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The Role of Extension in Climate Adaptation in the United States

Report from the
Land Grant - Sea Grant Climate Extension Summit
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***Report from the* Land Grant – Sea Grant Climate Extension Summit**

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National Institute of Food and Agriculture
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Report Authors:

Emily Susko, 2012 Sea Grant Knauss Marine Policy Fellow
Michael Spranger, University of Florida IFAS Extension and Florida Sea Grant College Program
Luis Tupas, National Institute of Food and Agriculture
Joshua Brown, National Sea Grant College Program
Michael Liffmann, National Sea Grant College Program

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I. Introduction and Motivation

“The scientific evidence is clear; global climate change caused by human activities is occurring now, and is a growing threat to society...it is essential that we develop strategies to adapt to on-going changes and make communities more resilient to future changes...Delaying action to address climate change will increase the environmental and societal consequences as well as the costs.”

American Association for the Advancement of Science, 2006

Climate-related changes are underway and projected to grow, according to the *2009 National Climate Assessment* (NCA). Conducted by the U.S. Global Change Research Program, the NCA endeavors to evaluate the following scientific evidence of climate change impacts on regions and sectors of the U.S.:

- Increasing temperature
- Increasingly intense downpours
- Rising sea level
- Rapidly retreating glaciers
- Thawing permafrost
- Longer growing season
- Longer ice-free season in the ocean and on lakes and rivers
- Earlier snowmelt
- Changes in river flows

Although these changes are already impacting the nation’s land and water resources, posing an increasing concern for those whose livelihoods depend on the resources directly, a significant portion of the American public does not understand the science or the implications of climate change. Much of the public remains skeptical that climate change is even occurring¹.

In order to create more vibrant and resilient communities and natural resources-dependent economic sectors able to mitigate and adapt to the risks associated with climate variability and change, there is a critical need to develop a “climate-literate society.” People must gain a better appreciation of how a changing climate is likely to impact their own lives, local ecosystems, regional industries and society at large.

Improving national climate literacy will require the coordinated actions of government, communities, academia, business and industry, and individuals. For over two decades, the United States Global Climate Research Program (USGCRP), a coordinated effort of 13 federal agencies and departments, has funded more than \$30 billion worth of climate change research to improve our understanding of climate systems. Now, these findings and other related research data and results must be disseminated to governments, communities, agricultural and

¹ George Mason University Center for Climate Change Communication and Yale Project on Climate Change Communication, “Global Warming’s Six Americas in September 2012.”

forestry interests, coastal businesses and industries, and the public at-large to inform critical resource management decisions.

The complexity of global climate change poses a challenge to the scientific and educational communities attempting to inform the American people. Simply providing the public with scientific facts is inefficient. Rather, the emerging interdisciplinary challenges—and opportunities—require public engagement mechanisms founded in a clear understanding of local situations and individual values.

Two university-based information distribution systems, in place throughout the country and experienced in presenting scientific research knowledge to aid public and private decisions, are particularly well-suited to address this need.

The Land Grant University System was created in 1862 when President Lincoln signed into law the Morrill Act of 1862. This law established a university in each state that was designated to teach practical agriculture, science, military science and engineering as a response to the agrarian and emerging industrial needs. To fund these new universities, the federal government provided grants of federal land (hence term “Land Grant”) that each state would either develop or sell to raise funds to establish and operate these new places of higher education. In 1887, the mission of these Land Grant Universities was expanded through passage of the Hatch Act which established a research component. Federal funds through the United States Department of Agriculture (USDA) were provided to create agricultural experiment stations that would conduct scientific investigations on agricultural related topics.

In 1912, the Smith-Lever Act was passed which created the cooperative extension services within the Land Grant Universities. This established a cooperative system of federal, state and local governments to bring university-based research to local areas through county-based extension faculty (agents) and university-based specialists. Today there are more than 3,000 extension offices nationwide that provide university-based research information in the areas of agriculture, youth development (4H), family and consumer sciences, community development and natural resources.

Both the research arm and extension arm of the Land Grant University System have been providing climate-related research and extension activities for decades. The goal is to increase the climate literacy of stakeholders in agriculture, forestry, and water resources and within local communities through science-based information and decision support tools that are disseminated through meetings, written publications and digital (internet) services.

The USDA’s National Institute for Food and Agriculture (NIFA) supports global change and climate projects that are addressing critical issues through integrated (research, extension, and education) activities. Current weather and climate projects focus on determining the effects of global change and climate on land-based systems and the global carbon cycle and on identifying agricultural and forestry activities that can help reduce greenhouse gas concentrations. Global change extension programs focus on technologies and practices to reduce carbon in the

atmosphere and risk management practices to anticipate natural and human impacts on agricultural ecosystem dynamics. In 2012, approximately \$12 million were made available to support new awards within NIFA's Agriculture and Natural Resources Science for Climate Variability and Change Challenge Area.

The National Sea Grant College Program (Sea Grant), established in 1968 to be analogous to the Land Grant system, focuses on coastal and marine issues in every coastal state and territory. Sea Grant is a similar federal-state partnership between the National Oceanic and Atmospheric Administration (NOAA), state universities and local governments. Over 400 Sea Grant extension agents and university-based research specialists collaborate to provide educational programming to coastal and Great Lakes residents.

Sea Grant programs have been investing in climate-related research and extension activities to help prepare U.S. communities for climate change since the 1990s.² In 2009, approximately 90 outreach professionals established a community of practice called the Sea Grant Climate Network. Its mission is to enhance Sea Grant climate programming and outreach nationwide by coordinating Sea Grant climate-related activities, sharing talent and resources, and collaborating with federal agencies and the communities served in the various states and territories.

In general, Land and Sea Grant extension agents face many of the same challenges in different contexts, and they recognize the value of sharing experiences and exchanging knowledge and approaches. As climate change begins to affect terrestrial, freshwater and marine resources, the need to improve climate literacy among citizens and resource users nationwide is one such challenge that could benefit from a coordinated extension-based approach involving Land Grant, Sea Grant and the networks' partners.

II. The NOAA Sea Grant and USDA-NIFA Land Grant Climate Extension Summit

To jointly address the need for improved climate literacy, NOAA's National Sea Grant Office partnered with NIFA's Institute of Bioenergy, Climate, and Environment to hold the first Climate Extension Summit (Summit) on March 13-14, 2012 in Silver Spring, MD. The Summit convened a small group of invited experts from both national networks to devise broad strategies and approaches to better engage the nation on issues concerning climate change and climate variability.

The Summit organizers focused on three distinct aspects of climate extension: (1) previous and current Extension efforts to improve overall understanding of climate variability and change, and their potential effects on natural resources and communities; (2) the capacity-building

² Recent examples of Sea Grant's climate extension activities can be found at www.seagrant.noaa.gov/whatwedo/climate and www.seagrant.noaa.gov/whatwedo/climate/cccai.html

needs of Sea Grant and Land Grant agents and specialists to address these effects; and (3) considerations for better preparing the next generation of Extension professionals to address this rapidly developing and challenging issue.

The Summit's objectives were to:

- Better understand the intersection of climate variability and change with the role of Extension;
- Identify and devise strategies to address the professional development needs of the Extension workforce;
- Identify resources and partnerships needed to strengthen climate-related programming in Extension;
- Explore transformational communication technologies as they may affect interactions with constituent groups regarding climate variability and change;
- Discuss subject-matter needs and universities' curricula to better prepare Extension's future workforce.

The invited experts included subject-matter specialists ("panelists") as well as "delegates" selected from among the extension leaders representing both networks. (See Appendix 1 for a list of participants and their affiliations.)

Fourteen Land Grant and Sea Grant subject-matter specialists and two recent graduate students served as the panelists. Emphasizing the joint nature of the summit, panelists from Land Grant were paired with panelists from Sea Grant to address the following climate extension topics from both terrestrial and marine perspectives: climate science in Extension, climate effects on ecosystems, natural resource sustainability, aquaculture and agriculture, community and economic development, hazard resilience, Extension-at-large, and graduate students in climate extension. The panelists delivered presentations on the state-of-the-knowledge of how climate variability and change affect their areas of expertise. They also offered "big ideas" from colleagues around the country and reviewed relevant literature. Ultimately, their presentations aimed to offer perspectives for future climate extension programming.

Ten delegates, representing Sea Grant and Land Grant Extension (Extension) leadership, also attended and served as the lead discussants following the panelists' presentations. They joined the panelists to participate in the breakout sessions that followed.

