Full proposal abstract

Climate change poses serious threats to coastal communities, including the possibility of prolonged and repeated flooding, intensified storms, saltwater intrusion into marshes and farmland, coastal erosion, and destruction of important infrastructure. There are ways in which communities can decrease their vulnerability and enhance their resilience in the face of these risks, but only if they can reach agreement on what to do. Seeking to support coastal communities in building consensus around climate change adaptation strategies, we propose to test a new approach to educating the public about climate change risks and catalyzing collective climate change adaptation action. In the process, we hope to broaden and deepen prevailing theory about collaborative decision-making in science-intensive public disputes.

Working collaboratively with partner communities in four New England states, we will conduct stakeholder assessments and risk assessments. Drawing on the findings of these assessments, our research team will work with NERRS staff and intended users to develop tailored, science-based role-play simulations for each partner municipality. At each site, the research team and partners will run multiple role-play simulation workshops with carefully selected local officials and local leaders, as well as general residents, in an attempt to catalyze greater public awareness of climate change adaptation options and the reasons for pursuing them. We will then work with local partners to measure the extent to which this process of public engagement catalyzes shared understanding and collective climate change adaptation action. We will do this by employing before-and-after surveys and in-depth interviews with simulation participants, as well as public debriefings with key stakeholders and elected officials. Simultaneously, we will work to initiate and support collaborative climate change adaptation planning efforts in each partner community.

The findings of this project will provide valuable insights into techniques for effectively engaging communities in public learning, risk management, and collaborative decision-making around science-intensive public disputes. We believe that role-play simulations offer a promising new way to engage citizens and other stakeholders in collaborative planning, and are eager to test this assumption with NERRS partners and coastal communities. It is our expectation that, beyond enhancing the suite of engagement tools available to NERRS and other organizations across the country, this project will directly help coastal communities across New England respond more effectively to climate change risks.

Full proposal narrative

1. Coastal Management Problem

Coastal areas face a variety of risks due to climate change, including possible impacts from sea level rise, increased storm intensity, subsidence and shoreline erosion, saltwater intrusion into freshwater wetlands, drought, new disease vectors, and increased temperatures (IPCC, 2007; USGCRP, 2009). Such impacts will pose significant challenges for land use planning, habitat preservation and restoration, and storm water and pollution control in affected coastal regions.

Although we can identify the possible risks and related consequences facing coastal areas, we cannot forecast which particular impacts will materialize in each location, and when and to what extent they will do so. For this reason, precautionary measures aimed at reducing municipal vulnerability and enhancing local resilience ought to be underway in all at-risk coastal areas in the US and elsewhere. Similarly, efforts to plan for and adapt to climate change should be integrated into everyday coastal planning (Rosenzweig and Solecki, 2001; Tobey *et al.,* 2010).

There are many 'no-regrets' investments and regulatory changes that coastal communities can make to reduce their vulnerability to climate change risks and enhance the resilience of social and ecological systems. However, these actions will require making public decisions amid considerable uncertainty (Susskind, 2010). Effective adaptation will also necessitate coordination among diverse stakeholders, including state and local officials along with private property owners and resource user. Additionally, in many cases adaptation will entail difficult tradeoffs among competing interest (Few *et al.,* 2007a, 2007b). Given that coastal communities will need to gain widespread support for difficult decisions in the face of uncertain science, climate change adaptation is, in many ways, an unprecedented challenge that will require innovative approaches to municipal and regional planning (Susskind, 2010).

Consultation with New England National Estuarine Research Reserve System (NERRS) staff and discussions with New England town officials indicate that many coastal New England communities are concerned about climate change risks; this finding is supported by results from workshops and needs assessments conducted by local NERR sites, such as the 2010 "Planning for Community Climate Change Adaptation" workshop delivered by the Narragansett Bay NERR and partners, the Great Bay Climate Summit held December 2011, and an in-process needs assessment being conducted by the Waquoit Bay NERR. Accordingly, many public officials are eager to conduct vulnerability assessments and to develop adaptation strategies for their towns and municipalities. However, as is the case in coastal communities throughout the US and internationally, various stakeholders throughout New England—including local elected and appointed officials, federal and state agency personnel, environmental advocacy groups, businesses, property owners, and many others—disagree about whether remedial or anticipatory actions can and should

be taken. Even where stakeholders generally agree that climate change risks ought to be addressed, they attach different levels of priority to specific adaptation options. This lack of agreement about climate change adaptation is further complicated by the fact that many communities in the US and elsewhere lack the information they need to make informed, long-term planning decisions; the capacity to incorporate climate change adaptation into on-going infrastructure and land use planning; or the political will to act (Few *et al.,* 2007a, 2007b; Susskind, 2010)*.* These challenges must be addressed if effective climate change adaptation is to proceed in New England and elsewhere.

2. Project Overview

To overcome these obstacles to adaptation action and to build widespread support for coordinated adaptation efforts in the face of uncertainty, we believe that, as argued by Susskind (2010), coastal communities will need to:

1. Generate increased public awareness and understanding of the climate change risks facing coastal communities and their surrounding ecosystems;
2. Engage large numbers of stakeholders in collaboratively thinking through possible risk management strategies;
3. Create appropriate forums for building agreement among stakeholders with conflicting views and interests; and
4. Employ innovative risk management techniques, such as scenario planning, that move away from traditional forecasting methods.

National Estuarine Research Reserves are well positioned to "help communities understand and adapt to anticipated local and regional climate change impacts" (NERRS, 2011: 5). They are also uniquely situated to play a role in catalyzing and facilitating the public education, engagement, and consensus building efforts needed to achieve the above-stated goals. However, to effectively do this, they will need a new set of tools and skills for educating the public about climate change risks, engaging diverse stakeholders in science-intensive decision-making, and building agreement across diverse stakeholder interests. In light of this need, the MIT Science Impact Collaborative (SIC), the Consensus Building Institute (CBI), and the Coastal Training Program (CTP) Coordinators from Waquoit Bay Reserve, Great Bay Reserve, Narragansett Bay Reserve, and Wells Reserve propose to work with four partner New England towns—Barnstable (MA), Dover (NH), Cranston (RI), and Wells (ME)—to design and test a new approach for catalyzing and facilitating collective action on adaptation in coastal communities. Along the way, we aim to build the capacity of NERRS staff in New England and elsewhere to help coastal communities plan and prepare for climate change.

