

Engaging Climate-Sensitive Sectors in the Carolinas

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Supported by

NOAA Climate Program Office

Regional Integrated Sciences and Assessments Program

May 2012 (Peer-reviewed)

Acknowledgments

This report was supported by the NOAA Climate Program Office, Regional Integrated Sciences Program.

The authors thank the decision-makers who participated in the study for their time and insights.

The authors thank Dr. Jennifer Brewer, Dr. Janet Cakir, Dr. Caitlin Dyckman, and Melissa Stults for their thoughtful reviews and suggestions.

We are also grateful to Peng Gao for his assistance with the statistical analysis, Juliana Lam for her assistance in producing maps for the final report, and Sarah Battersby and Elbie Bentley for providing cartographic advice.

The authors also acknowledge the contributions of research assistants Sam Ferguson, Dylan Foster, Chris Rappold, Daniel Tompkins, Erin Weeks, and Henrik Westerkam. They provided invaluable help during the course of the project.

Report Acronyms

AMO	Atlantic Multidecadal Oscillation
APA	American Planning Association
CAMA	Coastal Area Management Act
CPC	Climate Prediction Center
EECBG	Energy Efficiency and Conservation Block Grant
EFETAC	Eastern Forest Environmental Threat Assessment Center
ENSO	El Nino Southern Oscillation
EPA	Environmental Protection Agency
GHG	Greenhouse Gas
ILT	North Carolina Interagency Leadership Team
IPCC	Intergovernmental Panel on Climate Change
LEED	Leadership in Energy and Environmental Design
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NCDC	National Climatic Data Center
NCDENR	North Carolina Department of Environment and Natural Resources
NCSCO	North Carolina State Climate Office
NERRS	National Estuarine Research Reserve System
NGO	Non-governmental Organization
NIDIS	National Integrated Drought Information Systems
NOAA	National Oceanic and Atmospheric Administration
NPO	Non-profit Organization
NSF	National Science Foundation
NWS	National Weather Service
NWS-CS	National Weather Service- Climate Service Division
REPS	Renewable Energy Portfolio Standard
RISA	Regional Integrated Sciences and Assessments
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCRPG	Sustainable Communities Regional Planning Grant
SCSCO	South Carolina State Climate Office
SERCC	Southeast Regional Climate Center
SLAMM	Sea Level Affecting Marshes Model
SRS	Southern Research Station (United States Forest Service)
TACCIMO	The Template for Assessing Climate Change Impacts and Management Options
TNC	The Nature Conservancy
USACOE	United State Army Corps of Engineers
USDA	United States Department of Agriculture
USDOE	United States Department of Energy
USFWS	United States Fish and Wildlife Service
USGCRP	United States Global Change Research Program
USGS	United States Geological Survey

Executive Summary

The Carolinas face a combination of climate-related stresses and adaptation challenges. This project examined five major sectors - Forestry, Government, Tourism, Water and Wildlife - in order to better understand and assess regional capacity to adapt to the challenges presented by climate change. These sectors were selected because of their sensitivity to climate variability and change and significance to the regional and local economies of the Carolinas.

Document analysis, questionnaires, and interviews with over 100 decision makers engaged in climate change activities informed this assessment. The research focused on identifying existing climate concerns and information use, responses to climate change, the factors that facilitate and constrain activities, and the needs and recommendations to enhance adaptive capacity. Research was conducted from September 2010 to September 2011, with interviews taking place from June to September 2011. Interviewees were selected for their leadership and involvement in climate change and related sustainability issues in the region. Their insights represent the challenges at the forefront of climate change activities in the Carolinas.

Climate Concerns, Decisions, and Information Use

Climate plays a significant role in the decisions and activities occurring across all the sectors selected for this study. The region as a whole experiences significant climate variability, and many existing decisions and activities reflect adaptations to that variability. Respondents also noted concerns related to climate change and potential impacts on the region. Such concerns centered on sea level rise, increasing temperatures, increasing variability and changes in precipitation patterns, and the impacts of extreme events such as floods, drought, hurricanes, and tropical storms. However, while study participants acknowledged the potential risks and impacts associated with climate change, they also indicated that climate change is often overshadowed by other stresses affecting their sectors, most commonly population growth, development, and economic concerns.

To address these climate concerns, the sectors analyzed draw from a wide array of information sources. The heterogeneity of information sources used by study participants revealed that there is not a centralized source of climate information for the region or for any one sector. A broad range of federal and state-level providers, as well as non-government entities, are utilized. Sector leaders indicated that numerous informal information networks exist to share and disseminate climate data and information. These information networks often build on existing professional affiliations and shared concerns about physical and social impacts of climate. Attending conferences and building networks of colleagues were consistently identified as strategies to obtain accessible, relevant, and trusted information for all sectors. Interview findings indicate that relevance to decisions and job responsibilities is the primary driver of why certain climate information sources are used. Selection of information source is also conditioned by trust and credibility, accessibility and convenience, and the spatial and temporal scale of the data. Differences among sectors regarding the type of information needed and reliance on particular agencies or information sources is discussed later in the report (Chapter 10).

Climate Change Activities and Communication Frames

First steps toward adaptation are occurring in each sector reviewed for this report, although some sectors are more advanced than others. In addition, activities to address climate change in the Carolinas are currently limited by weak public support and the political environment. The majority of participants reported that they avoid using the phrase “climate change” altogether due to a number of social and political sensitivities. In the current political climate many of the existing or planned climate change activities have been scaled back and/or integrated into other efforts. To enhance support of these activities, sectors tend to frame their public communications and efforts on climate within the context of one or several well-established public issues of concern including green jobs, ecosystem conservation, hazard mitigation, public health, energy and national security, planning, and sustainability.

Participants identified a wide variety of activities ranging from climate-related data collection and monitoring, to adaptive management experiments in coastal land use, emissions reduction (mitigation), education and outreach, risk and vulnerability assessments for emergency management purposes, and habitat protection and conservation (see Table 11.3 for details). All of the sectors are pursuing projects on greenhouse gas reduction, education and outreach, and the collection of climate impact data. Adaptation related research and pilot projects are receiving greater, although not universal, support along the coastal areas where there is observational evidence of sea level rise and ecological impacts. Adaptation related interests also intersect around topics of water resource and land use management. There are more advanced adaptation efforts in North Carolina than in South Carolina as well as a larger community working on climate change in North Carolina. Despite efforts to identify people and obtain referrals, this study includes fewer participants from South Carolina.

Adaptive Capacity

The current mobilization of adaptation and mitigation efforts represents early indications of adaptive capacity in the Carolinas and demonstrates emerging strategies to build capacity and overcome constraints. Adaptive capacity was analyzed based on categories identified by Yohe and Tol (2002) including governance, knowledge and information production and use, human and social capital, institutional practices and decision-making, and technology. Adaptation mandates were frequently identified as useful in overcoming existing resource and political constraints. Building *human and social capital* through networks and partnerships was consistently identified as a major asset and need, particularly under fiscal constraints.

Institutional practices and decision-making strategies are supporting greater engagement with climate adaptation in the Carolinas. The Forestry, Water, and Wildlife sectors have substantial experience with long-term planning that includes the use of climate information and that could facilitate the future inclusion of climate change scenarios. Some Government planning practices also use longer planning horizons that lend themselves to integrating climate information. In Tourism, their longstanding practices of education and outreach and personal engagement are being adapted to increase public awareness of climate issues. The availability of *tools and technology* to support adaptation efforts is currently best established in the Forestry sector.

Needs and Recommendations

Sector respondents identified key needs and recommendations to support climate mitigation and adaptation and build adaptive capacity in the Carolinas. Under the current fiscal circumstances,

limited budgets and resources are a consistent theme that has broad repercussions on all other aspects of capacity. Study participants repeatedly commented on the role that federal and state budget cutbacks played in limiting activities to address long-term climate impacts.

To build *effective governance structures and processes*, participants identified several issues related to the development or revision of laws, policies, and regulations that encourage or mandate climate-related activities, as well as greater certainty from the federal level regarding anticipated rule-making and regulations. They also pointed out barriers to advancing climate change planning and action across jurisdictional and regulatory boundaries. Across sectors, they expressed a desire to engage in collaborations and multiagency projects but felt that the formal systems needed to facilitate those collaborations were lacking.

The most common and vigorous recommendation for building *human and social capital* was the creation and support of collaboration and coordination of networks, projects, and multi-dimensional research frameworks. Participants from all sectors noted this as a primary need and recommendation to move climate action forward in the Carolinas, especially given significant reductions in the available resources and political support for such action over the past several years.

Within the realm of *institutional practices and decision-making*, respondents identified a need for greater coordination and collaboration among government agencies. The conflicts among competing interests and responsibilities as well as lack of coordination and communication pose barriers to activities.

In the area of *knowledge & information production and use* study participants underscored a strong need for the “translation” of climate information and data into non-technical and issue-relevant language. Sector leaders recommend continued and enhanced outreach and education initiatives tailored to the needs and values of constituents so that support for activities to address climate challenges may increase. Respondents identified a variety of data needs from specific outputs in downscaling to data on vulnerable infrastructure, effectiveness of adaptation strategies in natural ecosystems, better understanding of tourist responses to changing climate conditions, and more information on other stresses that would interact with climate-induced changes. They also identified some general and specific research areas of importance to their sectors. In addition, some noted the need for the development of information, tools, and techniques to help inform adaptation decisions, including guidance on impact and adaptive capacity assessments, and cost-benefit analyses. Information to improve understanding of the social consequences and potential trade-offs associated with adaptation options was also identified.

All sectors have major interests intersecting around water resources, land-use, and coastal zone management. Improvements in factors influencing the overall adaptive capacity in these areas offer potentially broad benefits. The shared interests and overlapping responsibilities create the potential for expanding networks, partnerships and collaborations. The multiple viewpoints and interests within these sectors also mean that groups have different and conflicting interests. Under such circumstances, improved capacity to conduct impact and vulnerability assessments, greater availability of information to evaluate the efficacy, cost-benefit, social consequences and trade-offs of adaptation options, and improved governance structures are likely to become increasingly valuable to adaptation planning.

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1 Introduction

Global climate changes will pose major challenges for socio-ecological systems (Karl et al. 2009; Geyer et al. 2011; Parry et al. 2007; Warner, et al. 2009; VijayaVenkataRaman, et al. 2012). Climate variability and human-induced global climate change will have complex reach into U.S. social, environmental, and economic systems. National efforts to document the direct and indirect effects of climate change in the U.S. have demonstrated that water, energy, transportation, agriculture, health, and ecosystems are already experiencing climate stressors that are exacerbating existing non-climate challenges like population growth, development and urbanization, the overuse of resources, public health, and social inequities (Karl et al. 2009; Pankaj et al. 2011; Parry et al. 2007).

Diverse social, environmental, and economic segments may experience different degrees of climate impacts based on the presence of unique resources and stressors as well as the degree of their sensitivity to climate variance and change. Accordingly, mitigation and adaptation efforts aimed at moderating climate impacts must be informed by distinct analysis of climate impacts with particular regard for specific areas. Efforts must also be designed with context-specific resources, strategies, and challenges in mind.

To address this need, the U.S. Global Change Research Program (USGCRP) conducts the National Climate Assessment, under the auspices of the Global Change Research Act of 1990. The report, which is published every four years, is designed to synthesize and advance the current state of knowledge on climate science, identify research and information gaps, assist the federal government in prioritizing climate science investments, and assess and build regional capacity to cope with or adapt to climate variability and change (www.globalchange.gov). Accordingly, the USGCRP has requested regional and sectoral technical inputs to inform the National Climate Assessment. These inputs seek to understand and assess the various dimensions of regional capacities to cope, respond, and adapt to climate variability and change.

1.1 Study Objectives

The objective of this technical report is to assess the regional capacity of five sectors in the Carolinas (Forestry, Government, Tourism, Water, and Wildlife) to adapt to climate change. It was conducted by the Carolinas Integrated Sciences and Assessments, one of 11 RISA programs. RISAs are NOAA-sponsored programs that seek to advance scientific understanding of climate variability and change and improve society's ability to respond to climatic events and stresses. This report will be submitted as a technical input to the National Climate Assessment. The major research questions that guide this report are:

- What are the primary climate and weather *concerns* and *decisions* occurring in the Carolinas?
- What *types* of climate and weather *information* are used, who are the major *providers* of information, and what factors influence *why* specific sources are used?
- What types of climate change *activities* are planned or underway, how are these activities *framed*, and what factors have *facilitated or constrained* these activities?

- What is the *existing adaptive capacity* to climate change, and what are the current *needs and recommendations* to increase adaptive capacity, and how may they be met?

1.2 Scope of the Report

Based on existing research, published literature, and contextual knowledge of the region, five climate-sensitive sectors were selected for analysis for this report: Forestry, Government, Tourism, Water Management, and Wildlife Management. These sectors were selected because they have existing or potential sensitivity to climate variability and change, have documented management issues and concerns through recent national- or regional-level reports, and are significant to the regional and local economies across the Carolinas. Chapters 5-9 provide more detail about the role of each sector in the Carolinas, the extent of sector activities in the area and the impacts of climate on those sectors. A brief description of each sector is provided below.

Forestry

Forests are a significant land cover type in the Carolinas. Forest industries play a major role in the economies of both states, and recreational use of forests is also substantial. Forests provide a host of ecological services for the states, including enhancing air and water quality and providing wildlife habitat. Resource managers (forest or park), individual land owners, arborists (public and private) and the numerous public users of forests and forest products are all involved in the use and management of this sector. Although disturbances are a natural part of forest ecosystems, altered disturbance patterns resulting from climate change that exceed natural variability may reduce the ability of such ecosystems to maintain resilience. Drought and temperature variation, extreme weather events, and sea level rise all have the potential to impact growth cycles and processes and the health of forest resources. Indirect impacts will influence the health of wildlife resources, the economies of the states, and how forests are utilized for leisure and recreation in the Carolinas.

Government

Climate impacts will be experienced and managed at the local and regional level. Nearly 1,000 individual counties or municipalities exist in the Carolinas, providing water, energy, and waste management to residents and guiding development, planning, and environmental regulations. Government leaders from a variety of issue areas including public health, agriculture, commerce, public safety, transportation, energy, natural resources, and insurance, among others, are accountable to citizens in each respective government jurisdiction. The recommendations, policies, and regulations established within this sector directly impacts significant aspects of cultural, economic, and environmental systems throughout the region. Climate variability and change in temperature, extreme events (storms, flooding, heat waves, droughts), and sea level rise are expected to impact local, regional, and state-level physical and social processes. Emergency management, energy use and policy, transportation and infrastructure planning, natural resource provision, and public health will all be affected.

Tourism

Tourism is a vital aspect of local and state economies in the Carolinas. Tourist niches have been developed in each eco-region of the Carolinas (mountains, piedmont, and coastal plain), with attractions that involve outdoor recreation. Coastal tourism is particularly prominent. Annually, tourism contributes approximately \$37 billion in travel expenditures, payroll, and tax receipts in North and South Carolina combined. Tourism-based business and industries, natural resource

managers and regulators, commerce officials, and residential and out-of-state tourists are involved in maintaining and sustaining the tourism-based economy. Because this sector relies heavily on the benefits of the region's natural resources, the climate of the Carolinas has shaped the range of outdoor tourist opportunities available, as well as the popularity of the area among annual visitors. Changes in climate, including potential direct and indirect impacts like sea level rise, shoreline erosion, and habitat loss will influence tourism-based processes that rely on these natural resources to sustain the industry. Concurrently, climate changes may contribute to new tourism opportunities that both leverage and protect the natural environment.

Water Resources

In the Carolinas, over 2,600 active community water systems are responsible for the provision of safe and reliable public water supplies. The design of these systems must accommodate residential, industrial, commercial, agricultural and energy-related water use as well as water quality standards and ecological needs. Accordingly, water resource managers rely on engineering designs and management practices to maintain resource security and mitigate hydrometeorological variability. Water utilities, engineers, and consulting firms, as well as water users and customers, must all negotiate resource demands with available supply. In addition to climate factors including precipitation patterns, surface water flows, drought, and temperature, non-climate factors like land use, residential and commercial development, and reservoir capacity affect water security and supply. Changes in climate variables such as temperature and precipitation will therefore influence processes of wastewater and stormwater treatment as well as water-use management for consumption, energy production, and agriculture. This sector is limited to public and private utilities managers as well as engineering firms, with less participation from members of the broader water conservation and allocation community.

Wildlife Management

In addition to the 18 National Wildlife Refuges in the Carolinas, a host of state parks, recreation areas, forests, and wildlife management areas are established across North and South Carolina. Healthy ecosystems provide a range of ecological services that contribute to the well-being of citizens and the economies of the Carolinas. These include the maintenance of soil, air, and water quality; natural resources like plants, animals, minerals, and non-renewable resources; and the preservation of valued environmental treasures like wildlife preserves and historical places. Environmental conservation or recreation organizations (NGOs/NPOs, hunting and angling groups, farmers, recreational groups), management officials, and the species and ecosystems themselves interact to shape the character of wilderness areas in the Carolinas. Ecological systems must constantly adapt to variability in climate and be able to absorb change within an average range. However, sudden or extreme climate changes that disrupt species' distributions, affect natural systems (e.g., coastal and riverine hydrology, or wildfires or pest outbreaks) will influence critical aspects of wildlife and natural habitat management. Indirect impacts may influence regional biodiversity as well as human and environmental health.

1.3 Overview of the Report

This report is designed to rapidly assist readers with understanding key areas of concerns and priority for the Carolinas. *Chapter 2* provides a regional overview of the Carolinas, including a brief synthesis of key vulnerabilities, observed and projected climate impacts and concerns, and non-climate stressors such as population and land-use change.

Chapter 3 discusses the methods used for data analysis. This includes criteria used to refine the scope of the study and collect data, data collection instruments, and coding protocols and procedures. The findings of this technical report are based on an extensive document analysis, 117 web-based questionnaires, and 96 semi-structured interviews across five climate-sensitive sectors within the Carolinas.

Chapter 4 includes an overview of how subsequent chapters (5-9) are organized to present information on the sectors highlighted in this study.

Chapters 5-9 present respective sector-specific findings from the document analysis, web-based questionnaires, and semi-structured interviews. Each chapter includes a discussion of relevant sector concerns and decisions, the extent to which climate influences those decisions, and the type and scope of information used to inform critical decisions. Additionally, a review of sector activities to address climate change is provided with analysis of the frames utilized to communicate and justify activities and the facilitating and constraining factors that influence such activities. Finally, each chapter comments on elements of adaptive capacity revealed by the study as well as the needs and recommendations to enhance future climate change action identified by respondents.

Chapter 10 focuses on the networks that disseminate climate information and data to decision-makers in the Carolinas and reviews how existing social networks across and within the study sectors support activities related to climate. This chapter includes discussion of what types of climate information are used, why certain sources are particularly relevant or trusted, and how existing and emerging networks are fostering and enhancing capacity building efforts in the region.

Chapter 11 assumes a broad systematic approach towards analyzing the similarities and differences among the five key study sectors in regards to climate concerns and critical decisions, major areas of activity related to climate and the framing of these activities, factors that constrain and facilitate climate action, and prominent needs and recommendations across all sectors. In addition, the chapter provides discussion regarding key cross-sectoral challenges in the Carolinas including coastal, water, and land management. A focus on these broader themes and trends provides insight into the overarching climate concerns, current levels of action, and future capacity of the Carolinas region to adapt to climate change.

Chapter 12 provides a brief synthesis of the major findings of the study, while commenting on the capacity of the five sectors in the Carolinas to adapt to climate change. Emphasis is placed on how the concerns and interests, activities, and opportunities and constraints in each of the sectors can provide insight into the regional context and capacities of the Carolinas. Final recommendations are also summarized here.

2 Regional Overview of the Carolinas

North and South Carolina share similar climates, resources, economies and social culture. In addition, the Carolinas share key challenges and vulnerabilities, which center on land-use and development, coastal development, and water management. These challenges are interconnected and have far-reaching impacts on the availability of natural resources, services provided by state and local governments, and the health of ecological communities. For example, the Carolinas have experienced significant population and socio-economic transitions in the past 30 years. Between 1980 and 2010, North Carolina grew from 5.8 to approximately 9.5 million people and South Carolina from 3.1 to 4.6 million, primarily a result of in-migration from other states. Within the two states, rapid population growth has occurred in urban and coastal areas (See Figure 2.1). During that same time period, the regional economy has shifted from a predominance of agriculture and traditional manufacturing activities (such as textiles and furniture) to more knowledge-based and service-related industries (Bennett and Patton 2008; NC Department of Commerce 2011; Schunk and Woodward 2000). This transition is demonstrated in employment trends. In North Carolina manufacturing employment declined from approximately 824,100 employees in 1990 to 434,100 employees in 2011, while employment in the leisure and hospitality sector increased from approximately 239,900 to 399,900 employees during that same time period (US Department of Labor 2012). In South Carolina, manufacturing employment decreased from approximately 347,900 in 1990 to 216,100 in 2011. Leisure and hospitality employment increased from approximately 133,300 to 209,700 between 1990 and 2011 (US Department of Labor 2012). In addition, population growth, economic development, and economic shifts have contributed to significant land-use change, habitat fragmentation, urban sprawl, and increases in infrastructure costs (Napton et al. 2010).

Existing challenges and stressors are often exacerbated by climate variability, such as the notable periods of statewide drought that have occurred across the Carolinas in the past century (USGS 2002; Weaver 2005). In the past 15 years alone, there have been two major periods of drought across the Carolinas, which have led to reduced streamflow and reservoir storage and increased vulnerability of community water systems to potential shortages (See Figure 2.2) (NCDENR 2004; SCDNR 2003; Weaver 2005). Drought conditions have also led to enhanced salt-water intrusion and economic losses in agriculture, forestry, and hydropower generation.

Although the southeastern US did not exhibit an overall warming trend during the 20th century, temperature trends across the Southeast are characterized by notable variability (Konrad et al. 2012). Since the cooling period in the 1960s and 1970s, summer temperatures have increased steadily (2001-2010 was the warmest on record), though winter temperatures have cooled (Kunkel et al. 2012). There are no long-term trends in annual or summer seasonal precipitation in the last 100 years, although interannual variability has increased across much the region (Kunkel et al. 2012). Karl et al. (2009) project that increases in air and water temperatures will contribute to heat-related illnesses, water-borne diseases, declines in forest and agricultural production, decreased dissolved oxygen in aquatic habitats, and localized impacts to species and their habitats. There are additional specific impacts which are explored further in the sector chapters.