All participants were assigned to four small groups that were convened for several hours. The first group addressed the professional development needs of current Extension faculty and staff with regard to climate variability and change. The second group sought to identify resources and partnerships needed to strengthen climate-related programming. The third group considered how new technologies might affect Extension's communications with constituent groups, and the fourth addressed how to better prepare Extension's future workforce.

In these breakout sessions, the participants utilized a Logic Model framework³ to help them think about existing resources, strategies, activities and projected outcomes that would achieve the desired long-term result of a more “climate literate society.”

III. Summary--Keynote and Panelists’ Perspectives

Dr. Kathy Jacobs, the Director of the National Climate Assessment, provided the Summit’s keynote address. Also a faculty member in the University of Arizona’s Department of Soils, Water and Environmental Science, Dr. Jacobs is very familiar with Extension and its unique engagement role. From 2006-2009, she was the Executive Director of the Arizona Water Institute, a consortium of the three state universities that focus on water-related research, education and technology transfer in support of water supply sustainability.

Her presentation focused on observed climate change, the importance of adaptation (defined as the planning for changes that are expected to occur), and Extension’s role in helping with the adaptation process. She noted that adaptation entails (1) acting to reduce vulnerability and enhance preparedness for impacts, (2) responsibly managing risk and resources, and (3) using common sense planning to protect our health, safety and prosperity.

She noted that a particularly challenging aspect is that climate change is moving conditions beyond the range of human experience, according to findings of the National Research Council⁴. It is entirely possible that the climate system, and consequently the natural and human ecosystems, will experience significant transitions to new states. This may well render our historical experience as an incomplete guide for future adaptation.

Dr. Jacobs also discussed other climate adaptation challenges, including:

- uncertainties in estimating the nature, timing and magnitude of climate impacts;
- a tendency to focus on trends rather than extremes, and to ignore the potential for abrupt change;
- the longer-term and multi-generational issue challenges of weighing short-term costs versus long-term benefits;
- difficulties in explaining extreme events as indicative of trends or as being caused by climate variability;
- institutional impediments, at all levels, that give rise to:
 - maladaptive policies that lead to a rise in human exposure to disasters and emergencies;
 - resource limitations and resulting competition;
 - lack of data regarding costs and benefits of alternative adaptation options at multiple scales;

³ U.S. Department of Agriculture, National Institute of Food and Agriculture, “Logic Model Planning Process: Integrated Research, Education, and Extension Programs”

⁴ *America’s Climate Choices: Panel on Adapting to the Impacts of Climate Change*

- a significant shortage of climate science translation capacity.

She focused on the last impediment, noting that Extension has a significant role to play in advancing an inclusive, broad-based, and sustained process for assessing and translating scientific knowledge of the impacts, risks, and vulnerabilities. She stressed that better access to information at the regional and local scales can be achieved through regional coordination of science and services.

Extension, in its capacity as a national boundary organization, can serve as an intermediary between climate science and technology and the needs of end users or stakeholders. The term ‘boundary organization’ refers to institutions that facilitate the transfer of useful knowledge between science research and public policy. Indeed, the Land and Sea Grant Extension Services have a distinguished history of actively serving as an interface between scientists and decision-makers, focusing on problem-solving with the clientele groups they serve. Extension stresses practical outcomes and best professional judgment, and often reframes issues to suit its audience. For example, instead of addressing climate change, per se, educational programming focuses on impacts such as sea level rise, variability, and water security. Extension has often reinvented or repurposed its existing capacity to meet the needs of its constituents by focusing on adaptive management, testing the principles of being a “learning organization,” and investing heavily in internal capacity building.

Dr. Jacobs’ observations were echoed by the 16 panelists who also shared their perspectives with the attendees. (See Appendix 2 for the panelists’ abstracts.) All emphasized that climate change and variability will have increasingly visible impacts on natural resources and on the constituents whose livelihoods depend on them. Several reviewed the observed and expected impacts of climate change on the natural resource sectors in which they specialize.

The Land Grant extension panelists cited ways in which a changing climate affects terrestrial ecosystems. More extreme seasonal variations in temperature and precipitation are leading to increased severity of both droughts and storms and posing great difficulties for farmers and other agricultural interests. Plants and animals track even small changes in climate, and changes in habitat suitability are leading to local extinctions of range-restricted species.

Likewise, Sea Grant fisheries extension panelists noted that distributions of fish populations—targeted commercial and recreational species, as well as the invasive species that compete with them—are changing in response to changes in water temperature. Increased carbon levels are causing the oceans to become more acidic, harming shellfish and coral reefs.

Aquaculture industries will also be impacted. For these, major challenges will include rising sea levels that inundate aquaculture ponds with saltwater; water temperatures rising outside of fishes’ optimal ranges; increased frequency of extreme weather events; and ocean acidification, a particular concern for shellfish growers. Many constituents are already seeing these changes in climate and landscape. They would benefit from understanding adaptation options available to them. In response, many extension agents are already addressing climate change in their work.

Because climate change can be a politically controversial and emotionally-charged issue, Land Grant and Sea Grant extension agents take a range of approaches to communicating climate science, climate risk or vulnerability, and climate adaptation strategies to their constituents. The following are examples of their approaches:

- Listening to constituents' needs and providing climate information on an as-needed basis (Crimmins);
- Focusing on resilience to seasonal, interannual climate variability (Fraisie);
- Focusing on resilience to hazards and extremes (Swann);
- Focusing on other, non-climate benefits to individual adaptation strategies—after all, few are useful only in the climate change context (Jacob);
- Focusing on how climate affects constituents' everyday lives (Elliot);
- Thinking in terms of sustainability to address the man-made drivers of climate change, and emphasizing good stewardship (Simon-Brown).

In the panelists' remarks, two themes came up repeatedly. First, extension agents succeed in their missions of building trust-based relationships, connecting constituents to scientists and researchers, and translating research results into practical solutions to real world problems when they tailor scientific information to their constituents' needs. Thus **climate science and adaptation strategies are most effectively delivered at the smallest, most local, and most immediate scale possible**. As one panelist pointed out, Americans today are overwhelmed with information of all sorts and, **constituents will be most receptive to information that they are convinced is useful and relevant to them**.

Second, several panelists described approaches that link climate adaptation to hazard mitigation, recognizing that vulnerability to long-term climate change often implies vulnerability to shorter-term severe weather events as well. Communities of all backgrounds generally support planning for resilience. The need to improve risk communication and analyze risk perception is common to both short- and long-term risks. In Mississippi and Alabama, Sea Grant extension professionals are looking to help decision-makers integrate climate adaptation throughout the already-required state hazard mitigation plans. In Florida, Land Grant county agents working with the state's Climate Change Advisory Board found it was easier to approve a free-standing climate change element to the hazard mitigation plan. The Extension Disaster Education Network (EDEN) has initiated the Strengthening Community Agrosecurity Preparedness (S-CAP) program to strengthen ties within communities to improve disaster response, and this improved social resilience is necessary for responding to long-term climate change risks as well.

Panelists were divided on how much emphasis to place on the attribution of climate change to human-made causes. Some argued that, because the general consensus among the scientific community is that climate change is at least partially—if not largely—due to human-made emissions, avoiding that point is doing a disservice to science. Others argued that the political associations with attribution would jeopardize the trust relationships that have been

established with their constituents, effectively undermining the goal of providing adaptation information.

Looking forward, panelists discussed options for increasing Land and Sea Grant capacity to provide climate extension services. Should climate extension be a specialized service? Or should climate-related issues be integrated into existing programming? Florida Sea Grant has worked to increase capacity by providing climate science training modules for its agents. One panelist pointed out that agents have a responsibility to be leaders in communicating climate change and sustainability, while another pointed out that not all extension agents even believe in climate change.

Panelists also discussed options for increasing capacity by strengthening connections within and among extension networks. This could be accomplished through increased use of online networking tools—examples provided were Land Grant’s eXtension site and Sea Grant’s use of NING sites—or by establishing additional climate communities of practice, such as the active community along the Gulf Coast and Sea Grant’s Climate Extension Network.

Some of the challenges that climate extension services face are those common to extension programs in general. Shrinking investments have led to diminished resources and growing individual geographic responsibilities, as fewer agents work to serve greater numbers of constituents. On top of these factors, the general populace is decreasingly aware of the availability or even the existence of extension services.