Our proposed two-year research effort will have five overlapping phases, each with related objectives:

1. *Phase I: Assess risks and identify opportunities for and obstacles to climate change adaptation*—Based on our review of work that has already been done in the four partner communities (see more about these municipalities in Appendix 1) and meetings with local officials, community leaders, and knowledgeable climate change experts, we will prepare a summary risk assessment for each partner community. These assessments will highlight critical vulnerabilities as well as opportunities to enhance local resilience in the face of potential climate change impacts. Each assessment will draw on a) existing data sets that have already been developed through use of general circulation models (GCMs) to forecast likely levels of climate change in New England, and b) existing geographical grid-based projections of precipitation, temperature, and other climate variables that have been produced on a 20 square mile basis for most of New England (see Frumhoff *et al.*, 2007; Wake *et al.*, 2011).

   With these risk assessments in hand, we will prepare stakeholder assessments (or 'conflict assessments') (Susskind *et al.,* 1999) for each town. These will allow us to understand possible impacts of climate change on diverse stakeholders in each community, stakeholder views of adaptation and the intensity of their concerns, and potential barriers to climate change adaptation action. To produce these assessments, we will interview a carefully drawn sample of community stakeholders to determine their understanding of and views about the climate change risks identified through the summary risk assessments, as well as their attitudes toward adaptation planning. To assist with these assessments, we may also solicit stakeholder input through use of a non-randomized informal electronic survey. In each town, the stakeholder assessment will help us identify the most important groups and individual to involve in the following phases of our research.

2. *Phase II: Catalyze greater public awareness and build understanding through tailored role-play simulations*—Drawing on the assessments produced in Phase I, the research team will develop science-based, multi-stakeholder negotiation role-play simulations for each partner community. These simulations will be carefully tailored for the local context and designed to teach participants about the climate change risks and adaptation challenges identified as most important in each community. Depending on the needs of each partner town, these simulations will, in accordance with the RFP focal areas, emphasize land use planning, habitat preservation and restoration, storm water management, and/or pollution control. Each role-play simulation will ask residents to imagine how their community might respond to a specific set of climate change risks given a) limited resources, b) diverse and often conflicting interests and perspectives of different stakeholder groups, and c) high levels of uncertainty.

   In each locality, we will engage a range of stakeholders in multiple climate change adaptation workshops, during which stakeholders will participate in the tailored simulations. Participants will include carefully selected

stakeholder representatives identified through the stakeholder assessments conducted in Phase I, key government officials and agency personnel, and other town residents. We will use the role-play simulations to introduce stakeholders to relevant climate change risks, potential adaptation strategies, and possible methods of reaching agreement on adaptation in the face of different views about risk and risk management. Simulations will also demonstrate how consensus building (Susskind and Cruikshank, 2006) and scenario planning (Van Der Heijden, 2005) may be used to deal with uncertainty and conflicting interests. In each partner town, we anticipate engaging 100-200 stakeholders in these adaptation workshops. Some workshops may be organized in the evenings in conjunction with regularly scheduled organizational meetings. Others may be special weekend events. At each session, SIC and NERRS staff will jointly facilitate the simulation sessions and informal debriefings.

Role-play simulations are experiential, immersive learning tools that can be used to help individuals understand complex science-intensive policy-making situations (Bousquet *et al*., 2002; MaKinster, 2010), to begin to build consensus among diverse stakeholders about possible courses of action (Innes and Booher, 1999), and to foster social learning (Pahl-Wostl and Hare, 2004). SIC has used climate change-oriented role-play simulations in Massachusetts, Maryland, and Louisiana to enable officials and community leaders to anticipate and overcome the problems they are likely to face in seeking agreement on climate change adaptation strategies (see Susskind and Paul, 2010). Our intent in running these simulations with a carefully selected group of stakeholders, public officials, and citizens in each partner municipality is not to help stakeholders reach agreement on what they might actually do to address the risks of climate change. Rather, our goal will be to model how a community might go about reaching an informed consensus in the face of scientific uncertainty. Participation in the simulations is intended to increase public understanding that climate change risks are significant, and that there are many no-regrets strategies municipalities can use to reduce their vulnerability and enhance their resilience to climate change impacts.

Previous research indicates that social norms and “collective patterns of thinking” play an important role in determining whether communities take action on climate change (Norgaard, 2011), a finding that is backed by longstanding arguments that social norms heavily influence both individual and collective political behavior (Elster, 1989). Building on this body of work, we anticipate that engaging influential actors and key individuals (i.e., those responsible for incorporating climate change concerns into everyday decision-making) in each community in thinking through the dynamics of climate change adaptation and the importance of collective action will create a new social norm, which in turn may inspire collective adaptation action. Our goal is to establish climate change adaptation planning as “an idea in good currency” (Schon, 1971) and a “collective pattern of thinking” (Norgaard, 2011) in each partner community. Additionally, by introducing the general public to the science of climate change and the dynamics of collective risk management

decision-making, we hope to build the capacity of the citizenry—who have a stake in whether and how their community plans for climate change—to meaningfully participate in local level action on climate change. It is our belief that if enough of the right people in each community play these "games," there will be sufficient pressure to initiate actual climate change adaptation efforts. One of the main goals of this research is to test this hypothesis.

3. *Phase III: Engage stakeholders in collaboratively thinking through climate change adaptation options*— As stated above, we anticipate that the simulation workshops will trigger an interest in organizing actual community-wide, collaborative adaptation planning efforts in each partner community. To assess whether this is correct, we will conduct debriefings with selected workshop participants and public officials 18 months into this project and again at the end of the second year. If we sense any interest in undertaking coordinated adaptation efforts, staff from CBI and SIC will work with local decision-makers and NERRS staff to explore ways of structuring and initiating a comprehensive adaptation planning effort, as well as ways of incorporating climate change considerations into regular land use, regulatory and infrastructure investment decisions. Members of our team and colleagues at CBI have significant experience supporting local level adaptation efforts, and are well prepared to guide communities in thinking through how to engage in collaborative, comprehensive adaptation planning, should interest in moving forward with adaptation emerge from participation in this project.

