previously not available.) During the Elder-in-residence program, Chief Oren Lyons was able to interact with students in a variety of settings about the importance of climate change to the tribal communities, with the outcome that many students expressed how he gave them "the will to become active in helping restore the environment." The Wabanaki Center built on this by linking students with mentors, tools, and resources to assist them, with the result that one student was accepted into an REU program at Bigelow Laboratory and another was placed as a Summer Research Assistant in UMaine's Chemistry Department. With the database information now available for YR2, it is anticipated that it will now be easier to follow these students and provide additional resources and assistance.

The Emerald Ash Borer program has been extremely effective in helping to engage the tribal community, with the initial May workshop resulting in a hands-on workshop scheduled for August. This workshop will teach native students and their families about brown ash identification, conservation, and seed collection/preservation techniques, with a follow-up field trip in October for actual collection.

**5) General:** Our partnership with the Institute for Broadening Participation (IBP) also continued. IBP, which is a nonprofit organization located in the state, is committed to supporting future scientists as they make their way through their education and careers, and in particular, focuses on making an education and career in science more accessible to women, people of color, and first generation college students. They are also associated with the NSF IGERT program and the national Alliances for Graduate Education and the Proffessoriate. IBP assists in our recruitment efforts at all levels, and Maine EPSCoR works with IBP as a partner in the Maine STEM Collaborative. UMaine also continues participation with the Northeastern Alliance for Graduate Education and the Professoriate (NEAGEP); takes advantage of strategies that have been developed under the university's past and current NSF IGERT and REU programs; and is planning for various NSF grant solicitations to encourage the participation of women and underrepresented groups (i.e. NSF LSAMP).

**6) Disability programs**: Maine EPSCoR has recently begun working with UMaine's Center for Community Inclusion and Disability Studies to develop a specific action plan to foster participation by this population, and has begun the planning process to work with the EAST project at the University of Southern Maine to extend their programs into northern portions of the state.

### b.2 Institutional Collaborations:

This RII project was an important step for Maine EPSCoR, in that it represented the first opportunity to begin to really reach out statewide in a research theme that resonated will all institutions of higher education (the University of Maine is the state's only PhD-granting institution in STEM, and its flagship research institution).

In alignment with the SSI Strategic Plan, Maine EPSCoR created a formalized program called the "Sustainability Solutions Partners" (SSP) program to provide a mechanism for

primarily undergraduate institutions and community colleges in the state to participate in the SSI project. Since the mission for these institutions is teaching, with faculty research primarily taking place during the summer months, a hands-on approach was taken to mentor the incorporation of these institutions. This included SSP faculty travelling to UMaine to meet with SSI and Maine EPSCoR project personnel and to take part in workshops; videoconference meetings; and the Maine EPSCoR Director travelling to conduct site visits with all of the teams at their institutions. Several challenges were successfully worked through in the development of the SSP projects, such as variations in how research and grants were handled at each institution, and the fact that some institutions had very little experience dealing with research grants.

This enabled six SSP partner institutions to receive YR1 project funding from Maine EPSCoR and includes: Bates College, Bowdoin College, Colby College, College of the Atlantic, Unity College, and University of New England. Two other institutions have received planning grants from Maine EPSCoR to being the process of developing an SSP project and include: University of Maine Presque Isle, University of Maine Farmington. A planning grant to the University of Maine Fort Kent is pending. In addition, Maine EPSCoR has been working with University of Maine Augusta and University of Maine Machias to assist them in developing an SSP project. It is anticipated that all five of these latter institutions will be fully participating in YR2, and that 1-2 community colleges will be added as planned.

Since the SSI research focus is strongly dependent on collaborations with stakeholders, SSI/SSP researchers also engaged in 79 other collaborations with the following during YR1:

1) ***Institutions of higher education (20):*** University of Maine, University of Maine at Presque Isle, University of Maine at Farmington, University of Southern Maine, University of Maine at Fort Kent, University of Maine at Machias, Bates College, Bowdoin College, Colby College, Unity College, College of the Atlantic, University of New England, University of Missouri, SUNY-Syracuse, University of Georgia, Harvard University, University of Michigan's Center for the Study of Complex Systems, Stanford University's Hopkins Marine Laboratory, Rutgers University, and University of Lueneburg, Germany;

2) ***Industry/business partners (9)***: Four Directions Development Corporation, Woodard & Curran, Caswell Forest Products, E.D. Bessey and Son, Ocean Renewable Power Company, Gorrill Palmer, Wright Pierce, James W. Sewall Company, and Baskahegan;

3) ***State governmental partners (9)***: Department of Environmental Protection, State Planning Office, Department of Inland Fisheries & Wildlife, Department of Conservation, Maine Forest Service, Land Use Regulation Commission, Public Utilities Commission, Department of Health & Human Services, and the Office of Innovation;

4) ***Non-profit and other organizations (41)***: E2Tech, Portland Water District, Coastal Enterprises Inc., Small Woodland Owners Association of Maine, SmartGrowth Maine, Bangor Area Stormwater Group, Casco Bay Estuary Partnership, The Nature Conservancy, Maine Coast Heritage Trust, Maine Volunteer Lake Monitoring Program, Maine Audubon Society, Belgrade Regional Conservation Alliance, Conservation Law Foundation, Well National Estuarine Research Reserve, Maine Indian Basketmakers Alliance, Town of Orono, Town of Lincoln, City of Bangor, Town of Brunswick, Town of Topsham, Town of Freeport, Town of Yarmouth, Town of Cumberland, City of Portland, Natural Resource Conservation Service, Maine Organic Farmers & Gardeners Association, Cumberland County Soil & Water Conservation District, Cobscook Bay Resource Center, Maine Congress of Lake Associations, Natural Resources Council of Maine, Moosehead Regional Futures, LandVest, Association of Consulting Foresters, North Pond Association, East Pond Association, Docks to Doorways, Manomet Center for

Conservation Sciences, New England Governor's Conference, Penobscot Resource Center, UMaine Cooperative Extension, and the Belgrade Lakes Association. (see Template C. Collaborations)

In addition, Maine EPSCoR also collaborated with 30 additional partners in workforce development, education outreach and communication, and human resource development:
(in addition to the SSI and SSP partner institutions):
1) ***Institutions of higher education (4):*** University of Maine, University of Maine at Presque Isle, University of Southern Maine, and Colby College;
2) ***K-12 institutions (3):*** Maine School of Science and Mathematics, District #20 - Fort Fairfield, and Damariscotta Montessori School;
3) ***Industry/business partners (2)***: Unum and Cianbro;
4) ***State governmental partners (2)***: Department of Education and Department of Labor;
5) ***Non-profit and other organizations (19)***: UMaine Cooperative Extension, Maine Mathematics and Science Alliance, Maine Energy Education Program, Gulf of Maine Research Institute, Maine International Center for Digital Learning, Mount Desert Island Biological Laboratory (Maine INBRE), Maine Energy Promotional Council, Maine Space Grant Consortium (NASA EPSCoR), Institute for Broadening Participation, Girl Scouts of Maine, Aroostook Coalition for Women in Trades and Technology, Coastal Studies for Girls, Cornerstones of Science, St. John Valley Soil and Water Conservation District, Platform Shoes Forum, Maine Centers for Women Work and Community, Math and Science Mentoring Alliance, and the Portland Mentoring Alliance.

### c) Workforce Development:

Maine EPSCoR's SSI Strategic Plan outlines a holistic approach to workforce development – education, employment, and economic development are all important components of the process of creating a STEM workforce to ensure Maine's future. Strategies occur at many different levels of the RII project, and encompass: 1) K-12 outreach for students and teachers to develop the "pipeline"; 2) employment opportunities and professional development for faculty, postdocs, graduate and undergraduate students, and professional/technical staff; and 3) entrepreneurial training and support to assist in economic development.

Since Maine ranks last in the nation in earned doctorates in science or engineering (NSF 2006 survey), the overall goal for workforce development is to foster the current and next generations of sustainability science professionals. This will be accomplished by: directly linking K-20 programs to the diverse challenges and opportunities in this emerging field; expanding recruitment, retention, training, and other employment-based opportunities at all levels; and expanding capacity for knowledge dissemination for all levels. Specific workforce development strategies as well as corresponding educational outreach and human resource development strategies will be utilized.

Workforce development activities over the grant period resulted in 157 new positions created and supported in the SSI project, and included: 2 postdoctoral associate positions, 40 graduate student research internships, 81 undergraduate student research internships, and 21 high school student research internships. An additional 106 existing positions were also supported.

***Workforce Development in the SSI Research component:***

Eighty-five graduate students participated in 15 SSI sponsored conferences and seminars held this year including providing assistance with conference facilitation at the Environmental

Communication Symposium. SSI also provided travel support to five graduate students to participate in national conferences. On April 20, SSI sponsored a free grant-writing workshop for 35 people from the university and community, led by SSI faculty member Linda Silka.

Two new graduate courses were offered for spring and summer semesters. The spring course "Sustainability Science Research" focused on three critical water-related issues in Maine: groundwater, lake management and vernal pools. Team-taught by six SSI faculty: Jessica Leahy, Forest Resources; Laura Lindenfeld, Margaret Chase Smith Policy Center/Communication; Aram Calhoun, Wildlife Ecology; Andrew Reeve, Earth Sciences; Linda Silka, Margaret Chase Smith Policy Center; Jeremy Wilson, Forest Resources, the course provided unique opportunities for interdisciplinary student teams to work with key stakeholders to assess the effectiveness of current water policies and practices, and to develop recommendations for improving natural resource management. Seventeen graduate students participated in the course. The summer course "Environmental Communication in International Contexts" was offered by Laura Lindenfeld in conjunction with the Environmental Communication Symposium and provided 10 students with an overview of the growing field of Environmental Communication. Students had a unique opportunity to interact with eight visiting national/international scholars in the field. An undergraduate course in Advertising Campaigns offered in spring semester focused on sustainability issues by creating advertising campaigns to promote local food organizations and businesses. Laura Lindenfeld taught the course for 22 enrolled students. The final student presentations were featured in an article in the Bangor Daily News.

Graduate courses offered for the spring and summer 2010 semesters were open to graduate students at UMaine and USM, as these are the only two institutions in the state who have graduate degrees in science or engineering (the remaining RII institutions are primarily undergraduate). The upcoming fall 2010 course "Readings in Sustainability Science" is specifically targeted to prepare the incoming cohort of SSI PhD students, all of whom are based at UMaine, with the intent of establishing integration strategies for the cohort, who come from a variety of disciplines and are situated in departments across campus. As more graduate courses are developed, we will be strategizing on how to incorporate upper level undergraduate students from the participating undergraduate RII institutions (i.e. videoconferencing). (The May 2010 "Environmental Communication in International Contexts" course was offered to all RII institutions.) In addition, all institutions will be looking at how to integrate SSI-related curriculum content into non-SSI specific courses (i.e. policy, environmental law). Undergraduate curriculum has not been addressed yet in a systematic manner, as the focus has been on the incoming SSI graduate cohort at UMaine, but will be during YR2.

A Culture and Curriculum Committee (CCC) was established in fall 2009 as part of the SSI management structure. Chaired by SSI faculty Aram Calhoun, one of the roles of this committee is to develop long-term SSI curriculum plans for both graduate and undergraduate students. The committee is planning an orientation and two-course sequence for the cohort of SSI students arriving in fall 2010. The goal is to establish integration strategies for the cohort who come from a variety of disciplines and will be situated in departments across campus. The committee is working to provide curricular pathways for students across the different disciplines. This will utilize existing coursework, create new courses, and provide a mentoring structure for these students. Ultimately, the committee's work will provide the framework for submission of an IGERT proposal to NSF in spring 2011.

SSI faculty participated in two retreats in YR1 of the project. The first took place on August 4, 2009 and was attended by 50 SSI faculty members. The main purpose of this one-day retreat

was to provide an open forum for discussion and input on YR1 research project priorities including leadership structure, allocation of resources, recruitment of PhD research assistants, new faculty and postdoctoral needs, and evaluation processes. The retreat had many important outcomes and outputs. Team members were able to learn more about their colleagues, project goals, and individual expectations. The retreat provided structure to construct the first Request for Proposals for SSI. This RFP process lead to the selection of 15 external experts to be reviewers. These reviewers helped to direct research in productive directions. The retreat also resulted in the development of a governance structure and the formation of committees to guide critical areas of SSI operations.

The second retreat took place on May 12-13, 2010. Forty-eight SSI core faculty, 12 graduate students, and 10 professional staff attended this retreat that focused on research progress and integration strategies for YR2. It included presentations by each research team that focused on strategies for fostering future collaborative research and funding opportunities, and challenges the team faced in their research. This was followed by presentations and discussions by the leadership team regarding approaches for SSI integration in YR2 of the project. Presentations were also provided on data management, workforce and economic development, and building stakeholder relationships. An evaluation was conducted of faculty after the retreat. This retreat served as a seminal integrative event at which all SSI core teams had the opportunity to see the project as a whole. New opportunities and complementarities were discovered during this retreat that have now been incorporated into integrative proposals for YR2. The retreat provided a mechanism to strengthen the SSI project teams, as well as reinforcing the overall trajectory towards SSI goals.

Several speakers were invited to campus to present seminars this year. The goal was to provide faculty with different perspectives on various aspects of the SSI project. Examples include Elena Irwin, Dept. of Agriculture, Environment and Development Economics, Ohio State University, who gave a talk titled “Social-ecological systems research: some perspectives on the good, the bad and the ugly”; John Foley, Institute of the Environment, University of Minnesota, who discussed “The other inconvenient truth: A global crisis of land, food and the environment”; and Rutherford Platt, University of Massachusetts Amherst who spoke on “The Humane Metropolis: People and Nature in the 21$^{st}$ Century”.

Many SSPs are using their research projects to enhance undergraduate coursework as well as providing internships for undergraduate students. Upcoming conferences and workshops sponsored by SSI at the University of Maine will create opportunities for these students to interact directly with SSI faculty and graduate students encouraging further participation in SSI research. The 2010 Maine EPSCoR Conference on November 8, 2010 at UMaine will provide the first opportunity for SSP undergraduate and graduate students to present and discuss their research.

***Workforce Development in the Maine EPSCoR component:***

In order to maximize the state’s programs and resources in STEM, Maine EPSCoR is a key member of the Maine STEM Collaborative, which is a statewide partnership of education, research, business, government, and non-profit sectors who have come together to foster the improvement of STEM education in the state. (See Appendix 1 for Steering Committee membership.) Maine EPSCoR Director Vicki Nemeth is a founding member of the group, and serves on the Collaborative’s Executive Committee. She works closely with the group to assure that STEM efforts in the state, including the RII workforce development and educational

outreach efforts, are aligned with the Collaborative's goals, objectives, and strategic plan, and that collaborations are utilized as much as possible to maximize resources and efforts. While this statewide approach to improving STEM education is quite ambitious, the committee's Steering Committee membership consists of the key STEM leaders in the state. This has resulted in an extremely dedicated and cohesive group that is committed to creating real change, and they are convinced that this is a key for Maine to ensure a successful economic future. The Steering Committee meets in person monthly, and Maine EPSCoR has recently invested in videoconferencing capabilities to be placed at the Maine Mathematics and Science Alliance in order to facilitate easier participation.

In addition to providing STEM programming through the RII project, Maine EPSCoR plays a vital role in the state's overall STEM efforts by being able to provide resources in key areas. In May 2010, Maine EPSCoR sponsored a strategic planning retreat for the 16 members of the Collaborative's Steering Committee, which resulted in a framework that will continue to be built on to guide the state's efforts in STEM. During the retreat, the following goals were formulated for the Collaborative:

1) Foster STEM learning approaches that value prior learning across subjects.
2) Promote educator professional and leadership development in STEM.
3) Build, integrate, and coordinate STEM efforts in Maine.
4) Promote STEM careers and their pathways.
5) Demonstrate and advocate the link between investments in STEM and Maine's economic vitality.
6) Promote measurement systems to monitor and evaluate STEM.
7) Catalyze greater financial support for STEM education efforts in Maine.

Maine EPSCoR was also a primary supporter of the Collaborative's second STEM Summit in January 2010 at the Augusta Civic Center, which brought together stakeholders from diverse sectors to discuss the status, strengths, and needs of STEM education in Maine. The 338 registered participants spanned the breadth and depth of Maine's STEM initiative and included: higher education (44); K-12 teachers & administration (128); business/industry (46); government/nonprofits (98); K-12 students (12); and undergraduate students (10). The day-long Summit featured keynote addresses, breakout sessions, and exhibits that actively engaged participants in conversations.

The ability to determine impact and outcomes in this area requires accurate baseline data, and it was discovered during the proposal-writing process that this kind of data does not exist in a meaningful way for Maine. Therefore, Maine EPSCoR, in alliance with the Collaborative, made it a priority in YR1 to determine what data was needed, and then to commission a comprehensive STEM landscape study for the state. This study is being coordinated under the Maine STEM Collaborative by Maine EPSCoR, the Maine Mathematics and Science Alliance, and the Maine Department of Education. The study consists of four components: 1) all K-12 teacher certification and background; 2) student achievement and aspirations in STEM; 3) statewide study of STEM capacity; and 4) correlation with Maine workforce data. All data will be disaggregated as much as possible by geographic region, school districts, and poverty levels. The study will be on-going throughout the summer, with a scheduled completion date of October 2010. Maine EPSCoR will publish the final, comprehensive report, and widely distribute it in hard copy and on the web. The Collaborative and all of its partners will then finalize action plans based on needs that are identified by the study. Maine EPSCoR is poised to support key

actions in YR2, such as grant programs for STEM Schools, and for a STEM Partnership program.

The Maine EPSCoR office also implemented a wide array of programs and activities in YR1 that addressed workforce development through special programs, educational outreach, and human resource development. These included:

**Maine EPSCoR High School Research Internship Program:** This program brings high school students to campus to work with UMaine faculty and graduate students in STEM fields. The students actively work side by side in the labs and in the field, assisting researchers and presenting the results of their collaborations in both reports and public seminar presentations. During the summer of 2010, a total of 21 high school students are participating, including 18 students from Orono High School and 3 students from Bangor High School. Students apply through their schools and are chosen in a selective process. Several elect to continue their internships through the following academic year.

This program provides high school students with the opportunity to directly participate in cutting-edge research with faculty teams at a time when they are thinking about and formulating their post-high school plans. Through interviews with these participants we have determined that many can develop or solidify an interest in studying a STEM field in college through their experience conducting what they consider relevant and beneficial "real-world" research. The program both expands their interests if they were not interested in STEM and focuses them if they already were. Each year many of these students subsequently enroll at UMaine, and several are able to continue their internships as undergraduate students, as faculty have actively taken on a mentor role with them.

**Maine Center for Research in STEM Education (RISE):** The RISE Center received major support from Maine EPSCoR for their fifth biennial conference in June 2010 on "Integrating Science and Mathematics Education Research into Teaching." The conference consisted of keynote addresses, contributed and invited talks, workshops, panels and roundtables, a poster session, and evening programs. Registrants ranged from in-service teachers and faculty to undergraduate and graduate students in STEM or STEM education programs, to STEM professionals and STEM curriculum coordinators. The breakdown of participants is as follows: 1) ARI faculty: 20 male/21 female/1 diverse; 2) Tech Staff: 4 male/1 Female; 3) Nontech Staff: 8 male/14 female; 4) Postdocs: 2 male/1 female; 5) Grad Students: 11 male/13 female; 6) ARI Undergrads: 1 female; 7) K-12 Teachers: 45 male/63 female.

While it is too soon to see the impacts on classroom practice and student learning resulting from this conference, the interactions among teachers, researchers, and STEM faculty there set the stage for moving both research and teaching forward. Toward the end of the conference, the program included an Open Space Session, a time for participants to set the agenda by convening groups to discuss particular ways that they would like to take what they have learned during the conference and use it to improve STEM education. This session led to the formation of nine different discussion groups. One discussion group, proposed by a collaborative (professional learning community) of 9$^{th}$ grade science teachers that was formed after the Maine Center for Research in STEM Education's (RiSE Center) national conference in 2006, discussed assessing students' conceptual understanding of energy. About a dozen participants joined this discussion, including other interested teachers, invited speakers from the conference, and faculty from the University. They shared existing resources, such as the Energy Concept Inventory, and suggested questions that would be particularly useful in probing student understanding related to the common unit that these teachers are using in their classrooms. This

unit focuses on energy transfer in systems, using the Earth's oceans as a model system, and was taught by this group for this first time in 2009-2010, using common assessments. Pre-service teachers from the UMaine Master of Science in Teaching Program (MST) analyzed the assessment data and have worked with collaborative members to make data-guided modifications to the unit. Thus, this discussion is likely to lead to improved assessments, better understanding by teachers of related content and improved pedagogical content knowledge.

Another discussion group shared ideas about addressing the "black holes" of introductory chemistry, areas that are crucially important and difficult for students, but for which there are very few research-supported materials. This discussion identified research questions of importance to secondary teachers and university faculty that could be addressed collaboratively. These conversations are likely to lead to a shared research plan among faculty and teachers, meeting needs of both groups in introductory chemistry. MST students are constructing a website that will have resources suggested by participants in each of these Open Space Session discussion groups and provide ways for those who are interested to stay connected and follow-up on these discussions. This involvement by future teachers impacts their preparation in very positive ways, making them more aware of research supported instructional materials and assessments.

At the Maine STEM Initiative 2010 session that was held at this conference, presenters highlighted ways that teachers and students can become involved in proven programs. Teachers expressed the need for their students to learn first-hand about STEM careers through, for example, workplace visits and job shadowing. These types of programs have been greatly reduced due to budget cuts in the schools, so there was a discussion of other means of gaining support. In a separate session, similar programs being run in Texas and data supporting their success in motivating students to pursue STEM careers were presented by Dr. Cliff Houston. Discussions about how to replicate these programs in Maine ensued, and follow-up among interested participants is being led by Professor Susan McKay, director of the RiSE Center. The conference website will also provide information and links connecting participants to a variety of opportunities for STEM teachers and their students around the state, organized by grade level.

Finally, during this conference, teachers who will be participating in the newly funded Maine Physical Sciences Curriculum Partnership, a National Science Foundation Math Science Partnership involving the RiSE Center and 42 Maine schools, met with faculty over lunch to discuss their ideas about how to best move forward in the fall with the curriculum selection process. They reviewed the criteria for the selection of curricular materials and discussed the logistics of meetings throughout the fall. This lunch-time meeting, held in the context of this conference, provided a great opportunity to bring these groups together for an informational and planning session.

This conference is the fifth biennial conference on the theme of Integrating Science and Mathematics Education Research into Teaching hosted at the University of Maine, and each previous conference has led to documented vertical (among university faculty, students, and teachers) and horizontal (among researchers in different fields or among teachers at difference schools) partnerships. Based upon the discussions that occurred here in June, we anticipate that these partnerships will also be initiated and strengthened through this conference.

Maine EPSCoR also supported the participation of graduate students and postdocs from the RISE Center in a second workshop in June 2010. The national "Transforming Research in Undergraduate STEM Education (TRUSE)" conference allowed different disciplinary-based education research areas to be exposed to each other in very productive ways. The students and

postdocs were able to interact with professionals in the field that they otherwise wouldn't have met, and laid the foundation for future interdisciplinary collaborations.

**National Girls Collaborative Project:** Maine EPSCoR supported six mini-grants for the Maine Girls Collaborative Project (MGCP), which engaged girls of all ages in hands-on STEM activities and career exploration. These included: 1) "Engineering Your Future," UMaine Presque Isle TRiO Upward Bound program, Maine School of Science and Mathematics, and Aroostook Coalition for Women in Trades and Technology; 2) "Helping Girls Dream Big in Science and Education," Coastal Studies for Girls and Cornerstones of Science; 3) "2010 Earth Day: A Thirst for Conservation," St. John Valley Soil & Water Conservation District and UMaine Cooperative Extension; 4) "Think Tank with STEM Professionals,"Damariscotta Montessori School and Platform Shoes Forum; 5) "Enhancing Collaboration: CBOs and ME CTEs," Platform Shoes Forum and Maine Centers for Women, Work, and Community; 6) "Math Mentoring Project Portland High School," Math and Science Mentoring Alliance and the Portland Mentoring Alliance. (See section 2.b Diversity and Broadening Participation above for details.)

**Expanding Your Horizons:** Maine EPSCoR provided its fourth year of support for the Expanding Your Horizons STEM conference on campus for 515 middle school girls in grades 6-8. This conference, sponsored by UMaine's Womens Resource Center, links the girls with women role models who are active in STEM and provides hands-on STEM experiences and career information. (See section 2.b Diversity and Broadening Participation above for details.)

**Native Scholar Educational Outreach Program**: During YR1, Maine EPSCoR continued its partnership with the Wabanaki Native American Center at UMaine, and was assisted by the university's new Coordinator of Native American Research, Darren Ranco, who is also an SSI faculty member. YR1 activities included a targeted effort to engage the Native American population through research on the emerald ash borer threat (affecting traditional basketmaking), and the Wabanaki Center's Native Scholar Educational Outreach Program (NSEOP) for students. NSEOP activities included: 1) baseline data development; 2) Oren Lyon's Libra Professorship elder-in-residence; 3) outreach activities with high schools and UMaine Presque Isle; 4) Wabanaki STEM Resource Center; and 5) Native student STEM orientation. (See section 2.b Diversity and Broadening Participation above for details.)