IV. Process and Breakout Summaries

Following the presentations and plenary group discussions, four breakout groups consisting of all attendees were charged with developing the Summit’s second through fifth objectives. That is:

- addressing the capacity building and resource needs to meet the demand climate-related extension services;
- discussing new and enhanced partnerships and what additional resources are needed to strengthen Extension’s climate-related programming;
- discussing the role that transformational technologies might play in a joint climate extension initiative with emphasis on interactions with constituent groups, and;
- preparing Extension’s future workforce to more effectively address the climate change and variability issue.

Each group used the logic model planning tool to develop its ideas and plan for short, medium and longer-term outcomes of climate extension programming. By focusing on outcomes, the participants were able to “think backwards” through the model and identify how best to achieve the desired results. The participants provided the rationale for an initiative to better engage the country on issues concerning climate change and climate variability, and then

sought to describe the linkages between climate extension investments and activities, outputs, and the anticipated outcomes.

Summaries of the discussions held by each of the breakout groups appear below.

1. Professional Development Needs

In this breakout session, participants discussed the training and resources needed for extension professionals to adequately meet the growing need for climate-related extension services. While some extension programs have dedicated climate specialists, these programs are currently the exception. Rather, extension agents across specialties increasingly face the need to deal with the impacts of a changing and variable climate.

Thus one step is to invest in building capacity through additional **internal training opportunities** for current extension staffs and faculty. Participants noted that, biennially since 2005, Sea Grant has held the Sea Grant Academy, a two-week training session for new extension agents. Perhaps this could serve as a model for an intensive “Climate Academy” training program, held as a joint initiative between the Land and Sea Grant networks.

This training must focus on familiarizing extension agents with **climate science basics**—both the mechanisms (e.g., the role of greenhouse gases in trapping heat) and the projected impacts of climate change on various resource sectors. Because Extension’s approach is to specialize by locality, additional training can help agents find or develop the most relevant, smallest-scale climate information and models to share with their constituents.

Next, breakout participants suggested that extension agents would benefit from training in **written and oral communication** about climate issues. Extension agents, as they strive to learn their constituents’ needs and values, may also benefit from the general perspective offered by the social science behind risk communications.

Also, as climate can be a contentious topic, extension agents would benefit from training in **meeting and small group facilitation** and **conflict management**, with the aim of building confidence in broaching controversial issues. Ultimately, agents should be comfortable articulating current climate science even when faced with tough questions and skepticism from constituents.

Last, perhaps the most important information that extension agents can bring to their constituents are strategies to help them reduce vulnerability to changes in climate. Training extension agents in **risk management strategies**—both for mitigating physical, hazard-related risk or financial, business-oriented risk—will supply them with valuable tools for helping constituents understand the benefits and tradeoffs of enhancing resilience. Breakout participants suggested encouraging Extension to model sustainable practices that increase resilience while mitigating carbon emissions; others suggested training agents in the “no-regrets,” adaptation-focused approach that avoids the contentious attribution issue.

In addition to training current agents, extension programs could also consider **recruiting climate specialists**. Breakout participants suggested more directly engaging climate scientists and university faculty versed in change and variability impacts. Or, recognizing that climate is a crosscutting issue, they suggested programs hire a climate extension specialist and emphasize collaboration with extension agents in other specialties. Participants encouraged collaboration not just within extension programs, but also among agents tackling climate issues across the country, and suggested strengthening networking and supporting climate resource-mapping efforts.

Participants brainstormed other strategies for strengthening the climate capacity in extension programs, some of which re-envision extension programming. It would be helpful, for example, to foster situations in which extension **helps direct research priorities**, particularly when this can meet local data needs or solve local issues. Often, researchers set priorities independent of extension and extension agents must rely on applying the science opportunistically. Another strategy for increasing capacity is to invest in creating robust training modules for volunteers designed to insure fidelity of program implementation.

Viewing climate change as an integral aspect of curricula encourages expansion into existing contexts. Demonstrating that climate preparedness and resilience can have other benefits and values (human health, sustainability, stewardship) will increase the chances of climate extension's success. Participants envisioned extension agents versed in climate-related challenges and prepared to help their constituents adapt to these changes, regardless of their specialty.

2. Transformational Communication Technologies

Brainstorming ways of enhancing and expanding Extension's focus on climate adaptation strategies prompts consideration of a significant issue for the field: how Extension employs new and emerging technologies, from mobile devices to social networking to cloud computing. Participants in this breakout session were asked to discuss the role these "transformational technologies" might play in a joint climate extension initiative.

Participants agreed that rapid changes in technology are driving changing trends in business and in society; that these changes call for different approaches to engaging constituents; and, that new climate extension programming would benefit greatly from embracing and advancing the use of new technologies. Participants identified two categories of technological tools that would benefit climate extension programs' outreach efforts. The first are **social networking and social business tools** to expand Extension's audience and constituency, so that fewer agents can potentially reach more people. The second are **mobile technologies**, which help Extension work more effectively given the multiple demands on time and resources. These two are described below.

First, as extension programs are faced with limited budgets and personnel, social networking technologies have the potential to aid in reaching more clients across a broader geographic area. Online social networking, in freeing users from the constraints of geographic proximity, has revolutionized how people connect and organize. Participants suggested that Extension harness these networking trends to foster community engagement, establish and strengthen new relationships, and share solutions to emerging climate challenges. But while these technologies exist—and thrive—unattached to physical places, extension-appropriate technologies would help connect people back to places, fostering virtual communities that are tied to specific locations, so that agents can continue to deliver location-specific adaptation information. Indeed, Extension fills a unique niche in the landscape of resources, providing scientific information that is highly personalized, tailored to location, audience, and need. Breakout participants cautioned that Extension should look to adopt technologies that complement and flesh out this niche, rather than compete with other existing resources.

Secondly, mobile technologies allow agents and clientele to access specific information instantly, and this can be a valuable resource for addressing geographically-specific climate challenges. Mobile technologies can be devised to enable field access, helping clients make decisions about climate adaptation actions in real time. Extension would then add value to these tools by maintaining in-person involvement and guidance, ensuring that such technologies complement, not supplant, trust-based constituent relationships.

Above all, in considering new technologies, breakout participants emphasized that extension agents must continue to tailor their information for their audience, recognizing that clientele differ in their access to and comfort with different kinds of technology. Before advancing a technology for outreach, an extension professional must consider user demographics: factors such as age, (as younger generations are often more comfortable with digital and virtual interactions), urban vs. rural setting, and educational level, among others. **Adopting and adapting to new technological platforms seems crucial for improving outreach to the information-saturated smart device-dependent crowd, but personal, one-on-one consultation is still vital to the maintaining Extension's effectiveness as a trusted source of science-based information and advice.**

3. Resources and Partnerships

This group identified core resources and partnerships needed in order to continue strengthening climate extension efforts. The breakout group encouraged **a joint climate Extension initiative** that will enable Land Grant and Sea Grant programs to reach out and establish new partnerships and explore additional funding opportunities involving hazard resilience and food security. The participants agreed that **more joint programming** would allow for a consistent message and better and more efficient delivery of climate variability and change education to common constituents. A joint strategy will not only enable the identification and development of climate adaptation and mitigation strategies, but will also improve the chance of their adoption by Extension's key stakeholder groups.

Extension excels at forming partnerships. Traditionally Land Grant extension professionals in rural areas have linked food producers to transport agents, markets, and inputs suppliers, among others. It will be increasingly important for this extension system to build partnerships that help link farmers and other people in rural communities directly with voluntary and regulated carbon markets, private and public institutions that disseminate mitigation technologies, and funding programs for adaptation investments. Increased access to meteorological information will be imperative for knowledge transfer to clients.

The participants suggested that USDA and NOAA provide **more near-term, competitive funding opportunities for climate-related projects**. Such projects should emphasize broadening or expanding partnerships with other agencies such as Health and Human Services, Defense, Energy, Housing and Urban Development, Transportation, Interior and the Federal Emergency Management Agency. The projects would involve integrated basic and applied research, education, and extension activities in agriculture, natural and marine resources, family, youth and community development.

The group also agreed that new partnership strategies in this rapidly emerging field must involve others in planning, implementation and monitoring aspects. **Expanded partnerships with other climate information networks and professional associations** are essential for the effective delivery of climate extension programs and this can be a complicated task for those seeking to be more inclusive. But there are social science tools available to help plan. Social network analyses, for instance, map and measure relationships and information flows between people, groups, organizations, and other connected information and knowledge entities.