4. *Phase IV: Analyze the effectiveness of role-play simulations as an educational tool and as a catalyst for climate change adaptation efforts at the local level*—At each role-play simulation workshop, we will administer before-and-after surveys to track changes in individual awareness and attitudes toward climate change risk and possible adaptation strategies. One to two months after each workshop, we will arrange one-on-one in-depth interviews with about a quarter of the simulation participants in each town to examine whether there have been any longer-term changes in their understanding of climate change risks, their perceptions of the importance of adaptation, their beliefs about how their community should plan and prepare for climate change, and their willingness to support and/or get involved in adaptation activities as a result of their participation in the simulation. Findings from the participant surveys and the in-depth interviews will be compared to findings from a survey of a matched control group in each of the four partner communities to help isolate the effect of participation in the role-play simulation. These data will allow us to determine the effectiveness of role-play simulations as a tool for educating stakeholders about climate change adaptation and heightening public support for adaptation efforts.

   To gauge the impact of these efforts on actual adaptation efforts and collective decision-making about how best to manage climate change risks, we will also track climate change adaptation-related land use planning, infrastructure planning, and development decisions in each town to see if they

have been influenced in any way by participation in or publicity about the role-play simulation workshops. Our primary measure of impact on collective decision-making and propensity to take action will be whether, by the end of the second year of this project, participating towns have initiated comprehensive adaptation efforts, and to what extent these efforts reflect the stakeholder engagement and consensus building ideas presented in our role-play simulations; we will collect data on this during our debriefings with key local officials and stakeholders at the 18 month and two-year marks. These debriefings will also offer a secondary measure of the effectiveness of our intervention: during debriefings, our research team will examine 1) whether there has been a noticeable change in decision-maker and stakeholder thinking about the importance of adaptation and how to approach adaptation, and, more importantly, 2) whether certain agencies are seeking to incorporate climate change risk into their everyday decisions. To provide a tertiary measure of effectiveness, our team will observe relevant meetings of local officials and boards during the second year of our intervention to monitor whether any of the ideas presented in our role-play simulations appear to have been incorporated into everyday decision-making and local planning.

5. *Phase V: Conduct additional outreach and public education*—To support our broader public education mission and the collaborative goals of this research, we will also:
   a. Create and launch an interactive website providing information about climate change adaptation and local risk management. This website will build on the online climate change adaptation learning tools that SIC and CBI have already created with the Lincoln Institute of Land Policy (see CBI, 2011). Through this website, we will also make role-play simulations, teaching notes, and other related materials available for free to anyone who wants to use them to trigger discussions and engage stakeholders in thinking about climate change adaptation in their own community.
   b. Prepare a short video of one of the role-play simulations to show other communities and individuals what is involved in running and participating in a simulation, and what the reactions of participants are likely to be. This video will be available for free on the above-mentioned website.
   c. Launch an online, private forum where staff from the four partner NERR sites can converse with each other and the research team about any questions they may have about scenario planning, consensus building, and climate change adaptation. Staff from other NERR sites will also be invited to join this forum, if they wish to do so.
   d. Run role-play simulations with local students and educators at secondary schools in partner towns. SIC has run climate change adaptation role-play simulations with high school students in Massachusetts, and student and teacher feedback on the effect of the simulations on students has been overwhelmingly positive. Experience thus far indicates that students who participate are likely to discuss their experience with their parents and

peers, which in turn generates greater public awareness about climate change risks.

e. Organize press briefings about our role-play workshops and the goals of our project. Our graduate student research assistants and Collaboration Lead will work with partner NERR CTP Coordinators to prepare regular press releases, submit articles about the project for local media and newsletters, and speak at whatever fora might be appropriate.
f. Organize and host a free train-the-trainer session for any NERRS staff, local officials, local educators, and others interested in using climate change adaptation role-play simulations to engage their communities or student groups in thinking about and planning for climate change adaptation. The CTP Coordinators from the four NERR sites intend to engage NERRS Education Coordinators in designing and hosting this train-the-trainer session at a central New England location. If there is sufficient demand, we will host additional train-the-trainer sessions at other New England sites.
g. Attend the NERRS national meeting during and/or after the completion of this research project to present our research findings and host a train-the-trainer workshop for all interested NERRS staff from around the country.
h. Present and publish our findings for diverse academic and non-academic audiences. To ensure that the results of this research reach both academics studying climate change adaptation and practitioners involved in organizing actual adaptation efforts, members of our research team will present on this project at a range of professional conferences and workshops—including the American Academy of Arts and Sciences annual meeting and the American Planning Association annual meeting—and at meetings of various public administration associations. Our team also intends to publish findings in diverse scientific, planning, and climate change-related journals, and to write articles on this project for non-academic publications such as *Solutions Journal*.

3. Roles and Responsibilities

Project coordinator: **Lawrence Susskind**, Ford Professor of Urban and Environmental Planning at MIT, will be the project coordinator for this effort. Larry has over 40 years experience leading community education and planning efforts. The primary liaison between the project and the NERRS Science Collaborative, he will oversee all phases of the project. Larry will ensure the implementation of collaboration and project management plans, and will be responsible for the completion of biannual and final reports. He will also be responsible for any theory building that emerges from this project. He will commit two months per year to this project.

Fiscal agent: **Lori Kay,** Senior Accountant and Contracts Administrator for CBI, will be the fiscal agent for this project. Lori, who has over 23 years experience in

grant administration, will be responsible for monthly invoicing and other grant administration, and will review the budget every quarter to ensure that the project team is using its funds as planned. She and support staff will commit time as needed to this project.

Collaboration lead: **Danya Rumore**, Associate at CBI and PhD candidate in Environmental Policy and Planning at MIT, will be the collaboration lead for this project. Danya has over seven years experience conducting outreach for and working with community-based environmental and sustainability initiatives. Her current research and work focus on joint fact finding and consensus building in the context of climate change mitigation and adaptation; she intends to use the data collected through this research for her dissertation, which will be completed after the conclusion of this project. Danya will work directly with science investigators, NERRS staff, and intended users to ensure that all collaboration goals are met. She will be advised and supported by Larry Susskind and Patrick Field, who collectively have over five decades of experience facilitating stakeholder engagement in environmental planning and community decision-making. She will dedicate four months per year to this project.