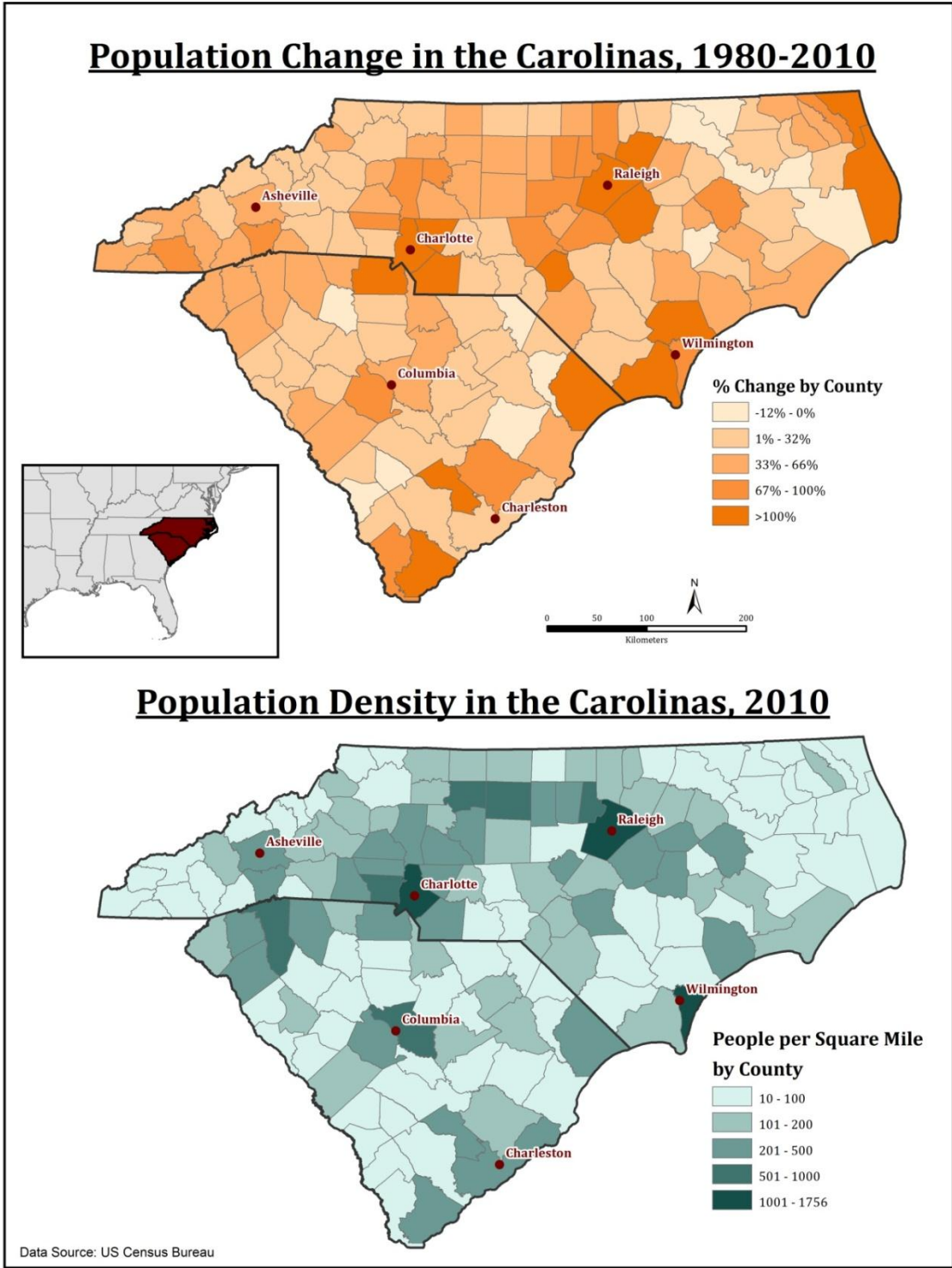
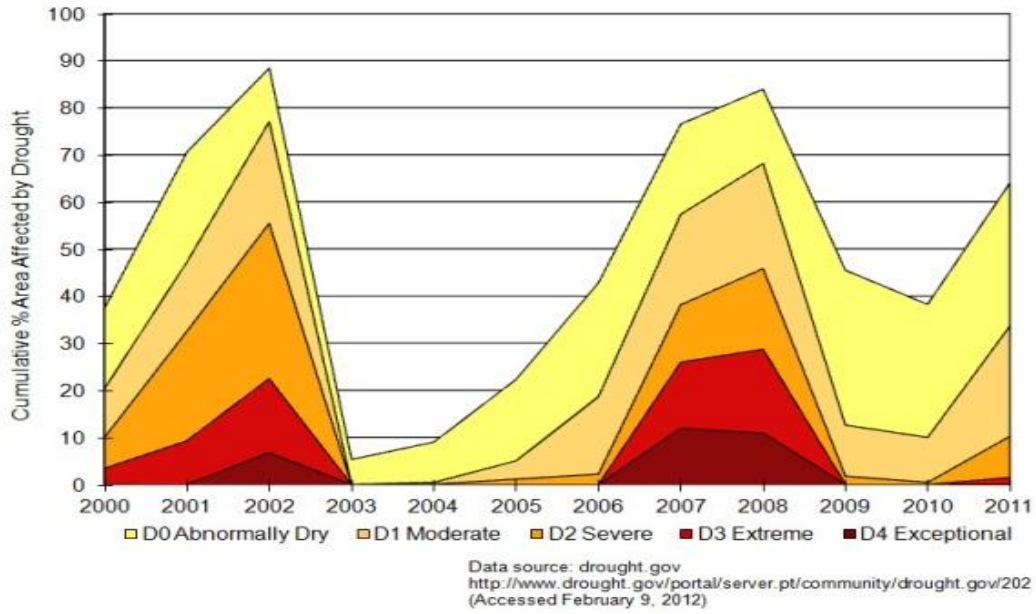


Figure 2.1 Population Change and Population Density in the Carolinas, 1980-2010

Map Author: Juliana Lam

North Carolina Drought Conditions
U.S. Drought Monitor, 2000-2011



South Carolina Drought Conditions
U.S. Drought Monitor, 2000-2011

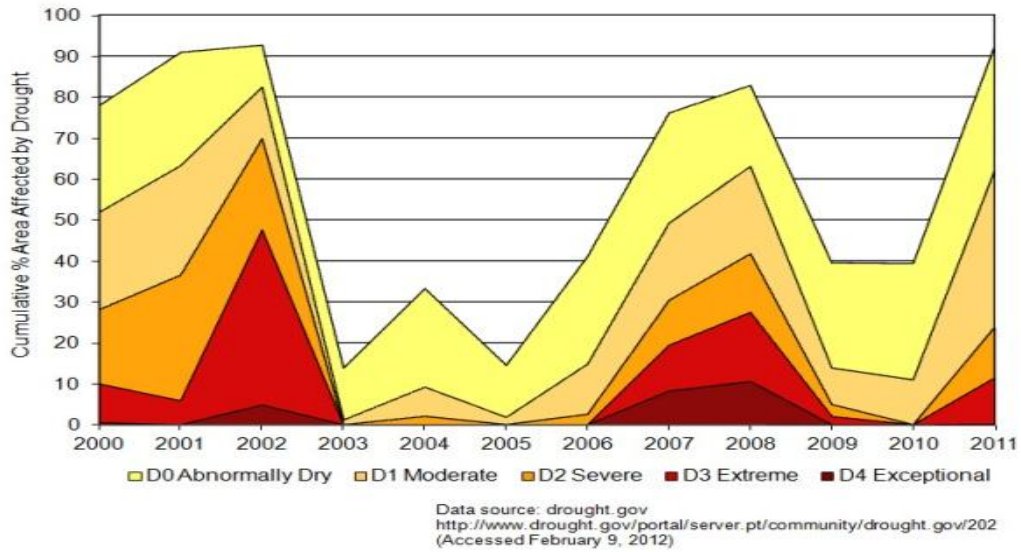


Figure 2.2 North Carolina and South Carolina Drought Conditions

Figure Author: Juliana Lam

Although long term changes in annual precipitation over the past 100 years have not been detected across the Carolinas (Konrad et al. 2012), interannual variability has increased in the past several decades across much of the southeast with more frequent wet and dry summers, compared to the mid-20th century (Wang et al. 2010). Changes in seasonal precipitation patterns may affect the timing and amount of water availability and contribute to increased risks of flooding and drought (Karl et al. 2009). Increasing precipitation variability, coupled with increased societal demand and land-use changes, may also intensify potential impacts on regional supplies and water quality. These changes will require water managers to begin considering climate as non-stationary (Milly et al. 2008). Variability in precipitation regimes are also likely to impact wildlife habitat such as bogs, wetlands, floodplain communities as well as forestry productivity (DeWan et al. 2010; Fox et al. 2011).

Flooding is of particular concern in coastal communities. In coastal North Carolina, approximately 152,000 people and 2,415 square miles of land are within the 100-year flood plain. In coastal South Carolina, 272,000 people and 1,789 square miles of land are in the 100-year floodplain (Crowell et al. 2010). Although coastal development has enhanced some aspects of local economies, it has also contributed to the degradation of coastal ecosystems and affected coastal erosion rates. Relative sea level rise across the Carolinas varies from approximately 2 to 4 mm/yr⁻¹ over the past 50 years (NOAA CO-OPS 2012). Sea level rise is likely to affect coastal communities and ecosystems across the Carolinas in several ways, including shoreline erosion, increased temporary and permanent flooding, increased salinity and saltwater intrusion, and loss of marshland habitat (Karl et al. 2009; Titus et al. 2009a,b). Other impacts include potential economic losses associated with limitation of recreation opportunities and declines in property values (Bin et al. 2007). Recent analyses consider flooding potential and the amount of land, population, and housing units at less than 1 meter above local Mean High Water for the contiguous US and found that North and South Carolina rank 3rd and 5th respectively in the total land area and 8th and 7th respectively for population levels (Strauss et al. 2012). Estimates of changes to flood return intervals at long term tidal gauges indicate that, by 2050, the current 100-year event may recur at intervals from 5-75 years in the Carolinas based on local conditions (Tebaldi et al. 2012). For a summary of sea level rise assessments across the Carolinas, see (Kettle 2012).

Climate change and variability across the Carolinas are likely to interact with existing non-climate stressors and impact water resource management, economic activities related to forestry and tourism, wildlife management, and services provided by local- and state-level governments (Karl et al. 2009; Stratus Consulting 2010; Titus et al. 2009 a, b; Wear et al. 2009). Interactions between climate and non-climate related stressors and concerns highlight the diversity of challenges faced throughout the Carolinas. They also illustrate the range of sectors influenced by climate variability and change.

3 Methods

This chapter outlines the methods used to collect and analyze data for this report. A “bottom-up approach” (Smit & Wandel 2006) was used to document and examine how decision-makers in the Carolinas are engaging with climate change; needs for data, information, and decision-support; and sector-specific capacities to address climate risks and concerns. The initial methodology used a web-based search to develop a comprehensive list of climate change-related documents and key decision-makers and organizations in each of the five climate-sensitive sectors throughout the Carolinas. Key documents were reviewed to provide background information on climate-sensitive sectors and decisions in the Carolinas, identify sector leaders to target for participation, and inform the development of questionnaire and interview protocols. Web-based questionnaires and semi-structured interviews were then used to obtain detailed information on the adaptive capacities of each sector to climate variability and change. NVivo, a content analysis software program, was used to analyze interview transcripts. Research findings were triangulated based on results from the document analysis, questionnaires, and interviews. Each of these steps is described in more detail below.

3.1 Search for Organizations, Decision-makers, and Documents

Extensive web-based searches used Google, LexisNexis, Web of Science, and Cambridge Scientific Abstracts to compile a comprehensive list of documents, decision-makers, and organizations engaged in climate-related decisions throughout the Carolinas. The protocol and keywords used to identify these sources are provided in Appendix A. Table 3.1 displays the criteria used to determine whether a source was to be included in the study. The initial search focused narrowly on climate change. Only a few documents, organizations, and decision-makers met this criteria so the search was expanded to include related terms. The preliminary list of organizations and documents was reviewed to identify additional sector-specific organizations and prominent individuals involved in climate mitigation and adaptation efforts. This included reviewing conference programs and proceedings and “helpful links” sections provided by organizational websites. Key organizations, documents, and decision-makers were recorded in Microsoft Access and were coded based on organizational affiliation, the scale and sector of interest, as well as their climate related activities and expressed needs (where documented). Complete bibliographic information was entered into EndNote.

Table 3.1 Criteria used to Select Organization, Documents, and Decision-Makers

<p><i>Organization selection criteria</i> - Organizations should demonstrate one or more of the following:</p> <ul style="list-style-type: none">• Organization displays information or resources about a climate change or variability issue on website or in print materials• Organization is engaged in climate-relevant planning, research or projects, including legislative or management authority over a climate-relevant issue• Organization has personnel assigned to, or responsible for, climate-related activities• Organization is recognized (self-appointed or by sector leaders) for its potential to contribute critical knowledge about the sector’s interests and concerns regarding climate
<p><i>Decision-maker selection criteria</i> - Individuals should demonstrate one or more of the following:</p> <ul style="list-style-type: none">• Plays a prominent or recurring role in a climate-related issue or project (e.g., organizational staff members, community member or citizen advocate)• Communicates information about climate issues or climate-related projects to internal or external audiences (e.g., through presentations, speaking engagements, authorship of texts)• Climate expertise (e.g., researcher, scientist, consultant)• Sector expertise (e.g., resource manager, leader of a professional association or agency, researcher)

Document selection criteria - Documents should demonstrate or focus on one or more of the following:

- The Carolinas (state and/or local)
- Some aspect of climate variability and change or a related mitigation or adaptation topic
- National or regional documents if they discuss regional (Carolinas or the Southeast) or sector-specific climate issues
- Elaboration of sector-specific perspectives on climate or related actions

3.1.1 Document Coding and Review

The second phase of the decision-makers, organizations, and documents search entailed reviewing and coding the collected documents. The information gathered through this process later informed the development of the questionnaires and interviews. The following set of research questions guided the review:

- What activities regarding climate change are occurring in the sector?
- Do the documents indicate a focus on any particular steps in the mitigation or adaptation process?
- Has the sector articulated any climate change needs? If so, what are they?
- What information do the documents provide about the networks involved?

128 documents were identified and included in the database during the search process described above. The sample included a wide range of gray literature, including technical reports, white papers, conference papers, and government planning documents (see Table 3.2). A protocol was developed to guide the coding and review of information found in the documents (Appendix B). Document text was imported into NVivo, a software program that supports the analysis of qualitative data and then coded according to the topics and categories defined in the protocol.

Table 3.2 Distribution of Document Types

Type of Document	Number	Type of Document	Number
Academic article	6	Newsletter	7
Annual report	3	Research plan	2
Assessment/study report	12	Strategic plan	13
Case study	1	Survey results	1
Conference paper/presentation	30	Tool	1
Fact sheet	9	Website	1
Government resolution/policy	2	White paper	35
Legislative report/testimony	3	Workshop summary	2
Magazine article	1		

3.1.2 Document Insights that Guided Further Study Protocols

This preliminary process of gathering information revealed several key themes regarding climate activities in the Carolinas and sectoral differences in terms of how, and the extent to which, stakeholders are engaged with climate issues and decisions. These themes are highlighted here briefly to provide a context for the development of the questionnaire and interview portions of the study.

The document review suggested that while decision-makers and organizations in the Carolinas have long considered elements of climate variability in decision-making processes, they are in the beginning phases of planning, decision-making, and action related to climate change.

Frameworks have been developed to conceptualize decision-making processes that involve climate change concerns (Moser & Ekstrom 2010). Three primary stages have been advanced (Moser & Ekstrom 2010), including an *Understanding Phase* (problem detection and awareness, information gathering, and codifying the issue), a *Planning Phase* (developing of options and alternatives, evaluation of options, and selecting options) and a *Management Phase* (implementation, monitoring, and evaluation). Documents reviewed for this portion of the study revealed that the vast majority of current activities fall within either the “Understanding” phase (e.g., detecting and defining the problem) or the beginning stages of a “Planning” phase (e.g., identifying and considering possible options to address the problem). These findings are consistent with other research that suggests that most adaptation efforts are in the understanding and planning phase and have not yet advanced to subsequent phases (See Moser & Ekstrom 2010).

The primary focus of most documents was to discuss the impacts of climate change or to provide recommendations and possible solutions for mitigation and/or adaptation actions. Very few documents address both mitigation and adaptation topics, most focusing on mitigation exclusively. Of the 128 total documents, only 13 were characterized as “strategic planning documents,” meaning that these documents specified actual measures and actions to be taken by the organization to address concerns about climate change. Furthermore, these particular plans were Climate Action Plans or local-level Sustainability Plans that focused heavily on climate change *mitigation* (e.g., reduction of greenhouse gas emissions, programs to improve energy efficiency) and not adaptation measures. Although specific measures were articulated within these plans, it was not clear the extent to which recommended measures were successfully adopted or evaluated. Few documents were written prior to 2008, indicating that climate change may be a new focus area for many organizations and stakeholders in the Carolinas. This factor may have contributed to the lack of information available about initiative outcomes or success. 51 articles were classified as assessment/study reports, research plans, white papers, or workshop reports, again reinforcing the assessment that discussions about climate change were in the initial decision-making phases in the Carolinas.

Documents identified several key concerns and issues related to climate change facing the five sectors reviewed in this study. While expected climate change variables in the Carolinas are primarily described in general terms (increasing temperatures, variable precipitation, increasing storm activity, sea level rise) more specific discussions focused on the effects of those changes on the region’s water availability, natural resources and ecosystems, local economies and social systems, and coastal resources and communities. In particular, 31 documents focus on coastal areas’ vulnerability to sea level rise, storm activity, flooding and inundation, as well as the consequent impacts on the natural and built environment.

Documents demonstrated some of the *mitigation* strategies occurring or planned in the region including:

- Climate action plans targeted at greenhouse gas emission reductions and energy efficiency,
- Research and development of alternative energy sources (biofuels, wind energy, solar),
- Forest-based carbon offset projects, and
- Sustainability planning to include LEED building standards, waste reduction, and energy measures.

Motivations for these *mitigation* plans include the need to proactively prepare for expected federal-state legislation requiring actions to reduce emissions, increase energy efficiency, improve energy security, improve air and water quality, provide opportunities for economic development, promote an improved quality of life, and/or save money.

Documents provided *very few examples of actual adaptation plans* or implementation of adaptation projects. Two exceptions included adaptation activities documented by the Alligator River National Wildlife Refuge in North Carolina and the Low Country National Wildlife Refuge Complex in South Carolina. Several state- and regional-level documents demonstrated how organizations and agencies are beginning to address climate concerns or proposing to mainstream climate into existing activities. Examples include: State Forest Resource Assessments (NC Division of Forest Resources 2010; SC Forestry Commission 2010), processes to update State Wildlife Action Plans (DeWan et al. 2010), and efforts to address coastal vulnerabilities (Deaton et al. 2010; Governors' South Atlantic Alliance 2010; SC Sea Grant Consortium 2009).

As noted above, because many of the organizations and stakeholder groups seem to be at the beginning stages of identifying and assessing options, only a handful of documents expressed specific needs and recommendations to move forward with climate change action. However, some documents indicated broad measures, activities, and resources that are necessary to facilitate both climate change mitigation and adaptation and that do not currently exist. These articulated needs include:

- The development of comprehensive, long term goals and objectives to guide climate-related activities and specific programs across multiple scales – such programs would be supported by funding, legislation, administrative mechanisms, incentives, and education and ensure that implementation of those goals and objectives occurs
- A more active role by government organizations in providing technical assistance and/or legislation that requires or guides actions for climate mitigation and adaptation across regions
- Research activities to improve our general understanding of climate, linkages between climate and environmental processes, and climate change impacts
- Assessments of the possible negative and positive effects and costs and benefits of various mitigation and adaptation options
- Data and technical tools (models, monitoring systems, mapping) to improve general understanding as well as support decision-making
- Education, outreach, and communication to the public as well as elected and appointed government officials
- Collaboration and integration across different levels and types of decision-makers and programs.

Finally, a comparison of sector-specific documents indicated that the sectors have different interests and concerns as they relate to climate change and other climate risks. Furthermore, while some organizations and documents specifically discussed climate change issues, many stakeholders appear only tangentially interested in climate. Table 3.3 summarizes the key themes that emerged through the document review.

Table 3.3 Sector-Specific Themes Revealed by Documents

Sector	Climate-Related Themes and Interests Found in Documents
Forestry	<ul style="list-style-type: none"> • Balancing needs for adaptation and mitigation • Impacts (drought, wildfire) • Biofuels
Tourism	<ul style="list-style-type: none"> • Coastal risks and impacts (economic, natural resources) • Sustainability, environmental stewardship
Government	<ul style="list-style-type: none"> • Energy efficiency, GHG emissions • Risk management, preparedness • Sustainability, environmental stewardship
Water	<ul style="list-style-type: none"> • Existing climate variability and risks • Increased variability and uncertainty, impacts on supply and quality
Wildlife	<ul style="list-style-type: none"> • Impacts to ecosystems, habitat, individual species • Sea level rise • Adaptation

3.2 Questionnaires and Interviews

Information obtained from the document analysis provided a new set of questions to guide the development of the questionnaire and interview portion of the study. Web-based questionnaires and semi-structured interviews were then used to further explore the regional adaptive capacity of five sectors in the Carolinas to climate change. These multiple research methods were used to triangulate research findings. Key questions included:

- Are study sectors generally in the *Understanding and Planning Phases* of climate change action in the Carolinas (as suggested by document analysis)?
 - What information is being used to inform these decision-making processes (documents rarely identified information sources)?
 - Were there specific events or elements within the past three to five years (2008 marker identified in the documents) that triggered action?
- What networks exist to share climate information or provide a platform for action?
- What is the prevalence of mitigation vs. adaptation activities and what drives an emphasis on one or the other (documents suggested activities are highly skewed towards mitigation)?
- What constraints and barriers, as well as facilitating factors, have been encountered in the enactment of mitigation or adaptation activities (documents rarely provided these details)?
- Are the needs and recommendations identified in documents the most salient within the Carolinas? Are they consistent across sectors or are there sectoral differences?

3.2.1 Selection and Recruitment of Research Participants

The primary selection strategies involved the identification of individuals who could be considered climate change “opinion leaders” in the region. An opinion leader is an individual who is actively involved with or knowledgeable about a topic, communicates information or raises awareness about that topic to colleagues, friends, or acquaintances, and influences and legitimizes the adoption of new opinions, attitudes, and behaviors of others (Katz 1957; Nisbet and Kotcher 2009; Rogers 2003; Valente and Pumpuang 2007). Because the project centers on identifying and examining what climate information and related resources are needed by decision-makers, we focused on finding individuals engaged in climate issues and activities but who were not necessarily climate scientists or climate service providers.