Extension should also emphasize creating partnerships that insure the integration of local or traditional knowledge--outside the scientific domain—that has been gained by communities through experience in adaptation to climate change and variability. Several participants noted that although technology to measure environmental changes has advanced dramatically over the last century, local residents' first-hand observations and traditional knowledge of environmental conditions are still useful to scientists and project managers, and their consideration is essential for adaptation buy-in.

Climate extension programming needs to become an integral part of state extension **efforts in education**. Along with helping the agricultural and natural resource sectors, Extension should work with local leaders in schools, museums, universities, and other public places and take a lead role in demonstrating sustainable technologies and reducing the emissions footprint. Properly implemented, such initiatives provide living laboratories for students, teachers, parents, and the broader public. They provide an opportunity to explore, learn, and understand what sustainability means and how it relates to reducing the risk of climate change.

Extension must identify new public and private funding sources for climate extension programs. In the future, public financing is likely to focus on adaptation measures that improve the resilience of entire communities. But ensuring that private sector investments help reduce vulnerability and contribute to effective adaptation may generate new sources of funding

towards appropriate outcomes. Regardless of how resources are generated, designing an appropriate delivery mechanism with the right institutional and operational arrangements is paramount. This includes facilitation of access and effective disbursement through the possible provision of programmatic, or even budget support, rather than project-based support in order to enhance action on adaptation.

These efforts would have several foreseeable results. In the short term, there will be changes in knowledge. Extension and its additional partners can help bridge the enormous gap and countless challenges posed to constituents by climactic and market uncertainties. Effective communications will bring about a better **understanding of appropriate practices** that will lead to increased partnerships and sharing of resources. Along with others, Extension can bring together additional audiences with a shared recognition of the need to adapt to the likely impacts of climate change. Extension and others aim to help communities of stakeholders develop integrated responses which include **looking into new opportunities that arise from changes** as well as reducing threats to existing conditions.

4. Future Workforce Needs

Several overarching issues framed this group's discussion regarding future climate extension workforce needs. The group agreed that the demand for Extension services continues to grow and the trend is not likely to abate. In the last decade or so, and without ignoring traditional audiences, Land Grant and Sea Grant Extension have shifted attention from production agriculture and seafood harvest to other "wicked" resource issues⁵ involving rural areas, population centers, watersheds, community development, hazards, food security, public health and safety, sustainable living, regulatory compliance, and resilient communities and economies.

At the same time, Extension's budgets are shrinking, resulting in considerable staff and faculty attrition. There are many unfilled vacancies and Land Grant programs have experienced losses of full-time positions. As a result, fewer individuals are doing more with less. Extension professionals face abrupt transitions from single-county to multi-county to regional and state-wide responsibilities. Agents are even being called on to fill in as statewide subject-matter specialists. With this changing backdrop, it is not surprising then that the group agreed that **partial funding for climate extension and related outreach is and will be the norm for the foreseeable future**. Thus, funding to inform and advise about climate variability, change, vulnerability, risk, adaptation and mitigation will have to be cobbled together in order for Extension to remain responsive to important needs.

The breakout participants recognized that despite the limitations posed by these challenges, there are some actions that can be taken in the nearer term to meet climate extension workforce issues. One possibility is to offer more **training in extension skills and tools to willing climate researchers**. Social science skills such as audience analysis, facilitation, conflict

⁵ Ropeik, David, "Wicked Problems. Might Our Biggest Challenge be Just Too Tough to Solve?"

management, and neutrality/objectivity/non-advocacy could help climate scientists work in conjunction with Extension staff to communicate their findings to stakeholders.

The group recognized that this remains a controversial concept, given the traditional dichotomy between research and extension and the perception that researchers are typically reluctant to engage the public the way extension professionals do. “Researchers are not good listeners” is an oft-heard argument in favor of the status quo. Indeed, there is the academic reality that researchers are often reluctant to conduct the more practical needs- and outcomes-based research and, in order to obtain tenure and be promoted, are pressed to deliver findings through professional venues such as peer-reviewed publications. But the push to have researchers work more closely with stakeholders to address their needs is not limited to the field of climate science. Climate extension services should either seek to replicate existing models of integrating research and extension or work to develop new programs that could well serve as a **model for the shift in paradigm**.

Not surprisingly, considering this traditional divide, graduate students and researchers are generally unaware of career opportunities in extension and other outreach positions. Graduate schools typically groom students for academic roles, but for most, master’s degrees represent the end of the academic career and extension is a distinct job opportunity. The breakout group suggested that funding climate extension internships (under Extension faculty) could encourage **graduate students** to be **more involved in climate-related extension work**.

The same holds true for post-doctoral scholars. Major climate research and outreach funding sources (NSF, NIFA, USFWS and NOAA Sea Grant and Climate Program Office) and the US Global Change Research Program now require more outreach which presents an opportunity for individuals with research backgrounds to do more extension work. Funding of **extension fellowships** might enable professional exchange programs.

Ultimately, more **global environmental literacy** and widespread understanding of how natural systems work is critical for both the success and expansion of climate extension’s future workforce. The recent national focus⁶ on improving STEM (Science, Technology, Engineering, and Math) education to better develop the American workforce may present the opportunity to incorporate climate science more broadly across the education system. The breakout group suggested providing “Basics of Climate” information for K-12 teachers, climate modules for classrooms and 4-H groups, and stewardship projects for students involving climate adaptation. Such initiatives could help prepare future decision-makers, engage and empower citizens to help in their communities, and introduce climate extension career paths at an early age.

⁶ Business-Higher Education Forum, “Meeting the STEM Workforce Challenge: Leveraging Higher Education’s Untapped Potential To Prepare Tomorrow’s STEM Workforce”, November 2011

V. Conclusions of the Climate Extension Summit

Climate changes are underway, projected to grow, and are already having an impact on land and water resources. Responding to these changes will require a climate-literate society in which citizens appreciate how a changing climate is likely to impact their lives and are aware of their options to mitigate these impacts.

The Land Grant and Sea Grant Extension networks have worked with stakeholders to develop alternative models for providing meaningful climate change and variability programming. But the connections within and among the two extension networks need to be strengthened. This can be done through a joint initiative involving more Land Grant-Sea Grant pooling of funds and programming efforts in states or regions where such opportunities exist. A joint climate Extension initiative would enable Land Grant and Sea Grant programs to reach out and establish new partnerships and explore additional funding opportunities involving hazard resilience, resource management, and food security.

A joint initiative should also encourage the two networks to invest in building capacity through additional internal training for current extension staff and faculty. Such training would initially focus on providing climate science basics and development of the most relevant, smallest-scale climate information and models to share with the Extension constituents. Extension agents would also benefit from training in risk communications and risk management. Ultimately, the extension staffs will need to be comfortable articulating climate science and implications even when confronted with difficult questions and skepticism.

Extension's workforce will also need more teaching and in-service training regarding social behavior and social media communities. Americans are using more technology, with higher frequency, than ever before, and Extension can harness this trend to better communicate with stakeholders. These communications technologies facilitate discussion, enabling stakeholders to be more active participants in the creation and development climate change and variability information. Extension can add value to these tools by maintaining in-person involvement and guidance, ensuring that such technologies complement trust-based constituent relationships.

The resiliency of communities and natural resource economic sectors will be determined by their abilities to mitigate and adapt to the risks associated with climate change. Governments, communities, academia, business and industry, and individuals must work together to address the many climate-related challenges and opportunities. The Land Grant Extension System and the National Sea Grant College Program are particularly well-suited to translate scientific knowledge of the impacts, risks, and vulnerabilities to millions of stakeholders.