Applied science investigators*:* **Patrick Field** and **Ona Ferguson** from CBI collectively have over 20 years of experience facilitating and mediating environmental decision-making at the local and regional level, much of it working with governmental agencies and stakeholders on important natural resource issues. As science investigators on this project, they will oversee the stakeholder assessments and will contribute to the Summary Risk Assessments for each of the partner towns. Additionally, they will conduct debriefings with key stakeholder representatives and local officials each year, and will provide adaptation planning guidance for any communities that wish to launch actual collaborative adaptation efforts as a result of our interventions. Pat and Ona have both been involved in numerous consensus building efforts involving local resource management and sustainable development. Annually, Pat will commit two weeks and Ona will commit three weeks to this project.

Paul Kirshen and **Cameron Wake**, science investigators and climate change adaptation experts for this project, will guide the development of Summary Risk Assessments and adaptation strategies for each partner community. Paul, a civil engineer, has carried out research and consulting on coastal zone adaptation in New England since 1998. He is also an IPCC Lead Author. Cameron, a Research Associate Professor at University of New Hampshire, has led a numerous climate change assessments throughout New England. Annually, Paul and Cameron will each commit two weeks to this project.

Tonna-Marie Surgeon-Rogers, Steve Miller, Christine Feurt, and Jennifer West, the CTP Coordinators from the four partner NERR sites, will act as science investigators on this project. With collectively over 30 years working with the NERRS Coastal Training Program, they each have significant experience working with coastal communities on climate change and other coastal concerns. The CTP Coordinators, who have already secured the support

of partner towns and organizations, will be heavily involved conducting risk and stakeholder assessments, developing role-play simulations, hosting simulation workshops, and assessing the public learning impacts of the simulations. They will work closely with a matched research assistant from MIT, and will play an integral role stakeholder engagement, outreach, and site-specific work in their partner town. Each CTP Coordinator will dedicate three weeks per year to this project.

Four MIT graduate student research assistants from the Environmental Policy and Planning Group in MIT's Department of Urban Studies and Planning will be selected to act as assistant science investigators on this project. One student will be assigned to work with each NERR site. These research assistants (RAs) will work closely with their partner CTP Coordinator and other NERR staff to organize workshops, conduct outreach, and prepare and disseminate communications materials, among other tasks. They will also be responsible for the majority of work involved in developing role-play simulations for the four partner communities, as well as collecting data at simulation workshops, transcribing interviews, and processing survey data. Under the supervision of our Project Coordinator and Database Manager, RAs will also conduct statistical analyses of our survey and interview results. Additionally, each of these students will act as a liaison between their partner NERR site, partner town, and the Project Coordinator and Collaboration Lead. Each graduate student will dedicate four months per year to this project, and will spend significant time—including most of the summer, if schedules allow—on-site in their partner town and reserve.

Research assistants will be selected based upon their relevant professional and research experience. Admission to the Master of City Planning Program at MIT is extremely competitive: All of the RAs will have prior college degrees in the natural or social sciences as well as several years of work and research experience prior to enrolling in the graduate program. Potential RA candidates have been identified, but will not be officially selected until receipt of funding. Research assistants will be assigned to NERR sites based upon their skills sets and fit with the NERR's needs.

Intended user representatives: **Thomas Lynch**, Acting Town Manager, and **Jo Anne Buntich**, Director Growth Management Department, Barnstable, MA; **Christopher Parker**, Director of Planning and Community Development, Dover, NH; **Jason Pezzullo**, Principal Planner, Cranston, RI; **Jonathan Carter,** Town Manager, Wells, ME; **Peter Slovinsky**, Maine Department of Conservation; **Kristen Grant**, Maine Sea Grant; **Ward Feurt**, Rachel Carson National Wildlife Refuge, ME.

Additional investigators: **Ezra Glenn**, Lecturer in the Department of Urban Studies and Planning at MIT and Analytics Advisor for this project, will advise on the design and implementation of statistical analysis of our survey and interview data. Ezra, who has over ten years experience working with and analyzing complex social science datasets, will commit up to 25 hours per year to supporting this project. He will work closely with **Tijs Van Maasakkers**, who will

act as the Database Manager. Tijs, CBI Consultant and PhD Candidate at MIT, is trained in statistical analysis and has managed databases for multiple organizations and projects. He will design and oversee the database system that will be used to manage data collected through the more than 600 surveys, 100 plus interviews, debriefings, and participant-observation in the four partner communities. Tijs will work directly with graduate student research assistants and will provide data quality control across all sites. He will commit approximately two months per year to this project.

Note: We have added these two positions to our research team in response to a) reviewer concerns about our team's capacity to conduct the proposed statistical analysis of our data, and b) recognition of the need for a trained database manager to oversee our large dataset and to provide quality control for our data entry and processing across sites.

4. Collaboration Objectives and Methods to Meet Project Goals

The key collaboration objectives of this proposed project and the methods for achieving these goals include:

1. *To actively engage NERRS staff and local stakeholders in collaboratively thinking through and defining the research problem, and in designing the research approach*: This proposal and the pre-proposal were developed in collaboration with the CTP Coordinators from the four New England NERR sites, who are interested in investigating whether tailored role-play simulations can be used to catalyze collective climate change adaptation efforts at the local level. NERRS staff and local officials from each host community will be active partners in preparing the four risk assessments and stakeholder assessments. We will work with NERRS staff and stakeholders to determine a) the most important risks that their community faces from climate change, b) the challenges and barriers that their community has encountered or is likely to encounter in undertaking climate change adaptation planning, c) opportunities for improving their community's adaptive capacity and ability to plan and prepare for climate change, and d) who key stakeholders and stakeholder groups are, and what their dominant interests and concerns are. This information will be combined with input from local scientific experts, including Paul Kirshen and Cameron Wake, to develop scientifically grounded role-play simulations that will teach local decision-makers, stakeholders, and residents about climate change risks and the techniques that can be used to decrease vulnerability and increase resilience in their area.

2. *To collaborate with NERRS staff and stakeholders in testing, refining, and running the role-play simulations:* Following the collaborative development of the role-play simulations, we will work with NERRS staff and community members to test and refine the simulations before they are officially run as part of the climate change adaptation workshops in each host community.