Data and information from the Access database (described above) was combined into a master Excel spreadsheet in order to identify individuals to contact for the questionnaire-interview phase of the project. This list included identified decision-makers, document authors, and individuals listed as organization contacts in the database. Organization contacts included the primary contact or director, key staff members, board members, and other officers. Individuals who were located in the Carolinas or whose geographic scope of management was pertinent to the Carolinas were retained. Individuals affiliated with national or international organizations and not located in the Carolinas were deleted from the list. This initial list included 1,735 individual names. We used a spreadsheet sort function to organize individuals according to frequency of occurrence and to generate an initial list of key individuals in the five study sectors and across all sectors to target. Members with the highest frequency counts were retained. We reviewed this list to ensure that individuals represented both states and sub-regions within each state, different types of organizations (e.g., academic, public, private, non-profit), and organizations working at different geographic scopes (local, state, southeast) in order to incorporate the dynamics of decision-making, activities, and perspectives occurring at multiple scales. A total of 130 individuals remained and were divided across Forestry (27), Government (32), Tourism (33), Water (18), and Wildlife (20) (See also Figure 3.1, Appendix I).

Research participants were initially contacted via telephone calls (Appendix C) and e-mails (Appendix D). During the initial contact, project staff discussed informed consent, which included a description of the project, how participants were selected, what activities participation entailed, the potential risks and benefits of participation, and their rights as a participant (Appendix E). Individuals who agreed to participate were e-mailed a “project packet” which outlined each of these details and a link to the online questionnaire, which included an informed consent portion that had to be completed prior to study participation. Follow-up interviews were scheduled during the initial contact or upon completion of the questionnaire, depending on the preference of the participant. Non-respondents were sent two additional reminders at approximately one week intervals.

Formal participation began with the completion of an online questionnaire hosted by Survey Monkey. The questionnaire consisted of 23 questions, ranging from types of climate information used and how it is accessed, current activities related to climate variability and change, and information needs (Appendix F). Survey participants were required to specify one of three levels of confidentiality: full confidentiality, to have only their sector- or organization association included in any reports, or to have their name and organization association used in any reports. Participants’ preferences for confidentiality are indicated in Appendix J.

Semi-structured interviews (Appendix G) were then conducted to follow-up on answers provided in the questionnaires and collect more in-depth information about the climate-related decisions made by the organization, needs for additional climate information or tools, climate-related activities currently planned or in progress, and any constraints that affect their sectors' capacity to respond to manage climate events. Interviews typically lasted between 45 to 60 minutes and were recorded if the interviewee granted permission. At the end of the interview, participants were asked to recommend other individuals who have relevant knowledge or experience of these issues and who may be interested in participating in the research project. These referrals were

added to the database of key decision-makers and contacted following the same protocol. This “snowball sampling” method produced referrals for 122 additional decision-makers. Thank you letters (Appendix H) were sent to participants after the interview. While substantial effort was made to ensure that pertinent opinion leaders were consulted for this report via thorough methods to identify documents, organizations, and key contacts, study authors acknowledge that the decision maker database may not include all relevant key leaders in the region. However, by triangulating multiple sources of information, the authors enhanced the representativeness of the perspectives provided within the five study sectors.

3.2.2 Participant Response Rates and Data

252 individuals were invited to participate. 117 individuals participated in the questionnaire for an overall 46% response rate. 96 participants completed both the questionnaire and interview, while 21 participants completed only the questionnaire. Figure 3.1 provides response rate data for all participants and by sector.

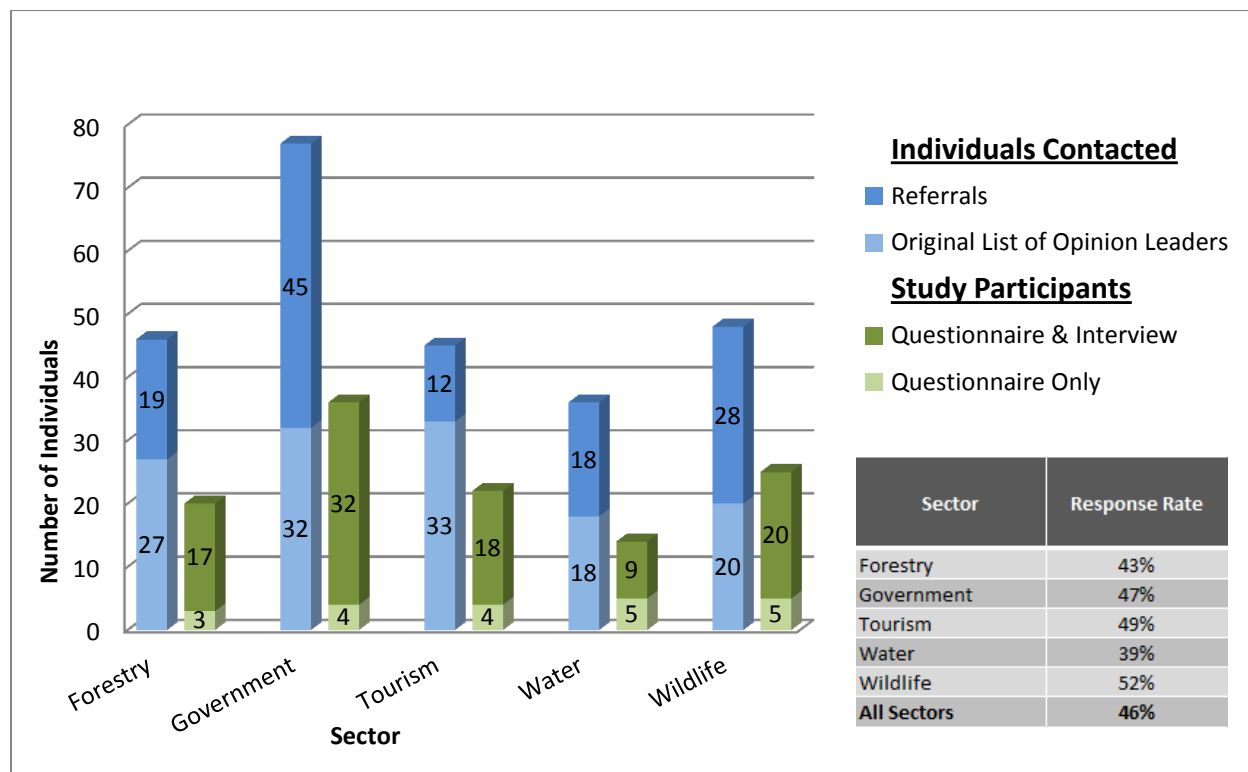


Figure 3.1 Response Rates and Participation by Sector

Table 3.4 shows the breakdown of participants by organization type and geographic scope:

- 55 represented NC (local and state level), 27 represented SC (local and state level), 13 represented both states (NC/SC), 22 individuals work across the Southeast
- 55 representatives from public agencies, 38 from NGO/NPOs, 13 from academia, and 11 from the private sector

Table 3.4 Interviewee Organization Type by Geographic Scope

	Local – NC	Local – SC	State – NC	State – SC	Carolinas	SE Regional	Total
Academic	2	0	3	0	5	3	13
NGO/NPO	7	2	8	10	1	10	38
Private	2	0	2	1	2	4	11
Public	17	5	14	9	5	5	55
Total	28	7	27	20	13	22	117

In North Carolina, at both the state and local level, opinion leaders who participated in the study worked mainly with public organizations or government agencies. In contrast, interviewees from South Carolina and the Southeast regional level represented a larger number of NGO/NPOs.

Figure 3.2 below provides additional information about the location and geographic scope of the study participants. There are obvious clusters in the capital cities of Raleigh, NC, and Columbia, SC, the location of many state agency offices. Other clusters of study participants seem to indicate locations with higher levels of engagement with climate issues and activities or major population centers.

As in any research, the degree to which various organizations are represented was dictated by target participants’ willingness to participate in the study. In this case, willingness to participate may have been influenced by the individual’s assessment of the “fit” of the organization for the study based on the level to which he/she perceived organizational engagement in climate action. Relevant activities may have been omitted from the study because targeted participants did not perceive the work of their organization to be of significance. Additionally, because the nature of the topic of the study is a politically sensitive issue within the Carolinas, response rates may have been influenced by participants who declined to participate due to political considerations.

3.3 Questionnaire and Interview Analysis

3.3.1 Questionnaires

Data from the questionnaire were used in a variety of ways. First, in most cases, participants completed the questionnaire prior to participating in the interview. Because many of the interview questions were intended to ask participants to expand on the questionnaire topics, project interviewers would download the individual's responses from Survey Monkey to serve as prompts during the interview. This provided a means to probe particularly salient responses and made efficient use of the interviewee's time.

Second, after the questionnaire-interview process was completed, questionnaire responses were downloaded from Survey Monkey directly to an Excel spreadsheet. Summary counts and descriptive statistics were used to synthesize responses to questions about the sources of climate information used by respondents, whether the respondent provided climate information to others, and whether the respondent was currently involved in activities related to climate variability and change. This information was presented for all participants and then separated by sector. Responses to open-ended questions were moved to separate spreadsheets where they were categorized according to common themes found within the data.

The summaries and syntheses of the questionnaire data were used to supplement and validate interview data and coding results in writing sector specific chapters (See Chapters 5-9). Cluster analysis techniques were used to determine the most commonly used sources of climate information and to identify any emerging trends regarding the use of such information across and within sectors. A more in-depth analysis of the responses to open-ended questions regarding key sources of information used by study participants was also conducted. Details of this process are outlined in Chapter 10.

3.3.2 Interviews

Audio files from each interview were transcribed as an MS-Word document using *Dragon Naturally Speaking* software. Each transcript was then reviewed by project staff to ensure the accuracy of the transcription process. Minor revisions were made to each transcript during the review process when transcriptions by *Dragon Naturally Speaking* did not match the audio file. Transcript file names were coded based on sector and interviewee number to ensure participant confidentiality.

Text within each transcript was initially organized into four major pre-defined categories: climate concerns and decisions, framing, activities, and needs. These topics correspond to the project's objectives and key questions. Interview transcripts were then imported into NVivo, a software program that supports the analysis of qualitative data, and "autocoded" according to the major topics listed above. Coding was conducted by five research assistants, with each coder having responsibility for one or two of the major categories. A protocol (Appendix K) was developed to guide the coding process. The protocol includes definitions for the primary categories and subcategories used in the analysis. Initial categories emerged from themes and ideas identified during the document analysis phase of the project and from interview notes. Two additional, major nodes – for networks and other stressors – were developed during the coding process to capture information about established networks within and across sectors and non-

climate stressors. These categories were revised as new sub-categories and themes emerged during the coding process. In some instances, text was coded into two or more major categories. For example, if a water manager stated that they monitored salinity levels because they were concerned about sea level rise and salt-water intrusion, this text would be coded under both the “climate concerns and decisions” and “activity” nodes. Detailed information on the coding protocol and definitions for each of these categories and subcategories are available in Appendix K.

Coding consistency was addressed by dividing coding responsibilities during the initial search, document analysis, and interview analysis among each of the major categories or nodes, rather than by sector. This ensured that each category was coded consistently across all sectors. Additionally, project staff met a minimum of once per week to discuss progress and review questions in order to ensure consistency and accuracy throughout the research process. Once all interview transcripts were coded, the NVivo program was used to examine the major themes indicated by the coded text, with particular focus on how those themes are demonstrated by the five study sectors.

4 Introduction to Sector Chapters

Chapters 5 through 9 each highlight one of the five sectors of interest selected for this study. This chapter provides an overview of how Chapters 5 through 9 are organized and the key chapter sections used to discuss the major decisions, climate information use, climate change concerns, climate change activities and framing, and needs and recommendations of each sector. This overview is designed to provide relevant background and terms utilized to analyze and interpret study findings. As a whole, direct quotes by participants are used to illustrate specific themes or points in each chapter. Quotes by participants who indicated they prefer full confidentiality are referenced according only to their sector. Quotes by participants who preferred that only their organizational affiliation be included or who completely waived confidentiality are referenced according to their organizational affiliation or their role within the sector respectively.

4.1 Introduction and Sector Overview

This section provides a brief synopsis of each sector as it is defined within this study, what entities are included in the sectors, and the scope of sector activities. In particular, emphasis is placed on why each sector was selected as an area of focus within the Carolinas. This overview also addresses how the sector is sensitive to climate variability and climate change and what areas of authority and responsibility the sector has to address climate-sensitive issues. Effort is also made to situate the sector within activities occurring at regional or national levels.

4.2 Key Decisions, Climate Information Use, Climate Change Concerns, and Framing

This section first highlights the dominant areas of responsibility within the sector of focus. First, information about the *most critical decisions* currently facing the sector is discussed by outlining what types of decisions are being made, the characteristics of those decisions, and how those decisions relate to weather or climate. Table 4.1 highlights the four categories used to differentiate decision types based on how the decision requires weather or climate information and the time horizons for such tasks.

Table 4.1 Four Major Decision Types: Tasks Implicated and Time Horizons

<p><i>Operational</i></p> <p>These decisions use <i>weather information</i> to influence daily or weekly activities.</p> <ul style="list-style-type: none"> • Examples: Water release amounts and schedules, energy production and capacity rates, outdoor activities.
<p><i>Seasonal</i></p> <p>These decisions use <i>seasonal climate forecasts</i> to influence activities for a period of several months.</p> <ul style="list-style-type: none"> • Examples: Agricultural harvesting or cultivation plans, water conservation strategies during dry months, emergency management budgeting for hurricanes or snow events.
<p><i>Annual</i></p> <p>These decisions use <i>climate information</i> to influence activities occurring within a calendar or fiscal year cycle. This information may be used to estimate costs or impacts due to seasonal phenomena or to identify historical trends or future projections.</p> <ul style="list-style-type: none"> • Examples: Annual budgeting/funding requests and allocations, yearly legislative priority setting.
<p><i>Long term</i></p> <p>These decisions incorporate <i>climate projections</i> or <i>regional climatologies</i> into decision-making frameworks. Time horizons for long term decisions typically range from 3-30 years, although longer planning does exist (e.g., dam relicensing occurs every fifty years).</p> <ul style="list-style-type: none"> • Examples: Establishing reservoir safe yields, infrastructure maintenance planning, comprehensive hazard mitigation initiatives.

Following a discussion of the types of decisions facing the sector and the degree to which those decisions concern climate, each sector chapter outlines the specific *types of climate information* used by the sector to inform sector decisions. Questionnaire respondents were asked to provide specific details about the “top three types of climate information obtained from state and federal agencies” used for their job. The categories of information derived from this request on the questionnaire are included in Table 4.2 below. Information about the time-scales of information used is included in these categories, as indicated by participants. Summary information provided in sector chapters may reference these classifications and information categories to explain distinctions between the types of information used and the issues of interest to study participants, although a much more detailed analysis of information use will be provided later in the report (See Chapter 10).

Table 4.2 Types of Climate Information Used by Participants

<p><i>Climatology</i> Historical characteristic values of climate variables for the Carolinas, represents the average weather over at least a 30-year time period and includes:</p> <ul style="list-style-type: none"> • Climate Normals: long term averages of meteorological factors • Climate Summaries: summary data for daily, monthly, seasonal, or annual time periods • Climate Extremes: the minimum and maximum values for a given phenomenon
<p><i>Specific Climate Variables and Events</i> Information specific to a particular climatic variable, including historical and current data and observations, tools to monitor existing and developing conditions,</p> <ul style="list-style-type: none"> • Temperature • Precipitation • Other climate variables of interest, includes 1) data regarding wind, wave, tide, evapotranspiration, ocean temperature, ocean and atmospheric conditions and 2) indices (e.g., heat stress, ENSO) that are derived by combing multiple data sets into a single measurement • Extreme events, such as tropical storms and hurricanes, includes tracking models, event projections and summaries • Drought, includes drought indices, monitoring tools and maps, information updates • Hydrology, includes streamflow data, lake and water table levels
<p><i>Forecasts-Outlooks</i> Information or products that provide a forecast or outlook about expected weather and climate conditions, time frames range from several days to monthly to seasonal</p>
<p><i>Weather</i> Observations or information about current or expected (short-term) conditions <i>*Although questionnaire instructions specified interest in climate information, some respondents did indicate the use of weather information in this section.</i></p>
<p><i>Climate Change</i> Models, projections, or studies that demonstrate long term (several decades or longer) changes in climate</p>
<p><i>Sea Level/Sea Level Rise</i> Data or information about historic, current, and future changes in sea level</p>
<p><i>Interacting factors</i> Data, information, or predictions that depict environmental (e.g., habitat, species, forest) conditions that are influenced or interact with climate</p>
<p><i>Impacts</i> Information or studies that show adverse effects of climate conditions or events, specific topics address:</p> <ul style="list-style-type: none"> • Observed or current impacts to coastal, ecological, or forest resources • Potential or expected impacts of climate change
<p><i>Societal Responses and Activities</i></p>

Data, information, case studies, or reports that indicate or address how humans influence and respond to climate, relevant topics include emissions, mitigation, adaptation, and vulnerability assessments
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Decisions that have a stronger focus on climate issues are interpreted to have a high level of climate sensitivity.

Climate sensitivity “is the degree to which a system is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise).” (Parry et al., 2007)

Direct and indirect climate effects are more generally referred to as *climate impacts* (Parry et al. 2007). Decisions that demonstrate a high level of climate sensitivity may involve concerns about the impacts of climate variability and climate change. The IPCC distinguishes between the two terms in this way:

- *Climate Variability* – Refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system, or to variation in natural or anthropogenic external forcing (Parry et al. 2007).
- *Climate Change* – Refers to a change in the state of the climate that can be identified (i.e, by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent, anthropogenic changes in the composition of the atmosphere or in land use (Parry et al. 2007).

For the purposes of this report, distinctions were made between decisions that involve concerns about *climate variability* and those more focused on *climate change*. Specifically, concerns about climate change, when they were articulated by student participants, are highlighted next in this section of each sector chapter. Guidance from Karl et al. (2009) was utilized to distinguish which decisions focus more on climate change concerns, as well as their direct and indirect effects (impacts) (See Table 4.3 below). Concerns that can be included in one of the categories below were categorized as climate change concerns in this study and are referenced as such in sector chapters.

Table 4.3 Climate Change Concerns & Effects (Derived from Karl et al. 2009)

<i>Climate Variable</i> • Key climate change concern	Direct Effects	Indirect Effects
<i>Temperature</i> • Average temperature increases	Species range and habitat shifts, seasonal weather pattern changes	Wildlife/habitat endangerment, altered ecosystem services, increased pests and disease, economic losses associated with weather-dependent industries
<i>Precipitation</i> • Hydrological cycle changes	Changing incidence of drought, and flooding	Degraded water quality, increased incidence of waterborne disease, reduced or uncertain water availability/quantity, impacts on electricity generation, agriculture
<i>Extreme Events</i>	Droughts, flooding, heat	Increased threat of fire, heat stress, property loss, and

• Increased frequency of extreme weather events	waves, downpours, hurricanes, cold season storms	costs to the economy
<i>Sea Level Rise</i>	Coastal erosion, inundation, flood events	Loss of coastal resources (wetlands, estuaries, etc.), impacts on infrastructure, salt-water intrusion on rivers and lakes, inland flooding

Finally, each sector chapter addresses the significant *framing mechanisms* utilized within each sector to communicate information about climate change activities to constituent or interested groups. As defined by Shoemaker & Reese (1996) framing “refers to modes of presentation that journalists and other communicators use to present information in a way that resonates with existing underlying schemas among their audience.” Frames are tools used to convey complex issues succinctly and efficiently for the purpose of providing accessible information to lay audiences in a manner that resonates with the values, beliefs, and interests of those audiences (Scheufele & Tewksbury 2007). Participants in this study were asked questions about how their organization and sector in general approach communication about climate change activities, what framing is preferred or more useful, and how the frames used correspond to the mission or responsibilities of the organization or sector. For a synthesis of these framing categories across sectors, please see Chapter 11.

4.3 Activities

The activities section of the sector chapters highlights the variety of activities designed to address concerns about climate within each sector as indicated by study participants. Activities that appear to require high levels of time, energy, and resources to achieve specific outcomes are considered prominent. Because the study assessed climate-sensitive decisions and concerns, participants revealed both *mitigation and adaptation activities*. Definitions used by the IPCC to distinguish these two terms (see below) guided the process of classifying activities as one or the other, although it should be noted that certain activities could be classified as both (e.g., biological carbon sequestration both mitigates future change by reducing the level of carbon dioxide in the atmosphere but also is designed to moderate present harm by responding to current carbon dioxide levels).

- *Mitigation*: An anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks (Parry et al. 2007).
- *Adaptation*: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation (Parry et al. 2007).
 - Anticipatory adaptation – Adaptation that takes place before impacts of climate change are observed. Also referred to as proactive adaptation.
 - Autonomous adaptation – Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare change in human systems. Also referred to as spontaneous adaptation.
 - Planned adaptation – Adaptation that is the result of a deliberate policy decision, based on awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.

Where possible, sector chapters also highlight the extent to which activities within the sector that address climate concerns have been “*mainstreamed*” into existing sector processes and policies or whether they are typically addressed as stand-alone projects and programs. Examples of stand-alone activities to address climate concerns include the development of Climate Action Plans by municipal governments which are developed for the expressed purpose of addressing challenges presented by climate change. On the other hand, mainstreaming strategies are defined as follows:

The aim of a mainstreaming strategy, as part of climate policies, is to capture the potential in other policy areas and sectors for implementing climate-friendly and climate-safe development pathways (Munasinghe 2002). It would help to enhance the climate change regime by increasing policy coherence, minimising duplications and contradictory policies, dealing with trade-offs and capturing the opportunities for synergistic results in terms of increased adaptive capacity and lower emissions (Kok & Coninck 2007).

Based on information obtained from study questionnaires and interviews, activities were placed into categories for the purpose of comparison across sectors. Twelve categories emerged to capture all of the primary sector activities. Activities were placed within only one category. However, activities within one category may be interrelated with other activities. For example, efforts to reduce carbon emissions in residential households may also include an outreach component. Each of these activities was coded separately for this particular analysis. These categories are outlined with descriptions in Table 4.4. Sector chapters highlight prominent activities within each sector, while also commenting on the proportion and use of specific activity categories in them.

Table 4.4 Categories of Prominent Climate Activities in the Carolinas

<i>Data Collection and Monitoring of Climate Impacts</i>
These activities involve addressing climate concerns through efforts to collect, monitor, and analyze data about climate variability and change and associated impacts. This includes assessing either the risk (threat) of climate-related hazards or the vulnerability (level of exposure and sensitivity) of specific human or ecological systems to those hazards.
<i>Ecological Protection and Conservation</i>
These activities involve addressing climate concerns through efforts to directly protect, conserve, and manage ecological systems, processes, and species.
<i>Education & Outreach</i>
These activities involve addressing climate concerns via efforts to educate stakeholders, employees, or the public about the challenges presented by climate variables. It also includes efforts to reach out to specific groups with targeted messages.
<i>Greenhouse Gas Emissions Reductions</i>
These activities address climate concerns by emphasizing reductions in emissions that contribute to global climate change.
<i>Land Management</i>
These activities involve addressing climate concerns through land management for either recreational or business (timber) use.
<i>Policy and Law Revisions (General)</i>
These activities involve efforts to design and implement broad policies or laws that address climate concerns. These are not always designed solely for climate purposes but do include provisions that attend to specific climate interests.
<i>Strategic Planning (General)</i>
These activities include general strategic planning efforts to address climate concerns. These are most often visioning plans that are not legally binding documents.