**Cyberinfrastructure:** additional educational activities are in the following Cyberinfrastructure section.

### d) Cyberinfrastructure:

During the proposal-writing process for this SSI project, Maine EPSCoR created a statewide cyberinfrastructure committee that developed a 5-year CI strategy (See Appendix 12) to address the needs of the state's research and education communities. All members of this committee are integrally involved with this NSF EPSCoR Track 1 RII project, as well as the NSF EPSCoR Track 2 RII and a corresponding NIH IdeA supplement for cyberinfrastructure. (All three projects are administered by the Maine EPSCoR office, which ensures effective coordination and leveraging of efforts.) All Maine EPSCoR CI activities are also integrated as part of the overall Northeast Cyberinfrastructure Consortium efforts for the New England region, and the Northeast Education and Research Network (NEREN), with Maine CI committee members actively engaged in both.

During this past year, the CI committee also assisted a Maine-based Internet Service Provider, Biddeford Internet Corp. d/b/a GWI, in a successful proposal for a $25M BTOP

broadband infrastructure grant. The award of funding for GWI's "Three Ring Binder" project was personally announced by Department of Commerce Secretary Locke at the University of Maine in December 2009. This project will build the new, critically-needed fiber routes throughout Maine that will provide the foundation for Maine EPSCoR's future CI efforts. This careful leveraging of multiple sources of funds to implement an overall statewide plan has proven a very effective strategy for the state, and will significantly improve the ability to collaborate across Maine and the region, and to generate increased access to national resources.

During YR1 of the SSI project, and in alignment with the 5-year Cyberinfrastructure strategy for the state, Maine EPSCoR implemented some basic, but essential, infrastructure activities that addressed the communication, collaboration, visualization, and data needs of the Maine EPSCoR/SSI research and education teams. All planned benchmarks for cyberinfrastructure in YR1 were met or exceeded.

**Communication Cyberinfrastructure:** Given the integrated, multi-disciplinary, and multi-institutional nature of this project, state-of-the art communication tools are an absolute necessity. Therefore, the following new cyberinfrastructure was purchased and installed:

1) Gigabit ethernet switches were installed in twelve buildings on the Orono campus of the University of Maine to facilitate virtual organization collaborations among SSI researchers, and to take advantage of the planned upgrade of high-speed fiber that will become available shortly. A new gigabit ethernet switch and wiring was also installed at UMaine's Corbett Hall, where Maine EPSCoR offices (and servers) are located.
2) A Tandberg 30 port High Definition videoconferencing Multipoint Control Unit (MCU) was purchased and installed, and is being used by SSI researchers for multi-way distance communications with large numbers of participants.
3) A Tandberg videoconference system was purchased and is being installed at the Maine Mathematics and Science Alliance (MMSA) in Augusta, which will provide the ability to videoconference meetings of the Maine STEM Collaborative, and will also allow MMSA to provide teacher professional development in STEM via videoconferencing.
4) A Tandberg videoconference system is also being purchased for the University of Southern Maine Law School, in order to allow SSI researchers there to develop and provide SSI-related courses to students anywhere in the state.
5) Webcams - and training in their use - have been provided to 16 researchers throughout the state in a trial program to evaluate their effectiveness in increasing communication and collaboration. Results are pending a follow-up survey.

**Visualization Cyberinfrastructure**: The SSI CI research team at UMaine (Segee, Zhu, Cousins, Koski, graduate students Withee and Bourgoin) has been working to further the development of visualization tools for improved scientific collaboration and communication. During YR1, they made significant advances and improvements to the proto-type visualization wall at the Foster Center for Student Innovation at UMaine, which now allows for high definition video to be displayed in real time. This is a significant improvement in performance, as frame rates have been increased from 2 seconds per frame to 30 frames per second and is critical for capturing motion. The monitors have been replaced and have gone from 19" monitors to 27" HD TV monitors, and the size of the display has increased from 16 MPixels to 36 MPixels. Complementary work with undergraduates supported by an NSF REU project (Zhu PI, Segee co-PI) has also allowed them to utilize compute power from the video cards to boost performance.

Their research and development focus is on the utilization of tools for collaborating at a distance, which will assist the Sustainability Science teams to communicate as a virtual organization. The prototype visualization wall at the Foster Innovation Center is their "working model," allowing them to evaluate and improve on performance. This wall has been used for data visualization during workshops on climate change, and a collaboration with UMaine's New Media program experimented with using video class projects that were specifically targeted to the visualization wall.

In addition, Maine EPSCoR purchased twenty Apple laptop computers that the CI research team configured for use in dynamic visualization walls for K-12 outreach efforts. This infrastructure leverages the team's NSF ITEST project (Segee PI, Zhu co-PI, Cousins Sr. Pers.) that focuses on modelling and visualization in climate change using the UMaine supercomputer and the Maine Laptop Initiative (MLTI) laptops in middle schools. Real-world data is compared to model outputs, and teachers and students learn to deal with data, geographic information, and collaborative tools. This education technology project was one of only 17 chosen by NSF to highlight at the Senate's Education Technology Showcase in Washington DC this past spring.

The team's visualization wall was also part of a training session at the 2010 MLTI conference at UMaine in May, with over 1000 K-12 students participating with their laptops. The session, entitled "Oh my Goodness, I Blew up the Screen," allowed students to find interesting places in Google Earth and view them on the 5'X3' tiled wall of laptops, and introduced them to visualization concepts.

The SSI CI team is also closely tied with the Maine International Center for Digital Learning, and is part of a statewide group that utilizes the MLTI laptops for STEM education related to research efforts throughout the state. CI team graduate students Jason Withee and Nathan Bourgoin attended the 2009 NSF EPSCoR Annual Conference in Washington D.C. and presented posters on their visualization work. Other dissemination venues have included the American Geophysical Union 2009 meeting, the Hawaii EPSCoR conference on visualization, and numerous talks throughout New England

**Data Planning**: The state's supercomputer resides at UMaine, and during YR1 the UMaine SSI CI research team forged a good working relationship with SSI researchers at the University of Southern Maine (USM) in order to evaluate the data needs for the overall SSI project. The team created a dedicated SSI server (messi.target.maine.edu) as the SSI database and linked it to the 100TB disk storage system at the supercomputer. An authentication system for SSI users has been put into place that transcends campus boundaries, and includes an automatic data backup process. The system has been designed to grow over time without data loss or user disruption, and is ready for use by the new SSI faculty modelers at UMaine and USM that will be starting in the fall. The team is also working on a data management plan, and the draft plan is expected to be ready for the NSF Reverse Site Visit in September.

As mentioned above, there is considerable overlap in Maine between the current Track 1 CI, the Track-2 collaboration, the BTOP grant, and the NIH IdeA supplement for CI, which provides for very effective leveraging of resources.

The Northeast Cyberinfrastructure Consortium (NECC) is a consortium of five states that are collaborating on building regional cyberinfrastructure. The NECC states, Delaware, Maine, New Hampshire, Rhode Island and Vermont, have a collaborative award from NSF EPSCoR (Track 2 RII) for specific fiber, research, and workforce development and diversity programs. The NECC states also have a coordinated set of supplements to INBRE and COBRE grants from NIH to further build cyberinfrastructure in the region. These supplements cover fiber, research,

electronics, and training in cyber-tools and education outreach in the region. The NSF EPSCoR Track 1 RII grants to these states also include cyberinfrastructure improvements that are coordinated with the above.

In Maine, the overall focus for the NECC project is extending the existing fiber optic network to add redundancy and reach additional research and education facilities. The NSF EPSCoR Track 2 RII award funds the leasing of fiber up the coast of Maine between Brunswick and Ellsworth to complete a geographically diverse fiber optic ring, and between Orono and Presque Isle to extend Maine's research and education network (MaineREN) into northern Maine to the Canadian border. The Maine EPSCoR NIH INBRE supplement award funds the leasing of dense wave division multiplexing equipment to light these new fiber routes with multiple 10Gbps wavelengths.

Maine has two separate BTOP awards that are providing middle mile fiber throughout the rural most parts of the state (Three Ring Binder Project) and the creation of 108 Public Computer Centers in public libraries around the state (Maine Public Library Information Commons Project).

The investments in cyberinfrastructure from NSF EPSCoR and NIH, along with the two BTOP awards and an additional $2.75M of funds committed by the University of Maine System (UMS), have allowed Maine to engage in a coordinated and leveraged effort for the state. This includes the expansion of MaineREN beyond the original NECC core network paths by leasing fiber installed as part of the BTOP Three Ring Binder Project to connect 5 additional University of Maine System campuses and outreach centers and 10 additional high schools.

In addition, the BTOP awards are allowing UMS and the University System of New Hampshire to establish a redundant northern interconnection between Maine's MaineREN and New Hampshire's IBEAM research and education networks to provide for more network resiliency throughout the New England Region.

Lastly, the Maine Public Library Information Commons BTOP Project will benefit from all these investments as all 108 public libraries are members of the Maine School and Library Network which uses MaineREN as its backbone.

### e) Outreach and Communication:

Outreach and communication are fully integrated throughout all aspects of this project, as it is a key component of the sustainability theme. Therefore, many activities and programs have already been detailed in the sections above and will not be repeated here. All efforts are in alignment with the Maine EPSCoR SSI Strategic Plan, which has an overall goal in this area to create and maintain an effective outreach and communication network through strategies that encompass all participants, stakeholders, and the general public. Targeted audiences are 1) internal to the project; 2) the scientific community; 3) stakeholders; 4) K-12; 5) general public; and 6) NSF EPSCoR, other jurisdictions, and other federal agencies.

Several websites were developed to provide information to stakeholders and the general public regarding SSI research and education projects. The main SSI research site is located at http://www.umaine.edu/sustainabilitysolutions/ and includes information on SSI and SSP research projects, faculty, students and staff, news and events, resources, and information for prospective students and current faculty. The site is updated weekly. Several research teams have already created project-specific Web sites that provide information and resources to stakeholders. Links are provided to these sites from the main SSI Web site. Sites include: Community Based Conservation: Maine Vernal Pools (http://www.umaine.edu/vernalpools/); Sustaining Maine's

Brown Ash Resource (http://www.umaine.edu/brownash/); and a demonstration Web site that provides the multimedia prototype for the interactive hydrologic analysis and modeling tool for the Sebago Watershed (http://tok.asap.um.maine.edu/sebago/). The Maine EPSCoR website, www.umaine.edu/epscor, has been undergoing major re-development to better reflect the comprehensive nature of this RII project, and the new site will be up shortly. Maine EPSCoR also supports the state's STEM website at www.mainestem.org.

Outreach and communication activities for the academic and research community included: 1) research and education collaborations with 79 academic, industry, government, national laboratory, and NGO partners; 2) SSI-sponsored 28 workshops and seminars for 789 participants; 3) 41 SSI faculty and graduate students presented papers/posters on SSI research at 113 regional/national/international conferences; and 4) 19 related scientific journal publications published by SSI faculty. In addition, SSI and Maine EPSCoR exhibited at a dozen local, regional, and national programs and activities, and gave numerous presentations on the project.

Outreach and communication to the educational and general community included support of multiple strategies to small businesses, K-12 teachers, university and college faculty, pre-service teachers, and students, reaching 3,524 individuals participating in activities and programs.

***Outreach and Communication in SSI Research Component:***

Understanding and strengthening connections between knowledge and action (K⇔A) is a key component of the SSI project. As such, all research teams must identify relevant stakeholders and build collaborative processes with these stakeholders that enhance K⇔A development. Over the past year, SSI/SSP teams at the ten participating institutions have begun to develop partnerships with 79 including academic, government, private sector and NGOs. These include:

1) ***Institutions of higher education (20):*** University of Maine, University of Maine at Presque Isle, University of Maine at Farmington, University of Southern Maine, University of Maine at Fort Kent, University of Maine at Machias, Bates College, Bowdoin College, Colby College, Unity College, College of the Atlantic, University of New England, University of Missouri, SUNY-Syracuse, University of Georgia, Harvard University, University of Michigan's Center for the Study of Complex Systems, Stanford University's Hopkins Marine Laboratory, Rutgers University, and University of Lueneburg, Germany;

2) ***Industry/business partners (9)***: Four Directions Development Corporation, Woodard & Curran, Caswell Forest Products, E.D. Bessey and Son, Ocean Renewable Power Company, Gorrill Palmer, Wright Pierce, James W. Sewall Company, and Baskahegan;

3) ***State governmental partners (9)***: Department of Environmental Protection, State Planning Office, Department of Inland Fisheries & Wildlife, Department of Conservation, Maine Forest Service, Land Use Regulation Commission, Public Utilities Commission, Department of Health & Human Services, and the Office of Innovation;

4) ***Non-profit and other organizations (41)***: E2Tech, Portland Water District, Coastal Enterprises Inc., Small Woodland Owners Association of Maine, SmartGrowth Maine, Bangor Area Stormwater Group, Casco Bay Estuary Partnership, The Nature Conservancy, Maine Coast Heritage Trust, Maine Volunteer Lake Monitoring Program, Maine Audubon Society, Belgrade Regional Conservation Alliance, Conservation Law Foundation, Well National Estuarine Research Reserve, Maine Indian Basketmakers Alliance, Town of Orono, Town of Lincoln, City of Bangor, Town of Brunswick, Town of Topsham, Town of Freeport, Town of Yarmouth, Town of Cumberland, City of Portland, Natural Resource Conservation Service, Maine Organic Farmers & Gardeners Association, Cumberland County Soil & Water Conservation District,

Cobscook Bay Resource Center, Maine Congress of Lake Associations, Natural Resources Council of Maine, Moosehead Regional Futures, LandVest, Association of Consulting Foresters, North Pond Association, East Pond Association, Docks to Doorways, Manomet Center for Conservation Sciences, New England Governor's Conference, Penobscot Resource Center, UMaine Cooperative Extension, and the Belgrade Lakes Association.

Most SSI seminars were open to faculty and students campus-wide as well as external participants. Regular email newssheets are distributed to the Mitchell Center's mailing list of 2,500 constituents. This list includes SSP faculty and SSI stakeholders as well as faculty with sustainability science interests from many other state educational institutions. SSI has sponsored 20 seminars this year with a total 361 participants. Spring seminars included presentations by prospective SSI faculty and postdoctoral fellows. Extended visits by three external faculty, Elena Irwin from Ohio State University, David Kitterage from University of Massachusetts, and Jim Levitt from Harvard University, provided extended opportunities for in-depth discussions and one-on-one conversations with SSI faculty and graduate students. A Sustainability Solutions Initiative kick-off event was also held on September 24, 2009. The keynote speaker was former Maine Governor Angus King who spoke on "Data-driven policy: the role of universities in creating a sustainable Maine". Over 300 people attended the event that was free and open to all.

During YR1, 23 SSI faculty and graduate students presented over 70 papers and posters on SSI research at 47 national conferences. On May 20-21, 2010, SSI hosted an international symposium at UMaine titled, "Environmental Communication Symposium". Almost 100 people, including 31 SSI and SSP faculty and students, attended the symposium. Eight leading scholars in the Environmental Communication field participated in the conference, Donal Carbaugh, University of Massachusetts, Amherst, Anabela Carvalho, University of Minho (Portugal), Steve Depoe, University of Cincinnati, Jennifer Good, Brock University (Canada), Mark Meisner, State University of New York, Nadarajah Sriskandarajah, University of Agricultural Sciences (Sweden), Stacey Sowards, University of Texas, El Paso, and Anne Marie Todd, San Jose State University. The symposium focused on the need to grow research and teaching in communication as sustainability science scholars and stakeholders attempt to link the production of knowledge with action to support healthy economies, ecosystems, and communities. It also explored important links for sustainability science and communication.

Building and maintaining partnerships with stakeholders is a major component of SSI research. As a result, faculty and students have held dozens of formal and informal meetings with potential stakeholders across the state to discuss the SSI project and related interests. In addition, SSI faculty and students have participated in numerous local and state activities to disseminate information about the project. Several displays have been created to support these activities along with printed materials that provide additional take-home information. The SSI team includes faculty from Communication & Journalism and New Media and this has provided the project with access to video, photographic, and web expertise that will prove invaluable to outreach and communication as the project moves forward. Current work includes editing of video clips for use on the web from both the SSI Research Retreat and the Environmental Communication Symposium, and selection of photographs for web and print use from the same venues.

***Outreach and Communication in the Maine EPSCoR Components:***

In addition to the workforce development and educational programs and activities detailed in other sections above, which all involved outreach and communication, Maine EPSCoR has also engaged in the following key activities:

1) Developed and produced a Maine STEM newsletter, a final report on the 2010 Maine STEM Summit (distribution pending), and informational materials, exhibits, and presentations on the Collaborative and STEM education in Maine.
2) Supported presentations on the Collaborative's efforts at the Arkansas EPSCoR outreach workshop in April 2010, and for the New Hampshire EPSCoR meeting in June 2010.
3) Produced Maine EPSCoR newsletter, brochures, presentations, posters, exhibits, etc. that have been utilized in numerous venues.
4) Worked with an independent contractor to develop presentation materials that were used to explain and promote Maine's revised S&T plan; featured stories of innovative companies in Maine that depend on S&T; public presentations were given in November & December 2009 with trade associations, chambers of commerce, etc.; an informational seminar prepared for the Leadership Maine class in January 2010.

Maine EPSCoR has invested in equipment and software to set up a communications office with the full capacity to produce its own film, photography, and graphic-design materials. During YR1, three UMaine New Media students were hired to help with expanded communication activities such as film, digital photography, websites, and print media (newsletters, press releases, brochures, posters, etc.). Videos have been created showcasing Maine EPSCoR, SSI, and Maine STEM Collaborative activities, and are posted on Maine EPSCoR's YouTube site and linked to the Maine EPSCoR website. In addition, the students have been working with an independent film-maker to produce a full-length documentary entitled "Pools of Life," which focuses on Maine's vernal pools and SSI's research in that area. This film will be distributed via DVD, and negotiations are underway to have it be televised. A second independent film-maker has also been working with the SSI K-A research team to create videos of SSI researchers for the SSI website. Maine EPSCoR has also created a Facebook page, and is investigating the use of Twitter.

Maine EPSCoR is also working with Maine Public Broadcasting Network to develop a collaboration that would showcase research and education efforts in the state via television and radio. Potential mechanisms are documentaries, accompanying K-12 curriculum that would make use of the Maine Laptop Initiative, webcasts, podcasts (on ITunes), and radio shows.

In addition, Maine EPSCoR also collaborated with 30 other partners in workforce development, educational outreach and communication, and human resource development (in addition to the SSI and SSP partner institutions). These included:

1) ***Institutions of higher education (4):*** University of Maine, University of Maine at Presque Isle, University of Southern Maine, and Colby College;
2) ***K-12 institutions (3):*** Maine School of Science and Mathematics, District #20 - Fort Fairfield, and Damariscotta Montessori School;
3) ***Industry/business partners (2)***: Unum and Cianbro;
4) ***State governmental partners (2)***: Department of Education and Department of Labor;
5) ***Non-profit and other organizations (41)***: UMaine Cooperative Extension, Maine Mathematics and Science Alliance, Maine Energy Education Program, Gulf of Maine Research Institute, Maine International Center for Digital Learning, Mount Desert Island Biological

Laboratory, Maine Energy Promotional Council, Maine Space Grant Consortium, Institute for Broadening Participation, Girl Scouts of Maine, Aroostook Coalition for Women in Trades and Technology, Coastal Studies for Girls, Cornerstones of Science, St. John Valley Soil and Water Conservation District, Platform Shoes Forum, Maine Centers for Women Work and Community, Math and Science Mentoring Alliance, and the Portland Mentoring Alliance.

Other educational outreach activities have been detailed in other sections but include: 1) National Girls Collaborative Project; 2) Expanding Your Horizons; 3) Native Scholar Educational Outreach Program; 4) Cyberinfrastructure activities; 5) High School Research Internship Program; 6) Maine Center for Research in STEM Education programs; and 7) Maine STEM Collaborative activities.

### f) Evaluation and Assessment:

Per our Strategic Plan, the Management Team has a five-pronged approach to project evaluation and assessment. Formative evaluation processes will improve the project's effectiveness, and summative evaluation processes will assess its impact in relation to its goals. All evaluations will determine: 1) the appropriateness of the investment relative to accomplishments; 2) if the investment strategy yields substantial improvement in research and competitiveness; 3) if linkages between the project's research, education, and innovation efforts are effective; 4) if strategies increase participation. Findings will enhance efficacy, identify obstacles, assist in developing corrective action plans as needed, and help plan improvements. In addition, as the project progresses, UMaine's VP for Research (Project PD/PI) will review standardized Return on Investment (ROI) parameters for research centers to ensure that value added aligns with investment.

The evaluation and assessment approach utilized in YR1 included:

***1) External Evaluation:*** The project's central goal is to create a research center that generates and transfers new knowledge of sustainability science through partnerships with diverse stakeholders, requiring high levels of consistent and meaningful integration. To track progress and help improve program delivery, Maine EPSCoR has contracted with experienced external evaluators to annually assess the project's performance, with a particular focus on the evolution and outcomes of collaborative relationships, student integration in the research process, and external stakeholder interaction. Drs. Eric Welch, U of Illinois Chicago, and Julia Melkers, Georgia Institute of Technology, are faculty in public administration and public policy with substantial experience in the evaluation of publicly-funded science programs, including EPSCoR.

The evaluation design includes formative evaluation to provide feedback to Maine EPSCoR management, and summative evaluation to provide outcome measures and related analysis for NSF EPSCoR and external stakeholders. The design uses a multi-method approach based on extensive quantitative and qualitative data to develop a rigorous, longitudinal appraisal of Maine EPSCoR research and related activities. A co-developed logic model will serve as the feedback tool for Maine EPSCoR management and evaluators. Over five years, the evaluation will use several data collection and analysis methods: a) *qualitative* investigation using interviews, document analysis, and case studies, and b) *quantitative* analysis of attitudinal, network, productivity, and other behavioral data collected in annual surveys. Analytical methods like social network data collection and analysis will track interactions among researchers and stakeholders and resulting outcomes. Survey and interview data will be collected from Maine EPSCoR researchers and staff, EPSCoR-funded students, and external stakeholders. Interviews

of university officials, advisory board members, and others will provide contextual data. The evaluators will interact regularly with Maine EPSCoR staff and researchers and will co-develop data collection instrumentations. This is important for tailoring the evaluation and making it useful to Maine EPSCoR. A detailed work plan has been developed with explicit data collection plans, sources, timelines, and annual report and other deliverables. While Drs. Welch and Melkers will be responsible for the primary evaluation, Maine EPSCoR provides regularly up-dated contact lists and other information.

In September 2009, Drs. Welch and Melkers spent three days at UMaine to begin the evaluation process. They first attended the 2010 Maine EPSCoR State Conference which showcased the various components and participants of this SSI RII project. This provided them with key information and allowed for networking with participants and stakeholders. Over the next two days, Dr. Melkers led the Maine EPSCoR team in their NSF-mandated Strategic Planning session. Dr. Welch also participated, allowing for the co-development of the strategic plan and the final evaluation plan for the project. The resulting five-year evaluation plan focuses on the development of collaborative linkages within the Maine EPSCoR Community and the related outcomes of these linkages. The evaluation addresses perceptions of faculty and students, as well as collaborative activities among faculty, between faculty and students, and between students. It also explores faculty relationships with external partners or users of EPSCoR-related research.

The YR1 external evaluation (see Appendix 10 for the Executive Summary) was primarily focused on the collection of baseline data that will allow the tracking of collaborative interaction and related outcomes over the next four years. As a result, this year's report is heavily formative and focused on developing baseline social network data and productivity data. Further, data collected at this early stage can provide insights to faculty and researcher concerns in the early planning stage of the grant. In the next four years of the evaluation, more attention will be given to productivity and outcomes of Maine EPSCoR SSI research and other activities. It is also important to note that the Maine SSI processes are dynamic and on-going. Thus, for example, outcomes and interactions that have occurred since the YR1 survey of faculty was conducted are not captured in this report. Those outcomes will be captured in the next year's report and data processes.

The YR1 external evaluation addressed a series of questions by means of survey and social network analysis methodologies. Evaluation questions addressed centered on: 1) research production and capacity; 2) preparing new researchers; and 3) stakeholder integration and outreach. The primary data collection was a survey of Maine EPSCoR faculty that included attitudinal and self-reported activities, as well as information necessary and critical to conduct social network analysis of ties within the Maine community. The faculty survey was administered on-line using Sawtooth Software from mid-December 2009 through January 2010. Surveys were administered to 85 faculty & professionals in all: 52 individuals who are affiliated with the University of Maine and 33 individuals affiliated with a total of 7 partner colleges and university campuses throughout Maine. Of the 85 total individuals surveyed, 74 responded (response rate of 87%). The response rate for the UM-SSI portion of the sample was 83%, while that of the other "Sustainability Solutions Partners" (SSP) was 88%.

Based on the survey data, the external evaluators offered these early recommendations to assist Maine EPSCoR in its further development:

*Recommendation #1:* Address issues raised by cultural and institutional barriers to cross-institutional collaboration. Response: Maine EPSCoR recognized early on that there would be

challenges based on long-standing barriers between institutions and has taken a hands-on approach to working through them. Since this survey was done, many pro-active efforts have been successfully implemented to engage academic institutions in an integrated, statewide manner, and YR2 plans will expand this area further.

*Recommendation #2*: Greater interdisciplinary capacity development. Response: to some extent this is also related to the cross-institutional barriers above, but strategies for YR2 have already been put into action to create a stronger integration across disciplines and teams.