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Appendix A: List of Participants

FIRST	LAST	AFFILIATION	EMAIL ADDRESS
Panelists			
Alicia	Betancourt	University of Florida	Betancourt-Alicia@monroecounty-fl.gov
Liam	Carr	2012 Sea Grant Knauss Fellow	liam.m.carr@noaa.gov
Mike	Crimmins	University of Arizona	crimmins@u.arizona.edu
Catherine	Elliot	Maine Sea Grant	cathy.elliott@maine.edu
Ann	Faulds	Pennsylvania Sea Grant	afaulds@psu.edu
Clyde	Fraisse	University of Florida	cfraisse@ufl.edu
John	Jacob	Texas Sea Grant	jjacob@tamu.edu
Ken	La Valley	New Hampshire Sea Grant	Ken.LaValley@unh.edu
Virginia	Morgan	Extension Disaster Education Network	morgamv@auburn.edu
Paul	Olin	California Sea Grant	polin@ucsd.edu
Viviane	Simon-Brown	Oregon State University	viviane.simon-brown@oregonstate.edu
Julie	Simpson	Massachusetts Institute of Technology Sea Grant	simpsonj@mit.edu
Laura	Snell	University of Nebraska-Lincoln	laura.snell@huskers.unl.edu
LaDon	Swann	Mississippi-Alabama Sea Grant	swanndl@auburn.edu
Molly	Woloszyn	Illinois-Indiana Sea Grant	mollyw@illinois.edu
Delegates			
Bob	Bacon	South Carolina Sea Grant	robert.bacon@scseagrant.org
Joe	Cone	Oregon Sea Grant	joe.cone@oregonstate.edu
Roger	Griffis	NOAA Fisheries	roger.b.griffis@noaa.gov
Juliette	Hart	University of Southern California Sea Grant	jahart@usc.edu
Kathy	Jacobs	White House Office of Science & Technology Policy and National Climate Assessment.	Katharine L. Jacobs@ostp.eop.gov
Michael	McGirr	National Institute of Food and Agriculture	mmcgirr@nifa.usda.gov
Eric	Norland	National Institute of Food and Agriculture	enorland@nifa.usda.gov
Adam	Parris	NOAA Climate Program Office	Adam.Parris@noaa.gov
Jon	Pennock	New Hampshire Sea Grant	jonathan.pennock@unh.edu
Margaret	Walsh	USDA Office of the Chief Economist	mwalsh@oce.usda.gov
Craig	Wood	University of Kentucky, eXtension Initiative	craig.wood@extension.org
Organizers			
Joshua	Brown	National Sea Grant Office	joshua.brown@noaa.gov
Wan-Jean	Lee	2012 Sea Grant Knauss Fellow	wanjean.lee@noaa.gov
Michael	Liffmann	National Sea Grant Office	michael.liffmann@noaa.gov
Michael	Spranger	University of Florida	spranger@ufl.edu
Emily	Susko	2012 Sea Grant Knauss Fellow	emily.susko@noaa.gov
Luis	Tupas	National Institute of Food and Agriculture	ltupas@nifa.usda.gov

Appendix B: Panelists' Biographies and Abstracts

KEYNOTES

Dr. Leon M. Cammen

National Sea Grant College Program

Dr. Leon M. Cammen is the Director of the National Oceanic and Atmospheric Administration's (NOAA's) National Sea Grant College Program. Since joining Sea Grant in 1990, Dr. Cammen has been a Program Officer for about half the state Sea Grant Programs and has served as Research Director. From 2004 to 2010, he was the Program Manager for NOAA's Ecosystem Research Program, a matrix program that includes the programs and laboratories from the Office of Oceanic and Atmospheric Research, the National Ocean Service, and the National Marine Fisheries Service that deal with coastal and ocean ecosystem research. Prior to joining Sea Grant, Dr. Cammen was a research scientist at Bigelow Laboratory for Ocean Sciences in Maine. His research interests include benthic ecology, the microbial loop, respiratory physiology, benthic-pelagic coupling, and ecosystem modeling. Dr. Cammen has authored over 30 publications in the fields of marine ecology and biological oceanography. Dr. Cammen received his Ph.D. in Zoology from North Carolina State University in 1978. He carried out postdoctoral research as a National Research Council Canada Fellow at the Bedford Institute of Oceanography, as a NATO Fellow at the Institute of Ecology and Genetics of Aarhus University in Denmark, and at Skidaway Institute of Oceanography. In addition, he has been a visiting scientist at Odense University in Denmark and a visiting professor at Aarhus University, teaching Marine Ecology and Microbial Ecology.

Dr. Franklin E. Boteler

National Institute of Food and Agriculture

Franklin E. Boteler (Frank) currently serves as the leader of the Institute of Bioenergy, Climate and Environment (IBCE) in the USDA National Institute of Food and Agriculture (NIFA). IBCE is one of four NIFA Institutes which fund transdisciplinary, outcome-driven programs that address national science priorities. Focused IBCE programs advance energy independence and adaptation of agricultural, forest, and range production systems to climate variables. Core programs within the Institute address basic natural resources including air, water, and soil in order to advance sustainable forest, range, and agricultural production. IBCE programs award approximately \$300 million per year in grants to support research, education, and extension. Previously, Dr. Boteler held progressively responsible positions with the North Carolina, Idaho, and Washington State Parks Systems. In Washington he functioned as the chief operating officer responsible for 1000 FTE's (including 250 commissioned park rangers), 125 parks, a \$100 million operating budget, and an \$80 million capital development budget. He regularly participated in cabinet meetings of Governor Locke in Washington and Governor Andrus in Idaho, prepared briefing documents and gave presentations to policy setting boards and commissions, and testified before state legislative committees. Boteler holds a doctorate and masters from the Pennsylvania State University School of Forest Resources and a B.S. in psychology from the University of Maryland. He has completed substantial executive

management training including a four week in-residence training on executive leadership at Federal Executive Institute, two weeks in residence at the Washington State Executive Managers Program, the North Carolina Certified Public Manager Program, and numerous courses from the Kennedy School of Government Studies at Harvard and the Brookings Institution.

Kathy Jacobs

Office of Science and Technology Policy

Kathy Jacobs is the Assistant Director for Climate Assessment and Adaptation at the Office of Science and Technology Policy. She is the Director of the National Climate Assessment, a major effort to evaluate climate impacts on regions and sectors of the U.S. She is also part of a team working to develop a national adaptation strategy, and is the liaison to the Subcommittee on Water Availability and Quality of the National Science and Technology Council. Jacobs recently chaired a National Research Council panel on climate change adaptation within the America's Climate Choices Project, and has served on six other Academy committees. From 2006-2009 Jacobs was the Executive Director of the Arizona Water Institute, a consortium of the three state universities focused on water-related research, education and technology transfer in support of water supply sustainability. She has 23 years of experience as a water manager for the state of Arizona, including 14 years as director of the Tucson Active Management Area, and has a master's degree in environmental planning from the University of California, Berkeley. Jacobs is on a mobility assignment from the University of Arizona, where she is on the faculty of the department of Soils, Water and Environmental Science.

PANELS

Climate Science in Extension

Molly Woloszyn

Illinois-Indiana Sea Grant & Midwestern Regional Climate Center

Molly Woloszyn has a joint position between Illinois-Indiana Sea Grant and the Midwestern Regional Climate Center, both a part of the University of Illinois in Champaign-Urbana. As the extension climatologist for both programs, she is responsible for communicating climate-related information to various audiences throughout the Midwest. Her educational background includes a B.S. in meteorology from Northern Illinois University and a M.S. in Atmospheric Science from Colorado State University.

Abstract: While working with teachers, municipal officials and professionals, and climate science and extension colleagues, I have realized there are some major obstacles to overcome as a climate extension educator. Some of the biggest obstacles I face relate to the lack of understanding of climate science and the political division and apathy that surrounds the topic of climate change today. In addition, climate change is often presented in a “doom and gloom” scenario, emphasizing the blame on humans. While it is important not to avoid that topic, emphasizing it often promotes anxiety and makes people disengaged. Therefore, my biggest challenge as a climate extension educator so far has been – what is the best approach to address the issue of climate change that engages all audiences, does not cause division, and that presents the information in an optimistic way that inspires opportunity and action?

Dr. Michael Crimmins

The University of Arizona

Dr. Crimmins is on the faculty of the Department of Soil, Water, and Environmental Science at the University of Arizona and is a Climate Science Extension Specialist for Arizona Cooperative Extension. In this position he provides climate science support to resource managers across Arizona by assessing information needs, synthesizing and transferring relevant research results and conducting applied research projects. His extension and research work supports resource management across multiple sectors including rangelands, forests/wildfire, and water resources as well as informing policy and decision makers. This work aims to support managers by increasing climate science literacy as well as developing strategies to adapt to a changing climate. He also serves as a drought monitoring expert on the Arizona Governor’s Drought Task Force and has worked with counties across Arizona to implement drought preparedness and impact monitoring plans.