<i>Sustainability Projects & Programs</i>
These activities are geared towards enhancing overall sustainability and include provisions to address climate concerns. Negotiation among social, environmental, and economic interests is common.
<i>Hazard Mitigation & Emergency Management</i>
These activities involve addressing climate concerns via efforts to reduce risk and vulnerability to climate-related hazards as well as emergency management and response activities in preparation for and during hazardous climate events.
<i>Infrastructure and Ecological Alterations</i>
This includes climate adaptation activities to address climate concerns by altering ecological systems and processes as well as the built environment.
<i>Internal Policies, Practices, and Management</i>
These are internal (within an organization) activities that involve efforts to prepare for, educate, and train organizational members to address climate concerns via internal operations or external projects, programs, or processes.
<i>Resource Management</i>
These activities involve addressing climate concerns via efforts to alter management practices to control the supply and demand of natural resources (water, timber, energy).

Interview participants were also asked to comment on the specific *factors that facilitated the success of activities* to address climate concerns and which *factors constrained or limited action*. Seven thematic factors emerged across all interview participants as displayed in Table 4.5, the presence or absence of each influencing whether or not the factor enables or impedes action to address climate concerns. Each sector chapter includes sections that discuss the major facilitating and constraining factors that impact climate action within the sector. Similarities and differences across sectors and examples of how each factor may facilitate or constrain action are discussed in more detail later on (See Chapter 11).

Table 4.5 Factors that Facilitate or Constrain Climate Activities

<i>Resources/Funding</i>
Financial or human resources available to support climate action
<i>Laws/Policies/Regulations</i>
Laws, policies, and regulation available to support climate action
<i>Data and Information</i>
Valid, scientific data available to inform decisions and provide details about the likelihood and certainty of outcomes
<i>Key People, Groups, Partners, Experts</i>
Influential people, groups, partners, or experts available or willing to serve as a champion or leader of climate action
<i>Networks/Collaboration</i>
Opportunities to form multi-party networks or collaborative initiatives where climate action can be planned, coordinated, and implemented across geographic scope or issue area
<i>Political/Public Support</i>
The level of public or political understanding and acceptance of climate information and general trust and support of science and climate action
<i>Non Climate Stressors</i>
Extent to which non-climate concerns are present within the sector and the level of sector priority assigned to these concerns

4.4 Adaptive Capacity

This section provides insight into the strengths of the sector in the context of how such elements might contribute to the adaptive capacity of the sector. Adaptive capacity has been defined as “the ability or potential of a system to respond successfully to climate variability and change, and includes adjustments in both behavior and in resources and technologies” (Parry et al. 2007). Adaptive capacity includes anticipating and mitigating potential threats and damages while also taking advantage of relevant opportunities and is one element of reducing vulnerability (Smit & Wandel 2006).

Table 4.6 provides examples of variables that have been theorized to influence *the adaptive capacity* of socio-ecological systems (Yohe & Tol 2002). Specific variables proposed to assess adaptive capacity within each of these categories are described in more detail. It is important to emphasize that adaptive capacity is not always realized within any given system. Adaptive capacity can be latent, meaning it is only realized when a system is exposed to a particular stimulus. Adger and Vincent (2005) have suggested that adaptive capacity can represent “a vector of resources and assets that represent the asset base from which adaptation actions and investments can be made”. In other words, although specific adaptation measures may not be enacted in a system that has yet to experience significant pressure to adapt, existing resources, knowledge, or networks within that system can be examined to assess the potential of adaptive capability under future stressors. Where possible, this section will outline sector activities or characteristics identified in the study that may contribute to an adaptive capacity “asset base” within the sector. These elements are treated as variables to highlight the realized and/or latent adaptive capacity of the sector to adjust to climate change. For further discussion see Chapter 12.

Table 4.6 Examples of Variables of Adaptive Capacity

Factor	Variables to Assess Adaptive Capacity
Knowledge & Information Production and Use	<ul style="list-style-type: none"> • Comprehensive processes that incorporate traditional and local ecological knowledge (Olsson & Folke 2001). • Consistent and valid monitoring of relevant physical and social variables of interest to the sector (Camacho 2009; Fuerth 2009). • Robust storage and management of information over time as well as the ability to assess the credibility and reliability of information.
Governance	<ul style="list-style-type: none"> • Use of decision criteria to include multiple view-points and ensure stakeholder input and engagement (Sales 2009). • Equitable allocation of decision-making authority and the accessibility and accountability of decision-making processes.
Institutional Practices and Decision-Making	<ul style="list-style-type: none"> • Foresight is utilized to anticipate future problems, collect relevant information, and develop responsive strategies (Fuerth 2009; Quay 2009) • Flexible, incremental decision-making frameworks and processes (Adger et al. 2009; Brooks & Adger 2005). • Prevalence of scenario planning for diverse future trajectories or situations (Margerum 2005; Steinitz et al. 2003). • Degree to which climate activities are mainstreamed into existing systems, structures, and processes (Kok & Coninck 2007). • Use of “no-regrets”, “win-win”, or “robust” strategies to address climate concerns (Parry et al. 2007). • Degree in which risk-spreading processes are implemented throughout the sector (Yohe & Tol 2002).
Technology	<ul style="list-style-type: none"> • Technological capacity of the sector including current tools, methods, or mechanisms

	<p>in place to apply specific technologies to climate challenges (Folke et al. 2002; Smit & Pilifosova 2003).</p> <ul style="list-style-type: none"> • Degree of innovation to devise new technologies and strategies to address climate concerns within the sector (Stern 2006).
Existing Resources	<ul style="list-style-type: none"> • Material (physical assets like dams, infrastructure, etc.) or economic (grants, loans, financial incentives) reserves that support climate action.
Human and Social Capital	<ul style="list-style-type: none"> • Extent of knowledge, expertise, and skills of community members as well as the networks, relationships, and presence of boundary organizations that exist to sustain climate action (Yohe & Tol 2002). • Degree to which the public understands how local climate challenges are impacted by broader climate phenomena and collective willingness to engage in activities that target larger scale climate processes.

4.5 Needs and Recommendations

This section is designed to synthesize the most frequently stated needs and recommendations within the sector to advance climate action. Study participants were asked to provide details about the information, tools, products, or processes that they believe are necessary to sufficiently address the prominent climate concerns within their sector moving forward. In addition, details about particular recommendations participants believe might enhance activities to address climate concerns within the sector were recorded. Each sector chapter comments on the most significant needs and recommendations as outlined by study participants within that sector. Five themes emerged across all sectors (See Chapter 11).

5 Forestry

5.1 Introduction and Sector Overview

Forests are a major land cover type in the Carolinas, covering more than 50% of the land area in each state (Bardon et al. 2010; SC Forestry Commission 2010). Activities and industries involving forest products, such as the production of lumber, pulp products, paper and paperboard, and furniture, are significant contributors to the states' economies. In South Carolina, the forest industry contributes over \$17 billion annually to the economy and leads the state's manufacturing sector in employment with 36,000 jobs (Miley 2008). While the sector has declined in North Carolina during the past two decades, forestry and related businesses still employ over 80,000 people, and the economic benefit of the forest products industry is estimated to be \$28.5 billion (Bardon et al. 2010). Forests also provide clean air and water, watershed protection, wildlife habitat, recreation and tourism opportunities, and non-timber forest products such as pine straw, medicines, and edible products.

Climate change impacts, including temperature variability, drought, tornados and hurricanes, and sea level rise all have the potential to affect forest health and productivity and forestry-related operations and industries. Drought and temperature variation may shorten or extend the growing seasons for various species, which may affect timber productivity. Extreme weather events and sea level rise have the potential to devastate timber stands or public forest lands. These climate change impacts on forest lands will also result in a number of indirect consequences to wildlife habitat, the tourism and recreation industry, and air and water quality. To address these concerns, several mitigation and adaptation strategies are available to decrease potential adverse impacts. Other strategies entail taking advantage of opportunities within the Forestry sector. For example, new technologies are being developed to use forest resources to store carbon or replace fossil fuels with forest-derived biofuels.

This chapter examines climate concerns as voiced within the Forestry sector through documents, questionnaires and interviews and efforts to mitigate and adapt to the changing climate in order to maintain a healthy, productive forest resource. Study participants include state agencies (5), federal agencies (5), non-profits and NGOs (8), private industry (1), and academia (1). Seventeen individuals agreed to complete the online questionnaire and the phone interview. Four individuals completed the questionnaire only. Private land owners, land trust representatives, state and national foresters, urban forest specialists, a paper manufacturer representative, and alternative energy policy advocates are among the different opinion-leaders who participated in the study. Input from this array of people who use forest resources in very different ways provides a broader understanding of the implications climate change will have on the Forestry sector as well as a more defined understanding of efforts currently being made to address these potential impacts.

5.2 Key Decisions, Climate Information Use, Climate Change Concerns and Framing

5.2.1 Key Sector Decisions

Decision-making in the Forestry sector can be categorized by the time horizon on which decisions are made. Short-term decisions center on *operational and seasonal* organizational

responsibilities. Longer term decisions focus on land management and land-use planning. These decisions vary depending on the types of forest land management practices in place and the types of forest resources being managed. For publicly held lands in which wildfire is a primary concern, forest plans are typically on a time frame of 10 to 15 years, fire return intervals are made on a 3 to 5 year planning cycle, and annual planning centers around the wildfire season (study participant working at the Uwharrie National Forest). For the private sector in which forests are maintained for timber sales, and more recently due to the potential production of biomass for biofuels, stands are managed on a 30 to 50 year time frame (Co-Director, Southern Forest Resource Assessment Consortium).

Short-term decisions regarding wildfire management and controlled burns that influence forest regeneration help to ensure good forest health. *Operational* decisions such as staffing for wildfire season or management of effluent release from paper mills are made on short-term, *seasonal and annual* bases. Predictions of weather conditions play an important role in anticipating wildfire conditions in order that staffing is present before the wildfire becomes unmanageable. Staffing and resources are moved to areas based on severity of fire conditions. Depending on the agency managing an area for wildfire, movement of staff may be both in and out of state, indicating a level of inter-organizational networking in emergency preparedness and management. These types of *operational* decisions dictate *annual* planning in terms of budgeting and staffing requirements. Long-term decisions within the Forestry sector include land-use management and conservation planning.

The segment of the Forestry sector working directly with biofuels is managing a very different set of decisions. Short-term decisions revolve around the current research and development of biofuel technologies. Advocacy work on current legislation affecting funding for this research is also a main focus. Longer-term decisions include strategic planning for incorporation of biofuels into renewable energy portfolios and energy markets and management of forested lands for the production of biomass. As noted by a South Carolina state level official, most planning is currently done on an annual time frame due to funding restraints. However, longer-term goals are incorporated into *annual* plans to work towards these goals incrementally.

Precipitation frequency and amounts, temperature, and frequency and intensity of extreme weather events, all of which may affect the structure, composition and ranges of individual plant and animal species, are climate concerns with the largest impact on the Forestry sector. Drought affects not only forest growth and productivity but also the ability to conduct and manage controlled burns and wildfires. Increased fire fuels on the forest floor through dying vegetation and decreased soil moisture present challenges in fire management. Drought also leads to the susceptibility of the forest to disease and pests. Extreme wind conditions during weather events such as severe thunderstorms, tropical storms, and hurricanes can cause damage to forests and surrounding population centers. Winter weather, to include ice and snow storms, particularly in the mountain regions of the Carolinas, can also be detrimental to forest structure. Climatic events which affect forest structure in the form of branch and stem failure, crown twisting, and uprooting, can have negative economic repercussions for foresters managing timber stands throughout the Carolinas (NC Division of Forest Resources 2010; SC Forestry Commission 2010). The incorporation of climate information into decisions made by the biofuels division of

the sector is based on long-term climatic trends which influence forest productivity, as opposed to daily or seasonal weather forecasts used by other divisions of the sector.

5.2.2 Climate Information Use

Information use in the Forestry sector is dictated by organizational responsibility and decision-making processes within multiple time horizons. The most often cited types of climate information obtained from state and federal agencies were those pertaining to *climatology*, *specific climate variables and events* (e.g., temperature, precipitation, extreme events, drought), and *short-term/seasonal weather forecasts/outlooks*. Relevance to job duties was the predominant response as to why specific sources were consulted most frequently. In addition, respondents indicated that a familiarity with the agency and knowledge about its role in providing a specific type of information in a user-friendly format influenced their preferences. The type of data required varied based on how and when it was used. For example, hourly weather forecasts were used in the Forestry sector for wildfire management, although *seasonal and annual outlooks* were referenced for scheduling controlled burns. *Climatological* information was used in reference to longer-term planning, resource assessments and research. Researchers within the sector are also developing modeling tools specific to forest land management in order to aid decision-makers in long-term planning efforts for both the public and private sectors. The emphasis on longer-term goals within the biofuels division of the sector dictated the use of climate information on a less regular basis. These organizations focus attention on longer-term climate trends to support decision-making and planning activities, as well as supporting advocacy efforts.

5.2.3 Climate Change Concerns

The level of incorporation of climate change concerns and awareness into decisions and activities varied across organizations. Efforts ranged from introductory investigations to mandates from upper-level management to incorporate the issue into both short- and long-term planning and activities. The incorporation of climate change into published documents as well as long-range management plans was more prevalent within the public sector of forestry than the private and in organization working with alternative energy sources. Within the public sector, incorporation was greater at the federal level than the state level due to federal mandates requiring consideration of climate change impacts.

Climate change concerns within the Forestry sector focused on predicted changes and impacts that may affect the region's forests and forest resources. Climate change concerns related to variability and increased intensity of climate concerns mentioned previously (precipitation levels, temperature, extreme weather events). Interviewees cited concern regarding the indirect impacts of climate change on land management planning and practices, such as decreased stream flow, saltwater intrusion in coastal regions, and increased precipitation variability, which will in turn affect wildfire fuels, forest productivity and species distribution. An increase in incidence and severity of drought may reduce forest productivity, thereby affecting yields for the private sector, while also impacting wildlife habitat and increasing susceptibility to pests, disease and wildfires. The challenges of managing an increased number of wildfires caused by drought with limited resources as well as managing controlled burns when there is excess fire fuel due to drought conditions were concerns raised by multiple interviewees. This, along with emergency preparedness and management of lands affected by more extreme weather events such as ice storms and hurricanes, reinforced concerns regarding climate variability. Future climate concerns

focus on the ability of forest land managers to effectively manage lands under unforeseen conditions.

There was a positive relationship between the level of incorporation of climate change considerations and long-term decision horizons. Climate change impacts were not seen as an imminent threat on a day-to-day basis, but there was recognition that a changing climate will impact forest ecosystems over time. Study results revealed that discussions of climate change impacts were more common in long-term planning. Incorporation of climate change in *operational* decision-making was very limited. Uncertainty about the rate of change was noted as a specific challenge in determining best management practices. Descriptions of climate change as slow-moving, indistinct and non-precise, were used as reasons for not mainstreaming potential impacts into an organization's work plan or activities. For example, one respondent articulated concern over the establishment of conservation easements and the need to anticipate and plan for change over the term of the easement, in order to establish best land use and management practices. A small number of interviewees indicated skepticism regarding the influence of human activity as a cause of climate change as well as concern about the level of certainty of the science. When asked what climate information was currently lacking that would be most useful, an executive of the North Carolina Forestry Association answered, "Proof of a direct cause/effect relationship between carbon dioxide emissions and climate change/warming." In contrast, interviewees working with organizations that actively pursue forest resource assessments and an understanding of the effect climate change would have on certain forest attributes, such as the South Carolina Forestry Commission, the North Carolina Division of Forest Resources, and the USDA Forest Service, voiced a greater acceptance of current scientific consensus on climate change. However, these same participants indicated that they do not try to discuss the causes of climate change, only the best ways in which to address impacts to forests. A study participant with the USDA Forest Service noted that:

What is happening to the forest landscape is happening and land managers and industry and private landowners are going to have to deal with it. And so how do we help them deal with it instead of trying to take on the argument; well, who is causing it and how bad it is? Let's just look at what is likely to happen and how we are best going to be able to deal with it and still maintain the services that the Forest Service provides.

Specific documents referenced by study participants for climate change information included IPCC reports, sector-focused documents which discuss climate change, and climate-related journals. The IPCC reports were cited as the most widely accepted body of scientific evidence about climate change during the interview process and thus regarded as a trusted source by the Forestry sector. Informal networks and interactions among friends and colleagues play a major role in how climate change information is disseminated throughout the sector. In questionnaire responses, conferences and workshops were listed most often as other sources for climate change information. This was confirmed by the prevalence of conferences and workshops as a recurring focus of conversation during interviews. Friends of respondents were identified as the second most used source of information outside of written documentation or data from state and federal agencies, emphasizing the importance of the informal network in dissemination of climate change-related information within the sector. Because the types of decisions made by those who work with biofuels focus on regulation and policy, the sources cited by this segment vary significantly from other study participants within the sector. The EPA and Department of Energy

were noted federal agencies. Specific climate information, such as heating and cooling degree days, was highlighted as relevant to the field in terms of future outlooks for the industry on the forest resource.

The development of decision-support tools specific to the Forestry sector was also mentioned as a main source of climate change-related information for organizations throughout the sector. The federal government, through the USDA Forest Service, is leading the way in incorporating climate change information and impacts into forest land management and planning. The Southern Research Station, located in Asheville, North Carolina, provides both research findings and planning tools for climate change impacts within the Carolinas' forests. The organization has completed extensive research on more localized impacts and has several decision-support tools available for use by forest land managers. Several tools have been generated by the Eastern Forest Environmental Threat Assessment Center, which is a collaboration of various Forest Service branches that include Research and Development, the National Forest System, and state and private forestry. The 'Template for Assessing Climate Change Impacts and Management Options' (TACCIMO) and 'Comparative Risk Assessment Framework and Tools' are readily available for use by forest land managers. TACCIMO was described by one interviewee as:

A really, very thorough, very up-to-date book report for the forest planners... Instead of them having to go through and review the list of literature, it is done for them and in a user-friendly interface. They can pull the management options out and be well-defended in terms of what management options they have chosen by scientific literature. (study participant from USDA Forest Service SRS)

This type of database was recommended both in analyzed documents and by interviewees. This example demonstrates existing work to meet the needs of decision-makers, enabling them to make informed decisions to incorporate climate change into forest land management practices.

Research by NGOs on the economic impact of climate change on the forest resource will help to inform the private sector regarding best management practices for managing timber stands, as well as the use of forest resources for the production of biofuels. Dissemination of this information through conferences and workshops may prove useful in incorporating these tools into decision-making and planning processes as these events were the most often cited source of climate-related information. These conferences and workshops provide a platform for further networking and collaboration within the sector as well as with other stakeholders. Such collaborations have the potential to lead to more comprehensive land-use planning to improve long-term forest health for both conservation and productivity purposes.

5.2.4 Framing Climate Change

Interviews revealed that internal discussion of climate change tended to be more direct and open while discussion with the public was often framed within the context of the *green economy/job development, energy independence and energy efficiency*, and *sustainability for future generations*. Climate-related issues were most often framed within the context of best land management practices for forest health. A study participant for the Southern Alliance for Clean Energy stated that

We do not always bring it back to global warming or climate change. We make that connection internally but a lot of times when we are talking about it publicly, it is really more about jobs, it is really more about diversifying our energy source.

Study participants repeatedly voiced the necessity of focusing on the potential impacts of climate change, avoiding the issue of causation because of the potential for putting up a barrier between themselves and their audience. Organizations working with boards of directors noted the potential for board members to be stakeholders in various types of organizations, thus underscoring the necessity for more discretion with this audience around the discussion of climate change. The Southeast Program Director for the Land Trust Alliance suggested the need for clarification among these audiences, to not blame specific industries, such as the energy sector, for causation but rather suggested steps to move forward on collaborative projects that promote mitigation and adaptation strategies. Additionally, the political climate in the Carolinas was voiced as a concern in terms of the ability to talk directly about climate change and potential impacts. As a South Carolina state level official indicated, “at this point in time we are not actively working on climate change. We are not using the term climate change and we are not actively involved in any policy that relates to climate change.” Political pressures constrained not only inclusion of climate change in planning processes but, in some instances, removed the topic from acceptable public discussion.

Despite significant challenges associated with climate change impacts on the Forestry sector, study findings revealed various research projects working to investigate opportunities regarding the capacity to use forest resources to mitigate climate change and indirect impacts. Specifically, research is being conducted regarding carbon sequestration in the states’ forests as well as the viability of forest-derived biomass as an alternative fuel source. The potential for increased forest productivity made possible by higher levels of carbon dioxide in the atmosphere, as well as the ability to plant more tropical species, were also points raised by study participants. In addition, Forestry sector organizations are working to educate stakeholders and the public on the impacts of climate change, which will affect the forest resource and the products derived from it. These and other sector activities, which incorporate climate change, are discussed in the following section.

5.3 Climate Change Activities

5.3.1 Types of Climate Change Activities Occurring in the Sector

Activities in which the Forestry sector addresses climate change and sector impacts were quite varied. The following list includes the general categories of activities discussed by interviewees. This list represents the diversity of activities within the Forestry sector which address concerns about climate change. In addition, many activities encompassed multiple higher level goals and objectives.

- Forest Land-Use Planning and Management
- Data Collection and Monitoring of Climate Impacts on the Forest Resource
- Internal and Public Climate Change Education and Outreach Initiatives
- Greenhouse Gas Emissions Reduction Efforts
- Sustainability Projects and Programs
- Hazard Mitigation and Emergency Management
- Internal Policies, Practices and Management
- Forest Resource Demand and Supply Assessments
- Forest Resource Risk and Vulnerability Assessments

- Ecological Protection and Conservation

Interview discussions with study participants focused mostly on activities regarding *emissions reductions, education and outreach, data collection and monitoring of climate impacts, and ecological protection and conservation.*

Forestry documents revealed that the sector has dedicated efforts to the development of resource assessments and analysis of the effects of climate change impacts on forest resources. State forest resource assessments included climate-related issues such as identification of climate-related impacts and discussion of forest management and planning options. These included the North Carolina Forest Resource Assessment 2010 and the South Carolina Forest Resource Assessment and Resource Strategy 2010. Other documents focused on the forests' role in adaptation and mitigation strategies in terms of moderating the effects of climate impacts. Forest resources and products were also being promoted as an energy source and an asset to enhance the country's progress toward energy independence.

Emissions reduction efforts focused on activities related to renewable energy, low/no carbon investments and projects, and, more specifically, biomass and biofuels. The intent of such activities appears to be to decrease dependence on fossil fuels and not necessarily to reduce greenhouse gas emissions.