*Recommendation #3:* Address issues raised by low interest in using cybertechnology. Response: YR2 strategies include sponsoring small-group training workshops for all SSI/SSP faculty that deal with several modes of communication technologies (videoconferencing, webcams, etc.).

*Recommendation #4*: Establish incentives to encourage outreach to stakeholders, and integration of stakeholders. Response: At the time of the survey, research teams had not really had time to begin their research or to reach out to stakeholders. Since then, SSI has established an SSI-wide KnowledgeAction research team that includes experts in stakeholder engagement processes and university – community partnerships. This team is in the process of developing strategies to identify and track new stakeholders and stakeholder concerns that are not already reflected in the SSI research portfolio. The KA team will also work closely with the University of Maine Cooperative Extension, which already provides major institutional capacity for stakeholder engagement throughout the state.

*Recommendation #5:* Continue to develop the Faculty/Staff, Student, and Stakeholder databases. Response: Maine EPSCoR worked with their consultant in March to expand an existing on-line reporting database that is used at UMaine. This allowed all SSI core faculty, SSP faculty, and graduate students to enter data on-line that will be used for current and on-going evaluation purposes. The SSI management team is also working on expanding a database for stakeholder information.

**2) *AAAS Assessment:*** Plans are underway for the American Association for the Advancement of Science (AAAS) Research Competitiveness Service to provide a scientific peer review in YR2 to ensure high quality program delivery. AAAS will recruit a panel of four experienced S&T professionals with relevant expertise, and the project site review in March 2011 (date TBD yet) will include one-on-one interactions with the management team, key administrators, project personnel, outreach participants, industry/small business, and stakeholders. The panel will examine focal questions on the project objectives to help ensure continued success.

**3) *SSI Advisory Board:*** An SSI Advisory Board will provide on-going project assessment for the research focus, which will be implemented through site visits, videconferences, and phone conferences with the management team, key administrators, project personnel, outreach participants, industry/small business, and stakeholders.

The SSI Advisory Board was formed in the fall of 2009 under the direction of chair Robert Kates, a member of the American Academy of Arts and Sciences and Presidential Professor of Sustainability Science at UMaine. The Board is comprised of 10 members who represent state, regional and national experts in fields of relevance to the SSI research mission, including K-A. The initial charge to the Board was to review SSI research projects and activities and provide feedback and recommendations to the team, and the first on-site meeting at UMaine took place on December 15, 2009. The agenda provided time for meetings with the Maine EPSCoR and SSI leadership team and short presentations by individual research project leaders. A summary report from the meeting is included (see Appendix 11).

The SSI Advisory Board's major recommendations included:

*Recommendation #1:* Articulating how individual projects fit within a Maine-futures framework, how they can be scaled up, and which projects can be conceptually merged. Response: The SSI Management team has issued a request for proposals (June 2010) to focus on integrative strategies. Approximately $400K (not including indirect costs) will be made available during YR2 to support new integrative research and related activities efforts that create synergies across the current portfolio of SSI projects - synergies arising from activities that connect projects, fill gaps, and/or compare and contrast multiple projects. This incentive-based approach to integration reflects our commitment to harness the collective intelligence of the SSI team rather than rely exclusively on a "top-down" or one-size-fits-all approach to integration. It is anticipated that these proposals could include strategies for: a) developing common modeling frameworks (e.g., alternative futures modeling) across multiple case studies; b) building new conceptual models for comparing and contrasting different case studies (e.g., examining how the dynamics of social-ecological systems (SES) and interactions between knowledge and action (K↔A) vary among projects); c) producing an inventory of Maine's sustainability science needs to place SSI's research portfolio in a broader context; d) creating integrative decision or research communication tools; e) coordinating research methods across projects; f) producing a series of SSI working papers that illustrate different facets of our approach, such as the ways in which SES trends differ among the landscape change *arenas* (i.e., urbanization, forest management, and climate/energy futures) being examined in SSI.

*Recommendation #2:* increasing the level of interaction and integration among research teams and with stakeholders. Response: Effective and broad-based stakeholder engagement is critical to SSI's success. Five additional strategies have been implemented to expanding and strengthen stakeholder engagement by: a) creating a research team focused on stakeholder engagement processes across the entire portfolio of current and potential SSI projects; b) working more closely with colleagues from UMaine's Cooperative Extension to leverage their long-standing engagement with a diverse array of stakeholders and communities; 3) hiring an expert in stakeholder collaboration to join SSI; d) recruiting a new postdoctoral fellow to study and strengthen stakeholder engagement; e) training a new cohort of SSI doctoral students in the theory and practice of university-community engagement. It is anticipated that at least five students will conduct research that will contribute directly to expanding and strengthening stakeholder engagement.

*Recommendation #3:* developing an effective data management system. Response: An SSI team focused on developing a coordinated strategy for computing, data management, and data stewardship has been established. In addition to the faculty who were initially involved in this effort, we have recruited additional faculty to guide this critical endeavor. Expertise has been added in cyberinfrastructure, database management systems, ecoinformatics, geographic information and analysis, and remote sensing. This team is currently conducting a team-by-team inventory to assess needs related to data storage and access, archiving, analysis, querying, and visualization.

The need for increased integration was a central focus of a recent SSI Core Faculty research retreat in May 2010 and is regarded as one of the greatest challenges for SSI and related efforts. For example, the ability to develop transferable lessons from place-based case studies focused on the theory and practice of sustainable development will be severely hampered without a coherent integrative strategy.

4) ***NSF EPSCoR Reverse Site Visit and Site Visits****:* In September 2009, NSF EPSCoR Program Directors Denise Barnes and John Hall attended the 2009 Maine EPSCoR State Conference and

participated over the next two days in the SSI Strategic Planning sessions. During this time, they were able to offer key guidance and observations as we began the implementation of this large, comprehensive RII project. In YR2 (September 2010), Maine EPSCoR personnel will travel to NSF to participate in a reverse site visit with an NSF EPSCoR review panel, which will further assist the Management Team in refining objectives and strategies.

5) ***Internal Project Evaluation and Assessment****:* the Maine EPSCoR Management Team (PD/PI Mike Eckardt, Assoc. PD/Co-PI/Maine EPSCoR Director Vicki Nemeth, and Co-PI/SSI Research Project Director David Hart) have engaged in on-going evaluation and assessment to help the project reach goals and objectives by meeting monthly to plan and oversee activities, and review financial and programmatic progress. Maine EPSCoR has developed a detailed model of objectives, metrics, benchmarks, and outcomes to utilize to assess progress. The SSI Management Team will meet at least bi-weekly to address research-related issues, recommend changes and solutions, exchange information, and plan and coordinate activities. CSS Core Team members (including SSP members) will meet monthly. The CSS Project Director and CSS project staff will work together, as will the Maine EPSCoR Director with the CSS office staff. Maine EPSCoR will report progress to the Chair of the state's EPSCoR Committee, with annual reports to the full MIEAB.

## g) Sustainability and Project Outputs:

YR1 outputs are detailed in other sections as well as Appendix 2 – SSI Objectives and Benchmarks, and the NSF EPSCoR Reporting Template E. Outputs. A summary is provided below:

**Positions supported**: A total of 263 individuals throughout the state at 10 institutions were directly supported on this project during YR1. Of those, 157 were newly-created positions that included: 2 postdocs, 40 graduate students, 81 undergraduate students, 21 high school students, and 13 technicians/professional/administrative staff. The other supported positions included: 53 core SSI faculty, 34 SSP collaborative faculty, and 20 technicians/professional/ administrative staff on the core project and at collaborating institutions.

**Participants in supported activities:** an additional 3,524 participants were indirectly supported through various outreach, workforce development, and collaborative activities and included: 353 faculty at academic research institutions, 84 faculty at primarily undergraduate institutions, 270 graduate students, 122 undergraduate students at academic research institutions, 310 undergraduate students at primarily undergraduate institutions, 131 technical/ professional/administrative staff, 257 K-12 teachers/pre-service teachers, 107 high school students, 1,025 middle school students, 150 elementary school students, 94 business/industry representatives, 315 NGO/government representatives, and 306 members of the general public through conferences and workshops.

**Publications:** SSI faculty published 18 related scientific journal articles. Six websites were produced, updated, and maintained.

**Proposals submitted:** 19 grant proposals were submitted by SSI /SSP teams ($6.3M), 9 awards were received ($2.4M), 8 are still pending ($3.7M), and 2 were rejected ($161,223). (A complete list of grants submitted/awarded in YR1 can be found in Appendix 5.)

During YR1, SSI engaged in multiple steps that will begin the process of building long-term sustainability for the project and enhancing research competitiveness. These include:

**Creation of an incentive program for faculty seeking external funding:** Plans are in development to provide up to $100,000 of YR2 project funding to faculty actively seeking grants

from external sources. Rather than limit the use of these funds for specific purposes, assistance can be requested for: administrative support for proposal development, grant-writing workshops, travel grants that directly enhance proposal development, external review of draft proposals, matching funds for new awards.

**Development of Request for Proposals for integration projects:** A YR2 RFP has been developed that focuses on SSI-wide integration, and was issued in June 2010. One of the goals of the RFP is to assist the team in strengthening integrative strategies for its work in sustainability science. This will increase competitiveness for national-level funding in a variety of programs especially those that address transformative and broadly interdisciplinary topics.

**Refinement of the Sustainability Solutions Partners (SSP) program:** Undergraduate educational institutions from across Maine have become active participants in the SSI project through the SSP program. The SSI Management Team will conduct additional site visits during August and September 2010 to gain feedback as how this program can be refined to maximize their participation and integration.

With the SSI research portfolio established, work is underway to develop connections that will increase statewide capacity in sustainability science research. These include an Environmental Communication Symposium (held May 20-21, 2010) which provided focused sessions for SSI and SSP networking; establishment of a K-A statewide network; and support of a graduate assistant dedicated to working with SSP teams to assist with assessment and development of K-A and communication needs.

**Establishment of the Economic Development Committee:** One role of the committee will be to promote partnerships and alliances with small business, industry and NGOs. Meetings have already occurred with companies and professional organizations to map out current capacities and to identify where we need to focus collective effort. New tools under development to visualize and evaluate sustainability problems will become available in YR2 to help leverage this process.

### g.1 Seed Funding and Emerging Areas:

In order to allow the SSI research group to address needs and opportunities that were timely and pressing for the state, funding mechanisms were put into place in YR1 to solicit and accept proposals from research teams (see 2.a. Research Accomplishments and Plans above). These proposals were subjected to external and internal review processes, and formed the foundation of the SSI research portfolio. In addition, the SSI Stewardship Council elected to provide support for two projects related to Maine's emerging sustainable energy sector. Maine's Ocean Energy Task Force made recommendations to Governor Baldacci in December 2009 to facilitate timely and efficient development of Maine's significant offshore wind, tidal, wave, and potentially other renewable ocean energy resources. SSI teams were able to collaborate with other UMaine researchers on offshore wind and tidal energy projects.

Another funding mechanism that is utilized by Maine EPSCoR is that of travel scholarships. These allow faculty and students throughout the state to take advantage of conferences, workshops, or collaboration opportunities that they would normally not have the funding to participate in. In YR1, support was awarded allowing participation in the following: 2009 Maine EPSCoR State Conference, Orono, ME; Science Education Technology Workshop, Washington, D.C.; Teaching for Sustainability Workshop, Portland, ME; 2010 Vermont EPSCoR State Conference, Burlington, VT; Technology Showcase, Washington, D.C.;

Northeast Cyberinfrastructure Consortium, Burlington, VT; Hawaii EPSCoR visualization conference November 2009.

### g.2 Human Resources Development:

Maine EPSCoR SSI's Strategic Plan outlines three goals for addressing human resource infrastructure, and accordingly, much of the focus for YR1 has been on putting the human infrastructure in place for this large Maine EPSCoR RII project. With the exception of some of the new hire searches, all other planned objectives and benchmarks for YR1 human resources development have been met or exceeded (see Appendix 2).

YR1 efforts established 23 research teams at 10 institutions, which consisted of faculty, postdocs, graduate, undergraduate, and high school students, and two parallel offices for project management (Maine EPSCoR and SSI Research). A total of 263 individuals throughout the state were directly supported on this project during YR1, and of those there were 157 newly-created positions. The breakdown for all of the positions supported consisted of: 53 core SSI faculty, 34 SSP collaborative faculty, 2 postdocs, 40 graduate students, 81 undergraduate students, 21 high school students, and 33 technicians/professional/ administrative staff on the core project and at collaborating institutions. (See Appendix 4 and Template B. RII Participants)

***Human Resources Development in the SSI Research component:***

Four new faculty searches were started in the fall of 2009, with Assistant/Associate Professors sought in social-ecological systems modeling, ecological modeling, biosystems engineering and sustainability, and community planning and development. Two of these positions have been filled (SES modeling and ecological modeling) with faculty starting in August and July respectively at UMaine. Of the other two positions, one has been completed and is waiting for official approval (at USM), and will begin in September. The other position has been reopened with advertising taking place in June (UMaine). All four new positions were targeted in the Maine EPSCoR Strategic Plan to being in fall 2010.

Recruitment for four postdoctoral fellows was also begun in the fall of 2009. One postdoctoral fellow has been hired and began work June 1. The search for the other three postdoctoral fellows was reopened and interviews are currently underway, with an excellent crop of candidates. It is anticipated that offers will be made over the next few months and the remaining positions will be filled. Delays in this process resulted for two reasons: 1) one candidate had accepted a position and then changed their mind; and 2) throughout the interview process for both the new faculty and postdocs, it became clearer that individuals with multi-faceted skills were needed for this innovative project.

A Graduate Recruitment Committee was established in summer 2009. Chaired by faculty member Malcolm Hunter, the initial objective for the committee was to establish a recruitment process to accept a cohort of SSI PhD students at UMaine for fall 2010. Advertising for these research assistantships began in fall 2009 with an Open House on February 5, 2010. Sixteen candidates attended the Open House, which included opportunities to meet with the SSI team, interviews with SSI and departmental faculty, lunch with a keynote address by SSI Advisory Board Chair Robert Kates, and a graduate student roundtable. Advisors made student selections after the Open House with input from the Graduate Recruitment Committee. Fifteen students were selected to begin in the fall semester. These students will join the four students who began as SSI PhD students in spring 2010. Of these 15 students, three are supported with departmental

funding, as departments have already recognized the value of the SSI project for the university and state, and elected to commit additional support.

A full-time Administrative Assistant was hired in November 2009 for the SSI research project office. This position provides invaluable support with day-to-day fiscal and administrative matters. The SSI office also hired a part-time expert in organizational management to provide support with long-term planning needs, improving research management systems, developing and refining governance systems, and identifying Best Management Practices in relation to open communication, mutual respect, shared governance and organizational learning.

During YR1, 72 SSI core faculty and graduate students expanded their knowledge base in this research focus are by attending/presenting at 169 regional, national, and international workshops, conferences, and symposiums.

***Human Resources Development in the Maine EPSCoR component:***

Maine EPSCoR supported multiple workforce development and outreach strategies to K-12 teachers, university and college faculty, pre-service teachers, students, researchers, and small businesses, reaching 3,524 individuals. All of these activities assisted in the development of the state's human resource infrastructure in this area. Projects and activities are detailed in section 2.b Diversity and Broadening Participation, 2.c Workforce Development, and 2.e Outreach and Communication. The breakdown of participants includes: 353 faculty at academic research institutions, 84 faculty at primarily undergraduate institutions, 270 graduate students, 122 undergraduate students at academic research institutions, 310 undergraduate students at primarily undergraduate institutions, 131 technical/ professional/administrative staff, 257 K-12 teachers/pre-service teachers, 107 high school students, 1,025 middle school students, 150 elementary school students, 94 business/industry representatives, 315 NGO/government representatives, and 306 members of the general public through conferences and workshops. (See Appendix 4 and Template D. Outreach)

The Maine EPSCoR office has begun the search process to hire two new professional staff: an Outreach and Program Coordinator (PA), and a Communications Coordinator, who will complete the planned team for this project.

### g.3 Leveraging NSF Programs:

Significant progress has already been made during YR1 on leveraging the Maine EPSCoR infrastructure support with other NSF program opportunities. SSI project team members are forming new collaborations to respond to other NSF funding opportunities, and strategies are being put in place by the SSI research management team for YR2 to assist faculty in preparing proposals (i.e. offering release time for proposal development.)

During YR1, the SSI Curriculum and Culture Committee formed a sub-committee that is working to prepare a SSI IGERT proposal for submission to NSF in 2011. Proposals are also under development for the NSF CAREER program. In addition, SSI faculty Linda Silka and Laura Lindenfeld are developing a proposal for an NSF Informal Science Education grant that will train SSI scientists to work with current (adults) and next generation (youth) decision-makers using new forms of media to overcome rural distances. The project will situate information within communication networks tied to people's decision making roles and will design communication strategies that link across a variety of sustainability science projects statewide.

During YR1, Maine EPSCoR also partnered with the following on NSF proposals and projects, in order to leverage resources and programs: 1) UMaine's Provost's office on a proposal that is pending the finalization of an award for the NSF ADVANCE program, which will focus on advancing women and leadership at the university; 2) UMaine Center for Research in STEM Education on an NSF Math Science Partnership proposal for middle school opportunities in physical science, which is also pending finalization of a major award; 3) NSF ITEST and NSF-REU proposals and projects that focus on supercomputer modelling and visualization in climate change using the UMaine supercomputer and the Maine Laptop Initiative laptops that middle school students have; 4) Maine Girls Collaborative Project (MGCP) at UMaine's Womens Resource Center, which is funded by a grant from the NSF National Girls Collaborative Project at the Puget Sound Center for Teaching, Learning and Technology (now the EdLab Group).

## h) Management Structure:

The Maine EPSCoR Office at UMaine has been formally established under a Memorandum of Understanding with the Maine Office of Innovation, and acts as the fiscal agent/proposing organization for the state's NSF EPSCoR programs; coordinates responses to NSF EPSCoR funding solicitations; is responsible for the implementation, administration, and evaluation of funded projects; and is the liaison to the NSF EPSCoR Office.

Maine EPSCoR recognizes that a successful project of this magnitude and scope depends on a strong management team and sufficient staff and expertise to develop, implement, and oversee it. The Maine EPSCoR office and the SSI research office at the Senator George J. Mitchell Center are both based at UMaine and operate under the aegis of the VP for Research (RII PI/PD), which provides a strong, synergistic foundation for success. The addition of a multi-level, parallel organizational structure for this RII project also provides effective programmatic and administrative oversight and successful implementation. (See Appendix 12 Organizational Chart)

**State EPSCoR Governing Committee:** The Maine Innovation Economy Advisory Board (MIEAB) serves as the EPSCoR governing committee for the state (see Appendix 1 for membership), and is under the Maine Office of Innovation, whose Executive Director, Catherine Renault, serves as the state's EPSCoR/IDeA Director. The MIEAB is responsible for oversight and coordination of the state's EPSCoR portfolio to ensure synergy with the Maine Science and Technology Plan. In 2009, the MIEAB developed a revised S&T Action Plan for the state that places an even greater emphasis on the areas that this Maine EPSCoR SSI project addresses. In addition, STEM education and workforce development strategies were added for the first time at the urging of Maine EPSCoR. While the MIEAB's primary role is to oversee the selection process for NSF RII and other federal EPSCoR/IDeA proposals, RII Project Director Mike Eckardt serves on the MIEAB, which meets quarterly, and provides updates on the progress of Maine EPSCoR projects.

**Maine EPSCoR Management Team:** The RII Management Team consists of: 1) Project Director/PI Michael Eckardt (UMaine Vice President for Research), who provides scientific, technical, and administrative leadership; 2) Associate Project Director/Co-PI Vicki Nemeth (UMaine Director of Research Administration & Maine EPSCoR); and 3) Co-PI/SSI Research Project Director David Hart (Director Senator George J. Mitchell Center, UMaine). (Eckardt and Nemeth have served in these EPSCoR capacities for over 7 years.) This team meets at least monthly, but interacts via phone and e-mail several times a week. Main actions have centered

around the development of the SSI organizational structure, policies, and procedures; a recommendation to hire an SSI assistant; strengthening SSP integration; and monitoring the new hire processes.

**SSI Research Management Team:** The SSI Research Project Director, David Hart, is responsible for all aspects of the research enterprise at the SSI core team level and SSP collaborator level. He is supported by the SSI Stewardship Council, committees, and a staff of four in the SSI office at the Senator George J. Mitchell Center at UMaine. Personnel in the SSI office who are committed to the RII project part-time (through voluntary cost-share) include: 1) Operations Coordinator; 2) Strategic Program Manager; and an 3) Outreach and Communication Coordinator. A full-time SSI Administrative Assistant was hired in November 2009 to provide invaluable support with day-to-day fiscal and administrative matters. A Sustainability Research Assistant in Organizational Management has also recently been hired part-time to provide support with long-term planning needs, improving research management systems, developing and refining governance systems, and identifying Best Management Practices in relation to open communication, mutual respect, shared governance and organizational learning.

The SSI Stewardship Council was formed to have oversight and responsibility for management of the SSI research project, and consists of seven members representing SSI faculty and staff, with SSI Research Director David Hart chairing. The council meets weekly and is responsible for: planning, coordination and implementation of research activities; integration of research and education activities; roles and responsibilities of other SSI committees; working with the SSI Advisory Board; establishing effective collaborations; ensuring the effective recruitment and mentoring of faculty, staff, and students; and sustainability and project outputs.

In addition, SSI Committees (faculty) have been established that provide guidance and recommendation in specific areas. These include: 1) Graduate Recruitment Committee; 2) Curriculum and Culture Committee; 3) Economic Development Committee; 4) Communication/Web Site Development Committee; 4) Data Management Committee; and 5) Postdoctoral Recruitment Committee. In addition, four faculty search committees were also established in collaboration with appropriate departments to conduct the new hire searches (included both SSI and non-SSI faculty members).

**Maine EPSCoR Office Team:** Vicki Nemeth, Director of Maine EPSCoR at UMaine, is responsible for all other programmatic and administrative components of the RII project, as well as general oversight. Her staff currently consists of a Financial Administrator, a Program Assistant and Diversity Specialist, a graduate student (Media Assistant), and two undergraduate students (one media, one administrative). The search process has begun to add an Outreach and Program Coordinator (PA), and a Communications Coordinator. All staff work closely with the SSI office personnel (on a daily basis), as well as other administrative departments at UMaine and the other collaborating institutions to ensure compliance and effective management. The Maine EPSCoR office serves as the administrative liaison with all of the SSP institutions, and the Director has visited each SSP campus and conducted a site visit with all of the research teams, and is usually in e-mail or phone contact at least weekly with each. With several of the institutions having limited experience with federal grants, she has also served as a mentor and resource to assist them through the project development and award processes. (The SSI office addresses the research collaborations with the SSPs, and the PD and SSI Research Director will be conducting additional site visits this summer to see firsthand the research going on at each campus.)

**Other Advisory Boards/Committees:** In addition to the MIEAB and the SSI Advisory Board (see above and Appendix 1), two other groups serve in an advisory and implementation capacity for this project. The Maine STEM Collaborative (see Workforce Development above and Appendix 1) is a statewide partnership of education, research, business, government, and non-profit sectors who have come together to foster the improvement of STEM education in the state. Maine EPSCoR Director Vicki Nemeth serves on the STEM Collaborative's Executive Committee, and seeks input from the group to assure that the RII educational and workforce development efforts are aligned with the Collaborative's strategic plans. Also, during the proposal-writing process for this SSI project, Maine EPSCoR created a statewide cyberinfrastructure committee that developed a 5-year CI strategy to address the needs of the state's research and education communities. Members of this committee are integrally involved with this NSF EPSCoR Track 1 RII project, as well as the NSF EPSCoR Track 2 RII and a corresponding NIH IdeA supplement for cyberinfrastructure. (All three projects are administered by the Maine EPSCoR office, which ensures effective coordination and leveraging of efforts.) (See Appendix 1)

## i) Jurisdictional and Other Support:

Resources available to the RII project include:

1) Advisory boards/committees: members of the MIEAB, SSI Advisory Board, the Maine STEM Collaborative, and the state's Cyberinfrastructure Committee are all an invaluable resource for providing expertise and guidance to the SSI project.

2) Maine EPSCoR office, Corbett Hall, UMaine: four offices are dedicated for Maine EPSCoR use in Corbett Hall, and staffing is primarily supported as a voluntary cost share. The communications office supports full media services such as film, photography, graphic-design, etc. A large conference room is also available, and is outfitted with a state-of-the-art videoconferencing system.

3) SSI office at the Mitchell Center, Norman Smith Hall, UMaine: all facilities in the building are available for SSI-related use, including a large seminar/workshop room, three conference rooms, and offices and workspaces for faculty, postdoctoral, and student use. All Mitchell Center staff directly support the SSI, primarily as a voluntary cost contribution to the project. The Mitchell Center's database of over 3,000 external constituents is also available for SSI-related use. A portable video-conferencing system is also available.

4) Faculty offices and labs: SSI faculty and students have access to additional state-of-the-art research facilities and equipment at the University of Maine and SSP institutions, including space for students.

5) Collaborations: access to other expertise as needed throughout the state through collaborations with stakeholders, and research, education, and outreach partners.

6) Cyberinfrastructure: Maine's integrated plan for enhancing broadband connectivity will directly benefit the SSI team.