Abstract: The Cooperative Extension System with explicit connections to Land Grant Universities and with thousands of personnel with diverse expertise living in large and small communities across the country has been highlighted as an ideal ‘boundary organization’ needed to aid with climate change adaptation and mitigation activities. The exact nature of adaptation and mitigation activities is often very locally specific with respect to what is appropriate, relevant and politically palatable. This local nature and specificity of climate

change information needs, educational plans, and adaptation and mitigation strategies requires local expertise and connections to local stakeholders inherently possessed in the network of Extension Agents and Specialists across the U.S.

McNie (2007) argues that researchers have concentrated on increasing the supply of scientific information often without a careful preliminary assessment of what information might be needed or useful. This idea could certainly be applied to climate science and Extension's role in reconciling the supply and demand of climate science information should be carefully examined. Rather than using the Extension system to find a 'home' for an endless supply of climate information, I argue that the system should be used as originally designed in assessing the demand for information and working to meet those demands. In the realm of climate science this includes finding a place for climate science in existing extension programs, conducting new and ongoing climate science needs assessments and working to tailor education programs and applied research projects to local needs. This strategy requires a high functioning and stable Cooperative Extension System with access to flexible funding mechanisms that support assessment and applied research at varying scales.

Coastal and Terrestrial Ecosystems

Dr. Juliet Simpson

MIT Sea Grant College Program

Juliet Simpson is a coastal ecologist with the MIT Sea Grant College Program. She studies the effects of climate change on coastal habitats, aquatic plant and algal ecology, water quality regulation, and the transport and fate of pollutants (nutrients, metals, pharmaceuticals and personal care products) to the coastal ocean. She earned a B.S. in Biology and Marine Science from Stony Brook Univ., and a Ph.D. in Ecology, Evolution and Marine Biology from U.C. Santa Barbara.

Abstract: I was planning to talk about how extension can better use technology, which I think is an area where Sea Grant can reach a lot more people and organizations than it currently is doing. I would like to discuss two aspects of this, (1) better use of electronic communication, and (2) helping to make high-tech products more available to potential users, from states to land managers to individual homeowners. (1) I will discuss communication technology in general (Facebook, Twitter, etc), highlighting some successful examples their use within Sea Grant. (2) I will briefly describe a project I'm working on as an example of making technology more widely available. We have partially funded the development of an ocean circulation model (FVCOM) that is great at predicting coastal inundation from storm surges and sea level rise; it could be an incredibly valuable planning tool, but it requires highly technical knowledge to use. We're developing a user-friendly web-based interface so that any town planner, home owner, state or municipal officer, can use the output of the model with a minimum of training.

Dr. Catherine Elliot
University of Maine

Catherine Elliott has been with UMaine Extension since 1986, and is currently Sustainable Living Specialist. She has a BScF in Forestry and Wildlife from the University of New Brunswick, Canada, and an MS in Wildlife Management and PhD in Wildlife Ecology from the University of Maine. During her career with Extension, Cathy has worked with private woodland owners and forest industry on forest biodiversity and habitat management, conducted programs in backyard and woodlot wildlife, and trained volunteers in wildlife habitat and sustainable living outreach. As a charter member of the National Network for Sustainable Living Education, Cathy has chaired the Online Course Work Team and conducted SLE workshops for colleagues and clients. Currently, she is working with two of Maine's three 4-H Camp and Learning Centers, overseeing summer and school day and residential camps where ecological literacy and sustainable living are foundational to all programs. Cathy is also a member of UMaine's NSF EPSCoR Sustainable Solutions Initiative, Knowledge to Action Team, that is utilizing multidisciplinary teams and stakeholder engagement to address sustainability issues in Maine.

Abstract: Our current knowledge of the effects of climate change and variability on terrestrial ecosystems varies greatly depending on the ecosystem in question. Some systems, particularly in northern and alpine areas, are fairly well studied and research has documented current effects of climate change. We can use models to predict changes in range for individual species, but it is difficult to predict changes in species assemblages and how interdependent species will be affected. We know that phenological changes are occurring, but are less clear on how they will affect interactions among co-occurring species. Generalist species, including invasive exotics, are likely to do well; specialist and range-restricted species are most vulnerable. Future direction for Extension should focus on ensuring that all educators understand climate science, climate change, and its implications for our clients, and are supported with curricula and resources to conduct programs relevant to their fields. Our educational programs should result in an ecologically literate citizenry who are invested in the well-being of themselves, their families, and their communities as they learn to live more sustainably and adapt to changing climate. Extension is uniquely positioned within the Land & Sea Grant systems to engage academic, research, and extension faculty members, students, and stakeholders in defining issues and research questions, conducting multi-disciplinary, solution-oriented research, and applying the results.

Natural Resource Sustainability

Dr. Kenneth J. La Valley
University of New Hampshire

Dr. La Valley is the Associate Director of the NH Sea Grant College Program as well as the Assistant Director of UNH Cooperative Extension. The administrative relationship between the land and sea grant programs at the University of New Hampshire creates a unique opportunity for Ken to coordinate and leverage programs for the benefit of NH and the region. La Valley's

current research interest is in conservation engineering of fishing gear that improves selectivity while reducing bycatch of non-target species. His extension work is focused on technology transfer of sustainable fishing strategies as well as improving the capacity of local fishermen to direct market their harvest.

Abstract: My presentation will describe the current activities of the Sea Grant Fisheries Extension Network focused on engaging the fishing community in climate change related education. In addition, primary fisheries concerns such as ocean acidification, species shifts and the impact on shellfish recruitment and potential links to disease prevalence will be discussed. Current research and education needs will be discussed in the context of improving Sea Grant extension's ability to integrate climate change into fisheries programming.

Viviane Simon-Brown
Oregon State University

Viviane Simon-Brown has been an Extension Sustainable Living Specialist at Oregon State University since 1998. During that time, she helped create and now directs the National Network for Sustainable Living Education (NNLSE), a group of 90+ colleagues at land grants throughout the US. Her current assignment is to coordinate an undergraduate dual degree in sustainability at OSU, offered Fall 2012.

Abstract: From a natural resources point of view, what are the biggest issues facing Extension and NOAA leadership concerning climate change? Both organizations need to build capacity not only about climate change science, but more importantly, about adapting to and mitigating its impacts. To be effective, Extension and NOAA professionals must be aware of the taboos within the subject, the societal barriers which impede progress, and the importance of "walking the talk" at every level within our organizations.

Aquaculture and Agriculture

Dr. Paul Olin
University of California

Dr. Paul Olin works as a Sea Grant Advisor in the University of California Sea Grant Extension Program based administratively at UC San Diego/Scripps Institution of Oceanography. Olin lives and works in Santa Rosa where he conducts applied research and extension programs in aquaculture with activities related to aquaculture policy as well as the culture of shellfish and emerging opportunities for offshore culture of finfish. Shellfish research includes evaluating field performance of hybrid and selected Pacific Oysters to increase production and enhance disease resistance. In Northern California he is engaged in monitoring recovery of endangered coho salmon in the Russian River as a partner in a broadly based multi-Agency partnership engaged in the Endangered Coho Salmon Captive Broodstock Recovery Program.

Dr. Olin is a member of the U.S. – Japan Natural Resources Panel on Aquaculture, the NOAA-Korea Joint Coordination Panel for Aquaculture Cooperation, and the California Aquaculture Development Committee. He is currently collaborating with the Department of Fish and Game and the Ocean Protection Council to review and edit a Programmatic Environmental Impact Report of Marine Aquaculture.

Prior to his work at the University of California he coordinated an international training program in shrimp aquaculture and was the Aquaculture Specialist for the University of Hawaii Sea Grant Program. He earned a B.S. in biology from the University of Miami, a M.S. in animal science at UC Davis, and a Ph.D. in zoology at the University of Hawaii.

Abstract: The impact of climate change on American aquaculture is not yet fully known. Few research studies have been completed to scientifically demonstrate impacts, but many are underway and early indications are that some environmental changes, in particular ocean acidification, have the potential to significantly disrupt production and alter entire ecosystems. It is expected that the four major effects of climate change, rising air and water temperatures, sea level rise, ocean acidification, and extreme weather will all impact aquaculture. Higher water temperatures are likely to alter the range, growth and distribution of many species which carries both risks and benefits. Increased infectious disease with rising temperatures is a vulnerability of aquaculture. Climate warming may stimulate the growth of harmful algal blooms which can release toxins into the water and kill fish and shellfish. As water warms, optimal growing conditions will shift north necessitating short term adaptation and longer term relocation. Rising sea level will also force the relocation of some aquaculture facilities.