[We] work to promote the sustainable use of bioenergy when and where it can be shown to benefit the climate. Not all biopower or biofuels are good for the climate. The complexities of bioenergy are daunting, but there is clear science showing that it can be beneficial, depending on the particulars. (study participant from Southern Alliance for Clean Energy)

The economic benefit of renewable energy was noted as the context within which these activities were framed in terms of public benefit and was articulated by one interviewee as the impetus for policy development of renewable energy portfolios. Research in biofuels as an alternative energy source has supported the development of collaborations between universities and NGOs. Outside of the use of forest resources for the development of biofuels, organizations within the Forestry sector also indicated short-term activities involving the use of alternative forms of energy for internal operations to reduce emissions and increase energy efficiency. Promotion of *sustainability* activities as a win-win in terms of cost reduction and environmental benefit (e.g., air and water quality) was a common framing for public presentation of these activities, as opposed to mitigation of greenhouse gas emissions, or climate change in general.

Education and outreach programs were the second most cited climate-related activity within the Forestry sector used to address the issue of climate change. Six interviewees and one questionnaire respondent described education and outreach initiatives related to short-term organizational activities. Activities discussed included annual meetings and conferences, workshops, webinars, educational tours, and public climate change exhibits. These education efforts were geared towards all organizational audiences, such as landowners, board members, employees and staff, stakeholders, and the general public of all ages. Education topics included general information about climate change impacts on forests, climate change mitigation and adaptation strategies, best land management practices, and the environmental benefits of forests in terms of providing wildlife habitat, improving air and water quality, and the conservation of

natural ecosystems. For those organizations which are still in the investigatory stages of addressing climate change issues in their operations, an increased awareness through public education and outreach of peer institutions was identified by interviewees as the thing which led them personally, or as an organization, to investigate climate change and its potential impacts on the Forestry sector. Thus, activities internal to the sector are increasing levels of awareness and education regarding climate change impacts to include a broader range of organizations and stakeholders. This shift was noted as a “gradual, growing area of focus” by one Forestry sector interviewee. The conferences and workshops which have been hosted by Forestry sector organizations and, which have climate change as a topic, if not the central theme, played an important role in this information dissemination.

Adaptation activities center on long-term land use planning and management in terms of anticipated impacts to forest species’ composition and productivity. *Data collection and monitoring of climate impacts* improves understanding of potential impacts to forests caused by a changing climate and, in turn, support planning and management adaptation activities. Data collection and monitoring efforts in the Forestry sector center on climate impacts on ecosystems, as noted by 5 interviewees and 1 questionnaire respondent. These activities include research on carbon sequestration in forests, effects of climate variability on specific species, and the effects of climate variability on future forest productivity, which was then translated into respective economic impacts. With regard to the use of forests for biofuels production, research is being conducted concerning the efficiency of various forest resources, e.g., whole trees versus logging residue.

Protection and conservation of the forest resource and ecosystem was also cited as an important role of Forestry sector organizations and relates to longer-term planning activities within the sector. Forest health related directly to forest productivity in terms of usable resources. Protection of species and ecosystems for their intrinsic value was mentioned by interviewees within public land management and land trusts. “We try to do things to encourage wide species diversity so that these systems are more resilient to disturbance” (study participant from USDA Forest Service Southern Region). Adaptation to changing forest ecosystems by wildlife and various species was discussed. Assistance with such adaptations via forest corridors and human assisted migration was addressed by one interviewee. In the opinion of one interviewee, a number of adaptation strategies have historically been part of the organization’s management practices. The interviewee cited provisions to increase habitat for brook trout, such as felling trees to create pools and maintaining the riparian buffer to cool water as examples of this type of existing forest management activity.

5.3.2 Factors that have Facilitated Planning and Implementation of Activities

One interviewee raised an interesting point regarding the level of awareness about a changing climate within the Forestry sector. The participant discussed the longevity of a career in forest land management, e.g., a 30 to 50 year commitment for a tree stand to mature and be ready for sale. Because of this, land managers are aware of climate variability such as the intensity of seasonal storms, seasonal time change and length, and the intensity of wildfires. When asked why the Forestry sector was ‘in tune’ to the change in our climate, the participant responded,

It is firsthand experience with the changing climate and the results and the impacts of that. It is like farmers. I think a lot of farmers also acknowledge that the climate is changing and most of them are not the denialist types who say ‘well, it has always been changing.’ Most

of them know that there are profound changes that have happened, that springs are coming earlier, that droughts are longer, and rains are much heavier and harder. We do not get the gentle rains that we used to in this region. We are also seeing invasive species come in and that makes it harder for them to grow crops. (study participant from Southern Alliance for Clean Energy)

In terms of the promotion of the forest resource as a tool in the development of alternative energy technology, noted triggers included recent energy cost increases and fuel shortages caused by natural disasters (Hurricane Katrina). In addition, economic markets which support investment in alternative energy technologies will be a facilitating factor. "So it is not just an academic exercise of people interested in promoting this, it is actually people who are making money off of these technologies and these initiatives that is essential, I think for it to have its own legs" (Forestry sector participant). The adoption of a Renewable Energy Portfolio Standard (REPS) in North Carolina was noted as a significant supporting factor in the development of research and interest from clients regarding the availability of woody biomass for renewable electricity and fuels. The establishment of the North Carolina Biofuels Center was also a supporting factor in biofuels research through grants and collaboration. Federal grant funds through the Department of Energy and the USDA were also noted *funding sources*. The Department Head for the North Carolina State University Department of Forestry and Environmental Resources pointed out the importance of funding from various granting agencies in helping to bring climate change research to the forefront: "It has become more prominent in our teaching and it has been a larger portion of our research portfolio and of course some of that is driven by the granting agencies and what they're interested in."

An increasing interest in climate change impacts on the Forestry sector led to the topic's inclusion in several annual organizational meetings and workshops where it had not previously been discussed, according to interviewees. This has led to a dissemination of information throughout the sector as participants returned to their respective organizations, furthering the conversation about climate change within the Forestry sector.

Collaboration among various interest groups within the sector was articulated as the key facilitating factor in moving research on forest land management forward. Specifically, the Co-Director of the Southern Forest Resource Assessment Consortium noted that the NC REPS led to *policy* and industry decision-makers coming to the table to discuss the use of forest resources for renewable energy whereas prior to the establishment of the REPS, conversation was disjointed. Collaboration was also cited as a key factor in forest land management for the protection of the forest resource habitat, various wildlife species, as well as the availability of information and networks of information in forest management. The work of the USDA Forest Service SRS is a key example of research collaborations working to develop tools to further the incorporation of climate change into decision-making, planning, and activities throughout the Forestry sector. The Southern Forest Futures Project, a collaborative project between the USDA Forest Service Southern Region and SRS, and the Southern Group of State Foresters, is working to "inform forest management choices, policy discussions, and science programs with the best possible understanding of the long term implications of changes in southern forests" (Wear et al. 2009, 1).

5.3.3 Factors that have Constrained Planning and Implementation of Activities

Funding, in terms of both monetary and human resources, was a noted challenge for various study participants in the implementation of climate change-related activities. Development of

biofuels is a capital intensive investment which has become even more of a challenge with the current credit market in the United States. In the development of biofuels technology, there is a tendency to have funding sources that are willing to take the initial capital investment risk, and monies that will come in once there is a proven technology. However, during the scaling-up process, which is necessary in renewable energy technology development, there is a lack of funding, and thus, technologies do not make the jump from trial period to market-ready. One interviewee referred to the lack of funding during this transition period as the “valley of death” for biomass technology development. Uncertainty regarding federal and state *policies* and incentives also plays a role in the reluctance of investors.

Current budget restrictions posed constraints on the forest resource management division of the sector as well. Allocation of funding to support conferences, workshops, and other public education outlets was a noted challenge by study participants because of budget cutbacks in government agencies, as well as a lack of funds in the private sector for spending outside of immediate organizational responsibilities. Financial constraints alone would not appear to be a permanent barrier to future advancements in addressing climate change issues in the Forestry sector. Other factors also present constraints to action. Because of recent changes in political leadership which, in turn, influence budget allocations, a return to pre-recession funding levels may not be forthcoming. The challenge posed by broken land ownership is another significant constraining factor. Fragmentation of forest lands presented a challenge to forest health in terms of invasive species and disease, diminished water quality, and the preservation and conservation of wildlife habitat and migratory corridors (SC Forestry Commission 2010). Varying interests among stakeholders raised questions in terms of best management practices; whether the forest resource should be managed for preservation or productivity, and whether the continued sale of forest lands for development was detrimental to overall forest health and productivity.

5.4 Adaptive Capacity

The impacts of a changing climate on forest resources are being widely addressed throughout Forestry sector organizations within the Carolinas. Concerns regarding precipitation levels and frequency, temperature, and frequency and intensity of extreme weather events are highlighting the need to adapt forest resource management to potential future climate scenarios. There is some evidence of mainstreaming climate change impacts to forests through inclusion in annual forest assessment plans. In addition, forest land managers working on both public and private lands, as well as those organizations working towards the development of biofuels production, are incorporating potential impacts into long-term decision-making and activities. However, immediate, stand-alone projects to mitigate or adapt to climate change in *operational* or shorter-term activities are not as prevalent. Current research and decision-support tools by various organizations within the sector will help to move these efforts forward.

Perspectives regarding the influences of a changing climate on the forest resource are influenced by the propensity of foresters and those involved in other divisions of forestry that have long-term careers and involvement within the sector. This factor facilitates the incorporation of climate change into long-term planning and decision-making within the sector through stakeholders’ personal experience in management of the forest resource. In the future, long-term land-use planning may depend on higher levels of collaboration among various stakeholders based on multiple uses of the forest resource and a growing fragmentation of forested lands due to urban expansion. Decision-support tools being developed internally by sector organizations

increase the adaptive capacity of the Forestry sector by providing hands-on guides, which can also help with collaboration efforts among various other stakeholders in adaptation planning. Changes such as the planting of different species, the extent and pattern of timber harvesting, and the need to retain migratory corridors for plant and animal species are a few of the decisions which will be influenced by future climate variability. The study revealed an especially strong correlation between the Forestry and Wildlife sectors in terms of preservation and conservation goals and objectives in land-use planning. For further information about sector networks and collaborations in the Carolinas, see Chapter 10.

The use of biomass in the development of biofuels as an alternative energy source faces constraints which delay technological advancements and mainstreaming of biofuels into renewable energy portfolios. Issues of potential climate change impacts are incorporated into the goals and objectives of organizations working to promote biofuels development. However, a lack of funding necessary to scale-up new technologies and public perceptions about the use of biomass as a source of fuel are limiting factors for this segment of the Forestry sector. Nonetheless, NGOs are working to step up public education initiatives and advocate for these technologies as part of the portfolio of alternative energy sources within the Carolinas.

Urban forestry can be used as an educational tool for public outreach initiatives to communities who lack a direct connection with forest resources. Increased incorporation of urban forests into population centers can also be used to mitigate climate impacts, such as the higher average daily temperatures caused by the urban heat island effect, as well as improving indirect climate change impacts such as negative effects on air and water quality.

The adaptive capacity of the Forestry sector to address the impacts of a changing climate on forest resources is gaining strength within the Carolinas. Decision-support tools developed by the sector are leading the way in land-use planning efforts which incorporate future climate scenarios. In addition, data collection and monitoring, as well as education and outreach initiatives, are working to further the understanding of climate change and its impacts to the forestry resource, both internally within Forestry sector organizations, as well as among other stakeholders and the general public. The forest resource can be used as a tool to mitigate climate change, although necessary action must also be taken to adapt to future climate scenarios in order to protect and conserve forests and the resources they offer the Carolinas.

5.5 Needs and Recommendations

Document analysis revealed a number of needs and recommendations to better address climate change and the impacts it will have on forests within the Carolinas. *Information* needs include long-term monitoring and assessment of forest species and populations, development of resource status databases, and research on the impacts of climate variability and change (Bardon et al 2010; CCSP 2008; SC Forestry Commission 2010; Southern Group of State Foresters 2009). This information would in turn be used to meet needs regarding the establishment of best management practices and programs for: forest stewardship (including urban forests), climate adaptation and mitigation, restoration, reduction of threats and stresses on forest health, and the development of the biomass sector. *Funding* is needed in order to support research and development of management strategies, programs, and projects, as well as to provide financial resources to enhance specific capacities such as the ability to respond to fire risks, ability to respond to changes in air quality regulations, and ability to initiate biomass manufacturing.

Collaboration and coordination across government agencies, the private sector, NGOs and with individual landowners could be used to improve policy and management strategies. In addition, *legislative and regulatory action* is needed to support and incentivize adaptation and mitigation measures as well as forest conservation efforts.

Questionnaire and interview responses reiterated needs and recommendations found within Forestry sector documents. A third of interviewees indicated a need for *down-scaled data and information* on climate impacts on forests in the different regions of the Carolinas. The scale most often called for was general to the Southeastern United States; although, regional and state specific information within the Carolinas was also expressed as being useful for a better understanding of the impacts for which land managers should plan. Many interviewees discussed a need for *summary and translation documents of data and information on climate change*. Such information is needed to support decision-making and planning processes for forest land management. Likewise, Forestry sector documents also suggested a need for decision-support tools. *Laws, regulations and policies* regarding greenhouse gas emissions, monetary valuation of carbon, and carbon credits were mentioned by a third of the interviewees. These interviewees called for more certainty from the federal government with regard to anticipated rulemaking and regulations. Additional education and outreach, both internal to the Forestry sector as well as to the sector's various audiences, was also recommended. *Education and outreach* objectives aimed to further the understanding of climate change impacts on forest lands in the Carolinas and to encourage coordination and discussion regarding best management practices moving forward was also highlighted as an area of need.

Needs and recommendations identified by documents and study participants would help to resolve challenges and constraints associated with climate change-related activities in the Forestry sector. The ability to meet needs including greater certainty on federal rules, regulations and policies are external to the sector. Nonetheless, interviews revealed that work is being conducted by the USDA Forest Service and other organizational research efforts on specific impacts to meet internal needs and recommendations.

6 Government

6.1 Introduction and Sector Overview

Although climate policy strategies have traditionally been crafted at the federal or international level, it is expected that climate impacts will be experienced – and most effectively responded to – at the local and regional level (Selin & Van DeVeer 2011). In particular, extreme events (storms, flooding, heat waves, droughts) are expected to impact local, regional, and state-level physical and social processes by damaging infrastructure, disrupting government services, and producing conditions that may cause public health problems (e.g., heat stress, vector-borne disease) (Stratus Consulting 2010). Climate action planning has therefore become an important element in the comprehensive planning efforts of urban, municipal, and regional governments, supported in part by a wave of sustainability professionals hired in the first decade of the twenty-first century to lead such collaborative efforts.

With 146 county governments (NC:100, SC:46) and 817 municipalities (NC:548, SC:269) in the Carolinas, many local government systems are beginning to develop planning strategies to address these potential impacts. State-level agencies in the Carolinas have also become involved in comprehensive climate change planning efforts within the past decade (NCDENR 2011; NCGA 2010a). Current projects are therefore not isolated within the municipal bounds of these areas, but rather involve regional partners within suburbs and rural communities that surround population hubs and are supported by state-level guidance and consultation. Collectively, this set of actors and institutions includes a network of local, regional, and state-level government structures, systems, and departments that are interconnected at multiple scales and issues of concern. This group is referred to as the Government sector.

Although many of the initial state and local efforts to address climate concerns in the Carolinas have traditionally focused on mitigation strategies to reduce greenhouse gas emissions, recent efforts to incorporate adaptation initiatives within these broader efforts are gaining steam while traditional GHG inventory strategies are becoming more refined to increase policy relevant outcomes (Boswell, Greve, & Seale, 2010). This trend is representative of climate action planning in North America (Wheeler 2008; Zimmerman & Faris 2011). The analysis that follows is designed to highlight areas of significant action within the Government sector to expose both promising efforts to address climate concerns within the Carolinas and challenging hurdles yet to be negotiated.

The thirty-four (34) participants for this sector included local city/county government employees (11), regional councils of government and NGO/NPO organizations (7), private industry leaders in energy and environmental management (2), state agency employees (7), federal agency employees with direct connections to work in the Carolinas (2), and individuals from academic communities engaged in research to translate physical science information to actionable public policy (5). For more information about the sample size and response rate of this sector please see Chapter 3.

6.2 Key Decisions, Climate Information Use, Climate Change Concerns and Framing

6.2.1 Key Sector Decisions

The Carolinas Government sector must balance multiple complex socio-ecological subjects on an ongoing basis. Issues span across areas of hazard and emergency management, energy use and policy, transportation planning and infrastructure, public utility provision, to economic growth and environmental pollution. Coastal zone management regulations, public health standards and support services, transportation infrastructure and fleet management, and policies aimed at the preservation of significant cultural and environmental resources influence the health and wellbeing of human and ecological systems in North and South Carolina. There is little doubt that the recommendations, policies, and regulations established within the government community in the Carolinas directly impacts significant aspects of cultural, economic, and environmental systems throughout the region.

6.2.2 Climate Information Use

In addition to *operational* decisions that utilize weather information to inform public health advisories, public utility operations, and emergency management activities, interview participants indicated that the Government sector in the Carolinas, by nature, has historically incorporated information and concerns about climate variability into *seasonal and annual decision-making* processes. In particular, individuals within this sector emphasized on-going efforts to manage impacts associated with climate variability in precipitation, temperature, and severe storm events which influence water, wastewater, and storm-water management systems, public health intervention plans, and emergency management preparedness programs. An awareness of historic climate variability is a critical aspect of *climate-focused* decision-making processes within this area of work.

To inform these management efforts, individuals within this sector utilize climate information to influence advanced planning and preparation to mitigate climate impacts. This information includes data on the *climatology* of the region, *forecasts and outlooks*, and *specific climate variables and events*. A myriad of additional localized information is consulted along with climate data to inform governance decisions, including *interacting factors* like population trends and development patterns and environmental quality variables. A large portion of this climate information appears to come from federal sources, although much of the relevant data obtained is scalable to a more regional level. As more government agencies in the Carolinas collect and analyze their own data, this trend may change.

6.2.3 Climate Change Concerns

While government officials are involved in the ongoing management of the impacts of climate variability, most questionnaire and interview participants noted the need to alter existing management and planning infrastructures in preparation for future *changing climate* conditions (NCDENR 2011; NCGA 2010a). Such efforts involve integrating an additional layer of planning into *seasonal or annual decision-making* processes that already incorporate climate variability dimensions as well as *long-term* planning processes. Decisions regarding which areas of responsibility are most at risk of impact from future climate changes, and how to plan for such changes decades in advance, are currently being negotiated. Several early leaders in the Carolinas have managed to incorporate climate change information into *longer-term* planning and decision-making infrastructures (discussed in Section 6.3), although this is not yet

widespread within this sector. Most of these decisions correspond with planning horizons that range from 5-30 years. A general consensus emerged among study participants that one of the greatest challenges facing state and local government leaders in the next several years regards making difficult decisions about how best to mitigate and adapt under changing climate conditions.

Many Government sector leaders have already initiated action targeted at minimizing the impacts of future climate change. The significance of mitigation activities occurring within this sector was evident in this study. Although adaptation concerns were articulated by interview participants, this appears to be a more recent development. Published documents heavily emphasize mitigation concerns about global emission rates and the role of governments in curbing energy intensive activities (NCCAPAG 2008; Brown et al. 2010; NCGA 2010a; Doron et al. 2009; SCCECC 2008). Attention is subsequently focused on mitigation efforts to reduce greenhouse gas emissions via energy efficiency and alternative energy initiatives. Efforts within this area largely fall within a broad “sustainability” umbrella and highlight concerns about the emission inventories of municipal and community systems, prompting reductions in fossil-fuel consumption and the management of public infrastructures like transportation and residential housing to reduce energy demand. One local sustainability coordinator noted this fact by saying “we definitely talk a lot about mitigation in lots of different plans, from our transit master plan to our downtown master plan. We have a sustainable communities initiative grant from the Federal Government so we do mitigation in a lot of areas” (Director, City of Asheville, NC Sustainability Office).

Although the Government sector continues to focus heavy attention on mitigation efforts to reduce greenhouse gas emissions, interview participants raised strong concerns regarding adaptation planning and preparedness. Interview participants expressed a growing consensus that key practices within the sector are vulnerable to impacts from climate change. Specifically, climate change impacts on resource management (water and energy), emergency management and mitigation, and land-use and comprehensive planning efforts were highlighted consistently as major concerns within the sector. A small group of interviewees emphasized concerns over the challenges involved in managing water, sewer, and storm-water systems under conditions of increased drought and flooding events. Such concerns are exacerbated by an already aging infrastructure and lack of resources, coupled with growing populations and developed landscapes in the region. For inland areas in the Carolinas, drought management and preparedness, along with associated threats like fire, were raised as top concerns for adaptation planning.

In addition to the general climate information consulted in this sector, efforts aimed at addressing *climate change* require supplemental information resources. General documents with information about *climate change and impacts and human responses and activities* are consulted to support the need and impact of local mitigation efforts. Moreover, climate information about *climatology* or *specific climate variables and events* is sought to inform ongoing adaptation planning. Although *climatology* information is not utilized as frequently for mitigation activities, it is more pertinent for adaptation measures. As such, access to trusted, easy-to-understand climate data will become more critical as communities in the Carolinas enhance adaptation implementation and continue to prepare for more severe climate impacts. Additionally, study participants associated with climate education and outreach efforts indicated the use of information about

specific *climate variables and events, impacts, and human responses and activities* on a short-term basis to make decisions about what stakeholder groups to target for collaborative projects, as well as what policy priorities to champion on an annual basis. Most of these efforts are ongoing, although some do correspond with a particular season of the year (e.g., hurricane season).

6.2.4 Framing Climate Change

As was evident by the dominant concerns and interests of interview participants, individuals within this sector are focusing on both climate mitigation and, more recently, adaptation challenges. Both of these two dominant areas of concern elicit different public communication and external framing approaches, therefore influencing the types of activities supported (discussed later) and the information used to inform such activities. Mitigation actions frequently are enveloped among larger *sustainability* frames to emphasize activities that enhance the overall environmental impacts of organizations and communities in the Carolinas. Several interview participants indicated that these comprehensive sustainability efforts tend to be more politically palatable because of their holistic nature. Furthermore, activities that focus on the reduction of greenhouse gas emissions are often connected to a broader emphasis on *energy security and efficiency*, and cost reductions, with additional framing around the building of a “*green*” *economy*, global competitiveness, and the benefits to overall *public health* and vulnerable populations. This interview participant who is a member of a NPO/NGO shared:

Working in a politically conservative state like South Carolina where skepticism of climate science is strong, we in the conservation community have decided to cede the scientific debate and focus our efforts on energy reform. We are working at the state and federal level to pass comprehensive energy reform, including a clean energy standard for South Carolina that promotes energy efficiency and reduces our dependence on fossil fuels. (study participant from Conservation Voters of South Carolina)

Although most interview participants that focused on mitigation were not reserved about the need to “tread lightly” around the topic of climate change publically, several candidly discussed the presence of internal communication, discussions, and planning around the issue. Notable participants within public health and local governments suggested that the topic was generally not contentious within their respective communities. This suggests that differences may exist between internal and external framing of climate concerns within the Government sector.