## j) Unobligated Funds:

As of June 30, 2010, $3,534,715 in NSF funds have been fully expensed or obligated. An additional $465,285 in NSF funds have been committed to specific purposes and activities, and are in various phases of awaiting invoices, purchase orders, payment, or internal financial systems action. According to the definition provided by NSF, this latter figure is our

"unobligated funds" and represents 11.6% of our total YR1 budget. The finalization of all financial activity for YR1 is expected to be completed in the next few months.

## 5) Jurisdiction Specific Terms and Conditions

Specific terms in the RII contract have been met and include:

1) Cost sharing provided at the required amount of $800,000 plus significant voluntary cost sharing (see reporting templates G & H)
2) Participant support is utilized only for activities falling under that category, and funds are tracked separately, with written policies and procedures in place.
3) General Programmatic Terms and Conditions: all terms and conditions have been met, with no key personnel changes or changes in project scope. All reporting requirements have been addressed in the sections above, in the supplementary tables provided, or in Fastlane.

## 6) Experimental/Computational Facilities

A key goal of SSI is to increase the University of Maine's capacity for conducting experimental social science research (e.g. experimental economics, strategic message testing and design, virtual-reality simulation experiments) by creating an experimental communication laboratory. Designs are now proceeding to create the 320sq.ft. experimental lab within the planned New Media building on the University of Maine campus. The lab will include observation, experiment and interview rooms. Architectural plans are currently under development for the structure and building is anticipated to begin in 2011. Maine's existing and planned cyberinfrastructure is also available to the SSI/SSP teams, from dedicated space on UMaine's supercomputer to the planned statewide broadband connectivity enhancements (see Cyberinfrastructure above) that will allow SSI researchers greater access for collaboration.

## 7) Publications

SSI faculty published 18 related scientific journal articles. Five websites were produced, updated, and maintained. (See NSF Fastlane and Appendix 9)

## 8) Honors and Awards

Five SSI faculty received special awards and recognitions in YR1 related to their SSI research:

- Rob Lilieholm (UMaine) received the Peirce and Florence Pitts-Webber Award for Outstanding Teaching in Forest Resources from the University of Maine's College of Natural Sciences, Forestry and Agriculture. Lilieholm was also asked to join a special team on "Innovative Conservation Models" for the New England Governors' Conference. He is serving on the International Scientific Advisory Panel for the 7th International Conference on Ecosystems and Sustainable Development, to be held this summer in Tuscany, Italy.

- Esperanza Stancioff (UMaine) received the AVA Gold Award for the DVD, "Building a Resilient Coast: Maine Confronts Climate Change".

- Jessica Leahy (UMaine) received the Peirce and Florence Pitts-Webber Award for Outstanding Research in Forest Resources from the University of Maine's College of Natural Sciences, Forestry and Agriculture.

- Jack Kartez (USM) was appointed to Editorial Board of the journal “Landscape and Urban Planning (Elsevier)”.
- John Lichter (Bowdoin) received the Charles Bullard Fellowship from Harvard Forest, Harvard University.

## C) HIGHLIGHTS

Three research and education highlights follow.

## D) REPORTING TEMPLATE APPENDIXES

The NSF EPSCoR required reporting templates are attached to the end of this report.

**Maine NSF EPSCoR Research Infrastructure Award EPS 09-04155**
**Maine's Sustainability Science Initiative**

**Research and Education Highlight #1**

**Maine EPSCoR at University of Maine**
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www.umaine.edu/epscor

*Photo: Theresa Secord, Executive Director, Maine Indian Basketmakers Alliance*

## Partnership with Wabanaki and Regulatory Stakeholders Creates Radical Shift in Research Direction

Led by Darren Ranco

Researchers with the Sustainability Solutions Initiative (SSI) at the University of Maine are studying *and* facilitating the ways that Wabanaki (translated, *the people of the dawn)* basketmakers and resource users, tribes, state and federal foresters, and landowners come together to prevent, detect, and respond to the Emerald Ash Borer (EAB), a potentially devastating invasive threat to all three species of ash trees found in Maine.

The research team has engaged in a purposefully deliberative approach in considering who is included in the process of research as well as how the research questions are identified. The team includes the Maine Indian Basketmakers Alliance, an American Indian owned and operated non-profit organization, as an internal partner to the research. Faculty researchers include two members of the Penobscot Indian Nation (John Daigle, Forest Resources, and Darren Ranco, Anthropology), one of the Wabanaki Indian Nations in Maine. The process of working with tribal and regulatory stakeholders has created a radical shift in the research question being pursued. Originally framed as a project to use indigenous knowledge and forestry data to map key locations of brown ash, the stakeholders indentified the EAB as their highest priority issue in focus group meetings in summer 2009.

Maine has a particularly unique opportunity to prevent, detect, and manage for the EAB. While ash trees are not considered a key economic resource in Maine's forest, the cultural, spiritual, and economic impact of the EAB on Wabanaki communities and basketmakers could be devastating. For this reason, the research team has built the collaborative process from this particular resource user group outward. Because of this critical interest in the resource and the hard work of many, collaborations between the tribes, basketmakers, foresters, and researchers is positive and longstanding. Since the EAB was first detected near Detroit in 2002, its spread has been much faster than expected, primarily by human transport of infected firewood. On January 20, 2010, the research team, along with other stakeholders, presented testimony to the Maine State Legislature in favor of LD 1607, *An Act to Regulate the Transportation of Firewood*, which was signed into law on April 1, 2010, making Maine one of the few states to enact preventative legislation to fight the spread of EAB by restricting the transport of firewood into the state.

In an approach that explicitly pairs social science research methods with knowledge-to-action goals, the team has used professionally facilitated meetings to identify common research goals and areas of interest with an ever-expanding group of partners and stakeholders. In the most recent meeting on May 21st, key research collaboration activities were identified in the areas of seed collection, public outreach, and mapping ash resources. These identified activities will provide the focus for future project research.

**Maine NSF EPSCoR Research Infrastructure Award EPS 09-04155**
**Maine's Sustainability Science Initiative**

**Research and Education Highlight #2**

**Maine EPSCoR at University of Maine**
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*Photo: Steve Depoe, University of Cincinnati, leads a panel discussion at the Environmental Communication Symposium*

## Environmental Communication Symposium
## A Model for Integrating Students & Partners

Led by Laura Lindenfeld

Solutions-driven sustainability science requires that researchers develop a deep understanding of diverse communities and stakeholders, their needs, and the platforms they use for communicating. Likewise, this work requires that researchers and stakeholders communicate in effective ways. As sustainability science scholars and stakeholders attempt to link the production of knowledge with action to support healthy economies, ecosystems, and communities, the need for research and teaching in communication grows. The interdisciplinary field of Environmental Communication brings unique and important components to the study of sustainability, and research in this growing field is essential for sustainability scientists to achieve their goals. Given the recognition that communication scholarship is central to sustainability science, the Sustainability Solutions Initiative (SSI) hosted an Environmental Communication Symposium on May 20-21, 2010 that brought together leading scholars from the field of Environmental Communication with researchers, educators, and students from both SSI and across the state of Maine interested in sustainability and environmental studies.

The Symposium provided opportunities for dialog and discussion about the Environmental Communication field. Through a series of roundtables, panels, and scholarly dialogs, over 80 participants obtained a greater understanding of this field and had opportunities to network with faculty and students from SSI and visiting scholars. Scholars included: Donal Carbaugh, University of Massachusetts, Amherst; Anabela Carvalho, University of Minho (Portugal); Steve Depoe, University of Cincinnati; Jennifer Good, Brock University (Canada); Mark Meisner, State University of New York; Nadarajah Sriskandarajah, University of Agricultural Sciences (Sweden); Stacey Sowards, University of Texas, El Paso; and Anne Marie Todd, San Jose State University.

The event served as a starting point for connecting SSI faculty and students with the statewide network of Sustainability Solutions Partners. Representatives from eight institutions of higher education met, many for the first time, to talk about their projects and began a dialog about how to integrate their projects with each other.

The SSI also offered a novel graduate course in conjunction with the Symposium. The course provided an overview of the growing field of Environmental Communication, and course activities were linked to the Symposium. Course participants read key texts in the field with a special focus on the visiting scholars. Online interactions and face-to-face class sessions preceded and followed the Symposium. During the Symposium, students had the opportunity to meet and interact with the visiting scholars and other participants in seminars, roundtables, and discussion sessions. Participants expressed strong enthusiasm for this course that connected them directly to the scholars whose work they had studied.

**Maine NSF EPSCoR Research Infrastructure Award EPS 09-04155**
**Maine's Sustainability Science Initiative**

**Research and Education Highlight #3**

*Photo: Team leader Andrew Reeve installs a stream-level logger on the Crooked River inlet to Sebago Lake*


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## Lake-Level Visualization Tool Supports Shared Vision Planning & Management

Led by Shaleen Jain & Andrew Reeve

Sustainability Solutions Initiative researchers at the University of Maine have been working with colleagues at the University of Southern Maine, Portland Water District, National Weather Service (NWS), and SAPPI to develop interactive hydrological models of the Sebago Lake Watershed. Water resources are a cornerstone of human and ecosystem sustainability and the viability of public water supplies hinges upon successful source protection efforts. This project is inspired by the pressing need for a scientific analysis and visualization tool that can focus and facilitate shared vision planning and deliberation of lake-level management strategies within the ongoing Utility – Water District – Stakeholder conversation.

Sebago Lake is the second largest lake in Maine and source of drinking water for 170,000 people in the Portland area. It has been identified as the most vulnerable source watershed in the northeast region, which underlines the importance of understanding the impacts of development and management decisions on the system. Sebago Lake level is regulated by a dam at the outlet and the water quality impacts of different water level regimes is controversial and as yet unknown. Knowing how this lake system responds to climate is a key need for many in the watershed.

A data-driven computational analysis of global climate teleconnections and development of a visualization tool to predict lake levels have been completed. The climate analysis shows that the winter hydrology is more strongly affected by tropical sea-surface temperatures than by local climate variability. This in turn affects lake turbidity and other water quality parameters. This is important to know as some factors affecting lake management lie well beyond the watershed boundaries. The model can be used to show how monthly precipitation interacts with dam operations to control lake level. Users of this model can vary precipitation (Fig. 1) and control the dam to dynamically control lake level. Work continues on this model to allow the weather forecasters to evaluate the skill and methodology of the short-term hydrologic forecasts to support flood warning and reservoir operations for the outlet dam.


*Fig. 1: Model input for water balance showing daily weather selection, precipitation (blue), and evapotranspiration (red).*

## Maine NSF EPSCoR Research Infrastructure Award EPS 09-04155
## Maine's Sustainability Science Initiative

# APPENDIX 1: Governing and Advisory Boards and Committees

| State EPSCoR Committee: Maine Innovation Economy Advisory Board | |
|---|---|
| **Member Name:** | **Affiliation:** |
| Dr. Pam Baker | Bates College |
| John Burns | Small Enterprise Growth Fund |
| Dr. Habib Dagher | Advanced Engineered Wood Composites Center |
| Chris Davis | Pemaquid Oyster Co., Inc. |
| Dr. Michael Eckardt | University of Maine |
| John Ferland | Ocean Renewable Power Company |
| Dr. Tim Ford | University of New England |
| Karin Gregory | Furman, Gregory, Hahn |
| Dr. Patricia Hand | Mount Desert Island Biological Laboratory |
| Rita Heimes, JD | University of Maine School of Law |
| Dr. Janet Hock | Maine Institute for Human Genetics and Health |
| Dr. Whitney King | Colby College |
| Dr. Robert Lad | University of Maine |
| Peter Merrill | WahlcoMetroflex, Inc. |
| Peter Murray | Quantrix |
| Captain Robert Peacock | R.J. Peacock Canning Co. |
| Dr. Hemant Pendse | University of Maine |
| Dr. Don Perkins | Gulf of Maine Aquarium |
| Jane Sheehan | Foundation for Blood Research |
| Dr. Graham Shimmield | Bigelow Laboratory for Ocean Sciences |
| Dr. Dale Syphers | Bowdoin College |
| Jill Goldthwait | The Jackson Laboratory |
| Miles Theeman | Affiliated Healthcare System |
| Stephen Von Vogt | Maine Marine Composites |
| Dr. John Wise, Sr. | University of Southern Maine |
| Dr. John Wright | University of Southern Maine |
| *Dr. Catherine Renault* | *ex officio member Office of Innovation, DECD* |
| *Dr. Betsy Biemann* | *ex officio member, Maine Technology Institute* |
| **SSI Advisory Board** | |
| **Board Member:** | **Affiliation:** |
| Robert Kates, Chair | Presidential Professor of Sustainability Science, University of Maine |
| Nancy Dickson | Senior Researcher, Kennedy School of Government, Harvard University |
| J. Morgan Grove | USDA Forest Service |
| Susan Hanson | Research Professor, Clark University |
| George Jacobson | Professor Emeritus, University of Maine and Maine State Climatologist |
| Ted Koffman | Executive Director, Maine Audubon |
| Thomas M. Parris | Vice-President for Sustainability, ISciences, LLC |
| Pam Person | Climate Change Task Force, League of Women Voters |
| Tarla Rai Peterson | Professor & Boone and Crockett Chair, Dept. of Wildlife and Fisheries Science, Texas A&M University |
| Ken Young | Executive Director, Kennebec Valley Council of Government |
| **Maine STEM Collaborative** | |
| **Executive Committee:** | **Affiliation:** |
| Jan Mokros | Executive Director, Maine Mathematics and Science Alliance |
| Anita Bernhardt | State Science & Technology Specialist & Regional Representative, Maine |

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| | Department of Education |
| Vicki Nemeth | Director of Research Administration & Maine EPSCoR, University of Maine |
| **Steering Committee Members:** | **Affiliation:** |
| Stefany Arsenault | Maine Energy Education Program |
| Tom Berger | Maine Math & Science Alliance Board & Colby College |
| John Dorrer | Director, Maine Department of Labor, Center for Workforce Research & Information |
| Jack Healy | Executive Director, Maine Pulp & Paper Foundation |
| Marcia Leander | Associate Vice President, Unum |
| Alan Lishness | Chief Innovation Office, Gulf of Maine Research Institute |
| Bette Manchester | Executive Director, Maine International Center for Digital Learning |
| Susan McKay | Professor & Director, UMaine Center for Research in STEM Education |
| Mike McKernan | Director of Education & Conferences, Mt. Desert Island Biological Lab |
| Peter Mickelson | Education Chairman, Maine Energy Promotional Council |
| Steve Pound | Associate Director, Workforce Development, Cianbro Institute |
| Terry Shehata | Executive Director, Maine Space Grant Consortium |
| Susie Valaitis | Associate Director, Institute for Broadening Participation |
| John Wright | Dean, School of Applied Science, Engineering, & Technology, University of Southern Maine |
| **Maine EPSCoR Cyberinfrastructure Committee** | |
| **Member Name:** | **Affiliation:** |
| Michael Eckardt | Vice President for Research, University of Maine |
| Vicki Nemeth | Director of Research Administration & EPSCoR, University of Maine |
| Jeffrey Letourneau | Associate Director, Communications & Network Services, University of Maine System |
| Bruce Segee | Associate Professor, Electrical & Computer Engineering, University of Maine |
| John Gregory | Executive Director, Information Technologies, University of Maine |
| Catherine Renault | Director, Office of Innovation, DECD |

**Maine NSF EPSCoR Research Infrastructure Award EPS 09-04155**
**Maine's Sustainability Science Initiative**

# APPENDIX 2: SSI OBJECTIVES AND BENCHMARKS

| **SSI Research Benchmarks** | | | |
|---|---|---|---|
| **Objectives:** | **Actions:** | **YR1 Benchmarks:** | **Progress:** |
| 1) Increase research capabilities through a multi-disciplinary, multi-institutional collaborative project | a) Create the Center for Sustainability Solutions | Develop organizational structure to coordinate research under EPSCoR project and other externally funded research | Established Stewardship Council and other mgt committees.<br>Regular meetings of research team including two retreats (8/09 & 5/10).<br>Bi-weekly team newsletter (dossier).<br>Fully functioning research Web site.<br>Hired Admin. Assistant and Research Assoc. in Organizational Mgt.<br>Established funding path for Sustainability Solutions Partners. |
| | b) Examine three landscape change research arenas: urbanization, forest ecosystem management, climate change; utilize two cross-focus research themes: social-ecological systems & knowledge to action. | Establish working teams and leadership; refine research agendas; provide core funding; recruit first cohort of doctoral students for Fall, 2010; award 1st round SSP funding; provide planning grants | Stewardship Council issues first RFP outlining year 1 research agenda.<br>Proposals reviewed by external reviewers and review committee.<br>Core funding awarded to 14 research projects and four RoR projects.<br>Four PhD students recruited for spring 2010; 11 PhD students recruited for fall 2010.<br>8 PUI SSPs funded. 1 additional pending receipt of planning grant. Working with 2 other to submit proposals.<br>USM funded as part of SSI core research. |
| | c) Increase program visibility in state and nation | Establish connections with state government, communities, NGOs, concerned citizens and other stakeholders | Connections established with a wide variety of organizations representative collaborations include:<br>Federal: US Army Corp of Engineers, NRCS, USDA Forest Service<br>State gov: Dept. of Environmental Protection, State Planning Office, Dept. of Inland Fisheries & Wildlife, Dept. of Conservation, Maine Forest Service, Land Use Regulation Commission, Public Utilities Commission, Dept. of Health & Human Services<br>NGOs: Small Woodland Owners Association of Maine, Natural Resource Conservation Service, Maine Organic Farmers & Gardeners Assoc, SmartGrowth Maine, Bangor Area Stormwater Group, Cumberland County Soil & Water Conservation District, Casco Bay Estuary Partnership, The Nature Conservancy, Maine Coast Heritage Trust, Cosbscook Bay Resource Center, Maine Volunteer Lake Monitoring Program, Maine Congress of Lake |

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| | | | Associations, Natural Resources Council of Maine, Moosehead Regional Futures, Maine Audubon, LandVest, Assoc of Consulting Foresters, Belgrade Lakes Regional Conservation Alliance, North Pond Assoc, East Pond Assoc, Docks to Doorways, Manomet Center for Conservation Sciences, Conservation Law Foundation, Wells National Estuarine Research Reserve<br>Municipalities: Orono, Lincoln, Bangor, Brunswick, Topsham, Freeport, Yarmouth, Cumberland, Portland<br>Tribal: Maine Indian Basketmakers Alliance, Four Directions Development Corp.<br>Other: E2Tech, Portland Water District, New England Governor's Conference, Coastal Enterprises Inc.<br>Private sector: Ocean Renewable Power Company, Woodard & Curran, Gorrill Palmer, Wright Pierce, James W. Sewall, Caswell Forest Products, E.D. Bessey and Son |
| | d) Create opportunities for research to support sustainable policies | Establish advisory group for input on needs and expectations; establish partners network | SSI Advisory Board established. Inaugural meeting held December 15, 2009. Established economic development committee. Initial meeting with E2Tech. |
| | e) Maximize the efficient and effective use of resources in the state through a holistic and inclusive process that is transparent and synchronous. | Identify, through stakeholder processes, resource management challenges in the state | Project teams are conducting surveys that will establish baselines for state natural resource challenges. See project reports for details. Example: K-A team is planning state-wide survey of municipalities to assist with identifying resource mgt. challenges at the municipal level. |
| 2) Increase Maine's competitiveness & funding in this focus area | a) Grant submissions | 4 submitted | 19 grant submissions |
| | | $400,000 awarded | $6,303,655 requested; $2,420,299 awarded |
| | b) Publications | Submit 3-5 major journal manuscripts & 8 other journal publications | 18 peer-reviewed journal articles published, 4 with primary RII support, 14 with partial RII support |
| | c) Technical presentations | 10-15 technical presentations | 121 technical presentations |
| | d) Funding Opportunities database | 5% increase in listings; provide training to participants | 33% increase in listings (to 3,500) |

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| 3) Create linkages throughout the state, region, nation, and world | a) Support state PUI involvement | 10 institutional collaborations supported | 10 - Bates, Bowdoin, COA, Colby, Unity, UNE, UMPI, UMF, USM, UM (UMFK pending) |
| | b) National & international R&D collaborations | 2 additional collaborations | 9 national & international collaborations |
| | c) Support visiting scientists | Support 1 visiting scientist | 3 visiting scientists supported:<br>Jim Levitt, Harvard Forest, Harvard<br>David Kitterage, Dept. of Natural Resources Conservation, UMass<br>Elena Irwin, Dept. of Agriculture & Development Economics, Ohio State |
| 4) Understand Social-Ecological Dynamics | a) Socio-economic research | Develop research methods and protocols, identify stakeholders | Outlined in 10 SES project reports: Calhoun, Colgan, Jain, Leahy, Lillieholm, Owen, Ranco, Teisl/McCoy, Wilson, Johnson |
| | b) Biophysical research | Develop research methods and protocols, identify stakeholders | Outlined in 8 biophysical project reports: Amirbahman, Calhoun, Jain, Jain/Stancioff, Lillieholm, Owen, Wilson, Johnson |
| | c) Knowledge to Action (K-A) | Develop research methods and protocols, identify stakeholders | Outlined in 9 K-A project reports: Amirbahman, Calhoun, Colgan, Hiebeler, Jain, Leahy, Lindenfeld/Silka, Lillieholm, Ranco |
| | d) Research on the Research (RoR) | Develop research methods; perform baseline assessments (2-3 projects | Outlined in 4 RoR project reports: Gardner, McCoy, Anderson, Porter |
| **Human Resource Infrastructure Benchmarks** | | | |
| **Objectives:** | **Actions:** | **YR1 Benchmarks:** | **Progress:** |
| 1) Directly support project personnel | a) New faculty hired | Begin search process | 2 new hires at UM completed; 1 at USM in final stages; 1 search renewed at UM |
| | b) SSI core faculty supported by RII | 30 faculty supported | 42 SSI faculty directly supported by RII; 11 additional SSI faculty supported indirectly |
| | c) SSP faculty supported by RII | 32 faculty supported | 33 SSP faculty directly supported by RII; 1 additional SSP faculty supported indirectly |
| | d) Postdoctoral associates hired (2-3 year appointments) | 4 new hires completed | 1 existing postdoctoral associate supported; 1 new hire completed; 3 searches underway |
| | e) Provide graduate students research assistantships | 8-10 graduate students supported | 18 SSI graduate students received research assistantships, an additional 22 graduate student employees supported |

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| | f) Provide undergraduate student research assistantships | Begin recruiting undergraduate students (15-20) | 81 SSI and SSP undergraduate students supported |
| | g) Provide high school student research assistantships | Design selection process for summer student researchers | 21 high school students participated in summer 2010 research internships |
| | f) Professional/ technical/ administrative staff hired/supported | 2 new hires completed & 8 others supported | 1 new SSI hire completed (AA).<br>6 professional staff supported<br>4 other classified staff supported<br>10 technical staff supported |
| 2) Provide technical assistance & research support for project participants | a) Sponsor research-related seminars and workshops | 2 seminars/ workshops for 50 participants | 20 seminars |
| | b) Sponsor technical assistance workshops | 2 workshops for 40 participants | 4 – grant writing, SSPs (press conf), Emerald Ash Borer, SSPs (Env Comm Symp) |
| | c) Sponsor annual statewide EPSCoR conference | Fall 2009 for 150 participants | 2009 Maine EPSCoR State Conference for 148 participants partially supported by RII |
| | d) Provide travel support for core project participants to conferences/ workshops | Travel for 25 participants | 16 SSI total - 9 faculty, 5 graduate students, 2 staff |
| | e) Provide travel scholarships for statewide participants | 17 scholarships awarded | 15 travel scholarships awarded |
| 3) Provide support for participant and workforce development activities | a) Develop/implement new graduate & undergraduate courses & curriculum including innovation courses for business & entrepreneurial skills | Form curriculum development team; initial planning for interdisciplinary graduate core courses; undergraduate sustainability science intro courses, innovation | Curriculum & Culture Committee instituted. Development of curriculum for fall 2010 curriculum underway.<br>Spring 2010 - 1 SSI graduate course (directly related), 1 undergraduate course (indirectly related). Summer 2010 – 1 SSI graduate course (directly related) |

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| | b) Develop/implement service learning opportunities | Develop course with service-learning components; develop summer service-learning internships at partner NGOs | Two new graduate courses developed that engaged students with stakeholders and professionals in the field |
| | c) Provide related STEM opportunities for K-6 students | 100 participants | 150 participants, 50% female |
| | d) Provide related STEM opportunities for middle school students | 1,000 participants | 1,025 participants, 75% female, 11% from diverse populations |
| | e) Provide related STEM opportunities for high school students | 150 participants | 107 participants, 49% female, 84% from diverse populations |
| | f) Provide related STEM opportunities for K-12 teachers & pre-service teachers | 50 participants | 257 participants, 56% female |
| | g) Provide learning opportunities for stakeholders/partner organizations | Develop professional exchange program | Established Economic Development Committee to devise strategies |
| | h) Provide professional internships for students | Develop professional internship program | Established Economic Development Committee to devise strategies |
| 4) Provide programs and activities to engage all aspects of the state's human and institutional resources | a) Diversity in new hires (% of total) | Women: 33%<br>Diverse: 5% | Women: 55%<br>Diverse: 4% |
| | b) Diversity in existing personnel | Women: 33%<br>Diverse: 5% | Women: 39%<br>Diverse: 8% |
| | c) Diversity in other participants | Women: 33%<br>Diverse: 5% | Women: 58%<br>Diverse: 9% |