The frequency and severity of extreme storms seems to have increased both on the Pacific and Atlantic coast as predicted by climate change models. Hurricanes Katrina and Rita in the Gulf of Mexico are good examples of this and demonstrate how aquaculture can be devastated both by loss of stocks and coastal infrastructure.

Ocean acidification is altering the ocean's pH and is a serious near term impact of climate change interfering with the ability of oysters, clams, and other shell forming organisms to create shell. There is likely a critical pH threshold that once reached would decimate shelled filter feeding organisms and could precipitate a cascading series of events irreversibly altering marine biodiversity, threatening food security, and damaging economies worldwide. The United States is a leader in research to document impacts of ocean acidification and identify this threshold; it should also provide political leadership internationally to develop solutions.

Dr. Clyde Fraisse
University of Florida

Clyde Fraisse is a Climate Extension Specialist at the University of Florida Agricultural & Biological Engineering Department. His extension and applied research program focus on developing and providing climate information and decision support tools to help agriculture,

forestry, and water resource managers better cope with risks associated with climate variability and change. Dr. Fraisse developed and maintains *AgroClimate.org*, a web-based climate information system customized for the agricultural industry in the southeastern U.S.A. and co-chairs the University of Florida IFAS Extension Climate focus group working on accessing potential impacts and developing climate variability and change adaptation and mitigation strategies for the agricultural industry in the region.

Community and Economic Development

Ann Faulds

Penn State University

Ann Faulds is Pennsylvania Sea Grant's Associate Director for the Delaware River program. With more than twenty years of experience in science instruction and aquatic resource education and outreach, Ann is active in watershed education, fish consumption communications, hazard and climate outreach, and AIS outreach. Other specialties include wetland, stream, and lake ecology and aquatic entomology. Prior to working with Pennsylvania Sea Grant, Ann taught in the Biology Department of West Chester University where she received her master's degree in 1998. Ann has been with Pennsylvania Sea Grant since 2001.

Abstract: Once a thriving economic center bordering the tidal Delaware River just south of Philadelphia, the City of Chester was designated as a financially distressed municipality in 1995. However, a recent surge in redevelopment via Pennsylvania's Keystone Opportunity Zone Program that will combine with an infusion of federal support for economic growth through the new Strong Cities, Strong Communities (SC2) initiative has begun to re-energized the waterfront and surrounding community. As such, the City of Chester is uniquely poised to act as a model for other coastal communities who are seeking to optimize the return on investments by rebuild their economic base while simultaneously planning climate adaptation strategies. With a host of partners, Pennsylvania Sea Grant seeks to develop a climate change and coastal hazards adaptation plan for the City of Chester that builds on the recommendations outlined in the Sea Grant and NOAA Coastal Services Center sponsored Roadmap Final Report (2011) and the City's Vision 2020 Comprehensive Plan.

Jay Moynihan

University of Wisconsin

Jay has a law degree and a BA in International Studies and Mass Communications. Since 2006 he has been the Community Development Educator for University of Wisconsin Cooperative Extension, in Shawano County, Wisconsin. In 2009 Jay designed and taught an MBA class *Rapid Climate Change Strategy for Business*, for Bainbridge Graduate Institute, Bainbridge Island, WA. He also down-scaled that curriculum for local teaching. Jay is a member of the UW-Extension Sustainability Team, UW-Extension Climate Change Curriculum Development Workgroup, National Network for Sustainable Living Education, Climate Literacy Network, Lake Superior Ecosystem Climate Change Adaptation Plan, Expert Review Group, Northeast Wisconsin

Educational Resource Alliance (NEW ERA) Sustainability Taskforce, and the Wisconsin Initiative on Climate Change Impact (WICCI), Outreach Committee. Jay is a contributor to *Toward a Sustainable Community: A Toolkit for Local Governments*, published by UW-Extension, team leader for and co-author of NNSLE's *Climate Change Handbook: A Citizen's Guide to Thoughtful Action*. Contributions in Education and Outreach 4b, Forest Research Laboratory, Oregon State University, Corvallis (2010, and author of *The Adaptation Factory*, adaptationfactory.blogspot.com.

Hazard Resilience

Dr. LaDon Swann

Auburn University

LaDon Swann is Director of the Mississippi-Alabama Sea Grant Consortium (MASGC), and Director of the Auburn University Marine Extension and Research Center (AUMERC), LaDon has an academic appointment in the Department of Fisheries and Allied Aquacultures at Auburn University. LaDon is responsible for implementing practical solutions to coastal issues through competitive research, graduate student training, and extension and outreach and K-12 education in Alabama and Mississippi. In addition to his administrative duties for MASGC and AUMERC, LaDon conducts research on shellfish aquaculture and habitat restoration. LaDon also has over 26 years of experience designing, delivering and evaluating engagement programs addressing local, regional and national needs. LaDon is actively involved in regional engagement through the NOAA Gulf of Mexico Regional Collaboration Team, multiple Gulf of Mexico Alliance priority issues teams and the Community Resilience Priority Area of the Gulf Coast Ecosystem Restoration Task Force. During 2010 LaDon served on the Oil Spill Recovery Commissions for Alabama and Mississippi and served as a primary point of contact for NOAA's engagement efforts. LaDon is the president-elect of the National Sea Grant Association and co-chair of Sea Grant's Hazard Resilient Coastal Communities Focus Team. LaDon is also a past-president of the U.S. Aquaculture Association.

Abstract: There are subtle to major differences between community resilience to natural hazards and climate change adaptation. For example, the political landscape is favorable to assist communities become more resilient to natural hazards like hurricanes and tornadoes. On the other hand, political will to develop climate adaptation strategies for communities, including businesses, is not as strong, if for no other reason, the gradual effects of climate change are rarely seen during the tenure of most politicians. In this presentation I will discuss the intersection the between the two. In the Gulf of Mexico Region this intersection is significant and involves and expanded workforce specialized in community and regional planning, law and policy, climatology, engineering, agriculture, fisheries, transportation, public health, sociology, psychology, political science, risk communicators, among others. More than ever Extension has to develop formal partnerships with non-traditional partners to expand programs in an area of flat or declining budgets. Key technologies that Extension will need to support their programs will include more and more accurate tools to make weather forecasts and to predict the local impact from climate change. Social media is another technology that will continue to be vital in Extension's risk communication programs. For Extension to have a

role in resilience and climate Extension programs, we must be willing to do what we do best; be nimble and adapt. To do this we have to recognize the importance of our role in communicating future needs of customers to the next generation of Extension professionals. Current Extension professionals are in the best position to develop formal curricula that will be used by higher education institutions. Extension administrators also have a responsibility to listen to field staff and then support their participation in professional development programs that will allow them to be relevant to the people we serve.

Dr. Virginia Morgan
Auburn University

Virginia Morgan joined the Alabama Cooperative Extension System (ACES) as an extension specialist and coordinator of the visual resources unit in 1992. In 1999 she was named co-leader of Extension Communications, while continuing her earlier assignment. In 2007, she changed roles to become Extension's lead person for disaster education, assume greater responsibility for Alabama's role in eXtension, and collaborate with the Assistant Director for Program Development. She has worked in program design and development, instructional methods and materials, adult development and team building, leadership development (communication skills, presentation skills, and conflict management), technology (distance education, videography, and still photography), and disaster education. Dr. Morgan became the Alabama representative to EDEN (Extension Disaster Education Network) in 2003. In 2006, she was elected to serve as secretary to the EDEN Executive Committee, and in 2007, assumed managerial/administrative responsibilities for the Disaster Issues Community of Practice—the EDEN-supported eXtension CoP. In 2010, she became EDEN Chair for a two-year term.

Abstract: Change, according to the ancient Greek philosopher Heraclitus, is always present. Change, in fact, is the only constant. Not only do we tend to resist change, we are reluctant to prepare for change. EDEN's mission is to reduce the impact of disaster through education. EDEN delegates represent all fifty states and three territories, and more than 75 different areas of expertise within Extension's major program areas. As a result, we have access to a wealth of knowledge to support the EDEN mission. Our challenge is to get people's attention about being prepared for natural or technological disasters unless they or their communities have experienced a disaster. This challenge becomes even larger when Extension personnel do not see a fit between their work and disaster education. Add the issue of climate change to the picture and the challenge can feel insurmountable. Extension is very good at facilitating discussions and building relationships that foster preparedness and mitigation efforts, as well as quicker recovery when a disaster occurs. If climate change is included in the list of hazards, Extension professionals must first understand the implications of this risk before they can facilitate community resiliency to it. A basic understanding of the science is especially important for those professionals not in program areas most readily associated with climate change. Administrators must support Extension professionals in the development of their understanding of climate change and its impacts. Extension administrators must listen and learn from field staff concerning reality at the local level. We need to find new collaborators

and engage current partners in new ways that allow us to remain relevant to the people we serve.