Among those interview participants who focus on planning efforts for adaptation or longer-term impacts, most indicated a heavy focus on the potential impacts (direct and indirect effects) of climate change on Carolina communities instead of the cause of climate change itself. In fact, a majority of respondents who addressed this issue made it clear that climate change as a topic was not generally a part of the rationale for adaptation action or preparation. Many noted the lack of clear climate signals in the region as further evidence that climate change as an impetus for action would not be agreeable. A focus on impacts was evident in the topics of greatest concern for interview participants focused on adaptation. Several interview participants expressed high levels of concern over the increased threat of catastrophic extreme events like hurricanes, particularly given the significance of coastal communities in the economies of the Carolinas (shipping, tourism, fisheries). Similarly, the most consistent issue raised within the Government sector in the Carolinas related to concerns over sea level rise along the coastal regions of both states. Several other interviewees highlighted the adaptation challenges associated with sea level

rise as the most pressing concern facing the climate governance community in the region. Concerns like these have influenced a dominant focus on the impacts of climate change. Much of this work is framed for public audiences (external framing) around the need to *plan and prepare* for risks to enhance resiliency. It should be noted that many of these same concerns are also relevant and often discussed broadly as cause for support of mitigation efforts as well. As a local planner stated:

I think framing climate change from a perspective that people can really understand here is important. So looking at erosion rates from sea level rise and looking at wetland loss from salt-water intrusion, and our water and loss of vegetation as a result of that. If we can translate, not just talk broadly about climate change, but translate how it impacts our region specifically and how it has already impacted our region. I think that is the most important thing. Otherwise I think people get confused and get carried away with the broadness of it and they need to look at it from a perspective of how it is going to affect them and how it will affect our community to fully understand it. (study participant working in a local NC municipality)

6.3 Climate Change Activities

6.3.1 Types of Climate Change Activities Occurring in the Sector

Innovative leaders within the Government sector have contributed a substantial amount of time, energy, and resources to *greenhouse gas emissions mitigation* strategies in the Carolinas. This focus was evident in published documents within the sector (NCCAPAG 2008; Brown et al. 2010; City of Charleston 2009; NCGA 2010a; SCCECC 2008). Document analysis revealed a sizeable spike in published documents on climate change in the Carolinas within the Government sector in 2008. These documents appear to correspond with several significant national and international events during that period that raised awareness about climate change mitigation. The fourth assessment IPCC report was published in 2007 and the U.S. Conference of Mayors Climate Protection Agreement was picking up steam, celebrating its 500th signatory in May of 2007. Additionally, several interview participants indicated that a number of local and state governments were beginning to plan for anticipated federal carbon legislation and the potential for significant impacts on the daily operations and costs for government systems. The concurrent nature of these events and the heightened level of national and international awareness during this period of time provided a synergistic opportunity for forward-thinking individuals within the Government sector of the Carolinas to begin to prepare, plan, and implement efforts to address the impacts of future climate change in the region.

Even still, the overall proportion of government organizations in the Carolinas actively engaged in the implementation of activities directed towards climate change is low. Nonetheless, questionnaire and interview participants confirmed that among government organizations that are addressing climate change concerns, there is a high level of focus on climate change *mitigation* efforts in the Carolinas. Many of these actions are concentrated in large metropolitan centers. A leading cohort of municipalities in the region has engaged in greenhouse gas emissions inventories, often followed by strategic plans to reduce overall emissions. These independent (stand-alone) plans, often called *strategic “sustainability” or “climate action plans,”* incorporate decisions about energy use, community growth and development, and strategic visioning. They often include strategies to initiate emissions reduction policies, “smart” transportation and *land management* designs and projects, and renewable or low-carbon energy incentives and programs. Together, these efforts can provide multiple benefits (economic) in addition to reduced carbon

emission levels. Although some local entities have contributed resource support for these efforts, several interview participants suggested that emissions inventories and climate action planning efforts may be solely supported by funding from federal sources. As a study participant from the Duke University Nicholas Institute for Environmental Policy Solutions said, “Federal grants are a big driver; they let localities do something they wouldn’t be able to do otherwise.” Climate Action Plans are generally designed to address local action initiatives, although regional efforts are in the initial stages within this sector. Stand-alone strategic climate action planning in the Carolinas generally concentrates on shorter 5-10 year planning horizons, with many plans that incorporate annual or bi-annual benchmark review requirements.

Along with such efforts are programs designed for public *education and outreach* regarding climate change and mitigation strategies. The high level of public education work in this sector often corresponds to mitigation goals and underscores current efforts to assemble and disseminate pertinent climate information to communities to engage them in behavioral strategies to reduce emissions. At least half of interview participants expressed that they were involved in public education and outreach activities that incorporated messages about climate change. Public outreach appears to be a large part of climate activities within the Government sector. Interview participants contend that educational efforts to inform citizens in the Carolinas about the potential impacts of climate change in the region and what can be done to reduce such impacts is a key component of any climate action strategy. Most of these education activities include information about ways to mitigate emissions to reduce climate change, with information about adaptation only now beginning to surface as the issue gains prominence in state and national circles.

While public education is an ongoing effort, the Government sector is highly involved in activities to *collect data and monitor climate and climate change impacts* in the Carolinas. Interview participants indicated that the lack of consensus regarding climate change signal trends (i.e, temperature rise or fall, increase or decrease in rainfall) in the southeast region of the United States often confounded efforts to prepare for such changes. Therefore, data monitoring and assessment work at a smaller geographic scale has become a critical strategy to further understand potential climate change impacts and threats in the region. These efforts include local and regional level risk and vulnerability analysis to identify public threats from changing climate conditions as well as communities or groups of people that may be most at risk of significant impacts from the consequences of a changing climate. These assessments inform *hazard mitigation and emergency management* protocols. The impacts of carbon emissions on communities, epidemiology studies regarding disease vectors or heat-related illness, and assessments of vulnerable infrastructure are all significant aspects of these monitoring protocols. Many of these efforts involve monitoring the social impacts (public health, economic implications, etc.) of climate change, although efforts to collect information about physical climate processes are also present. In particular, the impact of sea level rise along coastal communities and ecosystems is a major area of research.

A majority of independent (stand-alone) strategic climate action plans in the Carolinas pay little attention to adaptation measures and planning, confirming a national trend (Zimmerman & Faris 2011). A local North Carolina municipal sustainability coordinator expressed what many other interviewees did, saying, “we really have not spent a lot of time thinking about adaptation only

because I would say as a non-coastal community there aren't quite as many of those visual cues, you might say, to be thinking about.” Even still, some pioneer government organizations had launched efforts to incorporate *strategic adaptation planning* into long-term Government sector activities. This includes activities to consider how to reduce negative environmental impacts on social systems that result from changing climate conditions via targeted adaptive interventions to enhance resiliency of communities. Participants noted that when planning for adaptation, independent stand-alone climate adaptation plans are often not feasible (economically or politically) and therefore a different approach must be assumed.

The strategy often cited when addressing climate change adaptation in the Carolinas is “mainstreaming.” Study participants suggested that this strategy has become particularly salient given the political polarization around the issue within the Carolinas. The field of planning in general has often advocated this holistic approach to climate change mitigation and adaptation (APA, 2011). Participants that have utilized mainstreaming planning strategies to address climate change suggested that these plans can involve planning horizons that range from 5 to 30 year efforts. Included within these plans are efforts to incorporate management, *policy, or law revisions* into building codes, zoning ordinances, shoreline erosion mechanisms, emergency management efforts, and infrastructure and land-use planning that ensure that climate is considered in decision-making protocols. Interview participants also noted a focus on planning to adapt water and energy *resource management* (supply and demand), coastal resiliency efforts, and *infrastructure and ecological alteration* measures. Project participants shared several existing planning mechanisms that have been utilized as a spring-board to incorporate future climate changes into adaptation decision-making processes. These include:

- North Carolina CAMA Planning (requires comprehensive plans for 20 coastal counties in the state every five years)
- Private Resource Management Industry Integrated Resource Management Planning
- Local, Regional, and State-Level Hazard Mitigation Planning
- Regional, State or Federal-Level Transportation Planning
- Local & Regional Comprehensive/Strategic Planning

Adaptation implementation action, however, is in the beginning stages in the Carolinas at this point. Very few governance organizations have implemented tangible adaptation activities, likely because planning in this area is in the initial stages. In other cases, actions have been identified, but available resources have precluded them, as stated by the mayor of a small coastal town in North Carolina:

The only planning that we need along these lines is actually engineering services to get it done. But we don't need people to come and say here's \$100,000 to come up with a five-year or 10 year plan because dates are meaningless to us. I've got to get these stations moved eventually. Our sewer operator actually gets stuck out at the sewer treatment plant. If we know a big rain is coming, we try to pull him out of there for a day or two. (Mayor, Town of Plymouth, NC)

A notable exception exists in a number of coastal communities within the region where efforts are already under way to adapt infrastructures, policies, and procedures to cope with changing sea-level (CSO 2009; NCDENR 2011; NCDEM OGTM 2011). The lack of clear climate signals

and certain information about precise levels of impact in other areas of the region have complicated the adaptation preparation process so that many individuals in the Government sector are demonstrating a prudent caution to hasten quick action under uncertain scenarios. This is particularly true given the hostile political climate that exists in regards to climate action noted by study participants within the Carolinas.

Finally, members in the Government sector in the Carolinas have focused much attention on overall *sustainability* efforts within the region (City of Durham 2009; City of Raleigh 2009; NCLM, 2012). Sustainability activities often address a suite of environmental concerns in addition to those precipitated by changing climate conditions. Many of the significant military bases in the Carolinas have provided leadership in local sustainability initiatives, demonstrating a national sustainability priority among the federal national security branch (US AEPI 2007). These include population growth and “smart growth” efforts, considering development impacts on the natural environment, and a focus on the reduction of waste and pollution. Many local and regional entities now support sustainability councils or committees to guide comprehensive planning processes, although interview participants indicated that even these efforts were difficult to maintain given the quick turn-over of elected officials and the need for administrative support to advance comprehensive, long-term efforts.

6.3.2 Factors that have Facilitated Planning and Implementation of Activities

Although not a unique finding, study participants were frank that *funding and resource* availability are fundamental building blocks for activities to address climate change in the Carolinas. This was consistent across all areas of activity. A clear majority of participants noted funding as a significant element of their most successful activities, with select exceptions. In particular, federal and state-level support, as well as grants from private and public organizations, has spurred action to consider the impacts of climate on governance structures and systems. Efforts to create an economic incentive for communities to address climate mitigation and planning seem to be especially effective. This is acutely the case among activities that support zero or low-carbon energy efforts.

State and local *laws, policies, and regulations* also surfaced as factors that have facilitated activities in the Government sector within the Carolinas. State-level coastal zone management planning to incorporate climate change as well as the REPS (in North Carolina) were consistently raised as motivating factors to engage in planning preparations and action. Such state-level requirements appear to provide local governments the necessary nudge and guidance to engage in such efforts, specifically when it comes to incorporating planning for adaptation. However, participants noted that these requirements are most useful when they advance targeted action, have clear guidance, and include training for staff responsible for implementation. Additionally, a large portion of interview participants who serve within local-level governments underscored the essential need for clear policy goals, strategic plans, and ongoing support of local councils and administrative personnel to facilitate successful climate action. Participants consistently noted this connection to policy goals and plans as a key factor in facilitating and sustaining climate governance activities.

Because we had that strategic plan, it's allowed me to have alignment and stakeholder buy-in with flexibility so it's not me running around telling our senior managers you have to do this. Because it's in the plan, it's me saying, 'well here's the goal that kind of impacts your work or

service area, what are you working on for your goals that also meets these goals?’ And then a project is born. (study participant from City of Asheville, NC Sustainability Office)

Finally, an overwhelming portion of interview participants indicated that one of the more influential factors in supporting climate change governance activities is the presence of *key people, groups, partners, and experts* as well as *collaborative networks*. These include particularly active constituent groups, supportive councils and administrators, and shared public-private opportunities for action among nonprofit groups, private industries, and public entities. The presence of these opportunities has greatly influenced the activities that have emerged within the Carolinas, specifically encouraging large-scale mitigation efforts. For example, in South Carolina, a collective of electricity co-operatives, along with the state energy office and a number of nonprofit organizations have developed a model energy efficiency low-interest loan program to reduce carbon emissions and save on energy costs, even in the absence of state-level regulation.

6.3.3 Factors that have Constrained Planning and Implementation of Activities

Just as *resources and funding* were offered as key facilitating factors for activities within this sector, it was consequently also one of the primary constraints mentioned by interview participants. The lack of resources (both financial and in terms of staff and staff time) was a top concern for study participants. This constraint is not uncommon in national research (US COM 2008). As one city planner noted:

I think funding is important, although I think a lot of it is staff driven and so even though you need some form of funding, you also need the availability of staff time to do this and you also need the support of your management as well as the elected officials in your area. (study participant working in a local NC municipality)

Further diluting support of climate change governance action, participants suggested that the current fiscal restrictions and associated state and federal level funding cuts have hampered activities to address climate change in the Carolinas. Given that governments deal with multiple high-priority concerns, climate governance was not always of greatest focus.

While the lack of funding was listed as a major obstacle, it was not the only significant constraint identified within this study. The lack of overall *political and public support*, exacerbated by cuts to public funding, was noted as a prominent challenge within this sector. Although speculation regarding the reason for this phenomenon ranged broadly, participants expressed frustration regarding the inability to predict climate change impacts with certainty or precision within the region and suggested that this reality hindered efforts to educate citizens about potential threats and vulnerability and to develop support for mitigation or adaptation activities. The perceived lack of public understanding and acceptance of climate change in the Carolinas, and the lack of clear climate signals to communicate to constituent groups, was noted to underscore the need for public outreach and education along with enhanced data collection and monitoring. These last two were areas of activity supported by a significant portion of study participants.

Concurrent with information discussed about facilitating factors for activities, interview participants indicated that *key people, groups, partners, and experts* can alternatively detract from efforts to address climate change in the Carolinas. In particular, participants noted a perceived growth in opposition to any efforts associated with climate change, sustainability, or

environmental governance among elected leaders in the region, with few exceptions. This included city councils, state legislative bodies, and state and local level government leaders. As one local sustainability council member lamented:

We've avoided talking about climate change really. Of course the plan does talk about greenhouse gas emissions but we allude to it, that with climate change part of the rationale is to help protect the local economy against future variations in climate and of course supply of fuel is part of that, supply of food. But given, particularly because of the city council that got elected, we've kind of avoided talking about that. We want to be energy efficient, conserve resources, reduce the taxpayers' burden, save money for the city, and help protect the local economy, hopefully create some kind of new green industry. That's what we are saying.

Many interview participants noted the opposition they encountered to climate governance efforts as a hurdle while other sector leaders hesitated to participate in the study altogether for fear of reprisal from elected officials. Several leaders within this sector noted the difficulty in building trust with colleagues in other departments or areas of government to promote the benefits of climate change action as opposed to the belief that action adds additional burden or hassle. One of the most prominent constraints leveled by study participants related to existing *laws, policies, and regulations*. In particular, a lack of leadership or level of inertia regarding climate issues at the federal level was noted as a constraint as well as continued challenges in negotiating climate action with economic and development priorities (Titus et al. 2009b). Given that void, study participants indicated that the burden to address such issues has largely rested on local and state-level governance systems. However, local governments in particular often lack jurisdictional authority or the ability to regulate community activities regarding issues like energy use and cost, emissions regulation, and acceptable levels of pollution. This lack of regulatory authority, compounded by the complexity of navigating policies among multiple levels of governance, was of central concern for multiple interview participants. This particular constraint appeared to be paramount even over other issues like the lack of appropriate data or information. This interview finding was interesting as the majority of documents reviewed for this study suggested that the lack of data and relevant information was one of the most significant constraints for the sector.

6.4 Adaptive Capacity

Although this study revealed significant constraints to advance action to address climate change mitigation and adaptation in the Carolinas, prominent leaders in the Government sector are engaged in planning and preparation activities so that communities within the region may be better prepared to cope with future climate changes. Existing mitigation activities and networks, along with initial adaptation planning and preparation work, places the sector in a favorable position to act as more information is revealed about what to expect in specific areas within the region. An emphasis on “*no-regrets*” strategies like energy efficiency has been particularly successful. A number of municipalities in the region have engaged in mitigation efforts for decades, establishing themselves as national leaders on local climate action to reduce greenhouse gas emissions and enhance energy efficiency. Where activities to address climate concerns are occurring, public sector leaders are testing strategies and *planning for scenarios*, evaluating options, and *storing valuable knowledge and experience* that will aid the Carolinas Government sector as a whole in coping with future change. Interview participants often spoke of their duty as public servants to ensure that the public is best prepared for whatever is ahead by

demonstrating *foresight* of potential future problems. For example, a local planner in North Carolina commented:

I'll be honest with you, I hope that every projection about the future climate is totally wrong and that we're not going to have some of the impacts that appear likely to happen. As a responsible human being, I think that it's important for us to recognize we actually have to accept that this is the most likely thing to happen and not planning for it is irresponsible.
(study participant from local NC municipality)

Acting to address the noted *data and information void* expressed by study participants, the Government sector is actively engaged in local and regional monitoring of climate phenomena to provide a baseline for the *consistent monitoring* of relevant information for decision-makers in the region. At the same time, significant activity exists to educate and involve more segments of the population in climate action decision-making, so new collaborative groups and *multiple viewpoints* might present novel collective opportunities to address climate challenges. These efforts are in response to an expressed *need to communicate information to and educate public groups* so that they may be more involved in the climate action planning and preparation process. Such involvement may also begin to influence public and political support in favor of climate action, a constraint echoed by multiple interview participants.

Even though action to enhance future climate adaptation planning and strategies has been concentrated along the coastal areas of the region, leaders within this area of the Carolinas are out of necessity actively negotiating adaptation governance processes even under uncertain climate models and predictions. Despite differences in predicted sea level rise levels, governance officials are initiating strategies to “*mainstream*” adaptation planning into existing regulations, public utility operations, and community planning efforts. These early activities may help to establish best practices to create *flexible and incremental*, “anticipatory governance” procedures and practices that are able to incorporate new climate information as it is available while maintaining public services (Quay 2010). As the need for adaptation planning grows within the region, an established *network* of seasoned governance leaders may be available for guidance and support because of these early efforts along the Carolina coasts.

6.5 Needs and Recommendations

Areas of consensus did emerge among study participants regarding prominent areas of need to support climate change action within the Government sector. Many of these needs have emerged as a response to constraints to action and some clearly have triggered current activities within the sector. Although *funding and resources* were not always at the top of the list of needs, they were consistently rated as a major concern for interview participants. Even though individuals within the Government sector are moving forward as best as possible to prepare for future conditions, many interview participants were frank about the fact that there is only so much you can do without institutional support in the form of resources. While it is not the only need in the sector, funding was listed as a dominant constraint and an often cited need. Because interview participants often discussed this issue in other areas of the interview, adequate funding was assumed as a basic prerequisite, given that a majority of respondents indicated this as a major constraint to further action.

The need for *accessible*, trusted, and issue-relevant information was the most commonly shared need by interview participants. Although other items were listed more frequently as constraints

to action, the lack of pertinent climate data was shared as a need to support action moving forward. A majority of interview participants mentioned the need for specific information to enhance decision-making processes and activities. Study documents also confirmed this need (CSO 2009; NCDENR 2011; NCDEM OGTM 2011). Many respondents mentioned that small-scale, or locally specific climate data would aid in making more accurate decisions about preparedness. One interview participant suggested a formal “go-to” portal for information. “Everyone keeps bringing up the idea of the climate portal and one-stop shopping for all information in one location. From climate change information, to just data sets and having all that stuff available in one location.” (National Weather Service, NC). Most of the information needs expressed relate to very specific phenomenon, underscoring the fact that much of the work occurring in this sector relates to precise climate phenomenon and their associated impacts like severe weather, drought, and sea level rise. Furthermore, many of the activities within this sector to monitor and collect local data on climate changes are designed to help meet this need.

The second area of need relates to concerns about disjointed and unorganized efforts at multiple levels and scales of governance to address the impacts of changing climate conditions. Principally, respondents stated that a major need within this sector is formal networking infrastructures to enhance *coordination and collaboration* across multiple scales to support holistic and non-duplicative public service efforts. This need appears to be a response to constraints regarding the nature of existing governance structures, which hinder collective action because of the complexity and siloed nature of current activities. Study participants expressed a willingness to engage in collective multi-agency projects, yet did not feel that the formal systems were in place to adequately facilitate such efforts. Specifically, interview participants noted the need for better communication across organizations and sectors of government, enhanced systems to connect science and research to practitioners, decision-support tools, and incentives to engage in multi-party action. While stand-alone mitigation and adaptation projects are necessary, interview participants consistently noted the need to engage in *larger scale* efforts at the regional, state, and multi-state level. Interview participants were unclear as to where this level of coordination and collaboration might come from, although some did emphasize the importance of federal mandates and instruction. Several regional entities like councils of governments and research institutes already exist that might help facilitate such action (UNC UI 2007). Where opportunities for collective action have existed, they have often led to successful regional projects.

Finally, several interview participants expressed a need for more *community outreach and education* tools and opportunities to connect climate issues and impacts to the personal lives of constituents and community groups. Respondents frequently noted the need for outreach tools and programs that are less intimidating, allow personalized or tailored messages, and connect climate phenomenon to issues of public relevance like the economy or ecosystem services. As a local municipal government employee in NC shared, “we face a huge communication challenge.” Reiterating the perception that constituents generally are unaware of the many ways in which climate variables impact daily life, interview participants expressed the need to develop more advanced education processes to inform community-based decision-making processes. Many respondents noted that climate information often is overwhelming, impersonal, and too complex. Efforts to translate difficult and complex phenomena to lay audiences by demonstrating connections and avenues for action were indicated as a consistent need. However,

this need is not limited to public groups. Several participants also noted the need for more developed training and guidance documents and programs for internal staff members, government officials, and decision-makers.

7 Tourism

7.1 Introduction and Sector Overview

The Tourism sector in the Carolinas is vitally important to local and state economies. The Carolinas offer a multitude of various tourist destinations throughout the mountain, piedmont, and coastal regions of the states. Popular tourist attractions include beach vacations, skiing, whitewater rafting, golfing, hiking, and camping. In North Carolina, the sector supports \$17.1 billion in travel expenditures, \$4.2 billion in payroll, \$2.5 billion in tax receipts, and employs 198,900 residents (Center for Sustainable Tourism 2008). The U.S. Travel Association (2009) estimated that in 2008, travel spending in South Carolina produced 113,800 jobs, \$9.9 billion in travel expenditures, \$1.5 billion in tax revenue equaled, and \$2 billion in payroll.