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| | d) Native Scholars Program | 40 participants | 146 participants<br>Women: 50%<br>Diverse: 97% |
| | e) STEM Disability Program | 5 participants | Program implementation in planning stages with UM Center for Community Inclusion and Disability Studies, and Project EAST at USM |
| **Cyberinfrastructure Benchmarks** | | | |
| **Objectives:** | **Actions:** | **YR1 Benchmarks:** | **Progress:** |
| 1) Statewide videoconferencing capabilities | Install Media Control Unit (MCU) & videoconferencing equipment at SSI partner locations | 30 port multipoint MCU installed at UM | Tandberg 30 port High Definition videoconferencing Multipoint Control Unit purchased and installed, and is being used by SSI researchers for multi-way distance communications with large numbers of participants; webcams and training in their use have been provided to 16 researchers throughout the state; 1 Tandberg videoconferencing system has been purchased for the Maine Math & Science Alliance in August and another is being purchased for the USM Maine Law School in Portland |
| 2) Operating bandwidth available | Install bandwidth switchgears/modules in SSI researcher buildings | 12 switchgears/modules installed | 13 gigabit ethernet switches were installed at UM |
| 3) New communication and visualization tools | Deploy prototype visualization & communication portals | Undertake planning | Advances and improvements made to existing prototype visualization wall at UM's Foster Center for Student Innovation (19" monitors replaced with 27" HD TV monitors, increasing size of the display from 16MPixels to 36 MPixels) |
| 4) Large audience participation capabilities | Install video streaming equipment | Undertake planning | Pending YR2 decisions on location |
| **Outreach and Communication Benchmarks** | | | |
| **Objectives:** | **Actions:** | **YR1 Benchmarks:** | **Progress:** |
| 1) Implement multiple tools, processes, and pathways for general public communication & outreach | a) SSI: website, brochures, annual conference, MPBN partnership activities, MMSN | Hire web manager, science writer. Develop communications strategy. Plan 1st conference | SSI research website established and maintained. Developed links with New Media dept. for video and photography needs. Discussions underway with freelance writer to provide media strategies. Communication strategies to be completed summer/fall 2010. Related conferences held include Environmental Communication Symposium (5/10), Maine Water Conference (3/10). First state-wide conference to be held in conjunction with ME EPSCoR Conference in Sept. |
| | b) Maine EPSCoR office: website, newsletter, annual state conference, videos, podcasts, social networking sites | Hire Outreach & Comm. Staff; develop website; fall conference; 2 videos, 3 podcasts; 1 soc. network site | new Maine EPSCoR website near completion, 5 videos, 3 social networking sites (Facebook, YouTube, Twitter); newsletter pending distribution<br>Communication personnel search begun<br>Annual state conference planning underway for September 2010 |

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| | c) Integration with cyberinfrastructure | Establish connections with state government, communities, NGO's, concerned citizens and other stakeholders | Collaborated with Biddeford Internet Corp. and the Maine International Center for Digital Learning, and have presented to the Senate's Education Technology Showcase in Washington, D.C., the 2009 NSF EPSCoR Annual Conference in Washington, D.C., and numerous others through New England and the country. |
| 2) develop an internal communication network to allow for the effective sharing of information between participants | a) SSI regular meetings, workshops, training sessions, etc. | Monthly SSI core research team meetings;<br>1 summer SSP workshop;<br>4 seminars | SSI team meetings: twice/month fall 09; once/month spring 10.<br>SSI Retreats: 1-day retreat 8/09; 1.5-day research retreat 5/10<br>SSP/SSI Networking: Workshop included as part of the Env. Comm. Symposium (5/20/10).<br>Seminars: 20 seminars throughout the year |
| | b) Management & organization | Monthly EPSCoR team mgt. meeting; bi-weekly SSI mgt. team meetings | SSI Mgt: Six member Stewardship Council meets weekly. |
| 3) External dissemination of research information | a) To the scientific community | 2 major publications, 5 technical presentations | 18 peer-reviewed journal articles published<br>121 technical presentations |
| | b) To SSI stakeholders | Stakeholder collaboration on all research. Projects, progress, results summarized on website. Seminars and workshops for stakeholder participation. Annual conference. | Stakeholder engagement is required on all projects (See project reports for progress). Project abstracts on website. Report summaries are in progress & will be uploaded when complete. On-going discussions with SSPs to establish/ link to each project web site. Most seminars and workshops are open to external participants and are widely advertised to stakeholder groups. |
| 4) General Communication & Outreach | a) K-12 STEM partners | Maine STEM Collaborative activities; Maine STEM Summit | Maine STEM Collaborative strategic planning retreat; four statewide STEM landscape studies underway;<br>Maine STEM Summit held in Augusta in January 2010, attended by 338 participants |
| | b) State colleges & universities | SSP program; workshops, conferences, presentations | SSP participation in 2009 ME EPSCoR Conference, and 2010 Environmental Communication Symposium. SSI seminars and workshops are open to SSPs and are widely advertised to SSP faculty. Site visits to SSP institutions by Maine EPSCoR Director. |

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| | c) NSF EPSCoR community | Newsletters, press releases, highlights, site visits, reports, evaluations, outreach visits | NSF EPSCoR Program Officers Denise Barnes and John Hall attended September 2009 state conference and strategic planning session; pending distribution of newsletter and evaluation reports |
| | d) General public, legislators, key sectors, etc. | Projects progress, results summarized on website. Press releases for all major activities/ successes. Bi-annual newsletter. | Project abstracts are available on the SSI website. Report summaries are in progress & will be uploaded when complete. On-going discussions with SSPs to establish/ link to each project web site. Regular e-mailings to SSI community including stakeholders and SSPs. |
| **Management & Evaluation Benchmarks** | | | |
| **Objectives:** | **Actions:** | **YR1 Benchmarks:** | **Progress:** |
| 1) Implement evaluation and assessment activities | a) External evaluation by independent reviewers | Sept 2009 initial planning & evaluation development | Five-year evaluation plan developed<br>YR1 baseline evaluation completed January 2009; draft report received 4/10. Response plan for year 2 under development. |
| | b) AAAS assessment | N/A | Planning for YR2 site visit |
| | c) SSI Advisory Board | Establish board with 10 members - December 2009 first site visit | Summer 09 - Kates agrees to Chair Advisory Board. Fall 09 - 10 member Board established. First on-site meeting 12/15/2009. Summary report received 12/09. Update to Board provided by Kates 5/20/10. Board conference call to be scheduled June/July 10. |
| | d) NSF EPSCoR Reverse Site visit | N/A | Planning underway for scheduled Sept. 13, 2010 |
| | e) NSF EPSCoR staff site visit | September 2009 | NSF EPSCoR Program Officers Denise Barnes and John Hall attended the 2009 Maine EPSCoR State Conference and strategic planning session in September 2009 |
| | f) MIEAB reporting | Quarterly | RII PD reports at MIEAB quarterly meetings |
| | g) NSF EPSCoR reporting | Annual report filed on time April 2010 | First year report filed June 2010 (due to data collection challenges with 10 new institutions) |
| 2) Effective management & communication | a) Maine EPSCoR Management Team | Monthly meetings | Monthly meetings of project Co-PIs with frequent e-mail and phone conversations inbetween |
| | b) SSI Core Management Team | Weekly meetings | Stewardship Council formed as management team |
| | c) SSI Stewardship Council | Bi-Weekly Meetings | Weekly meetings of Stewardship Council beginning August 2009. |
| | c) SSI Team | Monthly meetings | Fall 2009 – twice per month.<br>Spring 2010 – once per month |

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| | d) Fiscal responsibility | NSF unexpended funds <10% | All funds expended, encumbered, or obligated by June 2010 |
| | | Corresponding % of matching funds expended | All matching funds expended, encumbered, or obligated by June 2010 |
| **SSI Project Sustainability Benchmarks** | | | |
| **Objectives:** | **Actions:** | **YR1 Benchmarks:** | **Progress:** |
| 1) Provide physical infrastructure to support R&D agenda | a) Provide capital equipment & renovation support | Planning for new social science research lab | $100K committed to 320 sq.ft. of space to be incorporated within the new New Media building. Architectural planning is underway. |
| | b) Provide support for materials & supplies | Social science research lab, research team, SSPs | $34,000 committed to SSI research teams for field, lab and other supplies. |
| 2) Show a positive economic contribution to the state by providing a solid platform for knowledge to action | a) Support small business & industry initiatives | Initiate planning process for new partnerships | Economic development committee established. On-going discussions with Jake Ward, Assistant VP for Economic Dev.<br>Meetings with business groups including American Council of Engineering Companies of Maine, Associated General Contractors of Maine, Coastal Enterprises Inc., E2Tech, Maine Office of Innovation.<br>Meetings with potential private sector partners including Gorrill Palmer, James W. Sewall, Woodard & Curran, Wright Pierce, Ocean Renewable Power Company |
| | Intellectual property, patent & licensing activity | Begin to identify intellectual property, patentable research | Economic development committee established. Meeting with Kris Burton, Technology Transfer Manager, Dept. of Industrial Coop. |

**Maine NSF EPSCoR Research Infrastructure Award EPS 09-04155**
**Maine's Sustainability Science Initiative**

# APPENDIX 3: Project Personnel

| Project Personnel | | | | |
|---|---|---|---|---|
| **Type** | **Last Name** | **First Name** | **Department** | **Demo*** |
| **University of Maine** | | | | |
| Faculty | Amirbahman | Aria | Civil & Environmental Engineering | |
| Faculty | Anderson | Mark | School of Engineering | |
| Faculty | Bell | Kathleen | School of Economics | F |
| Faculty | Calhoun | Aram | Wildlife Ecology | F |
| Faculty | Cole | Barbara | Chemistry | F |
| Faculty | Cronan | Christopher | School of Biology & Ecology | |
| Faculty | Daigle | John | School of Forest Resources | O |
| Faculty | Drummond | Francis | School of Biology & Ecology | |
| Faculty | Fernandez | Ivan | Plant, Soil, & Environmental Science | H |
| Faculty | Gallandt | Eric | Plant, Soil, & Environmental Science | |
| Faculty | Gardner | Susan | Education | F |
| Faculty | Hakola | Judith | English | F |
| Faculty | Halteman | William | Mathematics & Statistics | |
| Faculty | Hart | David | Senator George J. Mitchell Center | |
| Faculty | Hiebeler | David | Mathematics & Statistics | |
| Faculty | Hornsby | Stephen | Canadian-American Center | |
| Faculty | Hunter | Malcolm | Wildlife Ecology | |
| Faculty | Jain | Shaleen | Civil & Environmental Engineering | D |
| Faculty | Johnson | Teresa | School of Marine Sciences | F |
| Faculty | Judd | Richard | History | |
| Faculty | Kuykendall | William | New Media | |
| Faculty | Leahy | Jessica | School of Forest Resources | F |
| Faculty | Lilieholm | Robert | School of Forest Resources | |
| Faculty | Lindenfeld | Laura | Comm & Journ/M.C. Smith Policy Ctr | F |
| Faculty | Loftin | Cynthia | Wildlife Ecology | F |
| Faculty | Maasch | Kirk | Earth Sciences | |
| Faculty | MacRae | Jean | Civil & Environmental Engineering | F |
| Faculty | McCoy | Shannon | Psychology | F |
| Faculty | Noblet | Caroline | School of Economics | F |
| Faculty | Norton | Steve | Earth Sciences | |
| Faculty | Peckenham | John | Senator George J. Mitchell Center | |
| Faculty | Porter | Terry | School of Business | F |
| Faculty | Ranco | Darren | Anthropology/Mitchell Center | O |
| Faculty | Reeve | Andrew | Earth Sciences | |
| Faculty | Sader | Steve | School of Forest Resources | |
| Faculty | Saros | Jasmine | School of Biology & Ecology | F |
| Faculty | Scott | Michael | New Media | B |
| Faculty | Segee | Bruce | Electrical & Computer Engineering | |
| Faculty | Silka | Linda | Margaret Chase Smith Policy Center | F |
| Faculty | Simon | Kevin | School of Biology & Ecology | |
| Faculty | Stancioff | Esperanza | Cooperative Extension | F O |
| Faculty | Teisl | Mario | School of Economics | |
| Faculty | Vaux | Peter | Senator George J. Mitchell Center | |
| Faculty | Weiskittel | Aaron | School of Forest Resources | |
| Faculty | Wilson | Jeremy | School of Forest Resources | |

| Project Personnel | | | | |
|---|---|---|---|---|
| **Type** | **Last Name** | **First Name** | **Department** | **Demo*** |
| Faculty | Wilson | James | School of Marine Sciences | |
| Faculty | Zhu | Yifeng | Electrical & Computer Engineering | |
| Faculty | Zydlewski | Gayle | School of Marine Sciences | F |
| Grad Student | Albee | Emily | Education | F |
| Grad Student | Andrle | Katie | Wildlife Ecology | F |
| Grad Student | Bacon | Linda | School of Biology & Ecology | F |
| Grad Student | Bourgoin | Nathan | Electrical & Computer Engineering | |
| Grad Student | Brown | Vance | Commun & Journ/Forest Resources | |
| Grad Student | Budzinski | Colleen | Communication & Journalism | F |
| Grad Student | Call | Erynn | Wildlife Ecology | |
| Grad Student | Cline | Brittany | SSI/ Wildlife Ecology | F |
| Grad Student | Cosley | Brandon | School of Business/Psychology | |
| Grad Student | Fisher | Meaghann | Modern Languages & Classics | F |
| Grad Student | Girouard | Maria | Wabanaki Center | F |
| Grad Student | Gorczyca | Erika | School of Forest Resources | F |
| Grad Student | Gray | Alex | Civil & Environmental Engineering | |
| Grad Student | Hassett | Katherine | Resource Economics & Policy | F |
| Grad Student | Hayden | Anne | School of Marine Sciences | F |
| Grad Student | Hill | Jack | Mathematics & Statistics | |
| Grad Student | Hutchens | Stan | SSI/Wildlife Ecology | |
| Grad Student | Hutchins | Karen | SSI/Communication & Journalism | F |
| Grad Student | Jansujwicz | Jessica | SSI/Wildlife Ecology/School of Forest Resources | F |
| Grad Student | Letarte | Danielle | School of Economics | F |
| Grad Student | Levesque | Vanessa | SSI /School of Economics | F |
| Grad Student | Lyons | Patrick | School of Forest Resources | |
| Grad Student | Mullen | Amanda | Education | F |
| Grad Student | Newell | Ellen | Psychology/Education | F |
| Grad Student | Pickering | Ryan | School of Economics | |
| Grad Student | Plowden | Jennifer | School of Economics | F |
| Grad Student | Ryan | Kevin | Wildlife Ecology | |
| Grad Student | Sapiel | Minquansis | Wabanaki Center | O |
| Grad Student | Seitz | Eleanor | Communication & Journalism | F |
| Grad Student | Small | Heather | Intermedia | F |
| Grad Student | Spencer | Erin | Sustainability Solutions Initiative | F |
| Grad Student | Truesdell | Samuel | School of Marine Sciences | |
| Grad Student | Wellman | Joseph | Psychology/Education | |
| Grad Student | West | Andrea | Education | F B |
| Grad Student | Willett | Sara | Wabanaki Center | F |
| Grad Student | Withee | Jason | Electrical & Computer Engineering | |
| Grad Student | Zimmerman | Jacquelyn | School of Forest Resources | F |
| High School Student | Balaban-Garber | Rachel | Orono High School | F |
| High School Student | Benoit | Philip | Orono High School | |
| High School Student | Bird | Norah | Orono High School | F |
| High School Student | Brewer | Addison | Bangor High School | |
| High School Student | Bulteel | Alex | Orono High School | |
| High School Student | Caron | Zachary | Orono High School | |
| High School Student | Cole | Avery | Orono High School | |
| High School Student | Foster | Andria | Orono High School | F |
| High School Student | Guo | Mengting | Orono High School | F |
| High School Student | Harrity | Siobhan | Orono High School | F |

| Project Personnel | | | | |
|---|---|---|---|---|
| **Type** | **Last Name** | **First Name** | **Department** | **Demo*** |
| High School Student | Koehler | Benjamin | Orono High School | |
| High School Student | Koehler | Karl | Orono High School | |
| High School Student | Lesser | Daniel | Orono High School | |
| High School Student | Musavi | Leila | Bangor High School | F |
| High School Student | Ohno | Paul | Orono High School | |
| High School Student | Pasquine | Laura | Bangor High School | F |
| High School Student | Richards | Jessica | Orono High School | F |
| High School Student | Robinson | John | Orono High School | |
| High School Student | Robinson | Paul | Orono High School | |
| High School Student | Rowe | Mark | Orono High School | |
| High School Student | Walton | Allison | Orono High School | F |
| Postdoc | Hall | Damon | Sustainability Solutions Initiative | |
| Postdoc | Kim | Jong-Suk | SSI /Civil & Environmental Engineering | |
| Staff | Bartlett | Christopher | Sea Grant | |
| Staff | Dunham | Jennifer | Maine EPSCoR Office | F |
| Staff | Eckardt | Michael | Office of the Vice President for Research | |
| Staff | Growe | Cynthia | Maine EPSCoR Office | F |
| Staff | Hallsworth | Ruth | Senator George J. Mitchell Center | F |
| Staff | Hamel | Carol | Sustainability Solutions Initiative | F |
| Staff | Hermann | Michael | Canadian-American Center | |
| Staff | Homerding | Margaret | School of Marine Sciences | F |
| Staff | Kuykendall | Adam | School of Performing Arts | |
| Staff | Mitchell | John | Wabanaki Center | O |
| Staff | Nemeth | Vicki | Maine EPSCoR Office | F |
| Staff | Raymond | Kim | Senator George J. Mitchell Center | F |
| Staff | Zollitsch | Brenda | Sustainability Solutions Initiative | F |
| Technician | Finlayson | Christy | SSI/Anthropology | F |
| Technician | Kormendy | Zsolt | SSI/Wildlife Ecology | |
| Technician | Lake | Bjorn | SSI/School of Biology & Ecology | |
| Technician | Legaard | Kasey | SSI /School of Forest Resources | |
| Technician | Letourneau | Jeffrey | Communication & Network Services | |
| Technician | McCloskey | Jon | SSI /School of Forest Resources | |
| Technician | Melanson | Jesse | Maine EPSCoR Office | |
| Technician | Mercier | Wilfred | SSI /School of Forest Resources | |
| Technician | Simons | Erin | School of Forest Resources | F |
| Technician | Tremblay | Jill | Sustainability Solutions Initiative | F |
| Technician | Yan | Liying | School of Marine Sciences | |
| Undergrad Student | Armfield | Robert | Wabanaki Center | O |
| Undergrad Student | Baughman | Jessica | School of Economics | F |
| Undergrad Student | Buckley | Karl | Communication & Journalism/School of Forest Resources | |
| Undergrad Student | Bussell | Mallory | Communication & Journalism/School of Forest Resources | F |
| Undergrad Student | Chavis | Emily | Wabanaki Center | F |
| Undergrad Student | Dunn | Christopher | School of Economics | |
| Undergrad Student | Fitch | Matthew | New Media | |
| Undergrad Student | Grant | Jonathan | Wildlife Ecology | |
| Undergrad Student | Hecker | Lee | Wildlife Ecology | |
| Undergrad Student | Helmke | Scott | Wildlife Ecology | |
| Undergrad Student | Hutchinson | Sean | Communication & Journalism/School of Forest Resources | |
| Undergrad Student | Kennedy | Cody | Wildlife Ecology | |

| Project Personnel | | | | |
|---|---|---|---|---|
| **Type** | **Last Name** | **First Name** | **Department** | **Demo*** |
| Undergrad Student | Lajoie | Caitlyn | School of Economics | F |
| Undergrad Student | Legere | Matthew | Earth Sciences | |
| Undergrad Student | Melanson | Jesse | New Media | |
| Undergrad Student | Price | Kevin | School of Economics | |
| Undergrad Student | Purinton | Karen | School of Economics | F |
| Undergrad Student | Tomes | Andrew | School of Biology & Ecology | D |
| Undergrad Student | Tremblay | Jill | Anthropology | F |
| Undergrad Student | Vo | Giang | Maine Business School | F |
| Undergrad Student | Walus | Brandon | Wabanaki Center | |
| Undergrad Student | Wibberly | Megan | School of Economics | F |
| University of Maine Collaborators | | | | |
| Consultant | Donahue | Charlene | State of Maine Insect & Disease Laboratory | F |
| Consultant | Drummond | Marjorie | GrowSmart Maine | F |
| Consultant | Meadow | Curtis | TreFoil Corporation | |
| University of Southern Maine | | | | |
| Faculty | Briggs | David | Computer Science | |
| Faculty | Colgan | Charles | Muskie School of Public Service | |
| Faculty | Kartez | Jack | Muskie School of Public Service | D |
| Faculty | Owen | David | School of Law | |
| Faculty | Pavri | Firooza | Geography & Anthropology | F |
| Faculty | Wilson | Karen | Environmental Science & Policy | F |
| Grad Student | Bojarski | Slawomir | Muskie School of Public Service | |
| Grad Student | Glaser | Peter | School of Law | |
| Grad Student | Goff | Sandra | Muskie School of Public Service | F |
| Grad Student | Youngs | Thea | Muskie School of Public Service | F |
| Staff | Willis | Theodore | Research Administration | B |
| Undergrad Student | Carroll | Shannon | School of Law | F |
| Undergrad Student | Dailey | Abraham | Geography & Anthropology | |
| Undergrad Student | Ogren | Meghan | School of Law | F |
| Undergrad Student | Sanford | Cole | Geography & Anthropology | |
| Undergrad Student | Shuttle | Shannon | Environmental Science | F |
| Undergrad Student | Wood | Richard | School of Law | |
| Bates College | | | | |
| Faculty | Johnson | Beverly | Geology | F |
| Faculty | Lewis | Lynne | Economics | F |
| Technician | Dostie | Phil | Chemistry | |
| Undergrad Student | Lindelof | Jennifer | Geology | F |
| Undergrad Student | Ross | Zach | Economics | |
| Undergrad Student | Wool | Dava | Geology | |
| Bowdoin College | | | | |
| Faculty | Camill | Phil | Environmental Studies & Biology | |
| Faculty | Herrera | Guillermo | Economics | H |
| Faculty | Johnson | Eileen | Environmental Studies | F |
| Faculty | Lichter | John | Biology | |
| Undergrad Student | Bell | Andy | Biology | |
| Undergrad Student | Berghoff | Henry | Biology | |
| Undergrad Student | Elowe | Cory | Biology | |
| Undergrad Student | Hinman | Paul | Economics | |
| Undergrad Student | Jacobson | Holly | Biology | F |
| Undergrad Student | Johnston | Catherine | Biology | F |
| Undergrad Student | Towne | Ben | Biology | |

| Project Personnel | | | | |
|---|---|---|---|---|
| **Type** | **Last Name** | **First Name** | **Department** | **Demo*** |
| Colby College | | | | |
| Faculty | Bevier | Catherine | Biology | F |
| Faculty | Cole | Russell | Biology | |
| Faculty | Fleming | James | Science, Technology, and Society | |
| Faculty | King | Whitney | Chemistry | |
| Faculty | Nyhus | Philip | Environmental Studies | |
| Faculty | Wilson | Herbert | Biology | |
| Staff | Elliott | Alice | Goldfarb Center for Public Affairs & Civic Engagement | F |
| Staff | Lessing | Lauren | Museum of Art | F |
| Undergrad Student | Bittler | Kim | Chemistry | F |
| Undergrad Student | Bradley | Sharonda | Biology | F B |
| Undergrad Student | Bruno | Jasmine | Biology | F |
| Undergrad Student | Chang | Anne | Biology | F |
| Undergrad Student | Hoyt | Eleanor | Biology | F |
| Undergrad Student | Martin | Corey | Biology | |
| Undergrad Student | McCullough | Ian | Environmental Studies | |
| Undergrad Student | Schnettler | Erin | Science, Technology, Society | F |
| Undergrad Student | Sheppard | Danielle | Science, Technology, Society | F B |
| Undergrad Student | Todd | Alexandra | Biology | F |
| Undergrad Student | Westhafer | James | Science, Technology, Society | |
| Colby College Collaborators | | | | |
| Consultant | Kallin | Peter | Belgrade Regional Conservation Alliance | |
| Consultant | Shannon | Maggie | Belgrade Regional Conservation Alliance | F |
| University of Maine at Farmington | | | | |
| Faculty | Buckley | Daniel | Natural Sciences | |
| Faculty | Harper | Wendy | Business Economics | F |
| Faculty | McCourt | Matthew | Social Sciences and Business | |
| College of the Atlantic | | | | |
| Faculty | Anderson | John | Human Ecology | |
| Faculty | Cass | Don | Human Ecology | |
| Faculty | Cline | Kenneth | Human Ecology | |
| Faculty | Cox | J. Gray | Human Ecology | |
| Faculty | Friedlander | Jay | Human Ecology | |
| Faculty | Taylor | Davis | Human Ecology | |
| Staff | Deliso | Elizabeth | Human Ecology | F |
| Staff | Macko | Katherine | Human Ecology | F |
| Staff | Ten Broeck | Craig | Human Ecology | |
| Undergrad Student | Dickenson | Matthew | Human Ecology | |
| Undergrad Student | Doubnerova | Marketa | Human Ecology | F |
| Undergrad Student | Haris | Nick | Human Ecology | |
| Undergrad Student | Maiorana | Matt | Human Ecology | |
| Undergrad Student | Nielsen | Lindsey | Human Ecology | F |
| Undergrad Student | Slabach | Brittany | Human Ecology | F |
| Undergrad Student | Wartell | Jake | Human Ecology | |
| University of New Brunswick | | | | |
| Faculty | Maclean | David | Forestry | |
| Unity College | | | | |
| Faculty | Arnett | Amy | Ecology | F |
| Faculty | Dunckel | Kathleen | Computers & Geographic Information Systems | F |
| Faculty | Latty | Erika | Botany | F |

| Project Personnel | | | | |
|---|---|---|---|---|
| **Type** | **Last Name** | **First Name** | **Department** | **Demo*** |
| Faculty | Remsburg | Alysa | Biology | F |
| Undergrad Student | Arsenault | Arielle | Biology | F |
| Undergrad Student | Barber | Kelly | Sustainability and Global Change | F |
| Undergrad Student | Bell | Nils | Biodiversity | |
| Undergrad Student | Greer | Jasmine | Biology | F |
| Undergrad Student | Lamppa | Thomas | Biology | |
| Undergrad Student | Leach | Ari | Resource Management | F |
| Undergrad Student | Miller | Andrea | Biodiversity | F |
| Undergrad Student | Salvino | Cayce | Biodiversity | F |
| Undergrad Student | Zukas | Alison | Resource Management | F |
| University of Maine at Presque Isle | | | | |
| Faculty | Johnston | Jason | Math & Science | |
| Faculty | Putnam | David | Math & Science | |
| Faculty | Wang | Chunzeng | Math & Science | |
| Undergrad Student | Grivois | Keith | Math & Science | |
| Undergrad Student | Paul | Angie | Math & Science | F |
| Undergrad Student | Ryan | Sarah | Math & Science | F |
| University of New England | | | | |
| Faculty | Daley | Michael | Management | |
| Faculty | Feurt | Christine | Environmental Studies | F |
| Faculty | Morgan | Pamela | Environmental Studies | F |
| Faculty | Sulikowski | James | Marine Science Academic | |
| Faculty | Zeeman | Stephan | Marine Sciences | |
| Faculty | Zogg | Greg | History & Politics | |
| Staff | Davis | Jenna | Office of the Vice President for Research | F |
| Technician | Carlson | Amy | Environmental Studies | F |
| Undergrad Student | Almeida | William | Environmental Studies | |
| Undergrad Student | Amaio | Chelsea | Environmental Studies | F |
| Undergrad Student | Bergeron | Jessica | Marine Sciences | F |
| Undergrad Student | Carlson | Amy | Chemistry & Physics | F |
| Undergrad Student | Hammond | Marissa | Environmental Studies/Marine Sciences | F |
| Undergrad Student | Johnson | Samantha | Marine Sciences | F |
| Undergrad Student | Kelly | Lindsay | Environmental Studies | F |
| Undergrad Student | Loesher | Gale | | F |
| Undergrad Student | Madore | Justine | Environmental Studies | F |
| Undergrad Student | Sargent | Deidra | Environmental Studies | F |
| Undergrad Student | Wright | Derek | | |