This will allow us to ensure that simulations reflect the appropriate risks and the relevant adaptation options and challenges facing each partner community. NERRS staff, local officials, and well-organized community groups will be involved in planning and hosting simulation workshops. SIC and CBI staff will work with the four CTP Coordinators to conduct group debriefings at the end of each simulation workshop. There may be as many as ten workshops in each community over a one-year period.

3. *To ensure participation of representatives from all key stakeholder groups in the role-play simulations*: We will work with NERRS staff, local officials, and local groups to reach out to and encourage the participation of key stakeholder representatives identified through the stakeholder assessment conducted in each community, as well as to encourage the participation of other diverse community members. Many members of our research team have experience engaging representatives from a wide cross-section of groups in role-play simulations, workshops, and other public engagement activities. In addition to hosting public simulation workshops, we expect to run the role-play simulation with local boards, community associations, business groups, and other local organizations.

4. *To work in partnership with NERRS staff and local community members to analyze the effectiveness of role-play simulations as a tool for helping communities plan and prepare for climate change adaptation*: We will work directly with NERRS staff and key contacts in each partner town to finalize our before-and-after surveys and follow-up interview questions, and to analyze the survey and interview findings. We also expect to involve NERRS staff and community representatives in the development of our project website—which will explain how other New England and US residents can use the climate change role-play simulations in their own communities—and in creating related outreach materials.

5. *To initiate pilot consensus building efforts in partner communities where interest is stimulated by participation in the climate change adaptation workshops:* Where public officials request our support, our CBI advisors—Patrick Field and Ona Ferguson—will work with NERRS staff and local officials to help launch collaboratively designed efforts to build consensus around community-level climate change adaptation planning. Note, the funds requested for this project will not support actual adaptation planning efforts; funding for local adaptation planning will have to be raised independently by interested towns, who will need to contract separately with CBI for continued assistance. This has been made clear to the participating towns.

To ensure that collaboration goals are being achieved, our Collaboration Lead, Danya Rumore, will remain in constant contact with research team members, NERRS staff, and intended user representatives at all sites.

5. Applied Science Objectives and Methods to Meet Project Goals

In addition to seeking to build the capacity of NERRS staff to help coastal communities better understand climate change risks and undertake collective risk management efforts, this project is motivated by three overarching research objectives:

1. The need for better ways of communicating complex scientific ideas to decision-makers and stakeholders and bridging the gap between scientific knowledge and action has long been recognized (Brunner *et al.*, 2005; Cash *et al.,* 2003; Clark *et al.*, 2011; Lubchenco, 1998). To quote Jane Lubchenco, the current National Oceanic and Atmospheric Administration (NOAA) Administrator, we must improve our ability to communicate "the certainties and uncertainties and seriousness of different environmental or social problems, providing alternatives to address them, and educating citizens about the issues" (1998: 495). Based upon our preliminary research, we believe that tailored role-play simulations offer a promising technique for educating decision-makers and the public about science-intensive issues such climate change, as well as for conveying uncertainty and how to deal with it.

   To test this hypothesis, this research effort will investigate whether, and to what extent, participation in tailored role-play simulations can lead to both individual and public learning about climate change risks and community-level adaptation strategies. Three research questions are embedded within this larger research objective:

   a. Are role-play simulations effective tools for educating the public about science-intensive issues like climate change?
   b. Are role-play simulations effective tools for educating the public about the dynamics of collective risk management decision-making?
   c. Do role-play simulations provide an effective method for conveying uncertainty to stakeholders and introducing methods for planning amid uncertainty (e.g., using scenario planning techniques)?

2. It has been argued that stakeholder engagement in science-intensive decision-making is crucial for effective policy and planning (NRC, 2008, 2009). However, it remains unclear how to achieve this goal in a meaningful and lasting way. We hypothesize that widespread but targeted use of role-play simulations can a) generate broad stakeholder concern about science-intensive policy questions, b) build stakeholder capacity to meaningfully participate in science-intensive decision-making, c) generate new community-wide social norms, and d) introduce techniques for effectively engaging diverse stakeholders in science-intensive public decision-making. To test this theory, we will explore whether, and to what extent, participation in tailored role-play simulations achieves the following goals:

   a. Builds individual and collective awareness of the importance of and strategies for engaging diverse stakeholders in adaptation planning.
   b. Demonstrates methods for developing consensus—defined as widespread agreement but not unanimity (Susskind and Cruikshank, 2006)—on collective risk management choices.

3. Given that local level adaptation action has been slow to emerge in New England and elsewhere, we seek to develop a model for catalyzing collective action around climate change preparedness and risk management in coastal communities. A primary goal of this project will be to investigate the effectiveness of our role-play centered model in stimulating local-level adaptation and risk management efforts in our four partner towns.

To achieve these applied science objectives, we propose to, as described above, involve at least 100 – 200 participants—including carefully selected stakeholder representatives and local officials as well as residents, business leaders, environmental activists, high-school educators, and NERRS staff—in role-play simulations in each partner community. We will then track the effect of participation in simulations on individual and public learning, and will explore whether our intervention catalyzes community action around planning and preparing for climate change in our partner towns.

Key stakeholder representatives and local officials will be asked to participate in role-play simulation workshops through special invitations sent out by our NERRS and intended user representative partners. Other participants will be recruited through general community outreach, conducted in collaboration with local groups and organizations.

Up to ten role-play simulation workshops will be held in each location. At each workshop, prior to the role-play simulation, all participants will complete a carefully designed before-participation survey of about ten minutes in length. Surveys will include both multiple-choice and open-ended questions, and will be designed to gauge participant understanding of local climate change risks and possible adaptation measures. Surveys will also explore participant beliefs about whether and how their community should proceed with climate change adaptation in the face of substantial uncertainty and various barriers to effective adaptation action. SIC has spent the past year pilot-testing surveys for evaluating the effectiveness of climate change adaptation role-play simulations.