Weather and climate influence destination choices by tourists. Changes in climate, including potential direct and indirect impacts, are therefore likely to affect tourist destinations and economies. For example, sea level rise, shoreline erosion, and loss of habitats that support recreational activities (e.g., fishing, hunting) may adversely affect the Tourism sector (Curtis et al. 2011; Bin et al. 2007). Climate change may also enhance the potential to support successful tourism and recreation development through efforts to both leverage and protect the environment (Center for Sustainable Tourism 2008). Thus, climate change will present new opportunities for the sector despite foreseen challenges to current destinations.

Tourism sector study participants working with NGOs, non-profits, and other collaborative groups presented evidence that these groups are in the early stages of educating business owners and the public about potential climate change impacts to popular tourist destinations. Individual private tourism-based businesses who are incorporating the triple bottom line of people, profit, and planet into business models are becoming champions of sustainable business practices. These business owners are providing a framework for other businesses to follow. Although discussions and research regarding climate change impacts which may affect the sector are occurring in various regions of the two states, active efforts to incorporate adaptation into long-term decision-making are not currently at the forefront of planning processes.

Twenty-two opinion leaders participated in the study of which four individuals completed the online questionnaire only and eighteen individuals completed both the online questionnaire and the follow-up interview. The study participants represented state parks (3), national forests (2), state agencies (2), academia (4), NGO/NPOs (7), local convention and visitors bureaus (3), and private industry (1). These participants represented three categories of organizations – or sub-sectors – within Tourism: hospitality, outdoor recreation, and research and academia. While Tourism decision makers have shared interest in protecting and promoting tourism in the Carolinas and frequently participate in similar activities (e.g., developing sustainable business practices), interviews revealed sub-sector differences in terms of how climate information is used in decision-making, climate change concerns, and the extent of engagement with climate change activities.

- Interviewees working in the hospitality sector focused on business and economic considerations. Hospitality-oriented interviewees referenced climate information less than

other participants, and they voiced opinions indicating that climate change was not of immediate concern to their decision-making processes at this time. Interviews revealed a focus on sustainability in business operations rather than mitigation and adaptation activities to address potential climate change impacts on the sector. Sustainable business practices included building energy efficiency buildings, using alternative fuel vehicles, and waste reduction and recycling.

- Participants working in outdoor recreation indicated using climate information on a regular basis to inform operational and seasonal decisions, such as planning camping activities or outdoor excursions. This group also indicated a higher level of engagement with climate change issues and information. Concerns centered on the potential impacts of ecosystem alterations, increased frequency of extreme events, and sea level rise on the sector.
- A third subsector includes those working in academia and with NGO/NPOs whose focus is research or advocacy. Interviewees in this group are more versed in climate change information than representatives of the other sub-sectors. Activities include conducting research to support long-term planning for potential climate change impacts in the Carolinas. However, their use of daily or seasonal climate information is limited to that which may be relevant to research and does not necessarily affect organizational planning and decision-making processes.

The following analysis of the Tourism sector within the Carolinas delves further into the relationship between the potential implications of climate change on the sector, current activities taking place which address climate change, and next steps in incorporating climate change into activities and planning to meet future needs. Differences across the three sub-sectors are noted where pertinent.

7.2 Key Decisions, Climate Information Use, Climate Change Concerns and Framings

7.2.1 Key Sector Decisions

Tourism management decisions primarily entail planning for visitor activities and are made by hospitality and outdoor recreation-oriented organizations. Interviewees from these organizations cited decisions made on *operational and seasonal* time frames as well as *long-term* planning horizons. *Operational* decisions center mostly on staffing requirements, excursion and event planning, and maintenance of tourist destinations. Marketing and promotion of favorable conditions for outdoor activities or specific tourist destinations are conducted throughout the year to attract business to these locations. Budgeting and business-growth planning decisions are made annually by individual organizations and are often based on previous and anticipated visitor rates. Organizational responsibilities, which include ecosystem management of tourist destinations, range from day-to-day *operational* decisions to annual and longer-term planning. For example, decisions regarding prescribed burning in state parks and national forests to maintain ecosystem health are made on both an *operational* time frame and a *seasonal one*. These decisions range from staffing requirements for monitoring burns to planning large-scale controlled burns and needed resources for conducting these burns in advance. *Long-term* Tourism sector decisions center on land-use planning and future development. These types of decisions incorporate various stakeholder interests based on location, to range from local government urban planning designs to land-developer interactions and environmental groups

concerned with preservation of natural ecosystems, which are often an alluring factor for tourist destinations throughout the Carolinas. Interviewees working in academia and with NGO/NPOs discussed involvement in these planning processes as well.

7.2.2 Climate Information Use

Decisions made by the Tourism sector with regard to climate information are mainly concerned with tourist activities and natural resource management. These decisions are not *climate-focused*, but are related to climate in ancillary ways. For example, stream flow and tide data are used to inform kayaking and boating excursions, while severe weather forecasts are provided to campers and hikers in state parks and national forests. *Operational* decisions regarding wildfires includes staffing requirements and are dictated by wildfire fuel levels, which are influenced by precipitation levels. Wind and precipitation forecasts, in turn, influence these decisions. *Seasonally*, temperature and drought indices help to guide planning during the summer and fall controlled burn seasons. One study participant referenced annual decisions such as staffing levels and budgets as being influenced by climate predictions, e.g., winter staff hiring is determined by winter weather forecasts. Annual special event scheduling and planning was also influenced by such forecasts. A study participant working at the Chimney Rock State Park discussed an annual event called ‘The Dog Days of Summer’, which was held in celebration of the end of the summer visitor’s season. The interviewee stated that the event was not held the previous summer due to excessively high temperatures making outdoor activities for visitors unsafe because of the possibility of heat exhaustion. Current variability in storm intensity and unpredicted higher tides in coastal regions were articulated as a concern by the president of the South Carolina Nature-Based Tourism Association, which affects daily operations for tourism businesses whose activities involve outdoor sports and excursions.

Various types of organizations provide climate information to inform different activities within the Tourism sector. Because different types of organizations are working to meet assorted needs, there is no single organization that stands out in providing applicable information to all sub-groups within the sector. In addition, specific information needs were met based on information type required. *Weather data*, the most often cited type of climate information used by the sector, is used mainly in regards to *operational* decisions such as outdoor activity planning and providing weather data to visitors. This information is most often sought out from specific state and federal agencies. Information about *specific climate variables and events* is used for emergency planning and preparedness. An Assistant Professor at East Carolina University who works with the Center for Sustainable Tourism noted that this information can also be used by businesses to encourage travel to tourist destinations. For example: “So let’s say if there is a hurricane that looks like it is coming towards South Carolina or something like that and it does hit or veers away, getting that message out there that businesses are open in South Carolina. It is fine to vacation here.” *Climatology data* is used in research within the sector to anticipate future needs in emergency planning and preparedness.

The online questionnaire requested that study participants identify key sources of climate information for their job. Sources included state and federal agencies, key printed documents, and other relevant sources from which they obtain climate or climate-related information. State and federal agencies were the most often cited source of this information. Although more federal than state level agencies were listed as sources of information, the type of information provided by the majority of listed federal agencies is regional or local in scale (e.g., NWS Regional-Local

Offices and the Southeast Regional Climate Center). Familiarity was the most common response when asked why certain sources were preferred over others for climate information. This familiarity included not only awareness about the types of information or data provided, but also the format in which information is presented (e.g., web interface, translation or summaries of data). Specificity of information provided was also mentioned in terms of both the scale of the data (e.g., regional or local, and the type of data needed for specific decisions).

7.2.3 Climate Change Concerns

Climate change concerns for the outdoor recreation sub-sector focus on impacts to natural ecosystems which in turn affect wildlife and plant species in tourist destinations throughout the Carolinas. Specifically, interviewees voiced concerns regarding long-term impacts to natural resources such as habitats, fish, shellfish, waterfowl and various plant species upon which tourism business in the Carolinas depends.

Because the tourism industry is often the largest contributor to the local economy in many tourist destinations in the Carolinas, climate change concerns translate into economic concerns for local businesses and communities. Documents and interviews revealed concerns about the vulnerability of coastal resources and the coastal-tourism economy to sea level rise and extreme events such as intense storms and flooding. Such events could, in turn, lead to beach erosion, shoreline change, infrastructure damage, disruption to tourism and related businesses, saltwater intrusion into water systems, and a decrease in the real estate market and property values. In addition, concerns were raised regarding sea level rise and flooding in terms of building and development in tourist destinations. Climate stresses are likely to interact with other recent trends— such as population growth, increase in infrastructure-building in low-lying areas, and alteration and loss of natural areas – to exacerbate coastal risks and vulnerabilities. Academic and NGO/NPO’s within the sector are working to address these concerns through research and advocacy. In contrast, the hospitality subsector did not raise climate change concerns as prevalently during interviews.

As discussed in the previous sections (7.2.1 and 7.2.2), Tourism sector decisions are often based on business or economic considerations, rather than specific climate concerns. Despite documented concern about climate change by the outdoor recreation and academic/research subsectors, there were few examples where interviewees noted using climate change information for decision-making or long-term planning. Climate forecasts and models were mentioned by a few interviewees in regards to annual budget planning, land management decisions in forest restoration and prescribed burning, and the affects future predicted climate scenarios may have on wildlife species living in a niche habitat within state parks or national forests. Current economic trends were a contributing factor to the limited efforts of organizations to address mitigation and adaption to a changing climate. In addition, one interviewee pointed out that the tourism industry tends to be reactive rather than proactive. Therefore, daily operations are geared towards attracting clientele rather than future planning for mitigation of – and adaptation to – climate change impacts.

There are individual agencies and organizations within the Tourism sector that are doing significant work in terms of research, data collection and monitoring, and sustainable business practices to raise awareness within the sector about climate change in order to stimulate activities which address noted climate change concerns. Education and outreach programs are geared

towards increasing awareness of climate change and making connections between the potential impacts of climate change and management decisions:

We want to make sure that where they [private businesses] build their hotels or attraction is going to be above ground or above water in 50 years. So that is where a lot of our time is spent, talking at conferences, kind of looking at what we know about sea level rise. And then on the other side of the state in the mountains, we're looking at what flooding, these torrential rains that are becoming more and more frequent, what that's going to mean, one, from a construction standpoint if you are building on steep slopes and you have all of this rain and that would mean more houses, more vacation rentals would fall into the river. And then also from a crisis management standpoint, if you only have one road going into your town, what happens when that gets washed out and everybody, 70% of the people that are there, do not live there. (state level Sustainable Tourism Coordinator)

Networks play an important role in the Tourism sector in terms of a source of climate change information. General information about climate change and potential climate change impacts, which may affect the sector, is disseminated through workshops, conferences and networking. A majority of questionnaire respondents indicated participating in conferences and workshops where climate change was a topic of discussion, if not the focus of the event. Colleagues and other organizations within the sector were indicated as a source of climate change information for over half of respondents, while friends and Listservs were sources listed less frequently but still accounted for at least a quarter of all respondents. Personal relationships and networks appeared to play a major role in climate change information sharing across the sector, as well as influencing the other sources of climate information to which opinion leaders and decision-makers refer.

7.2.4 Framing Climate Change

A limited number of interviewees indicated addressing climate change and its potential impacts with their target audiences. These participants stated that their organizations were taking the stance that climate change is both real and will have severe implications for the tourism and recreation industry. Other organizations noted the economic and political climates and uncertainty of specific impacts to their location as factors limiting the inclusion of climate change in either operational activities or long-term planning.

Interviewees who did incorporate climate change into their organization's activities stated that climate change as a topic of discussion with the general public was restricted. Interviewees attributed the inability to speak openly about the issue to a political climate that did not fully support the issue, as well as audiences who were skeptical in regards to the reality of climate change and human influence on the climate system. Conversations with tourists about climate change were noted as centering on the impacts to the coastline due to sea level rise, increased storm frequency and intensity, flooding, drought, and impacts to wildlife and habitats. *Sustainable* development and tourism were also mentioned in terms of framing. One interviewee read from the organization's legislative standpoints which states:

We support the creation and development of an integrated local and regional sustainable development plan by working together with a sustainable development alliance including local and regional partners. [Our organization] is committed to playing a leadership role in this initiative, while identifying and nurturing regional stewardships, partnerships, and collaboratives. (Tourism sector participant)

When asked how they discussed the topic of climate change with their audiences, interviewees stated that the most effective means of generating a positive response from tourists included providing factual information about ecosystem functions and personalization of the issues. Ecosystem function information concentrates on how impacts such as warming river waters or beach dune erosion translate into affects not only to specific species but to the entire ecosystem, therefore underscoring the need for *ecosystem conservation*. Phenology was a discussion topic as well in regards to presentation of ecosystem function impacts. Climate change communications workshops are helping to bridge the communications gap between scientists and interpreters who work with the general public, further empowering these individuals in their ability to provide information that is understandable and tangible to the layperson. An interviewee working with the Congaree National Park emphasized the need to separate the role of the visitor's guide from that of an advocate because of the need to maintain a level of trust in the information provided.

Making connections between people and these resources that we have, they're going to start to figure out that climate change is real, and when they do, we want to be the ones that they come to trusting. If we cross the line into advocacy, then we're going to turn people off and we're going to undermine the trust in ourselves and that means we have not protected this resource. (study participant from Congaree National Park)

Personalization of the issue is geared towards making a connection between visitors and the natural resource. Examples include citizen science projects such as the Great Backyard Bird Count and smaller excursions such as tagging sea turtle nests. Creating a personal experience through interaction with affected species presents an opportunity to discuss potential impacts with visitors and to share information about how their actions might help to conserve and protect. "If you can show your audience how [climate change] is affecting [species] then they are more likely to buy into what you are saying and take responsibility for their own actions" (Park Ranger at a NC state park).

Framings regarding *emergency management and hazard mitigation* were also mentioned, most notably in regards to coastal impacts management. The Executive Director of the Bald Head Island Conservancy indicated a growing awareness in coastal areas of the importance of various coastal ecosystems as 'insurance policies' themselves. The interviewee articulated an understanding among visitors and residents that certain variances such as those to protect dunes are there to protect the natural resource which in turn protects their homes; that the variance is not simply an aesthetic rule.

7.3 Climate Change Activities

7.3.1 Types of Climate Change Activities Occurring in the Sector

Opinion leaders and decision-makers who participated in the study revealed efforts to engage in climate mitigation and adaptation within the Tourism sector through research, data collection and monitoring, and resource management planning. Activities within the sector relate to sub-groups of the sector based on involvement in outdoor recreation activities (e.g., camping, hiking, whitewater rafting), general tourism and hospitality (e.g., destination vacations), and research (e.g., Center for Sustainable Tourism, NGO/NPOs), although overlap does exist. For instance, a study participant working in outdoor recreation with Congaree National Park discussed a number of research projects conducted at the park, a few of which are discussed below.

Data collection and monitoring of climate impacts on ecosystems as well as human systems was a noted activity by several interviewees working with research organizations. Research programs focus on inventories, monitoring, understanding, and evaluating shifts or changes in ecosystems. Specific examples mentioned include:

- Rare species population shifts or declines based on climate change patterns
- Estimation of ecosystem services from the establishment of oyster reefs in the Albemarle-Pamlico sound and how they are changed depending on location and future climatic conditions
- The study of algal and diatom communities as drivers in ecosystem change, and changes in flooding patterns, timing and frequency

Understanding potential ecosystem changes and impacts on natural resources was noted as motivation for research with the ultimate goals of *ecological preservation and conservation* by outdoor recreation-oriented interviewees. Merging the science with impacts on human systems was also a major focus of research within the Tourism sector. Conflicts over biodiversity and recreational management were also mentioned as an issue for the sector. Economic impacts were an emphasis of research, particularly to include costs and benefits to tourism businesses caused by climate change impacts as well as property valuation in tourism destinations. Research regarding human response to climate impacts further supported these efforts through the study of perceptions of weather and climate change by tourists, tourism businesses, and property owners and their influence on destination choice, business operating decisions, and property values.

Education and outreach activities played a major role in the way in which the Tourism sector is addressing climate change and potential impacts to the sector. Efforts included affiliations with faculty in universities from various disciplines, advocacy and lobbying on both a state and federal level, consultation and planning assistance, public outreach and education programs, and stakeholder workshops, conferences, and outreach. Faculty affiliations helped to coordinate comprehensive research efforts in order to provide better decision-support tools for the sector. Advocacy and lobbying efforts at the local, state, and federal levels were aimed at expressing the importance of addressing climate change, not only because of its effect on the Tourism sector, but for overall human and environmental health. Multiple interviews suggested that engaging local voices was also important, pointing out that their intimate knowledge of a location could play a vital role in planning and development to address climate change impacts. Consultation and planning assistance was offered through white papers and decision-support tools to inform local community leaders about what they should be aware of in terms of how federal and state policies on adaptation will affect local decision-making and outcomes.

Public education and outreach programs, utilized by all subgroups of the sector, included summaries and translations of scientific data and research findings, best practices for travelers to reduce their carbon/environmental footprint, showcasing sustainability initiatives, and providing an overall, basic climate change framework to increase understanding about personal actions which can be taken to mitigate or adapt to climate change impacts. Education and outreach inform the public about the impacts of climate change, and also help to bring in or retain business after extreme weather events. For example, by working with emergency management, messages were broadcast to let visitors know that destinations are still open for business. *Hazard mitigation and emergency management*, which include risk and vulnerability assessments, were

incorporated into various ‘in-reach’ education efforts to inform tourism businesses about mitigation and adaptation practices. Stakeholder workshops, conferences, and outreach supported networking within the Tourism sector (e.g., education and training for NGO members). External networking and partnerships also supported collaboration with other types of organizations and agencies whose duties intersect with the Tourism sector. Communication strategies were noted by several interviewees as the focus of these types of sector trainings.

Many tourism businesses in the Carolinas are nature-based businesses, using the states’ natural resources and beauty to attract visitors. The president of the South Carolina Nature-Based Tourism Association noted the importance of using these resources wisely in business practices as opposed to exploiting them for profit stating, “The truth is that when you utilize a natural resource, if you do not give back to it you destroy it.” *Sustainability projects and programs* which consider the triple bottom line of people, profit and planet are becoming widespread within the Tourism sector. Incorporating sustainability into operational planning and decision-making appears to be one of the more palatable means of mainstreaming this information into organizational responsibilities. Decisions to purchase hybrid company vehicles, implement energy conservation measures in existing facilities, and build LEED-certified visitor and research centers were examples mentioned by interviewees from various types of organizations throughout the sector. One interviewee working for an NGO described a conference held annually which educates members on how they can incorporate such sustainability initiatives into their own organizations. Government agencies cited top-down mandates to incorporate carbon footprint-reducing measures into operational plans.

7.3.2 Factors that have Facilitated Planning and Implementation of Activities

Current engagement surrounding climate change impacts affecting the Tourism sector has been driven by increasing levels of awareness about potential impacts within the sector. *Workshops, conferences, and networks* will continue to play a key role in providing climate change impact information to sector members and increasing communication levels between sector members and the public. As recommended by interviewees, *collaboration* to establish best management practices will help to initiate these activities and planning efforts. “I think that the issue that we’re kind of sharing with folks is this might not be an issue today, it might not be an issue a year from now, but five years from now, ten years from now these issues are going to be a big deal” (state level Sustainable Tourism Coordinator). No singular event or trigger was identified by interviewees as the reason for growing interest in the topic; rather, it has been a gradual shift as climate change concerns are raised. An interviewee from the Uwharrie National Forest (NC) stated, “I think more than anything it has been the general media that has brought that to the public's mind and from that caused the conversations to increase not just in numbers but also in depth.” As the sector is learning more about potential impacts, research and data collection are being driven by information needs that will support adaptation planning. *Political support*, in the form of top-down mandates, and *funding* from the federal level have been major supporting factors for government agencies.

Data collection and monitoring activities are supported through *networks* and exchange of information both within the Tourism sector as well as with outside organizations and agencies. A growing awareness about climate change was articulated by one interviewee as the reason specific research has been undertaken to connect the science with impacts to human systems. Connecting climate scientists with interpreters helps to bridge the communications gap in talking

about climate change and climate change impacts with tourists, and aids in furthering the conversation between resource managers and travelers. One participant voiced the opinion that organizations that focus on this type of research within the Tourism sector are providing an outlet, previously unavailable, for tourists or property owners to express their own opinions or feelings about climate change and climate change impacts. “I think just being able to have that voice through our surveys is important” (Assistant Professor, East Carolina University – Center for Sustainable Tourism).

The availability of up-to-date *information* to be used in public education and outreach efforts facilitates the sector’s ability to inform its audience about climate change issues and impacts. *Trainings* and *partnerships* which teach communication methods about climate change further aid sector opinion leaders and decision-makers in disseminating information to the public, as well as other stakeholders engaged in the sector. Public education and awareness are the driving force behind other activities within the sector as well. One interviewee noted that, although a traveler may not base a destination choice on sustainability practices, other decisions, such as the choice between two hotels, may be made based on one businesses commitment to addressing its carbon footprint over another’s. Incentive programs are providing free marketing and promotion to businesses who implement ‘green’ business practices in order to drive consumers to them. Leadership within the industry is also helping to promote these types of initiatives. Business owners who are taking these steps are setting examples that they are able to operate at a profit, while diminishing impacts to surrounding ecosystems upon which they depend for their business. Conscientious consumerism is reciprocally driving the profitability of these businesses.

7.3.3 Factors that have Constrained Planning and Implementation of Activities

Limited resources in terms of both funding and research staff were a noted constraint by interviewees in regards to data collection and monitoring activities. “I have active collaborations going with people at a number of universities but we are limited by manpower and money, as everybody is” (Tourism sector participant). Although federal funding has been a major facilitating factor for government agencies, one interviewee working with an NGO noted limited federal funding as a constraint in moving their research efforts forward.

Lack of political and public support due to pre-conceived ideas about climate change and climate change impacts, which can be influenced by a number of external factors such as religious or political affiliation, often present challenges in public education and outreach efforts for the Tourism sector. Several interviewees reiterated the importance of not only framing the message based on one’s audience, but limiting incorporation of the phrase ‘climate change’ or anthropogenic causes to certain audiences. Without the ability to address the issue openly, conversations are limited with respect to impacts and potential mitigation or adaptation policies.

Struggles internal to the sector include a reactive rather than proactive mindset for many business owners. One interviewee who works with a coastal community articulated concerns about low attendance to annual emergency preparedness seminars noting that businesses lacked concern about the potential for a devastating extreme weather event because one has not affected the area in a number of years. “We need to be hit by a couple of big storms. We have not been in years and people have gotten complacent about that and I think that it is human nature to underestimate and devalue the threat until something really specific comes of it” (study participant from NC NPO/NGO).