*Demographic Abbreviations:
F – Female
B – Black or African American
H – Hispanic
O – Other Ethnic
D – Person with Disability

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## APPENDIX 4: Project Personnel Diversity

| **Directly Supported Personnel:** | **YR1 Benchmarks** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Total** | **Males** | **Females** | **Blacks or African Americans** | **Hispanics** | **Other Ethnic** | **Persons with Disabilities** | **Unknown** |
| Core faculty | 53 | 35 | 18 | 1 | 0 | 3 | 2 | 0 |
| Collaborative faculty | 34 | 23 | 11 | 0 | 0 | 0 | 0 | 0 |
| Postdocs | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| Graduate students | 40 | 14 | 26 | 1 | 0 | 0 | 0 | 0 |
| Undergraduate students | 81 | 38 | 43 | 2 | 0 | 0 | 1 | 0 |
| High school students | 21 | 12 | 9 | 0 | 0 | 1 | 0 | 0 |
| Tech./Prof./ Admin. staff | 33 | 16 | 17 | 1 | 0 | 1 | 0 | 0 |
| **TOTALS:** | **264** | **140** | **124** | **5** | **0** | **6** | **3** | **0** |
| **Direct Overall %:** | | **53%** | **47%** | **2%** | **0%** | **2%** | **1%** | **0%** |
| **Indirectly Supported Participants:** | **YR1 Benchmarks** | | | | | | | |
| | **Total** | **Males** | **Females** | **Blacks or African Americans** | **Hispanics** | **Other Ethnic[1]** | **Persons with Disabilities** | **Unknown** |
| ARI Faculty | 353 | 207 | 146 | 2 | 4 | 6 | 0 | 0 |
| PUI Faculty | 84 | 39 | 45 | 0 | 0 | 0 | 0 | 0 |
| Graduate students | 270 | 121 | 149 | 0 | 0 | 0 | 0 | 0 |
| ARI Undergrad students | 122 | 38 | 84 | 0 | 1 | 32 | 0 | 0 |
| PUI Undergrad students | 310 | 121 | 189 | 0 | 0 | 20 | 0 | 9 |
| K-12 teachers & pre-service teachers | 257 | 112 | 145 | 0 | 0 | 0 | 0 | 0 |
| High school students | 107 | 55 | 52 | 0 | 0 | 90 | 0 | 0 |
| Middle school students | 1025 | 255 | 770 | 0 | 0 | 110 | 0 | 0 |
| Elementary school students | 150 | 75 | 75 | 0 | 0 | 0 | 0 | 0 |
| Tech./Prof./ Admin. staff | 131 | 45 | 86 | 0 | 0 | 0 | 0 | 0 |
| Business/Industry | 94 | 63 | 31 | 0 | 0 | 0 | 0 | 0 |
| NGO/Government | 315 | 180 | 135 | 1 | 0 | 31 | 0 | 0 |
| General Public | 306 | 153 | 153 | 0 | 0 | 1 | 0 | 0 |
| **TOTALS:** | **3524** | **1464** | **2060** | **3** | **5** | **290** | **0** | **9** |
| **Indirect Overall %** | | **42%** | **58%** | **0%** | **0%** | **8%** | **0%** | **0%** |

[1]Other Ethnic includes only Alaska Natives, Native American, Native Hawaiians, and other Pacific Islanders as defined by NSF.

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# APPENDIX 5: SSI Grant Proposals

## YR1 SSI Grant Proposals Submitted & Awarded

| SSI Grant Proposals Submitted & Awarded in Year 1 | | | | | | |
|---|---|---|---|---|---|---|
| **Submit** | **Name** | **Institution** | **Title** | **Sponsor** | **Sponsor Request** | **Award** |
| 9/1/09 | Calhoun, A. | University of Maine | Maine Municipal Guide to Vernal Pool mapping and conservation | Maine Outdoor Heritage Fund | $6,665 | $6,665 |
| 9/1/09 | Segee, B. | University of Maine | Maine's Three Ring Binder | U.S. Department of Commerce | $1,250,000 | $1,250,000 |
| 9/29/09 | Camill, P. | Bowdoin College | Historical and projected changes in carbon export to the Gulf of Maine resulting from land use and climate change | National Aeronautics and Space Administration | $1,138,234 | $1,138,234 |
| 1/1/10 | Perlut, N. | University of New England | Grassland Bird Research Fund | Private Gift | $5,000 | $5,000 |
| 1/10/10 | Lindenfeld, L. | University of Maine | School of Policy & International Affairs Collaboration & Research Grant | UMaine School of Policy & International Affairs | $3,000 | $3,000 |
| 1/20/10 | Segee, B. | University of Maine | Enabling Next Generation Ocean Modeling and Climate Forecasts at the UMaine | National Aeronautics and Space Administration | $730,404 | pending |
| 2/4/10 | Segee, B. | University of Maine | CDI-Type I: GPU-Accelerated Interactive Supercomputing for Climate Studies | National Science Foundation | $452,736 | pending |
| 2/15/10 | Segee, B. | University of Maine | STEM-ME Teacher Conference | National Science Foundation | $249.851 | pending |
| 2/15/10 | Segee, B. | University of Maine | Scaling Up Inquiry-based Dynamic Earth Applications of Supercomputing | National Science Foundation | $1,329,541 | pending |
| 2/15/10 | Camill, P. | Bowdoin College | Equipping the New Earth and Ocean Science Curriculum of at Bowdoin College | Sherman Fairchild Foundation | $495,300 | pending |

| SSI Grant Proposals Submitted & Awarded in Year 1 | | | | | | |
|---|---|---|---|---|---|---|
| **Submit** | **Name** | **Institution** | **Title** | **Sponsor** | **Sponsor Request** | **Award** |
| 2/26/10 | Daigle, J. | University of Maine | Sustaining Brown Ash (Fraxinus nigra) Basket Trees Under Threat from the Emerald Ash Borer | Northeastern States Research Cooperative | $86,336 | rejected |
| 2/26/10 | Cronan, C. | University of Maine | Using public participatory modeling to build Bayesian belief networks and a cellular automata model for strategic land use planning | Northeastern States Research Cooperative | $74,887 | rejected |
| 3/15/10 | Perlut, N. | University of New England | Exploration of Movement Patterns and Survival of the Grey Squirrel | University of New England | $2,000 | $2,000 |
| 4/1/10 | Colgan, C. | University of Southern Maine | Transportation & Land Use Planning for Central York County | Maine Department of Transportation | $4,800 | $4,800 |
| 4/5/10 | Calhoun, A. | University of Maine | Engaging Communities in Vernal Pool Conservation | Davis Foundation | $25,000 | pending |
| 4/12/10 | Owen, D. | University of Southern Maine | Law School Summer Research Grant | UMaine School of Law | $7,600 | $7,600 |
| 4/15/10 | Perlut, N. | University of New England | Where Do They Go, and What do They Do? Using airplanes and Radio Telemetry to Solve a Conservation Mystery | University of New England Vice President for Research Office | $8,000 | $3,000 |
| 4/21/10 | Segee, B. | University of Maine | MRI-Consortium: Development of a Virtual Interactive Environment for Workgroups | National Science Foundation | $334,301 | pending |
| 5/15/10 | Kuykendall, W. | University of Maine | MaineStreets New Media Workshops for Community Newspaper | McCormick Foundation | $100,000 | pending |
| | | | **Total Submitted: 19** | **Total Awarded: 9** | **$6,303,655** | **$2,420,299** |

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## APPENDIX 6: Maine EPSCoR & SSI Equipment Purchased

| Maine EPSCoR Equipment List | |
|---|---|
| **Equipment Name:** | **Purchased:** |
| **Canon Camcorder** | **2/1/2010** |
|  | High Definition Camcorder<br><br>**Specifications**<br>Manufacturer: Canon<br>Model: XL-H1s 3-CCD<br>Details: 1080i HDV, Interchangeable Lenses, 20x Genuine Canon Lens, HD-SDI, Timecode, Genlock |
| **Canon Camera, Lens, View Finder** | **2/19/2010** |
|  | Century Precision Optical Lens<br><br>**Specifications**<br>Manufacturer: Century Precision<br>Model: CEVS08CV72<br>Details: Wide Angle Converter Lens<br><br>Century Precision Optics<br><br>**Specifications**<br>Manufacturer: Century Precision<br>Model: CEAD7235<br>Details: Achromatic Diopter |
| **Lowell Lights** | **2/19/2010** |
|  | Lowell DV Creator Kit 55<br><br>**Specifications**<br>Manufacturer: Lowell<br>Model: LODV903Z<br>Details: 1950 Total Watts: Rifa EX55, Omni, Tota, Prolights. 120v Bulbs, Barndoors, Umbrella. Gel frames, gels, stands, flag. TO83 hard kit case. |
| **Visualization Wall** | **4/13/2010** |
|  | The visualization wall demonstrates a distribution display that can be created using laptops to view data on an extreme scale not possible with a single computer. The Maine Learning Technology Initiative provides all middle school students with a MacBook, thus a classroom of students could use their laptops to create this display. In addition to the enhanced visual experience, this also helps bring students together in a team environment.<br><br>Specifications: 13" MacBooks. Portable shelf unit. |
| **SSI Equipment List** | |

| Equipment Name: | Purchased: |
|---|---|
| **WeatherHawk 232 Weather Station** | **5/2/2010** |
|  | Two weather stations have been acquired to fill the data gaps identified during the initial stages of the Lake-Watershed Systems Sustainability subproject with the Sustainability Solutions Initiative. The stations will be deployed in Standish and Songo Locks, and will provide a real-time meteorological data stream to support the hydrologic modeling and prediction efforts for the Sebago Lake watershed in Maine.<br><br>**Specifications**<br>Manufacturer: WeatherHawk<br>Model: 232 Weather Station<br>Details: Includes serial cable. No software. |

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## APPENDIX 7: YR1 SSI On-site Workshops, Seminars, Presentations

| SSI On-site Workshops, Seminars, Presentations | | | | |
|---|---|---|---|---|
| **Date** | **SSI Event** | **Presenter** | **Title** | **Affiliation** |
| 9/10/09 | Social-ecological systems research: some perspectives on the good, the bad and the ugly | Elena Irwin | Associate Professor, Environmental & Development Economics | Ohio State University |
| 9/24/09 | Data-driven policy: the role of universities in creating a sustainable Maine | Angus King | Former Governor of Maine | |
| 9/28/09 | The Humane Metropolis: People and Nature in the 21st Century | Rutherford H. Platt | Emeritus Professor, Geography & Senior Fellow, Institute for Sustainable Cities | University of Massachusetts & CUNY |
| 1/15/10 | The other inconvenient truth: A global crisis of land, food and environment | John Foley | Director, Institute of the Environment | University of Minnesota |
| 1/25/10 | Are we asking to much of the Yukon River? International treaties, Yukon River Salmon, and food security in a changing arctic | Philip Loring | Doctoral Candidate | University of Alaska - Fairbanks |
| 1/26/10 | The cultural inventory as an alternative form of public participation in natural resource management | Damon Hall | Post Doctoral Research Associate | University of Maine |
| 2/1/10 | Social Limits on Sustainability: a case study from Tamil Nadu | Timothy Waring | Assistant Professor, SES Modeling | University of Maine |
| 2/8/10 | Rural environmental licensing I Rondonia, Brazil: Insights from systems-dynamics and agent-based approaches | Andrew Bell | Doctoral Candidate | University of Michigan |
| 2/25/10 | SSI from a Coastal Perspective | Kristin Wilson | Doctoral Candidate | University of Maine |
| 3/9/10 | Land use structure and population and employment densities: Empirical analysis of the Columbus (Ohio) metropolitan area | Jia Lu | Assistant Professor | The Catholic University of America |
| 3/12/10 | Using GIS and statistics to model pedestrian-motor vehicle collisions in King County, Washington | Junfeng Jiao | Doctoral Candidate | University of Washington |
| 3/15/10 | Reformulating standard hydrologic design tools to better predict the impacts of land use and climate change | Steven Shaw | Assistant Professor | Cornell University |
| 3/16/10 | Dynamics of the Amenity City: Agent-based simulation of neighborhood location decision dynamics | Yuseung Kim | Doctoral Candidate | University of Colorado - Denver |

| SSI On-site Workshops, Seminars, Presentations | | | | |
|---|---|---|---|---|
| **Date** | **SSI Event** | **Presenter** | **Title** | **Affiliation** |
| 3/17/10 | 2010 Maine Water Conference | David Hart/John Peckenham | Director, Senator George J. Mitchell Center, Director, Maine Water Institute | University of Maine |
| 3/18/10 | Watershed protection under changing management, land use and climate conditions | Aleksey Shesukov | Research Associate | Kansas State University |
| 3/19/10 | Comparing the explanatory and predictive capacity of two Markov models to predict land-cover change: The “landscape variables” versus the “household variables” approach. A case study of Rondõnia, Brazil | Nancy Becera-Cordoba | Environmental Scientist | EEE Consulting |
| 3/19/10 | Process-based modeling of aquatic ecosystem services at watershed to regional scales: issues and progress | Wil Wollheim | Research Assistant Professor | University of New Hampshire |
| 3/22/10 | Riparian reforestation and channel change: Mechanisms, timescales, and scope | Maeve McBride | Assistant Professor | University of Vermont |
| 3/25/10 | Moving towards sustainable watershed management by improving modeling and assessment strategies | Pouyan Nejadhashemi | Assistant Professor | Michigan State University |
| 3/29/10 | Predicting Distribution and Abundance of Organisms in the Face of Global Change | Brian McGill | Assistant Professor, Ecological Modeling | University of Maine |
| 3/31/10 | Terrestrial-aquatic ecosystem linkages: A framework for studying northern landscapes | Ishi Buffam | Post Doctoral Research Associate | University of Wisconsin |
| 4/20/10 | Grant Writing and Sustainability Workshop | Linda Silka | Director, Margaret Chase Smith Policy Center | University of Maine |
| 5/20-21/10 | Environmental Communication Symposium | Laura Lindenfeld | Associate Professor, Communication & Journalism/Margaret Chase Smith Policy Center | University of Maine |
| 5/21/10 | Emerald Ash Borer Workshop at UMaine | Darren Ranco | Associate Professor, Anthropology/Senator George J. Mitchell Center | University of Maine |
| 5/18/10 | Vernal Pool Project Focus Groups | Jessica Jansujwica | Graduate Student | University of Maine |
| 5/25/10 | Vernal Pool Project Focus Groups | Jessica Jansujwica | Graduate Student | University of Maine |
| 5/17/10 | Vernal Pool Project Focus Groups | Jessica Jansujwica | Graduate Student | University of Maine |
| 5/10/10 | Vernal Pool Project Focus Groups | Jessica Jansujwica | Graduate Student | University of Maine |

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# APPENDIX 8: SSI Technical Presentations

| SSI Technical Presentations | | | |
|---|---|---|---|
| **Name** | **Institution** | **Scope** | **Description** |
| Amirbahman, Aria | University of Maine | International | "Exploring complex relationships among fish tissue mercury concentrations, drivers of trophic status, and watershed characteristics in Maine lakes." Paper presented at the Goldschmidt Conference, Oak Ridge, TN. |
| Arnett, Amy | Unity College | Local | "Impact of Hemlock Woolly adelgid on Maine's Forests", Unity College, Unity ME |
| Arnett, Amy | Unity College | National | "Invertebrate biodiversity patterns in a hemlock-dominated forest: Effects of vegetation, woody debris, and light", Ecological Society of America annual meeting, Pittsburgh, PA |
| Bell, Kathleen | University of Maine | State | Bell, K.P. and S. Jain. 2009. Maine Sustainability Solutions Initiative and Coupled Systems Modeling. Maine EPSCoR Conference, September 21, 2009. |
| Bell, Kathleen | University of Maine | National | Bell, K., Colgan, C., Jain, S., Lindenfeld, L., Lilieholm, R., Leahy, J., Porter, T., and L. Silka. 2009. Integrating Communication Studies into Issue-Driven Interdisciplinary Research: Maine's Sustainability Solutions Initiative as a Model. Conference on Communication and the Environment, University of Southern Maine, Portland, ME, June 28, 2009. |
| Bell, Kathleen | University of Maine | National | Bell, K.P. and J. Kline. 2009. Assessing patterns in the conversion of rural lands to residential use. AAEA & ACCI 2009 Joint Annual Meeting, Milwaukee, WI July 27, 2009. |
| Bell, Kathleen | University of Maine | State | Bell, K.P. and J. Leahy. 2009. Extending the Frontiers of Citizen Science: New Applications to Lake Development, Recreation & Associations. Maine Volunteer Lake Monitoring Program's 2009 Lake Monitoring Conference, Turner, ME, July 11, 2009 (keynote address). |
| Bell, Kathleen | University of Maine | National | Bell, K.P., Leahy, J., Vaux, P., Wilson, J., Snell, M., Tylka, M., Paluga, C., and A. Schwarz. 2009. Sustainable Lake Management in Maine's Changing Landscape. Webinar presentation, US EPA Collaborative Science Network, July 1, 2009. |
| Bell, Kathleen | University of Maine | State | Green Jobs for Women; Panel Speaker on Access, Training, and Green Jobs; University of Maine, Orono, ME, December 11, 2009. |
| Calhoun, Aram | University of Maine | State | Vernal pool conservation and the municipal economy; International Tax Assessor-s Organization Annual Meeting |

| SSI Technical Presentations | | | |
|---|---|---|---|
| **Name** | **Institution** | **Scope** | **Description** |
| Calhoun, Aram | University of Maine | State | Morgan, D. E., and A.J.K. Calhoun. 2010. Conserving Maine Vernal Pools through Collaborative Local Initiatives. Maine Water Conference |
| Cole, Russell | Colby College | State | Impacts of Land Use Changes on Water Quality in Salmon Lake and McGrath Pond. Amy Holmen, Emma Gildesgame, Katherine Orrick, David Firmage, Russell Cole, and Tracey Greenwood. Department of Biology, Colby College |
| Cole, Russell | Colby College | State | Nutrient Loads and the Presence of an Invasive Species Threaten Salmon Lake and McGrath Pond, Kennebec Co., ME. Ian McCullough ('10), Jessica Balukas ('10), Michael Bienkowski ('10) and Jordan Schoonover ('10), Russell Cole, David Firmage, and Tracey Greenwood. Department of Biology, Colby College |
| Colgan, Charlie | University of Southern Maine | State | The Sustainable Solutions Initiative: Implications for Environmental Consulting Opportunites |
| Colgan, Charlie | University of Southern Maine | State | Sustainability and the Future of STEM Education |
| Colgan, Charlie | University of Southern Maine | State | Incorporating Sustainability in High School Science and Math Education |
| Colgan, Charlie | University of Southern Maine | Regional | Population and Employment Trends in Cumberland County and the Gorham-South Portland Corridor |
| Daigle, John | University of Maine | Regional | EAB and the brown ash task force/ Presented collaborative research plan and findings from Stakeholder meeting completed in October 2009 to the Northeast Pest Council 72nd Annual Meeting |
| Hart, David | University of Maine | State | Sustainability Solutions Initiative: Rationale, Strategy and Goals. (Presentation at Maine EPSCoR State Conference) |
| Hart, David | University of Maine | State | Sustainability Solutions initiative: Strategic planning challenges and opportunities (presentation at NSF EPSCoR Strategic Planning Meeting) |
| Hart, David | University of Maine | Local | Introduction to the Sustainability Solutions Initiative: Rationale, Strategy, and Goals. [presentation to Janet Waldron's "Energy Team"] |
| Hart, David | University of Maine | State | Introduction to Maine's Sustainability Solutions Initiative: Rationale, Strategy, and Goals. [presentation to American Council of Engineering Companies of Maine] |
| Hart, David | University of Maine | International | Welcome and Introduction to Maine's Sustainability Solutions Initiative: Rationale, Strategy, and Goals. International Environmental Communication Symposium hosted by SSI. |
| Hart, David | University of Maine | National | Welcome and brief introduction to Maine's Sustainability Solutions Initiative. SSI Conference organized by Dr. Darren Ranco: "Protecting the Ash for Future Generations II Kolunkayowan wikpiyik" |

| SSI Technical Presentations | | | |
|---|---|---|---|
| **Name** | **Institution** | **Scope** | **Description** |
| Hunter, Malcolm | University of Maine | Regional | Amphibians and forestry: a 19-year retrospective from Maine. University of Connecticut |
| Hutchins, Karen | University of Maine | State | Constituting Communities: Debates about Maine's Symbolic North Woods |
| Hutchins, Karen | University of Maine | State | Event: Communication and Journalism Department Research Colloquium Series, Fall 2009 Presentation Title: Land Debates about Maine's North Woods: A Rhetorical Analysis of the Plum Creek Development Project on Moosehead Lake |
| Johnson, Beverly | Bates College | State | Poster Presentation. Doolittle, H.*, Lindelof, J.*, Johnson, B., Dostie, P., Bates College Environmental Geochemistry Class (GEO 240), 2010, Winter chloride fluctuation as a result of road salt application along the Androscoggin River in Auburn, Maine. Maine Waters Conference, March 17, 2010, Augusta. (*denotes undergraduate students) |
| Kartez, Jack | University of Southern Maine | Local | Invited lecture, School of Biology & Ecology, UM, December 11, 2009: "Linking knowledge to action: somehting borrowed, somehting new, a broad perspective, a narrow one too." |
| King, Whitney | Colby College | State | Belgrade Lakes Watershed Sustainability Project – March Meeting Whitney King, Colby College – "The Perfect Recipe for a Green Lake: A Nonlinear Mixture of Fluid Dynamics, Fish Poop, and Sunlight" – Wednesday, 3/17/2010. |
| Lichter, John | Bowdoin College | Local | Faculty Lunch Seminar at Bowdoin College; John Lichter and Guillermo Herrera presented conceptual aspects of SSP project. |
| Lilieholm, Robert | University of Maine | International | Proactive Stakeholder Alliances in the Renewable Energy Industry: Theoretical Framework and Evidence from the Field. International Society for Business and Society, Snowmass, CO (Porter presenting, with Zivanovic, Lilieholm and Leahy). |
| Lilieholm, Robert | University of Maine | State | Lilieholm, R.J., D. Foster, L.C. Irland and M. Hunter. 2010. Wildlands and Woodlands: A Vision for the New England Landscape. Maine Land Conservation Conference, Topsham, ME. |
| Lilieholm, Robert | University of Maine | State | Alternative Futures Modeling: Exploring the Future to Sustain People and Landscapes. Maine STEM Summit Conference, Augusta Civic Center. One of four invited keynote speakers, with Governor John Baldacci (with Hart). |
| Lilieholm, Robert | University of Maine | Regional | Impacts of State and Federal Rule-making on Forest Management in Maine: Lessons Learned and Future Trends. Fall Meeting of the Maine Division of the Society of American Foresters, University of Maine, Orono. |