Following completion of the before-participation survey, participants will be briefed about local climate change risks, the technique of scenario planning, and the logistics of the role-play simulation. For the next 90 minutes, they will participate in the role-play simulation. In the simulation, participants will be grouped into tables of seven or eight individuals and asked to assume assigned roles (i.e., roles reflective of key interests in their community, but not their ‘real life’ roles) and to engage in a mock negotiation about how to deal with a specific climate change-related concern facing their community—for example, how to protect a critical ecosystem in the face of increased flood risk or sea level rise, or

how to address increasing storm water runoff and related issues. As discussed above, simulations will draw on risk assessments and related scientific information for each community, and will be tailored to reflect the stakeholder concerns specific to each town. In each town, all participants will receive shared "General Instructions" outlining the mock decision-making process in which they will participate. They will also each receive detailed "Confidential Instructions" that explain their individually assigned role and related interests. They will then be asked to negotiate an agreement about the issue at hand while remaining consistent with their assigned role and associated concerns.

Immediately after the simulation, project staff will conduct a group debriefing—which is similar to a focus group—with all participants, using the simulation exercise as a conversation starter to ensure that participants have a clear, science-based sense of the risk management options worth considering in their area. During these debriefings, researchers will take detailed notes on participants' reactions to the simulation and how their experience relates to adaptation planning in their town. Participants will then be asked to complete an after-participation survey (again, about ten minutes in length). The after-participation survey will resemble the before-survey, but will include additional questions exploring participant intentions to act. We will use these before-and-after surveys to track whether—and to what extent—learning about climate change, related risks, scenario planning, adaptation strategies, and consensus building has occurred, and whether there is a stated desire to contribute to adaptation efforts. Research staff will, in collaboration with our NERRS and town partners, design and pre-test surveys to ensure that they are understandable to all audiences and not prone to misinterpretation.

The same before-and-after survey questions will be administered to a control group of approximately 40-50 people in each community. Control group participants will be selected randomly. This matched control group will not participate in the simulation.

Data from the before-and-after surveys from both the trial group and the control group in each partner community will be analyzed and compared to determine whether, and to what extent, participation in the role-play simulation appears to have affected individual and collective understanding of climate change, related risks, and adaptation options. These data will also be used to analyze to what extent participation in the role-play simulation affected individuals' and community perspectives about the utility of scenario planning and consensus building as approaches for supporting collective risk management. Findings from each town's simulation group will be compared to findings from each town's control group to verify that participants in the simulations were representative of the general population in each community and to isolate the effect of participation in the simulation on variables of interest. With the help of our Analytics Advisor, Ezra Glenn, and under the supervision of our Database Manager, Tijs van Maasakkers, we will undertake a range of multivariate analyses aimed at identifying relevant statistical associations among key variables. Relationships that we will investigate include: whether concern about climate change is correlated with education level or socio-economic status,

whether changes in understandings due to the simulation are statistically relevant, and whether there is a statistically relevant difference among the findings from our partner towns.

Survey data will be useful in providing a large amount of quantitative and qualitative data about participants' immediate changes in understanding and perspectives; however, survey data will not provide any sense of the depth or lasting nature of these changes, should they occur. Additionally, before-and-after survey data may be prone to biases associated with self-reported learning and self-reported propensity to act. Therefore, we will augment and enhance our survey finding with data collected during workshop debriefings and, more importantly, follow-up interviews with key informants. One to two months after the actual exercise, we will conduct in-depth interviews with about one-quarter of the role-play participants in each partner town. Interviews will follow up on participants' before-and-after survey results and will explore the extent to which participation in the role-play simulation affected individuals' longer-term attitudes toward climate change risks and their propensity to support collective action. We will use NVivo software to qualitatively and quantitatively analyze interview data.

Finally, we will use observation and our debriefings with key stakeholders and local officials 18 months into the project and at the end of the two years to carefully track whether comprehensive adaptation plans are undertaken or whether any adaptation-related land use planning, infrastructure planning, and environmental regulatory efforts are stimulated in each host community. Where adaptation efforts are undertaken, SIC and CBI will work with NERRS staff to support these efforts. Additionally, our Collaboration Lead, Danya Rumore, intends to continue working with these communities after the completion of this project as part of her continued dissertation research.

Findings and experiences from the four partner towns will be compared to examine what factors and variables contribute to or inhibit a) the effectiveness of tailored role-play simulations in catalyzing climate change adaptation efforts, b) the effectiveness of role-play simulations as a climate change adaptation public education tool, and c) collective action on climate change adaptation. Given the small sample size, cross-comparison among sites will only allow for a preliminary investigation of these variables, but may provide useful insight that can support future research.

Appendix 1: Overview of Partner Towns

Barnstable, Massachusetts

The Town of Barnstable, Massachusetts is home to about 45,200 people. It is the largest town, both in size and population, on Cape Cod. According to the 2010 U.S. Census, the median income for a household in Barnstable was $61,545 and 5.9% of families and 8.2% of the population were below the poverty line. The racial makeup of the town is approximately 89.3% White, 3.0% Black or African American, 3.1% Latino or Hispanic, 1.2% Asian, and 0.6% Native American.

Situated about halfway along the arm of Cape Cod and with 170 miles of coastline, Barnstable is highly vulnerable to climate change impacts, including sea level rise and damage associated with intensified storms. Many town officials are concerned about climate change, but Barnstable has not yet moved forward with efforts to fully assess risk or to prepare for impacts. Municipal leaders anticipate that participation in this project will build the social and political will needed to move forward with collaborative adaptation planning and will increase the capacity of town officials to effectively integrate climate change risks into their everyday decision-making.

See Reference Map 1.

Dover, New Hampshire

Dover, New Hampshire is located within the coastal Piscataqua River watershed. The population of the town is about 30,000, making Dover the largest community in the New Hampshire seacoast region. According to the 2010 Census, the racial makeup of the city was 90.6% White, 4.6% Asian, 2.2% Latino or Hispanic, 1.7% Black or African American, and 0.2% Native American. In 2010, the median household income was $53,641 and about 7.0% families and 10.0% of all people were below the poverty line.

Given its coastal situation and proximity to the Cochecho and Bellamy Rivers, Dover is at risk from climate change-related risks associate with sea level rise, increased flooding, and impacts from intensified storms. As in many New Hampshire municipalities, climate change adaptation is not currently a topic of municipal concern in Dover. Some town leaders and municipal board members are aware of the pressing need to begin adaptation efforts, but they are cautious about approaching this issue due to the generally conservative views about climate change in New Hampshire. Municipal leaders feel that there is a need for broader public concern about climate change risk before they can prioritize adaptation planning and related efforts. It is hoped that this project can introduce residents to the importance of climate change adaptation and stimulate greater interest in incorporating climate change risk into everyday planning and decision-making in Dover.