Extension At-Large

Alicia A. Betancourt

University of Florida

Alicia A. Betancourt, Family and Community Development Agent for University of Florida, IFAS-Monroe County Extension, has a M.A. in Community Development; B.A. in Public Administration. She has worked on development of the Monroe County Climate Action Plan, the Monroe County Energy Efficiency Strategy and Energy Reduction Task Force for over four years. She collaborated on the development of a Regional Climate Action Plan. She was appointed to the Regional Greenhouse Gas Technical Committee. She coordinates the Climate Change Advisory Committee, the Municipal Employee Green Team, and she develops related programs for citizens and businesses.

Dr. John Jacob

Texas A&M University

Dr. John Jacob is the director of the Texas Coastal Watershed Program, Texas A&M University. His current project, Coastal CHARM (Community Health and Resource Management), focuses on enabling coastal communities in Texas to improve quality of life in cities and towns while preserving and enhancing the natural coastal environment. He is Professor and Extension Specialist with a joint appointment with Texas Sea Grant and Texas AgriLife Extension, through the Department of Recreation, Park, and Tourism Sciences.

Joint Abstract: The Land and Sea Grant platform of integrated university research, education, and extension is a powerful model that could and should be ramped up to meet the challenges of an urban America in an era of complex energy and natural resource issues, including climate change. To have a real impact, however, university extension must escape the “producer” lock box in which it currently finds itself.

Both of the presenters in this slot are involved directly in on-the-ground local community and planning issues. Climate change (CC) is a potentially divisive issue in many of our communities. In many cases we are asking communities to embrace CC when they have yet to address some of the very basic issues of coastal hazard mitigation, for example. Few communities in fact consider worst-case or near-worst-case scenarios of existing hazards such as coastal flooding and storm surge. Consideration of these hazards, completely independent of any consideration of CC, could lead to exactly the kinds of behaviors we might like coastal citizens and officials to do in response to the potential perturbation of CC. Climate change could still be appealed to for the incorporation of a prudent amount of “freeboard”.

We argue here for consideration of a “No Regrets” approach for at least some Extension staff. Those of us taking this “indirect” approach with our communities need to be aided and abetted by the climate change adaptation and mitigation community to see which climate change opportunities (e.g., grants) could be accessed to aid local communities in their quest to build more resilient and vibrant communities. Issues such as smart growth and coastal hazard reduction would seem to be fertile ground where climate change monies could obtain sought-after results regardless of how local communities think about climate change.

We present examples of no-regrets or low-regrets approaches by Extension in Texas and Florida.

Graduate Student Panel

Laura Snell

University of Nebraska

Laura Snell is currently a masters student at the University of Nebraska in Lincoln, Nebraska studying agronomy with an emphasis in range and forage studies. She received her undergraduate degree from the University of Nebraska in 2009 and then worked for the University of Georgia Extension Education Center in Eatonton, Georgia. Her research focuses on nitrous oxide emissions from managed pasture in eastern Nebraska but she also studies dual management approaches to rangeland in Namibia, Africa. Laura developed the Lincoln adopt-a-stream during her undergraduate degree and volunteers with several non-profit and youth organizations.

Abstract: After conducting a brief survey with fellow graduate students in my department, I came up with a list of positive aspects of working for extension. The number one positive comment was that working for extension provides great flexibility and variety in everyday tasks, topic of study, and types of people benefiting from your work. If you enjoy working with people of all ages and connecting with people who have similar interests, extension is a very good career field. Extension workers are typically more community centered than the average college professor or researcher and they provide applied research for a variety of people from different backgrounds. Many students commented about the positive memories they had of being in 4-H and that their county extension educators were important influences. Some concerns were expressed over the consolidation or elimination of extension positions in several states. The work load associated with extension positions that cover larger areas and diverse populations can seem overwhelming. Apprehension about future funding availability and the need to do more with limited financial resources were discussed. Students also mentioned the need for more communication and collaboration between researchers, educators, extension professionals and private enterprises.

Liam Carr

Texas A&M, NOAA Office of External Affairs

Liam Carr recently defended his Ph.D. dissertation in Geography at Texas A&M University. His work focused on improving management for data- and resource-poor fisheries in the U.S. Caribbean. He has a Master's of Forest Science from Yale University and dual undergraduate degrees from the University of Southern California. Following Yale, Liam worked for two years at the University of the Virgin Islands – St. Croix, as an Extension Analyst with the Virgin Islands Marine Advisory Service. Over that time, Liam led work educating St. Croix's youth on the damages of Non-Point Source pollution on the island's coral reef systems, conducted research focusing on reef health and impacts associated with both sedimentation and the impacts associated with the 2005 coral bleaching event, and participated on visiting research projects focusing on everything from sea turtle nesting to fishery stock assessments to tourist enjoyment of beaches.

Liam counts among his highlights as an Extension Analyst presenting the first sedimentation rate report for St. Croix at the 2005 NPS Pollution Conference in St. John, USVI and working with the St. Croix Education Complex (High School) Science Club to develop an educational program focusing on invasive lionfish, which threaten to decimate the local reef fish community. This program directly led to the development of a Lionfish Derby Tournament Series in St. Croix, and other public outreach tools to highlight the value and importance of coral reefs to the people of St. Croix. Originally from New London, Connecticut, Liam now calls Washington DC home, as a 2012-2013 Sea Grant Dean John A. Knauss Fellow, where he works in the NOAA Office of External Affairs.

Appendix C: Final Agenda

Tuesday, March 13

7:30 *Check-in / Registration*

8:00 **Welcome Remarks** – Leon Cammen (National Sea Grant College Program) and Frank Boteler (National Institute of Food and Agriculture)

8:30 Review Agenda and Set the Stage – Mike Spranger (University of Florida)

8:40 **Climate Science in Extension** – Molly Woloszyn (IL-IN Sea Grant) and Michael Crimmins (University of Arizona)

9:15 **Coastal and Terrestrial Ecosystems** – Juliet Simpson (MIT Sea Grant) and Catherine Elliot (University of Maine)

9:50 *Break*

10:05 **Natural Resource Sustainability** – Ken La Valley (NH Sea Grant) and Viviane Simon-Brown (Oregon State University)

10:40 **Aquaculture and Agriculture** – Paul Olin (CA Sea Grant) and Clyde Fraisse (University of Florida)

11:15 **Community and Economic Development** – Ann Faulds (PA Sea Grant)

11:50 *Lunch*

12:50 **Hazard Resilience** – LaDon Swann (MS-AL Sea Grant Consortium) and Virginia Morgan (Extension Disaster Education Network)

1:25 **Extension At-Large** – John Jacob (TX Sea Grant) and Alicia Betancourt (University of Florida)

2:00 **Graduate Student Panel** – Liam Carr (2012 Sea Grant Knauss Fellow) and Laura Snell (University of Nebraska – Lincoln)

2:20 Breakout Group Instructions – Mike Liffmann, Luis Tupas, Mike Spranger

A: Current Professional Development Needs

B: Resources and Partnerships

C: Transformational Technologies

D: Future Workforce Needs

2:30 Breakout Group Working Session 1

- 3:15 *Break*
- 3:30 Breakout Group Working Session 2
- 4:15 *Wrap-Up* – Mike Liffmann, Luis Tupas, Mike Spranger

Wednesday, March 14

- 8:00 *Walk-In*
- 8:30 **Keynote** – Kathy Jacobs
- 9:00 Group A Report-Out
- 9:30 Group B Report-Out
- 10:00 *Break*
- 10:20 Group C Report-Out
- 10:50 Group D Report-Out
- 11:20 Large Group Summary Discussion
- 12:00 *Lunch*
- 1:20 Review Prioritized Recommendations
- 1:30 Report Writing Session
- 3:30 Next Steps, Closing Remarks – Mike Liffmann, Luis Tupas, Mike Spranger