| SSI Technical Presentations | | | |
|---|---|---|---|
| **Name** | **Institution** | **Scope** | **Description** |
| Lilieholm, Robert | University of Maine | International | Damery, D., M. Kelty, J. Benjamin, and R.J. Lilieholm. 2009. Developing a Sustainable Forest Biomass Industry: Case of the U.S. Northeast. 7th International Conference on Ecosystems and Sustainable Development, Wessex Institute of Technology, Chianciano Terme, Italy, July 8-10, 2009. |
| Lilieholm, Robert | University of Maine | International | Read, A., R. Read, C. Yelton, J. Yelton, G. Callas, T. Masechik, K. Bisson, K. Callas, and R.J. Lilieholm. 2009. Newforest Institute: Restoring Habitat for Resilience and Vision in the Forested Landscape. 7th International Conference on Ecosystems and Sustainable Development, Wessex Institute of Technology, Chianciano Terme, Italy, July 8-10, 2009. |
| Lilieholm, Robert | University of Maine | National | Sharik, T.L., and R.J. Lilieholm. 2010. Undergraduate Enrollment Trends in Natural Resources at NAUFRP Institutions: An Update. 8th Biennial Conference on University Education in Natural Resources, Virginia Polytechnic Institute and State University, Blacksburg, VA. (Sharik presenting) |
| Lilieholm, Robert | University of Maine | Regional | Kenefic, L., J.S. Wilson, J. Brissette, R. Nyland, and R.J. Lilieholm. 2010. Silvicultural Rehabilitation of Cutover Mixedwood Stands. Annual Meeting of the New England Chapter of the Society of American Foresters, Durham, NH. (Kenefec presenting) |
| Lilieholm, Robert | University of Maine | International | Tessema, M.E., R.J. Lilieholm, D.J. Blahna, and L. Kruger. 2009. Resource Use, Dependence and Vulnerability: Community-resource Linkages on Alaska's Tongass National Forest. 7th Int'l Conference on Ecosystems and Sustainable Development, Chianciano Therme, Italy, July 8-10, 2009. |
| Lindenfeld, Laura | University of Maine | State | Linking Knowledge with Action through Community Engagement. Presented at the State EPSCoR Conference |
| Lindenfeld, Laura | University of Maine | National | Linking knowledge-to-action through alternative foodways. Presented at the College of the Atlantic Conference, Food for Thought, Time for Action. |
| Lindenfeld, Laura | University of Maine | International | Communication and the Environment: Linking Knowledge with Action. Presented at the University of Hohenheim, Germany |
| Lindenfeld, Laura | University of Maine | National | Rupturing the Commodity Fetish: On Documentary Food Films. Presentation at the National Communication Association. |
| Lindenfeld, Laura | University of Maine | International | Representations of Food and Health on "The Food Network." Presented at the University of Hohenheim, Germany |

| SSI Technical Presentations | | | |
|---|---|---|---|
| **Name** | **Institution** | **Scope** | **Description** |
| Morgan, Pam | University of New England | International | Poster prepared for presentation at conferences (will be presented by Dr. Pam Morgan and students at Joint Meeting of New England Estuarine Research Society and Atlantic Canada Coastal Estuarine Science Society in St. Andrews, New Brunswick May 15-18, 2010). Title: Sustaining Quality of Place in the Saco River Estuary Through Community Based Ecosystem Management |
| Owen, Dave | University of Southern Maine | Local | "Urban Streams, Impervious Cover, and Regulatory Innovation" - presented to graduate/faculty seminar in Wildlife Ecology, University of Maine |
| Owen, Dave | University of Southern Maine | State | "Urbanization, Water Quality, and the Regulated Landscape" - faculty workshop, University of Maine School of Law |
| Owen, Dave | University of Southern Maine | State | Participation on urban streams panel, Maine Association of Planners annual meeting. |
| Owen, Dave | University of Southern Maine | National | "Urbanization, Water Quality, and the Regulated Landscape" - presentation at the Yale-Stanford Junior Faculty Forum (Yale Law School) |
| Perlut, Noah | University of New England | Local | Biodiversity and Agriculture: Can They be Sustainable bedfellows? Department of Environmental Studies Series on Sustainability, University of New England |
| Porter, Terry | University of Maine | International | Porter, T. (2010). Complexity and sustainability: An alternative paradigm and research approach. International Association for Business and Society, Banff, Alberta, Canada. March 25-28. |
| Ranco, Darren | University of Maine | Regional | “Situating Penobscot Indian Environmental Diplomacy: Critique, Alterity, Distinction,” Keynote Talk at the Symposium on Indigenous Knowledge and the Environment, UMass Boston, November 10, 2009. |
| Ranco, Darren | University of Maine | State | “Risk Assessment and Native Americans at the Cultural Crossroads: Making Better Science or Redefining Health?” University of Maine Department of Psychology Clinical Psychology Diversity Talk, March 31, 2010. |
| Sader, Steven | University of Maine | State | Sader, S.A. Remote sensing applied to forest disturbance and fragmentation monitoring in Maine. USDA Building, Scarborough Maine |
| Segee, Bruce | University of Maine | State | Presentation to Jackson Labs, Supercomputing and networking in Maine |
| Segee, Bruce | University of Maine | National | Enhancing Communications for Collaboration with Cyberinfrastructure, talk to 2009 SSI annual meeting |
| Segee, Bruce | University of Maine | National | Maine's cyberinfrastructure, to Bill Stoy and Judi Stoy of the NSA |
| Segee, Bruce | University of Maine | National | NSF Education Technology Showcase, presentation at NSF |

| SSI Technical Presentations | | | |
|---|---|---|---|
| **Name** | **Institution** | **Scope** | **Description** |
| Segee, Bruce | University of Maine | National | NSF Education Technology Showcase, presentation at NSF. One of only 17 projects nationwide |
| Segee, Bruce | University of Maine | National | Maine's visualization capabilities and goals. Presented to an EPSCoR conference on visualization in Hilo Hawaii |
| Silka, Linda | University of Maine | Local | Smart Growth: Bringing Disciplines Together to Develop Innovative Solutions; Colloquium to UMaine School of Economics |
| Silka, Linda | University of Maine | Local | Presentation on Community-University Research Partnerships to Sustainability Solutions Course (with John Rebar, Head of Cooperative Extension, and Paul Anderson, Head of Sea Grant Extension) |
| Silka, Linda | University of Maine | Local | Intuitive Judgments of Change: Their Implications for Knowledge to Action and Stakeholder Engagement; Presentation to UMaine Research Cafe |
| Silka, Linda | University of Maine | International | The Many Approaches to Community-Based Participatory Research: Learning From the Differences; Keynote Address at University of Houston's Conference "New Models for Reducing Barriers between Researchers and Communities", Houston, TX |
| Silka, Linda | University of Maine | International | The Ethical Dilemmas that Emerge in Community Member-Faculty Collaborations/Presentation at the American Psychological Association Annual Convention, Toronto, Canada |
| Silka, Linda | University of Maine | International | Producing Social Change Through Partnerships: Learning From the Visionaries. Symposium Organizer and Chair for the American Psychological Association Annual Convention, Toronto, Canada |
| Silka, Linda | University of Maine | Local | Immigrant Communities: What They Can Help Us Learn About Communication. Invited Presentation to the UMaine Department of Communication and Journalism |
| Silka, Linda | University of Maine | Regional | You Want to Study Me? A Model for Creating Community Participatory Research Partnerships. New England Regional Minority Health Conference: Eliminating Racial and Ethnic Health Disparities. Providence, RI |
| Silka, Linda | University of Maine | Local | Overcoming Power Differences: The Obstacles to Effective Partnerships Between Universities and Communities; Invited Presentation to UMaine Socialist Series |
| Silka, Linda | University of Maine | National | Taking It to the Curbside: Engaging Communities to Create Sustainable Change for Health; Panel Presentation with national leaders including director of the NIH National Center on Minority Health and Health Disparities; Harvard Medical School, Boston, MA |

| SSI Technical Presentations | | | |
|---|---|---|---|
| **Name** | **Institution** | **Scope** | **Description** |
| Silka, Linda | University of Maine | Local | Presentation to UMaine Psychology Department on "Effective Interdisciplinary Grant Writing Strategies" |
| Simons, Erin | University of Maine | Local | Present and future status of biodiversity in Maine's commercial forests as indicated by a suite of condition indicators. |
| Stancioff, Esperanza | University of Maine | International | National Perspectives on Climate Change Adaptation: A Panel Discussion of Climate Change Adaptation Efforts in Diverse Coastal Regions of the United States. The Coastal Society's 22nd International Conference Shifting Shorelines: Adapting to The Future |
| Stancioff, Esperanza | University of Maine | Regional | Maine's Climate Change Adaptation Response in Coastal Communities Northeast Sea Grant Network Meeting |
| Teisl, Mario F. | University of Maine | Regional | Mario F. Teisl, Caroline L. Noblet and Jonathan Rubin. 2010. Understanding the public goods' motivations of New England biofuel consumers. Invited presentation. The Northeast Sungrant Annual Meeting; Syracure NY. May 24–26. |
| Teisl, Mario F. | University of Maine | Regional | Caroline L. Noblet, Mario F. Teisl and Jonathan Rubin. 2010. What will New England Consumers want from their Biofuels? Invited Symposium Paper (Bioenergy Demand, Economics and Feedstock Supply). Northeastern Agricultural and Resource Economics Association Annual Conference Atlantic City, NJ. June 13-15. |
| Teisl, Mario F. | University of Maine | Regional | Katherine Hassett, Mario F. Teisl, Caroline L. Noblet and Shannon McCoy. 2010. Linking People's Environmental Concern to their Exposure to Various Outdoor Activities. Northeastern Agricultural and Resource Economics Association Annual Conference Atlantic City, NJ. June 13-15. |
| Teisl, Mario F. | University of Maine | International | Mario F. Teisl, Caroline L. Noblet and Shannon McCoy. 2010. Mapping consumers' 'green', economic and security motivations to participate in various energy behaviors. Invited presentation. 3rd International Workshop on Ecolabeling, Laboratory of Forest Economics, INRA–AgroParisTech. Rennes, France June 2-3, 2010. |
| Teisl, Mario F. | University of Maine | National | Sara B. Fein, Amy M. Lando, Alan S. Levy, and Mario F. Teisl. 2010. Trends in US consumers' safe handling and consumption of food and their risk perceptions 1988-2006. Food Safety Education Conference. Atlanta, GA. March 23-26. |

| SSI Technical Presentations | | | |
|---|---|---|---|
| **Name** | **Institution** | **Scope** | **Description** |
| Teisl, Mario F. | University of Maine | International | Mario F. Teisl and Teresa Johnson. 2009. Institutional set-up and best-practice in the environmentally sustainable coastal zone development/management – the U.S. experience. Invited presentation. Role of the Aarhus Convention in the Environment Protection System Workshop – Podgorica, Montenegro September 16-17. |
| Wilson, James | University of Maine | Local | Modeling coupled systems |
| Wilson, James | University of Maine | National | Intelligent agent modeling of Baja California fisheries |
| Wilson, James | University of Maine | International | Costly information and self-organization in complex social systems |
| Wilson, Jeremy | University of Maine | Regional | Spruce budworm decision support: Application and pitfalls. 10/29/09. CFRU Fall Field Tour and Forum |
| Wilson, Jeremy | University of Maine | Local | The death of the stand? |
| Zhu, Yifeng | University of Maine | Local | "Computer and Storage Clouds," Technical collaboration conference with Fairepoint communications, University of Maine, Sept., 2009 |
| Zhu, Yifeng | University of Maine | International | "A New Semantic-Aware Metadata Organization for Improved File-System Performance and Functionality in High-End Computing," High End Computing File Systems and I/O Workshop in Washington DC (organized by National Science Foundation), Aug., 2009 |
| Zhu, Yifeng | University of Maine | International | "A New Metadata Organization Paradigm with Semantic-Awareness for Next-Generation File Systems", in Proceedings of The 22nd International Conference on High Performance Computing, Networking, Storage and Analysis (The 22nd ACM/IEEE Annual Supercomputing Conference - SC'09), Portland, Oregon, November 14-20, 2009 |
| Zhu, Yifeng | University of Maine | International | "Inquiry-based Dynamic Earth Applications of Supercomputing (IDEAS): An ITEST project to enhance middle school science and technology education in rural Maine," the annual conference of the Society for Information Technology and Teacher Education, Charleston, SC, March, 2009 |
| Zhu, Yifeng | University of Maine | International | "Energy and Thermal Aware Buffer Cache Replacement Algorithm", in 26th IEEE Symposium on Massive Storage Systems and Technologies (MSST), May, 2010 |
| Zhu, Yifeng | University of Maine | International | "A study of Self-similarity in Parallel I/O Workloads," 26th IEEE Symposium on Massive Storage Systems and Technologies (MSST), 2010 |

**Maine NSF EPSCoR Research Infrastructure Award EPS 09-04155**
**Maine's Sustainability Science Initiative**

# APPENDIX 9: SSI Publications

| SSI Publications | | | | |
|---|---|---|---|---|
| **Research Area** | **Institution** | **Type** | **Citation** | **RII Support** |
| Sustainability Solutions Initiative | University of Maine | Journal Article | Irwin, E.G., **K.P. Bell,** N.E. Bockstael, D.A. Newburn, M.D. Partidge, and J. Wu. 2009. The Economics of Urban-Rural Space, Annual Review of Resource Economics (1): 435-462. | Partial |
| Sustainability Solutions Initiative | University of Maine | Journal Article | Neumann, B., K.J. Boyle, and **K.P. Bell**. 2009. Property Price Effects of a National Wildlife Refuge: Great Meadows National Wildlife Refuge in Massachusetts, Land Use Policy 26(4): 1011-1019. | Partial |
| Sustainability Solutions Initiative | University of Maine | Journal Article | **Cronan, C.S.**, **R.J. Lilieholm**, **J. Tremblay**, and T. Glidden. 2010. An assessment of land conservation patterns in Maine based on spatial analysis of ecological and socioeconomic indicators. Environmental Management 45: 1076-1095. DOI 10.1007/s00267-010-9481-7 | Primary |
| Sustainability Solutions Initiative | University of Maine | Journal Article | **Hart, D.D.** and **A.J.K. Calhoun**. 2010. Rethinking the role of ecological research in the sustainable management of freshwater ecosystems. Freshwater Biology 55 (Suppl. 1), 258–269. | Primary |
| Sustainability Solutions Initiative | University of Maine | Journal Article | **Hunter, M.L. Jr.**, M.J. Bean, D. B. Lindenmayer, and D.S. Wilcove. 2009. Thresholds and the mismatch between environmental laws and ecosystems. Conservation Biology 23:1053-1055. | Partial |
| Sustainability Solutions Initiative | University of Maine | Journal Article | Semlitsch, R.D., S.M. Blomquist, **A.J.K. Calhoun**, J. W. Gibbons, J.P. Gibbs, G.. Graeter, E.B. Harper , D.. Hocking, **M.L. Hunter, Jr.**, D.A. Patrick , T.A.G. Rittenhouse, B.B. Rothermel, and B.D. Todd. 2009. Effects of timber management on amphibian populations: understanding mechanisms from forest experiments. Bioscience 59:853-862 | Partial |
| Sustainability Solutions Initiative | University of Maine | Journal Article | **Benjamin, J.**, **R.J. Lilieholm**, and D. Damery. 2009. Challenges and Opportunities facing the Northeast Bioproducts Industry. Journal of Forestry 107(3):125-131. | Primary |
| Sustainability Solutions Initiative | University of Maine | Journal Article | Trask, K.M., R.W. Rice, S. Anchors, and **R.J. Lilieholm**. 2009. Management Styles of Lumber Mill Managers in the Northern United States. Forest Products Journal 59(3):29-34. | Partial |

| SSI Publications | | | | |
|---|---|---|---|---|
| **Research Area** | **Institution** | **Type** | **Citation** | **RII Support** |
| Sustainability Solutions Initiative | University of Maine | Journal Article | **Teisl, M.F.**, **C.L. Noblet**, and J. Rubin. September 2009. Can Environmental Promotion Backfire? Evidence from the Vehicle Market Social Marketing Quarterly 15(3); 2-32 | Partial |
| Sustainability Solutions Initiative | University of Maine | Journal Article | **Teisl, M.F.**, **C.L. Noblet**, and J. Rubin. December 2009. The Psychology of Eco-Consumption Journal of Agricultural & Food Industrial Organization Special Issue: Quality Promotion through Eco-Labeling Vol. 7 Issue 2 Article 9 | Primary |
| Sustainability Solutions Initiative | University of Maine | Journal Article | Kopácek, J., J. Hejzlar, J. Kana, **Norton, S.A.**, P. Porcal, and J. Turek. 2009. Trends in aluminium export from a glaciated mountain area to surface waters: Effects of soil development, atmospheric acidification, and nitrogen-saturation: J. Inorg. Biochemistry, 103, 1439-1448. | Partial |
| Sustainability Solutions Initiative | University of Maine | Journal Article | Navrátil, T., J. Rohovec, **A. Amirbahman, S.A. Norton,** and **I.J. Fernandez**. 2009. Controls of natural amorphous aluminum hydroxide on sulfate and phosphate anions in sediment-solution systems: Water, Air, and Soil Poll., 201, 87-98. | Partial |
| Sustainability Solutions Initiative | University of Maine | Journal Article | SanClements, M. D., **I.J. Fernandez,** and **S.A. Norton**. 2009. Soil and sediment phosphorus fractions in a forested watershed at Acadia National Park, ME, USA. For. Ecol. Manag., 258, 2318-2325. | Partial |
| Sustainability Solutions Initiative | University of Maine | Journal Article | **Ranco, D.** 2009, Models of Tribal Environmental Regulation: In Pursuit of a Culturally Relevant Form of Tribal Sovereignty: The Federal Lawyer 56(3): 46-50. | Partial |
| Sustainability Solutions Initiative | University of Maine | Journal Article | Briggs N.A. and **S.A. Sader**. Tracking forest change and development using low cost remote sensing imagery and GIS integration. Northern Journal of Applied Forestry 25(4): 148-155 | Partial |
| Sustainability Solutions Initiative | University of Maine | Journal Article | **Teisl, M.F.**, S.B. Fein and A.S. Levy. 2009. Information effects on consumer attitudes toward three food technologies: organic production, biotechnology, and irradiation Food Quality and Preference 20:586–596 | Partial |
| Sustainability Solutions Initiative | University of Maine | Journal Article | Binks, L.A., D.A. Maclean, **J.S. Wilson**, and R.G. Wagner. 2010. Temporal changes in species composition of mixedwood stands in northwest New Brunswick: 1946-2008. Canadian Journal of Forest Research 40:1-12. | Partial |

| SSI Publications | | | | |
|---|---|---|---|---|
| **Research Area** | **Institution** | **Type** | **Citation** | **RII Support** |
| Sustainability Solutions Initiative | University of Maine | Journal Article | Gu, P., J. Wang, **Y. Zhu,** and H. Jiang, A Novel Weighted-Graph-Based Grouping Algorithm for Metadata Prefetching, IEEE Transactions on Computers, Vol. 59, No. 1, pp. 1-15, January 2010. | Partial |

**Maine NSF EPSCoR Research Infrastructure Award EPS 09-04155**
**Maine's Sustainability Science Initiative**

## APPENDIX 10: External Evaluation Executive Summary

**Executive Summary**
**from**
**Evaluating the Maine EPSCoR Program: Sustainability Solutions Initiative**
**Annual Evaluation Report: Year 1: October 2009 - March 2010**


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The five-year evaluation of the Maine EPSCoR *"Sustainability Science Initiative"* focuses on the development of collaborative linkages within the Maine EPSCoR Community and the related outcomes of these linkages. The evaluation addresses perceptions of faculty and students, as well as collaborative activities among faculty, between faculty and students, and between students. It also explores faculty relationships with external partners or users of EPSCoR-related research. This Annual Evaluation Report provides a summary and overview of the results from the data collection efforts for Year One of the Maine EPSCoR SSI evaluation effort.

This year's evaluation is primarily focused on the collection of baseline data that will allow the tracking of collaborative interaction and related outcomes over the next four years. ***As a result, this year's report is heavily formative and focused on developing baseline social network data and productivity data.*** Further, data collected at this early stage can provide insights to faculty and researcher concerns in the early planning stage of the grant. In the next four years of the evaluation, more attention will be given to productivity and outcomes of Maine EPSCoR SSI research and other activities. It is also important to note that the Maine SSI processes are dynamic and on-going. Thus, for example, outcomes and interactions that have occurred since the Year One survey of faculty was conducted are not captured in this report. Those outcomes will be captured in the next year's report and data processes.

### Evaluation Questions

This year's evaluation addresses a series of questions by means of survey and social network analysis methodologies. Evaluation questions addressed include:

- **Research production and capacity**
    - What communication, knowledge, and collaborative linkages currently exist among Maine EPSCoR faculty? To what extent are existing relationships the result of EPSCoR proposal activity or other EPSCoR related activity?
    - To what extent do social and collaborative ties exist across disciplines and institutions? What barriers to integration across disciplines and institutions are identified by researchers?
    - How knowledgeable are the Maine EPSCoR researchers about the expertise of others in the community?
    - To what extent have ties among EPSCoR affiliated faculty resulted in the production of outputs such as journal articles, conference presentation or grant proposals?
- **Preparing new researchers**:
    - To what extent do Maine EPSCoR faculty work with undergraduate and graduate students, and postdocs? To what extent do Maine EPSCoR faculty who are working with students produce journal articles and other outputs?
- **Stakeholder Integration and Outreach**
    - What are the anticipated barriers to working with external stakeholders? What incentives may increase productive interaction with external stakeholders?
    - In what ways do researchers in the Maine EPSCoR community plan to use new
    - cybertechnology to advance teaching, research and outreach? What barriers may matter for effective use of cybertechnology?

**Data Collection**

The primary data collection effort for this year's evaluation was a survey of Maine EPSCoR faculty that included attitudinal and self-reported activities, as well as information necessary and critical to conduct social network analysis of ties within the Maine community. Most survey questions were close-ended. However, a set of open-ended questions allowed for faculty comment and important qualitative data. Specifically, the survey included questions designed around the following themes:

- productivity and time allocation of Maine EPSCoR faculty.
- faculty perceptions regarding interdisciplinarity and interactions with other faculty
- experience with interdisciplinary collaboration among Maine EPSCoR faculty;
- barriers and facilitators to collaboration and interdisciplinarity in the Maine EPSCoR;
- barriers and facilitators to cross-institutional collaboration between University of Maine researchers and other partner institutions;
- prior collaborative interaction with faculty in other institutions, undergraduate students and graduate students;
- collaborative activity of faculty, frequency of communication, familiarity of faculty with others' areas of expertise, and production of collaborative interactions;

The faculty survey was administered on-line using Sawtooth Software from mid-December 2009 through January 2010. Surveys were administered to 85 faculty in all: 52 individuals who are affiliated with the University of Maine and 33 individuals affiliated with a total of 7 partner colleges and university campuses throughout Maine. Of the 85 total individuals surveyed, 74 responded (response rate of 87%). The response rate for the UM-SSI portion of the sample was 83%, while that of the other "Sustainability Solutions Partners" (SSP) was 88%.

**Key Findings**
The bulk of the report provides data and findings based on the survey and social network analysis. Main findings are listed below in three sections, one each for overview of faculty respondents, faculty perceptions and experiences and social networks. Detailed network maps and statistics are provided in the full report along with a discussion of the results.

### *Overview of Maine EPSCoR SSI Faculty Respondents*

In order to address several of the evaluation questions noted above, it is useful to understand the characteristics of the faculty associated with the Maine EPSCoR that responded to the survey. Based on the survey data, the following provides a general overview of survey respondents:

**Faculty Position and Institution**

- The ranks of Maine EPSCoR SSI respondents are equally distributed across different ranks – assistant, associate and full professor.
- Approximately 60% of faculty respondents are from the University of Maine.
- All SSP institutions are represented in the survey data.

**Faculty Discipline**

- Approximately 53% of all respondents work in the biological or environmental sciences, while 39% work in social science and 8% in engineering fields.

**Faculty Production and Time Allocation**

- SSI faculty allocate significantly more time to grant writing and research activities, while SSP faculty spend more time teaching.
- SSI faculty produce an average of 2.8 grants per year compared to SSP production of 1.2 grants per year, over the last five years.
- SSI faculty have also produced more publications and presentation in the last two years than do SSP faculty.

### *The Faculty Perspective: Collaboration, Interdisciplinarity and Engagement with Stakeholders*

The aims of these section are to understand the perceptions that Maine EPSCoR faculty have with regard to work climate, collaboration, and interdisciplinarity, assess prior experience working across institutions and with stakeholders, and to collect respondent thoughts about barriers to interdisciplinary collaboration, interaction with stakeholders, and use of new cybertechnologies. Based on the survey data, the following provides a summary of findings:

**Perception of General Work Environment**

- The Maine EPSCoR SSI work environment is perceived to be comfortable and stimulating. This holds true for respondents from both SSI and SSP institutions.