See Reference Map 2.

Wells, Maine

Situated on the southern coast of Maine, Wells is home to a little less than 10,000 people. However, as a popular beach vacation spot, the population of the

community triples during the summer and the fall. Wells is also home to an ecologically diverse estuary. The racial makeup of the stable population of the town was 98.5% White, 1.2% Latino or Hispanic, 0.8% Asian, 0.8% Black or African American, and 0.9% Native American as of the 2010 Census. In 2010, the median household income was $62,896 and 3.2% of families and 5.3% of all people were below the poverty line.

In addition to facing climate change impacts associated with sea level rise, intensified storms, and heightened flooding, Wells will also have to confront potentially negative impacts on the fragile estuary and tourist economy. The Town of Wells is preparing for a Comprehensive Plan update in 2015. Municipal officials, including the Town Manager, Town Engineer/Planner, Code Enforcement Officer, Fire Chief, and Selectmen would like to include climate adaptation and coastal hazard preparation as part of the plan rewrite. They anticipate that participation in this project will provide vital community engagement that has thus far been difficult for the town to achieve, as well as climate change information that may be helpful in the development of the Comprehensive Plan. The Town of Wells is home to Rachel Carson National Wildlife Refuge, the Wells NERR and Kennebunk, Kennebunkport, Wells Water District. This combination of nationally significant coastal lands and vital infrastructure for a number of southern Maine towns adds to the importance of this project to local communities beyond the borders of Wells.

See Reference Map 3.

Cranston, Rhode Island

With a population of about 80,000, Cranston is the third largest city in the state of Rhode Island. The city is part of the greater Providence metropolitan area. As of the 2010 Census, the racial makeup of the city was 81.9% White, 5.3% Black or African American, 5.2% Asian, and 0.3% Native American, with about 10.8% of the population identifying as Latino or Hispanic of any race. In 2010, the median income for a household in the city was $57,649 and 8.1% families and 10.6% of all individuals were below the poverty line.

Due to its situation on the Rhode Island coastline, Cranston faces climate change risks associated with sea level rise, heightened flooding, and impacts on coastal infrastructure. The devastating effects of the 2010 floods in particular, as well as the projected frequency of similar events as a result of climate change, have heightened the awareness and concern of City staff and officials. While an updated Hazard Mitigation Plan was completed in 2010, little has been done to actively address the impacts of climate change on the City. Substantial technical and financial assistance, as well as stakeholder involvement, will be needed to move forward with strengthening, supplementing, and implementing the recommendations outlined in the Plan as well as incorporating these strategies into other City plans and regulations. The City's municipal staff, officials, and others are very interested in engaging key stakeholders and community members in developing climate change adaptation measures, and anticipate that participation in this project will be helpful in achieving this goal.

See Reference Map 4.

Appendix 2: Diagrams of Research Process

Diagram 1: Risk and stakeholder assessments, and their relationship to role-play simulation workshops

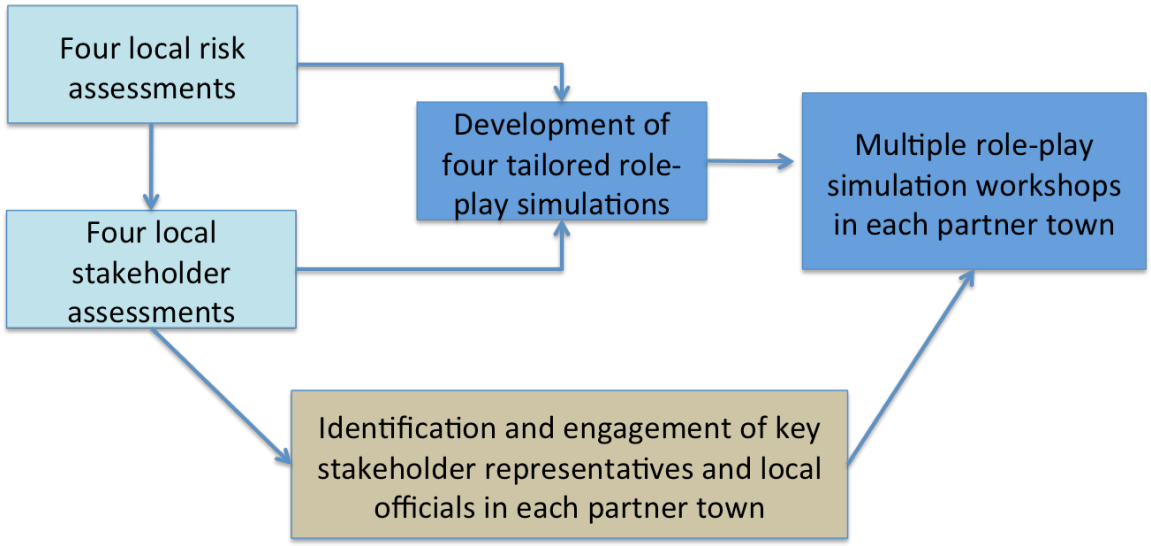


Diagram 2: Overview of process for evaluating the effectiveness of role-play simulations as a public education tool