**Perception of Interdisciplinarity**

- The majority of Maine EPSCoR faculty members perceive the SSI project to be as or more interdisciplinary as other research projects they know about.
- Survey respondents indicate strong preference for working across disciplines, and perceive their fields and departments to be supportive of interdisciplinary work.
- Over 90% of both SSI and SSP faculty believe the benefits of interdisciplinary research outweigh the costs.
- While Maine EPSCoR faculty identify numerous barriers to interdisciplinary collaboration (academic culture, communication, methodological and theoretical differences, familiarity and understanding, and resource and institutional issues), these expectations are not perceived in a negative light.

**Cross-Institutional Environment**

- SSI and SSP Respondents indicated much higher levels of prior collaboration experience with academic researchers outside the state than in the state.
- There is very little prior experience working with Native American communities among faculty respondents. However, there is substantial experience working with non-profit organizations (SSI and SSP) and private firms (SSI).
- Faculty have substantial experience working with students, although SSI faculty work more with graduate students and SSP faculty work more with undergraduate students.
- Faculty identified several barriers to inter-institutional collaboration: different cultures, interests and incentives, knowledge and familiarity with researchers, and logistical and distance barriers.
- Barriers to interaction with stakeholders included different goals, expectations, and incentives as well as issues related to resources and the logistics or interactions.

**Plans for Use and Barriers to Use of Communication Technologies**

- Approximately 34% of faculty have used video or teleconferencing technologies.
- Use of these technologies were primarily planned for meeting and coordination with other researchers for project activity. Few faculty recognized potential for using the technologies for research or teaching. About half of the respondents indicated no planned use.
- Three general types of barriers to use were reported: technical, logistical, and level of comfort / effectiveness.

### *Maine NSF EPSCoR SSI Faculty/Researcher Networks: Familiarity, Communication, and Collaboration*

The central purpose of NSF EPSCoR is to increase capacity of researcher, institutions, and students within EPSCoR states. Relying on studies that address social, human and technical capital of researchers, the evaluation incorporates a series of social network analyses to address capacity development and related outcomes. This section of the report presents network baseline results regarding the familiarity of Maine researchers with each other, communication among Maine researchers, and existing and early collaborative outcomes within the Maine EPSCoR community.

**Overall**

There are a number of issues regarding the nature of linkages and interaction among Maine EPSCoR researchers that are important in developing a strong collaborative community.

- Baseline ties among Maine EPSCoR faculty and researchers are almost exclusively within SSI or SSP groups. There is very little early or existing interaction across groups.
- Almost all networks are generally well integrated across faculty/researcher rank *(assistant, professor, full, and other researchers)*
- The level of existing cross disciplinary linkages among EPSCoR faculty will need to increase in order to accomplish Maine SSI goals.

**Familiarity and Communication**

- There is a high level of basic familiarity among Maine researchers, but is not reflected in collaborative interaction necessarily.
- The Maine SSI proposal process served as an introductory mechanism for a large proportion of Maine researchers.
- The Maine EPSCoR researcher community has a high level of "close" and "collegial" relationships, suggesting a strong foundation for building a collaborative community.
- Exiting levels of familiarity among researchers may ease the development of collaborative ties, especially within SSI institutions.
- Cross SSI-SSP institutional familiarity is limited.
- Regular, daily communication is limited and strongly institution-based.
- Increased communication and familiarity is expected to increase as Maine SSI develops.

**Collaboration**

- Collaboration within the EPSCoR faculty community on research proposals and conference papers shows important early collaboration in building collaborative groups in Maine EPSCoR.
- Existing collaborative ties suggests some activity that will expect to increase in the following year(s).
- Existing and early collaboration linkages among Maine researchers provide a foundation for continued and early collaborative outcomes.
- Cross SSI and SSP collaborative linkages are limited to small clusters in proposal activities, but also in other collaborative exchange (below).
- Some early collaborative activity exists within SSP, showing the development of some research groups in Maine SSI.
- Important exchange of knowledge resources among a larger number of faculty than is evidenced through collaborative production suggests important collaborative activities.

Maine faculty indicate that *knowledge resources*, and some infrastructure-related resources are received from their Maine EPSCoR collaborators. Most of the linkages between SSI and SSP have little limited knowledge *ex*change.

**Recommendations**

The following is a summary of the recommendations provided in the evaluation report. Additional detail for each is provided in the full report. The recommendations are based on the data analysis contained in this report. They are intended to be advisory to the Maine EPSCoR

SSI management and will hopefully be a basis for discussion on the future direction of the SSI project. Because the scope of the evaluation covers the course of five years, these should be viewed as preliminary and formative within the evaluation context. In subsequent years, they will be merged with other data gathered in additional data collection processes.

Based on initial and early observations regarding issues that may cause barriers to Maine EPSCoR's meeting its goals, we offer the following early recommendations. These are designed to assist Maine EPSCoR in its development.

## 1. Address Issues Raised by Cultural and Institutional Barriers to Cross Institutional Collaboration

Evaluation results indicated a clear separation in both personal and collaborative networks across institutions of higher education in Maine. Close ended survey questions also showed that activities conducted by researchers in both environments are different. Finally, open ended survey questions identified specific barriers to cross institutional interaction. These differences have existed for a long period of time. However, to build capacity in the state and implement the vision of the sustainability science center, stronger productive collaborative interactions must be developed across academic institutions.

To this end, we suggest proactive efforts to engage faculty on both sides. Perhaps this could take the form of a meet and greet reception, or a half day workshop that brings potential collaborators together with the primary objective of raising familiarity. We suggest that even though University of Maine makes up the majority of the faculty and is, to that extent central to the project, University of Maine faculty should reach out more and probably travel more to other campuses for these kinds of activities.

In addition, we suggest that Maine EPSCoR SSI management consider carefully the survey responses contained in this report when it develops research funding opportunities and sets expectations for researchers in SSP institutions.

## 2. Interdisciplinary Capacity Development

The survey uncovered similar although less significant barriers to cross disciplinary integration than noted above. To some extent, issues related to the barriers to working across groups are linked to cross institutional collaborative barriers. Overall it appears that there is a strong interest and experience already within Maine EPSCoR for conducting cross disciplinary work. It may be useful in addressing cross institutional barriers, that the barriers to cross disciplinary work also be acknowledged in discussions and activities designed to promote these interactions. In particular, some comments addressed the importance of identifying and agreeing upon cross disciplinary research questions. In order to maximize the on-going cross disciplinary integrative work, increased interaction and discussion around research plans and ideas should facilitate cross disciplinary synergies.

### 3. Address issues Raised by Low Interest in Using Cybertechnology

Because communication across academic institutions and with stakeholders who are often in different locations are key to the success of the Maine EPSCoR project, and because Maine has received additional funding for cybertechnology infrastructure, the Maine EPSCoR SSI management should give particular attention to addressing comments and concerns about the technology from faculty respondents at both SSI and SSP institutions. A large proportion of faculty have no plans to use video or teleconferencing technology. Yet many also do not recognize potential uses for teaching and research. It is likely that lack of awareness about potential uses is one reason why plans are limited. Additionally, faculty recognize limitations of reliability and access as the primary barriers to use.

Therefore, as Maine EPSCoR SSI begins to deploy the availability of technology, it must consider that adoption is a complex social issue that requires faculty to both see the need or opportunity and have confidence in their actual ability to access and use it conveniently. Management should consider identifying individuals who use the technology on a regular basis for research and teaching and provide demonstration workshops or other mechanisms to increase perceptions of need and opportunity. In addition, substantial testing and demonstration of the reliability, as well as strong training and informational resources must be in place before the technology will be more widely adopted.

### 4. **Establish Incentives to Encourage Outreach to Stakeholders, and Integration of Stakeholders**

Faculty respondents identified a number of potential barriers to interaction with stakeholders. And while few faculty and researchers currently involved with Maine SSI have experience working with Native American communities, there is a substantial level of experience working with non-profit organizations, government and private firms among the researchers on both campuses. This suggests that faculty have some capacity for working with external partners which should ease some of difficulties in establishing these interactions, while also providing guidance to those Maine faculty with less external experience.

Given the importance of integrating external stakeholders in the SSI vision, it may be useful to develop institutional mechanisms that identify interested stakeholders, create incentives for their involvement and assistance, and promote these opportunities within the faculty. While the evaluation will collect data that will be useful in the next year and provide insight to interactions, outcomes and any issues in external stakeholder collaborations, Maine EPSCoR should also consider assigning a deliberate set of activities and responsibilities in this regard. Similar to cross institutional collaboration, interaction with stakeholders may require some deliberate attention as it may not evolve organically on its own. Maine EPSCoR should work to refine and maintain its database of external stakeholders (using the evaluation process as an annual update for these external ties), as well as engage in a dialogue and assistance to facilitate faculty and researcher interaction with external partners.

While this represents a potentially high administrative cost, done early in the project, it would create dividends in later years. We expect that having a series of specific activities early in the

project will require less centralized assistance as faculty develop their own capacity to work with external stakeholders.

5. **Continue to Develop the Student/Faculty/External Stakeholders Database.**

Maine EPSCoR staff has taken some important first steps in creating and a contacts database for students, faculty, and external stakeholders involved with EPSCoR. In order to facilitate future years of the evaluation, particularly the development of longitudinal data, these data must be as complete as possible. The evaluation team will continue to work with Maine EPSCoR to refine this database.

**Maine NSF EPSCoR Research Infrastructure Award EPS 09-04155**
**Maine's Sustainability Science Initiative**

## APPENDIX 11: SSI Advisory Board Report

### Advisory Board to the University of Maine Sustainability Solutions Initiative

### Summary Notes, Meeting of Dec. 15, 2009

In meeting each other on the Board, we discovered our enthusiasm for the project, most of all for the dedication to address significant Maine sustainability problems at the nexus of change in climate, forest management, and urbanization and to move solutions to these problems into action. The involvement of the State and the major higher education institutions, the significant funding, the initial five-year grant period, the involvement of the natural and social sciences, and of scholars, practitioners and stakeholders also attracted the individual members to serve on the Board.

Through our opportunities to explore the current portfolio of research projects with the involved scientists, to meet informally with available faculty and students, and to interact with the Stewardship Council, University leadership, and particularly David Hart, we reaffirmed our initial enthusiasm, while identifying a substantial set of concerns. In the notes that follow, we list these concerns and some suggestions as to how these may be addressed. In doing so, we readily note that many of these concerns are shared by the Initiative leadership and faculty, and efforts to address some have been well underway.

In particular, we use the 14 funded research projects as a guide to understanding current Faculty Initiatives: the larger project framework, the problems addressed, the projects proposed, and the functioning of the Initiative. We do this cognizant of some constraints on the set of projects: the limited time to develop projects, to get to know team members and how they think about research, the limited funding for these initial projects, the needed students and new colleagues still to be recruited. But within these limits, the projects still reflect direction and thinking and our comments given directly to team members come early enough to allow further project development.

**Alternative futures, interactive trends**

Given that SSI's mission is framed in terms of promoting pathways towards sustainable development, there was strong agreement on the need to produce alternative visions of those pathways. To explore these, there are readily available methods that include scenario construction, interactive modeling of the three major trends, and participatory stakeholder and citizen dialogues. Much available material both within the State and in the region can contribute to such efforts. But the projects that come closest to supporting scenario construction and interactive modeling, the Socio-economic Models of Maine and the Conservation Lands Priority would need to both expand and work together, incorporating support from the other groups.

**Problems addressed, solutions envisaged**

So what problems seem to be addressed by the collection of projects, what kinds of solutions are envisaged? Consider some of the big long term State problems related to SSI's major trends: the persistence of the two Maines, the future of the north woods, the next generation of jobs, the opportunity for a renewable energy industry. At best these are nibbled at and only in a few projects. Or if we consider some problems that are current issues related to the big problems, the projects hardly address any of these. These issues include where to locate transmission lines or wind power, how to create and

sustain a biofuels industry, what management criteria should the Land Use Regulatory Commission use or should serve as principles for the Great Maine Forest Initiative, or how to adapt to climate changes already underway. Similarly, there are few solutions envisaged. The projects on Mercury and Fish Consumption, Vernal Pools Protection, and Conservation Lands Priorities come closest to providing specific solutions.

We suggest that within a framework of alternative futures, a small set of major State problems be identified that relate to the long-term interactive trends of change in climate, forest management, and urbanization. Each of these should be briefly described, and current issues, formal processes, and community dialogues related to them noted. This should be updated over time. In posing these problems, the multiple, competing community goals need to be identified, such as developing a diversified economy and conservation. The current portfolio of projects seems weak on development needs, yet it is precisely help in achieving such balance that might be most useful to such undertakings as the Great Maine Forest Initiative.

While major attention needs to be directed to the big problems, current issues also need to be addressed, especially those salient to decisions that will be made. It is important for SSI to have interim results that provide solutions to current problems. Linking the two, a gap analysis might help. It is also important that SSI be represented in the formal processes, and community dialogues underway, if only to offer help related to the major problems to which it is committed. A capability to be present, offer testimony, and respond to special needs, should be developed beyond the constraints that make faculty participation difficult. We note that none of the current portfolio of projects seem to have been asked for by potential users, except the vernal pools project, and only after towns were introduced to their capabilities.

**Initiative functions**

We see three major needs in how the Initiative functions. The first is the need to move quickly beyond the initial starting places with a major shift in planning effort. None in the portfolio of projects seem to be new, all seem to be extensions of existing work, albeit combining previous work from the many impressive individuals involved. While there is strength in building on what research faculty best know to do, SSI must move quickly over the next six months. Now that the projects are underway. project PIs should be asked to more clearly articulate how the projects are situated within the SSI Maine-based futures framework (see above), how they might be scaled-up, and which projects can be conceptually merged.

The second is the need to achieve much greater interactions than are currently visible, We perceived both significant efforts at interdisciplinary collaboration within teams and a major lack of more extensive integration between teams or with potential stakeholders. We were surprised by how little integration effort there was in preparing the projects, and it is unclear how sustained interaction can be maintained for addressing the iterative character of linking knowledge with action. We think it might be valuable (if not already done) to study the mechanisms used by successful interdisciplinary groups on the Maine campuses such as various IGERT projects or the Climate Change Institute and we encourage Board members to share their experience with their own institutions with SSI.

Our third need is related to data and informatics. The Initiative has many novel aspects beyond its goals (emphasis on communication and communication technology, research on research), but seems to have underestimated needs for novel action on data and informatics. Data storage and access may become one of the major long-term contributions of the Initiative as it brings together the many diverse but existing sets of data related to changes in climate, forests, and urbanization into a common spatio-temporal platform, as it creates decision support tools and interactive agent-based models to both

stimulate and simulate action, and uses its new, more integrated models to answer questions and explore Maine's alternative futures. To do so will require thought as to what to save, how to access it, which new staff, software and hardware. Early plans should include links to the new advanced internet connections. To consider the scale of effort, a Board member from an institution devoted to urban ecology cited their budgeting of about 13% of their $1.5 million budget for these needs.

**Initiative Future**

Finally, we thought that it was not too early to begin discussion of the Initiative's future. Looking forward, it's important that SSI think about how it will decide whether it has been successful five years out based on the results of its funded projects. It would be helpful to define some criteria that will be use to evaluate success and to judge how individual projects contribute to that progress. Among such criteria should be a focus on solutions and their movement into action. But we are also concerned with internal criteria and concern was expressed with, for example, how junior faculty members will be evaluated for their interdisciplinary work.

It was also not too early to address the roll-out of the products (problem solutions, analyses, models, data bases, information), how to make these publicly accessible, useful for decision makers, suitable for K-12 curricula, and to inform the media and general public.

Nor is it too early to think beyond the five-year grant period. Perhaps the major product of a successful Initiative will be the opportunity to address the long term challenges of the State with new models, data sets, and interdisciplinary insight to both enrich the ongoing efforts that link to the goals of SSI and to create new sustainability solutions. Creating a home for this capability, supporting it over time, and demonstrating and encouraging its use is a solution to be sustained.

APPENDIX 12: Maine's 5-Year Cyberinfrastructure Plan

# Growing Maine's Cyberinfrastructure 2010-2015

***Reaching a sustainable position of cyberinfrastructure crossroads of the world with a revenue stream and an educated workforce to sustain it***

Cyberinfrastructure is as important for research, development, education, clinical and economic activity in the 21st century as traditional infrastructure (roads, bridges, trains, airports) was in the 20th. Any cyberinfrastructure plan needs to address three key areas, namely, ***advanced networking, high performance computing, and collaborative applications***. Like traditional infrastructure, Cyberinfrastructure is important because of what it enables.

- Helps people "be there"
  - Remote collaboration
  - Sharing data in real time
  - Telemedicine
- Helps make effective use of scarce resources
  - High performance microscopes
  - Massive computer facilities
  - Specialized medical equipment
  - Particle accelerators
  - Telescopes
- Helps perform the "impossible"
  - Molecular level modeling
  - Climate/weather prediction over years or centuries
  - Remote surgery
  - Virtual prototyping
- Computation, data storage, data movement, visualization
- With the right cyberinfrastructure location doesn't matter
  - Virtual field trips
  - Accessibility to Advanced Placement courses
  - Statewide Student Information Systems
  - Crosses political, social, and economic boundaries

GOALS: Sustainable High performance computing, networking and educated IT workforce for research, education, and economic growth in Maine

# Growing Maine's Cyberinfrastructure

## Step 1: Planting the seeds (completed)

### Advanced Networking

- Fiber connectivity allowing data rates: tens of billions of bits per second WITHIN Maine,

hundreds of millions of bits per second (shared) connectivity to outside Maine

- Fiber optic backbone from Bar Harbor to Portland
    - Connect major Research and Education entities along path
    - Leverage existing, unused fiber optic capacity already deployed but unused
    - Multiple companies have fiber deployed along I-95 corridor between Portland and Bangor
- Fiber optic connection between Portland and Boston

### High Performance Computing

- High Performance Computing center at Target Technology Center
    - 512 core cluster computer
    - 64 core shared memory computer
    - Several small clusters
    - Visualization server
    - 144TB NAS for data storage
    - Dedicated Fiber optic connection to the University of Maine
    - Tiled visualization wall
- Supercomputing center at The Jackson Laboratory
- Smaller cluster computers (public and private) around the state

**Applications/users**

- Laptop computers for all middle school teachers and students and half the high schools
- Broadband internet connectivity for all schools and libraries (10 Mbps minimum)
- Active Computer modeling research programs
    - Marine Science
    - Chemistry
    - Physics
    - Blood flow
    - Hypersonic missiles
- Increasing  number of researchers who use computer models,
    - Demand for compute time is increasing by a factor of 4 per year
- Online college courses
- ITEST program links middle school laptops, computer modeling, and large scale visualization
    - Inquiry based learning
    - Teamwork involving students and their laptops
    - Planetary-wide experimentation involving many thousands of years
    - Students choose parameters and see the effect on climate
    - Safe, hands-on experimentation and teamwork using Cyberinfrastructure
- Multidisciplinary REU program in high performance computing
    - Undergraduates creating the next generation of tools for their academic area
    - Emphasizes the cross disciplinary nature of high performance computing
- 
- Expanding cyberinfrastructure training for educators and researchers
    - National and International Speakers
    - Workshops
    - University Courses
    - Webinars

# Step 2: The seeds sprout

**High Performance Computing (2010-2012)**

- Build a 20 TFLOP cluster computer with funding from the State of Maine, NSF, NIH,and NASA
    - Locate at UMaine (Neville Hall data center) to augment the existing cluster computer at Target Technology Center
    - Follow NSF cyberinfrastructure model
        Compute cluster is free for Maine researchers and businesses
        Extra cycles are available to TeraGrid

- Lease a portion of available data center space at Target Technology Center to commercial entities
    - Data center space is in short supply and absolutely essential for Maine
    - Data center space is costly
    - Data center space requires uninterruptible power and cooling

- Data center space requires high bandwidth connectivity
- Proceeds from lease agreements pay operating costs/administration of Supercomputer center
- Focus on Maine Companies, e.g., L.L. Bean, Sewall Company, DeLorme, Idexx, Hanaford, etc. because of the high connectivity that will be created in Maine

**Advanced networking (2010-2012)**

- Establish fiber optic border crossing to Canada
  - Houlton, Maine to Woodstock, New Brunswick (border crossed 7/30/2010)
  - Tie INTERNET2 and CANARIE together in Maine
- Maine will not be the "end of the road" for the US, but the "gateway to the world"
  - Maine can link the eastern provinces to the rest of Canada through Boston
  - Current connections go around Maine to the north and via submarine cable from Halifax to Boston
- Three Ring Binder Project (funded 12/2009) to provide 1100 miles of middle-mile fiber
  - Community anchor institutions
  - Schools and libraries
  - Build condominium fiber optic infrastructure into eastern, western, and northern Maine
    South western Maine
    - Farmington, Kingfield, Rumford, etc.
      - Work in conjunction with FCC RHCP Program
        - Rural and Western Maine Broadband Initiative
- Northeast Cyber Consortium (RII Track 2)
  - Maine coast from Portland to Ellsworth
    Brunswick, Rockland, Belfast, etc…
  - Northern Maine
    Millinocket, Houlton, Presque Isle, Fort Kent, etc.

**Applications/Users (2010-2012)**

- Sustainabable Science Initiative (RII Track 1)
  - multidiciplinary research team
  - virtual organizaion involves all higher education in the state
  - various levels of cyber-expertise
- Maine Institutions create data cooperative
  - Distributed backups of data mean no loss even in the event of a catastrophic failure at a site.
  - Computer resources are shared for the benefit of all
- Virtual field trips
  - School classes can "visit" places throughout the state without leaving the classroom
    Jackson Laboratories
    University of Maine
    Other research facilities
    Hospitals
- Virtual doctor visits

    - Patients at rural hospital can receive care from doctors at urban hospitals without the stress of a long ambulance trip or helicopter flight
    - Doctors can spend time treating patients rather than driving to remote hospitals
- Virtual tourism
    - Maine attractions are made available throughout the world via high bandwidth feeds
        Acadia national park
        Coastal areas
        Maine aquarium
- Virtual Corporations
    - Telecommuting
    - Maine businesses without physical space for employees

# Step 3: The seedling grows

**Advanced Networking (2010-2013)**

- Extend condominium fiber optic infrastructure across eastern and western Maine
    - Leverage envisioned east-west Transportation, Utility & Communications Corridor
        Calais, Dover-Foxcroft, Coburn Gore, etc…
    - Connect with New Hampshire BTOP funded infrastructure Project, Network New Hampshire Now, to create regional interconnectivtiy
- Establish condominium fiber optic border crossings to Canada
    - Connect Montreal to Halifax across Maine

**Applications/Users (2011-2013)**

- Significant growth in regional and international research
    - EPSCoR Track II for northeast region
    - Closer ties with University of New Brunswick
    - Closer ties with Dalhousie University
- Laptop program expands to the rest of the high schools
    - Lab-based courses conducted using cyberinfrastructure
    - High performance in-classroom visualization becomes routine
    - Students become familiar with basics of programming and modeling as a matter of course.
- Federated identity management
    - Join Incommon federation
    - eases regional collaboration

# Step 4: Blossoming

**The Old Maine becomes the New Maine (2013-2015)**

**High Performance Computing (2013-2015)**

- Major low carbon footprint data center ("The Data Mill") at a paper mill
    - 100,000+ sq ft of useable space
    - Secure site
    - Power generation onsite ( < $ 0.06/KW-Hr)
    - Cooling
        - cooling facilities onsite greatly reduce the air conditioning costs
        - River water, evaporation towers
    - Fiber entrances from Data Mill to Three Ring Binder middle mile routes
    - Datacenter space made available at $100/sq ft/month
        - much less than national average
    - Major data corporations move to Maine
        - e.g., Google, Yahoo, Youtube
    - Offsite backup
    - Disaster recovery
    - With Cyberinfrastructure data center can be anywhere
- Datacenter operations migrate from Target Technology to "The Data Mill"
- Data Center Space in Target is re-claimed to double the size of the information technology incubator (owing to increased demand)

**Applications/Users (2013-2015)**

- Healthcare to the home
    - Remote monitoring
    - Video consultation
    - E-Prescriptions
- Sharing of Medical Images via picture archiving and communication systems (PACS)
- Electronic Medical Records
    - HealthInfoNet (statewide electronic clinical information sharing network)
- Emergency Management
    - Pandemic response coordination
    - Natural disaster

# Step 5: Bearing Fruit

**Sustainable position(2015)**

- Revenue hits $10M/month ($100/sq ft *100,000 sq ft)
- Costs hit $8M/month (power, space, cooling)
- Remaining $24M/yr reinvested for sustainability and growth
    - System administrators
    - Programming experts
    - Student research assistants
    - Computer modernization
        - retire Neville Hall computer, replace with 1000TFlop machine
    - Research support

- Telepresence allows meaningful collaboration across distance
    - Virtual organizations
    - Shared support staff
    - One teacher for a class in several towns
    - Consolidate faculty and administration without bussing students long distances every day.
- Maine becomes a haven for IT companies
- Trained workforce
- Quality of life
- Good (and sustainable) infrastructure
- All Maine residents use cyberinfrastructure in their daily lives
- Maine graduates are computer literate and technologically savvy
- Computer modeling significantly improves safety, cost, and timeliness
- Maine is a "cybercenter" of economic activity

Maine NSF EPSCoR Research Infrastructure Award EPS 09-04155
Maine's Sustainability Science Initiative
APPENDIX 13: Organizational Chart