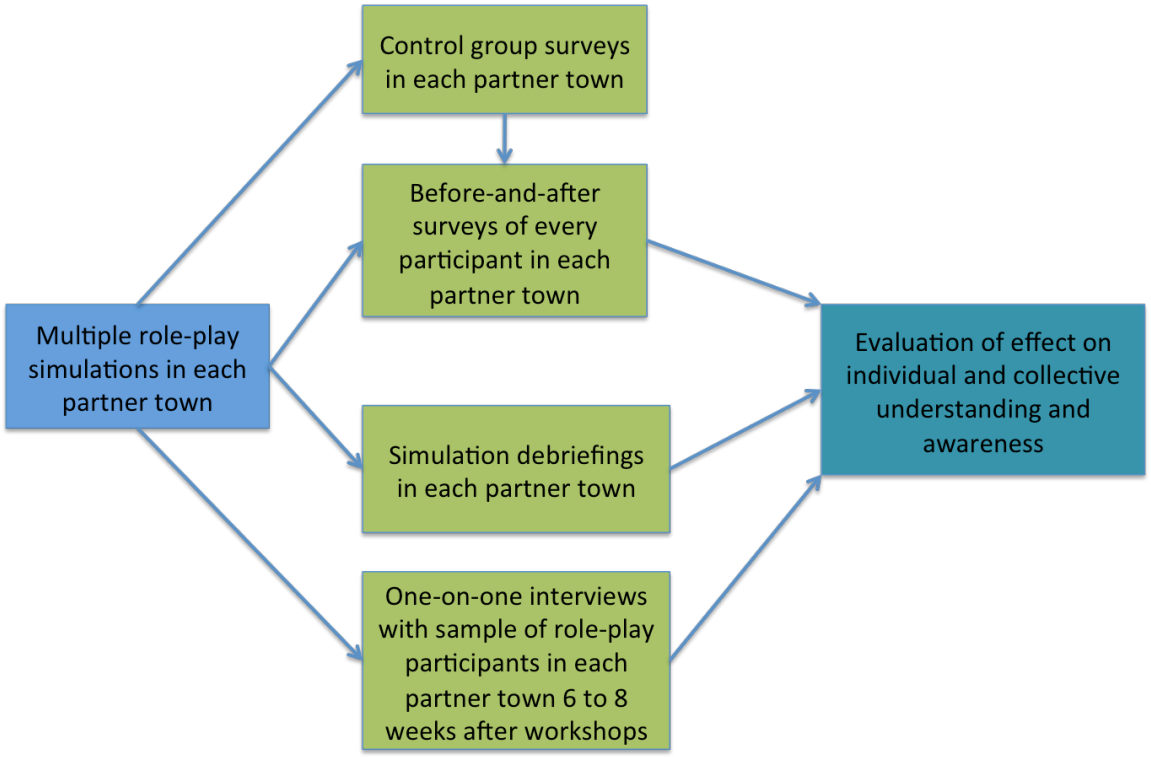
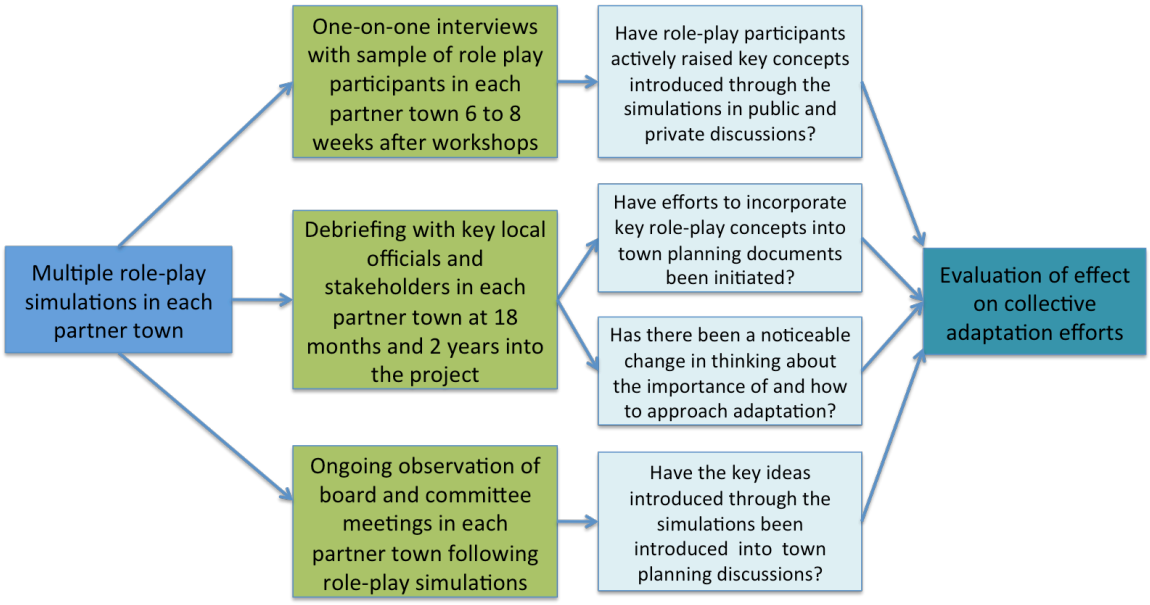


Diagram 3: Overview of process for evaluating the effectiveness of role-play simulations as a catalyst for climate change adaptation action



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National Estuarine Research Reserve System Science Collaborative
FY 2012 Funding Opportunity Timeline

Proposal title: Building the Capacity of Coastal Communities to Address Climate Change Risks Through the Use of Role-Play Simulations

Project coordinator: Lawrence Susskind

Fiscal agent: Lori Kay

	Year 1					Year 2			
List Project Objectives, Products, Activities	Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4
Conduct climate change risk analyses in 4 towns and develop risk assessment report	X	X	X						
Conduct stakeholder assessments in 4 towns	X	X							
Develop understanding of key climate change risks and key stakeholder concerns in 4 towns	X	X	X						
Launch online forum to allow for ongoing discussion about research among researchers and other NERRS sites		X	X						
Collaboratively work with NERRS staff and stakeholders in each town to develop and test tailored role-play simulations			X	X					
Organize role-play simulation events in collaboration with NERRS staff and local partners				X		X			
In collaboration with NERRS staff and local partners, conduct outreach and recruit key stakeholders and community members for participation in the simulation				X		X	X		
Run role-play simulations in 4 towns, collect before-and-after survey data						X	X		
Collect survey data from control groups in 4 towns						X	X		
Conduct follow-up interviews with participants						X	X	X	
Conduct train-the-trainer sessions for NERRS staff, local officials, and high-school teachers				X		X	X	X	
Post simulation materials, teaching notes, videos, and other educational and outreach materials online; make publicly available							X	X	
Conduct debriefings with key government officials and stakeholders							X	X	X
Process and analyze data from before-and-after surveys and interviews							X	X	X
Review data and findings with representatives from partner communities								X	X

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Submit findings for publication in key peer-reviewed journals and other media									X
Present findings and conduct train-the-trainer sessions at all interested NERRS sites								X	X
Consult and review progress with intended users and all research partners	X	X	X	X		X	X	X	X