The *current economic market* was also noted as a constraint in moving the conversation forward in terms of addressing potential climate change impacts through mitigation or adaptation efforts, although it is not an insurmountable constraint. “With the economy being where it is, it has been more difficult than we thought to get businesses engaged, but I think that is just a matter of time” (Tourism sector participant). In addition, some government officials who may be proponents of sustainability practices, such as low-impact development plans or emissions reductions, were in political positions in which they must also balance support for growth in the local economy.

The people that represent the districts are caught a little between a rock and a hard place. They cannot go say [that they] participated in [a] Department of the Interior survey that was sent to [them] through nature-based tourism and [that they] support no offshore drilling or [they] support limiting the number of cruise ships coming in...because they are politically affiliated. They cannot do that. That is the biggest obstacle...I cannot ask those tourism regional representatives to do that because they are funded politically, but small businesses I can because we are individually owned. (President, South Carolina Nature-Based Tourism Association)

The hospitality subgroup of the Tourism sector did not exhibit the same level of engagement as NGO/NPOs or publicly-funded organizations such as state parks and national forests. Information dissemination within the sector can be used to initiate mitigation and adaptation planning by increasing awareness about potential impacts climate change will have on tourism and recreation regions within the Carolinas. This may take a shift in mentality from a reactive industry to a proactive industry to be able to meet future tourists’ demands under various potential climate scenarios. There were also new opportunities for the sector based on future climate scenarios, however. For example, extended seasons due to warmer temperatures in mountain regions may increase the annual number of days state parks are able to be open for visitors.

7.4 Adaptive Capacity

Different segments of the Tourism sector are addressing climate concerns in unique ways based on their roles within the sector. These distinctions can be seen between the different divisions of the sector included in the study, e.g., research-oriented groups, hospitality-oriented groups and entities working directly with tourists and visitors in outdoor recreation. Adaptive capacity within the Tourism sector is best examined on a regional, sub-state scale in the Carolinas due to the unique vulnerabilities facing different regions of the states. For example, the influence of sea level rise and its associated impacts in the coastal regions will require different types and levels of adaptation in comparison to the influence of warming winter temperatures and precipitation variability in mountain regions (Curtis et al 2009). Interviewees from various organizations and agencies revealed information use, activities, needs and recommendations distinctive to their organization’s role and location within the Carolinas.

Study participants working in state parks, national forests, and academia emphasized research, data collection and monitoring activities. NGO/NPOs and local convention and visitors bureaus are working to inform individual businesses as well as local, state and federal officials about mitigation and adaptation practices to address the sector’s climate concerns. Sustainable business practices were a focus of individual tourism-based businesses within the sector as a starting point to begin to address the role they will play in mitigating greenhouse gas emissions, improving

energy efficiency and conservation, and protecting and conserving natural resources upon which their business operations rely. These “*win-win*” strategies are examples of institutional practices and decision-making which support the adaptive capacity of the sector and demonstrate mainstreaming issues surrounding climate change within the sector.

Public education and outreach was emphasized by all organizations as key in moving any activity which addresses climate change issues forward. The Tourism sector has a key role to play in education of the general public in regards to the impacts climate change will have on natural resources in the Carolinas, both those enjoyed for their intrinsic value as well as those used for human health and wellness. In addition, tourism research organizations, such as the Center for Sustainable Tourism (East Carolina University), provide an outlet for visitors to share their concern for specific resources that will be affected by climate change. Thus, the strength of the Tourism sector is encompassed in the nexus of public interaction with tourism organizations that are working to educate the public about potential climate change impacts in the Carolinas and in turn building *human and social capital*. As mentioned in the framing section of this chapter, personalizing the relationship between a particular species or location and an individual creates a connection by which an individual can link their own actions with the implications they have on a larger scale.

These connections can be made on several other scales as well. For example, there is opportunity to incorporate climate change into discussions among multiple stakeholders in land-use planning in tourist destinations. This may increase levels of education and awareness about climate change impacts in the Carolinas not only among the general population but among decision-makers and opinion leaders as well who deal with infrastructure and urban planning, land development, and land preservation and conservation. By engaging multiple stakeholders in these issues, novel ways to address potential impacts, adapt to future climate scenarios, and decrease additional human-impacts to sensitive ecosystems are made possible. Specific private business adaptation efforts, such as updating infrastructure in anticipation of future climate scenarios, were cited as not being an immediate need to incorporate into current business models for many tourism business owners. However, sustainable business practices, which attract consumers, and education and outreach efforts which inform tourists about vulnerable ecosystems or species, will help to raise awareness surrounding climate change impacts in the Carolinas.

7.5 Needs and Recommendations

Needs and recommendations suggested by interviewees were a reflection of the constraints and barriers to furthering various types of activities within the sector. *Information needs* noted by interviewees focused on information that could be used to support planning and decision-making in the face of climate change impacts on the Tourism sector. For example, research recommendations regarding human systems’ impacts were suggested by one interviewee to better understand tourist psychology leading to improved data collection to support better business planning. Information needs will be met both by outside groups as well as constituents internal to the sector.

Document analysis revealed a need *for improved information and understanding* about climate change and how climate and climate change affects the Tourism sector, as well as a need to include natural resources and the built environment into this analysis. This need involves more support for and improvement to research, data, and monitoring, particularly of weather and

climate, and weather and climate impacts on natural resources (e.g., water quality, salinity, ecological surveys, floodplain mapping). Improved access to, and availability of, weather and climate data and information will support these efforts, as well as education of decision-makers, visitors, and the general public. Interviewees reiterated this need through requests for accessible and trusted information, translation and summary documents, as well as specific data and monitoring information requests. Translation and summary documents were highlighted to better understand climate science in a way that is applicable to decision-making within the sector. Information requests most often cited by interviewees centered on down-scaled climate change impact projections to improve natural resource management, development planning, and emergency preparedness. Research recommendations by study participants further support the need for improved information and understanding about climate change in the Carolinas, focusing on species population declines and habitat loss due to climate change impacts as well as human systems impacts.

Sector documents also indicated a need for support of adaptation planning, which included a number of recommendations such as:

- more state-level engagement in developing adaptation policy, strategies and planning processes that are comprehensive and flexible
- development of information, tools, and techniques to help guide adaptation decisions, e.g., impact and capacity assessments, cost-benefit analyses
- development of contingency plans for future hazards and severe events
- funding to support projects, research, monitoring, and outreach

Interviewee recommendations did not echo these recommendations as strongly in terms of support for adaptation planning, with the exception of one interviewee who indicated the need for political leadership, in particular, to support mitigation and adaptation strategies. “I think a key challenge is getting leadership to focus on the planning that allows us to prepare” (Executive Director, Bald Head Island Conservancy). Document analysis revealed recommendations in terms of the role of government in identifying and acknowledging problems and potential solutions to engage in systems-thinking, to provide leadership, and to develop networks.

Recommended actions to mitigate climate change impacts and protect natural resources included greenhouse gas emissions reductions, increased energy efficiency and conservation, and environmental protection and conservation. *Collaboration* within the sector was suggested by interviewees as a means of disseminating information about best practices in implementing these types of measures.

8 Water

8.1 Introduction and Sector Overview

Effective water resource management is critical to the maintenance and development of human and ecological systems. Water resource managers play a pivotal role in the allocation of water resources to residential, industrial, and agricultural users. *Operational decisions* involving the use of weather information are standard within the sector. Managers rely on system design standards provided by water resource engineers to enhance the security of water supplies and protect supplies from hydrometeorological impacts such as drought or floods. However, there are a number of non-climate and climate-related challenges affecting the management of water resources (USCCSP 2008b; Brekke et al. 2009; Nicholls et al. 2008). Land use and land cover changes, caused by residential and commercial development, affect the runoff patterns and sedimentation rates that lead to altered stream flows and reservoir storage. Withdrawal and consumption of water supplies, which are affected by population growth and economic activities, can also lead to changes in streamflow and altered biogeochemistry of water resources. Ageing water resource infrastructure, caused by both natural deterioration and sedimentation, also compromises the performance of infrastructure to supply water and mitigate flooding or drought-related hazards.

Climate change is expected to impact water resource management in a number of ways (USCCSP 2008b; Miller and Yates 2006). Disruption of the hydrologic cycle may affect the variability of seasonal and annual surface water flows and available water storage, which will pose decision-making challenges in the face of uncertainty. Water quality is also expected to be affected by warmer water temperatures, changes in precipitation patterns (e.g., more frequent and intense heavy precipitation events), and saltwater intrusion in many coastal environments. These impacts may be exacerbated by other stresses, such as increased demand for hydrologic power generation, increased water use, population growth, existing water quality problems, and needs for adequate flows to maintain aquatic ecosystems. It is therefore critical to understand the linkages between wastewater treatment, stormwater, water for reuse, drinking water, improving energy efficiency, and how to distribute water resources in order to moderate climate change impacts (AWWARF 2008; Stratus Consulting 2010). These changes in future climate and non-climate factors suggest that water management will be more effective by incorporating assumptions of non-stationarity (Hirsch 2011; Millet et al. 2008). These changes also underscore the importance of early adopters in the Water sector, who are attempting to develop altered streamflow sequences and *no regrets* strategies. Such innovations are critical in facilitating information sharing and illustrating success stories.

North and South Carolina depend on both surface and groundwater supplies to meet residential and industrial use, though surface water is the largest source. Changes in water quality and quantity are likely to impact the ability of over 2,600 active community water systems in the Carolinas to provide safe and reliable public water supplies. Further, increasing regulatory constraints (for water quality as well as water allocation and use) may influence how climate variability and change is integrated into decision and management processes.

This chapter examines the key decisions, climate change activities, and general adaptive capacity of the Water sector. As noted earlier in this report, the purpose of this portion of the study was to

focus on climate impacts on water utilities management and engineering, thus the water sector was defined to include individuals who are involved in the development of water supply plans, resource management, and the provision of water for public use. There was less focus on finding members from the broader water conservation and allocation community. The analysis was informed by a literature review of documents related to climate change and water resource management, web-based questionnaires, and semi-structured interviews with key decision leaders in the Water sector. Fourteen opinion leaders participated in the study of which five individuals completed the online questionnaire only and nine individuals completed both the online questionnaire and the follow-up interview. The study participants represented academia (1), municipal government (2), NGOs (3), engineering firms (5), federal government (1), private utilities (1), and private industry (1). Although the sample size is only 14 participants, our analysis centers on water utility management and engineering, a much narrower focus than the broader water conservation and allocation community, and therefore is likely representative of the trends within our focus area. The analysis begins by examining the key concerns and interests among participants in the Water sector. Climate change-related activities are then discussed, including enabling and constraining factors. The analysis concludes by discussing needs and recommendations identified by participants and the overall capacity of the sector to adapt to climate change.

8.2 Key Decisions, Climate Information Use, Climate Change Concerns and Framings

8.2.1 Key Sector Decisions

Participants in the Water sector throughout the Carolinas must balance competing interests and concerns, which occur at different temporal and spatial scales. In the short-term, managers must provide safe, reliable, and affordable water supplies to users. Acquiring water sources from inter-basin transfers requires significant collaboration and negotiation during periods of water shortage, such as droughts. In the long-term, planning decisions must focus on engineering design parameters and providing buffering capacity for extreme events. These planning horizons typically do not occur more than 50 years into the future.

Weather and climate conditions influence decisions on a wide range of issues, from daily operations to long-term planning. At the *operational* level, participants indicated that they were engaged in several activities, such as monitoring lake levels, river inflows, and pumping rates. These factors were used to inform management decisions, such as how and when to transfer water among systems, when to advise water use restrictions, and how much water to release downstream. Concerns over water supply were especially relevant between May and September, when water use increases dramatically and evapotranspiration is high. Water managers therefore became concerned if reservoirs, which are normally filled by December, are not filling by March or April of each year. Managers often engaged in *seasonal decision* processes to prepare for these various scenarios. Participants also noted that extreme weather events affected staffing operations, as these events necessitated additional efforts to secure and maintain reliable water supplies to the community.

8.2.2 Climate Information Use

To inform these management decisions, participants frequently use information about the impacts associated with a *specific climate variable or event*, such as hourly, daily, weekly, and

monthly flows. Interviewees indicated that streamflow data was important in decision-making because it allowed them to make the incremental adjustments necessary to accomplish the long term goal of water reliability. Drought indices, such as the Palmer Drought Severity Index, were also cited as a frequently cited source of information. Information uses are tightly coupled with *seasonal, annual, and long term* planning activities. At the *seasonal or annual* level, this information was used to inform management decisions such as the timing of interbasin water transfers and the issuing of water use restrictions. It also was used at the *long-term* planning level for the design parameters of water supply systems to provide reliable water supplies. Information use was driven primarily by trust and availability.

8.2.3 Climate Change Concerns

Interviewees expressed the greatest concern for changes in temperature, hurricanes, precipitation, severe weather, and climate variability such as El Nino/La Nina. However, interviewees were much more concerned about higher order impacts such as more frequent and severe droughts, sea level rise, and flooding because management priorities focus on long-term reliability of water supplies. In this context, participants expressed greater concern for changes in the long-term trends in precipitation and water supply, rather than the impacts of short-term pulse events. Historical *climatology* and *forecasts and outlooks* about future climate change were necessary to address these concerns. Interviewee concerns related to drought and issues of water reliability were consistent with the climate stressors identified in the document analysis. Other climate change concerns identified in the interviews were related to the long-term impacts to hydraulics and water tables, which can be affected for months following tropical storms and hurricanes. Concerns over water quality were related to changes in the operational costs of treating water.

Few participants in the Water sector stated that they currently utilize *climate change* models or *forecasts and outlooks* of change, though many interviewees suggested that they were interested in feeding this information into streamflow models for *long term decision-making*. This finding is consistent with classic engineer design and is summarized by an engineer based at a firm in the Carolinas: “We are at a classic engineering. We look at what has happened in the past, not necessarily what is going to happen in the future [...] We are going to assume that it is going to be pretty much the same in the next hundred years.”

Conferences and workshops, as well as colleagues and organizations within the Water sector, were the most common ways that participants obtained climate change information about *specific climate variables and events, impacts, and interacting factors*. Individuals relied more frequently on federal agencies than state agencies to obtain climate information. Information use was driven primarily by trust and availability. Availability of climate information was important to participants because time constraints prevented extensive queries of climate information and reports. Factors that influenced availability included convenience, easy to understand information, and condensed summary reports. For example, one water sector interviewee stated that “when I’m searching for all that stuff [climate information], it is whatever comes up in the highest rank in Google.”

8.2.4 Framing Climate Change

Participants in the Water sector, including advocates, engineers, and utility managers, consistently discussed climate change using a *planning and preparedness* frame to highlight long-term changes in water reliability. This framing allowed participants to discuss climate

change-related water management issues by connecting perceived risks to practical management strategies. Several approaches were used to frame climate change in the context of water reliability. All of the approaches stressed the tailoring of discussions about climate change to a specific audience. These approaches are highlighted in the following quote by a South Carolina water utility manager:

If I we're saying that we're doing everything we can to mitigate impacts from global warming or climate change, they would look at me and say you need spend your time doing something else. But rather if I said we understand climate variability in weather patterns is affecting our ability to provide our intended service, that we need to prepare for those changes, they say you know, wow, that's great, we're glad you're thinking ahead.

Participants stated that they consistently avoid using the terms climate change and global warming. Instead, participants point to droughts, floods, and other real-time and place-based weather-related events because these events resonated with constituents. Participants also focus on the implications of climate change, rather than the science of climate change, because they perceive that decision-makers and politicians are more interested in how climate change will impact their personal interests and the interests of the public. *Hazard mitigation* frames were often employed. This emphasis is consistent with interviewees expressing greater concern for the higher order impacts (direct and indirect effects) of climate change, rather than changes in climate trends. In this context, participants chose to focus discussions on the impacts of climate change, as opposed to the drivers of change and changes in the rates and magnitudes of change.

8.3 Climate Change Activities

8.3.1 Types of Climate Change Activities Occurring in the Sector

The majority of activities in the Water sector that addressed climate change concerns were related to *data collection and monitoring of climate impacts* and *water resource management*. These activities included daily water supply monitoring, daily stream flow data monitoring, and drought condition monitoring (related to water supply) and addressed the immediate and long-term management concern of providing reliable water supplies. Many of these activities have been occurring for several decades, and were framed in the context of *planning and preparedness* to address current weather and climate variability. Several interviewees discussed activities related to *data collection and monitoring* activities, whereas others discussed activities related to *water resource management*. Data collection and monitoring activities were related to water resource management in several ways.

First, long-term stream flow records were used to build *long-term planning* applications, such as simulation models, to help engineers design appropriate parameters for a given system and water balance. These applications were used to assist communities and organizations in understanding local climate and hydrological conditions, and thus helped to evaluate proposed projects, such as irrigation, stormwater, and wastewater design. Second, information on drought conditions was useful in determining when to restrict water use, how much water to release from dams, and release schedules.

Few participants in the Water sector have incorporated information on long-term climate change into planning activities; however, participants were beginning to consider how they may mainstream climate information into existing models and planning processes. For example, a

water resource engineer indicated that their company was seeking to integrate climate information into altered streamflow models. This firm was working with the Water Research Foundation on a couple of pilot projects to generate altered stream sequences that may result from changing precipitation regimes and runoff. In another example, a water utility manager indicated that their utility was taking a “*no regrets*” approach to climate change adaptation. The utility was concerned that climate extremes will overwhelm the capacity of existing water collection systems. Therefore, the utility was investigating how to efficiently mitigate the risks to future flooding events by replacing parts of the old system with new components that will increase the ability of the system to collect and move water around. The utility was also investigating what materials might be more durable to stress from contractions in the soil given the possibility of extreme temperature conditions.

Participants in the Water sector, especially water utilities, are also beginning to engage in activities that seek to *reduce greenhouse gas emissions*. Reducing greenhouse gas emissions is important for many utilities because it allows them to reduce their carbon footprint, lower their operating and management costs for water distribution and wastewater treatment, and thus, cut costs for consumers. In this context, participants indicated that they have begun to define baseline greenhouse gas inventories, so they can identify ways to reduce operating costs.

Together, the suite of activities within the Water sector addressed several *climate-related* concerns. Many of these activities, such as the water resource and supply management activities, have been occurring for several decades, and were externally framed in the context of addressing current weather and climate variability to manage risk and *mitigate hazards*. However, there were several emerging activities in the Water sector that addressed climate change more directly, such as the development of flow sequences that incorporated changes in precipitation and the reduction of greenhouse gases. These emergent activities that addressed climate change more directly are framed as “*no regret strategies*” or cost savings, rather than addressing the future impacts of climate change.

8.3.2 Factors that have Facilitated Planning and Implementation of Activities

Interviewees identified several factors that facilitated the planning and implementation of *climate-change* activities, including *political and public support* (perceptions of risk, use of frames), the presence of *networks and collaboration*, and *laws, policies and regulations* (federal mandates). Many of the facilitating factors identified in the interviews centered on framing discussions of climate change to enhance *political and public support*. Specifically, many participants in the Water sector framed climate discussions by linking management changes to issues that resonated with constituents. This enabled them to justify current management actions to constituents without directly linking these changes to climate change. For example, a water utility manager mentioned that they are trying to communicate the connections between changes in business practices to the level of service provided to the customers because customers are more willing to support changes if they understand they will receive higher levels of service.

Two other important facilitating factors were *networks and collaboration* and the extent to which public *perceptions of risk* and effective communication techniques contributed to *public and political support*. Participants indicated that sustained visibility of climate concerns within networks was important in facilitating efforts. For example, a water resource engineer stated they began researching climate variability and change-related issues after they heard conversations

about climate change by other experts in their field. Perceptions of risk were also important facilitating factors as interviewees stated that clients were not likely to support climate change activities if they did not feel at risk to change. Finally, effective climate change communication was important to discuss the different models and assumptions in a manner so that clients are able to understand potential outcomes.

8.3.3 Factors that have Constrained Planning and Implementation of Activities

Participants in the Water sector discussed several factors that constrained the development and implementation of activities that addressed climate change. The majority of the constraints identified in the interviews were related to activities that addressed water supply and demand management. Limited *resources and funding* were the most frequently cited constraints to the planning and implementation of activities by interviewees. For example, a Water sector study participant stated that one of their clients had many climate-related activities that were underway and gaining momentum. However, the economic downturn “helped squelch the momentum.” Under greater resource scarcity decision makers became more conservative in allocating resources to new or existing sustainability activities, especially when there were many other *non-climate stressors* that were perceived as more important.

Interviewees also indicated that *political and public support* (e.g., public perceptions of climate change) was another major barrier to implementing climate change activities. Perceptions of climate science as a “voodoo science” made climate science appear undependable and unreliable and thus, difficult to develop and implement activities to address these potential threats. However, perceptions of climate science appeared to be a relative constraint, rather than an absolute one. Many participants in the Water sector were framing discussions of climate change as opportunities *to plan and prepare* for current or future risks and threats, rather than discussing climate change directly or focusing on scientific data. Although participants indicated that they did not focus on scientific data in their discussion with their constituents, they did mention that uncertainty surrounding how climate will change in the future did constrain their ability to integrate climate change into water balance models. Other constraints identified in the interviews included how climate change might exacerbate increased water demands because of *non-climate stressors* like population growth and the *lack of data or information* (e.g., downscaled climate information).

Constraints identified in document analysis were consistent with the findings from the interviews. Additional constraints included existing *laws, policies, and regulations*, limited authority of the state to manage water supplies and availability, and the difficulty of getting buy-in for water policy changes.

8.4 Adaptive Capacity

This study revealed several characteristics of the Water sector that highlights their adaptive capacity by integrating climate change concerns into existing management practices. First, many participants recognized that climate change may be occurring and are implementing *consistent data monitoring* protocols to further understand the problem. Openness to consider how climate change could affect water management highlights the Water sector’s concern that climate change may become an important factor affecting water management.

Secondly, there are early adopters and *innovators* in the Water sector who are mainstreaming climate change into planning and management. For example, a few water resource engineers are attempting to develop altered streamflow sequences from climate change models to use in the development of design standards. There are also water utilities taking “*no regrets*” approaches to adaptation and externally framing these projects in the context of ensuring cost-effective and long term reliability of water supplies. These examples are critical in raising awareness, *storing and sharing information*, and communicating success stories. They are also important in highlighting the feasibility of harnessing resources and implementing adaptation planning strategies and enhancing the *technological capacity* of the sector to cope with future change.

Thirdly, the existing *networks* within the sector are an important avenue for facilitating the exchange of information and increasing the awareness of climate change. Interviewees and questionnaires consistently indicated the importance of conferences and workshops to obtain and exchange information and ideas. For example, one water resource engineer stated that they became more aware of climate change and began to incorporate the phenomenon into their decisions after attending a conference where another water resource engineer was speaking on how climate affects water management. This example also highlights the *foresight and flexibility* of the Water sector to integrate climate information into management and design standards.

8.5 Needs and Recommendations

Several needs and recommendations were identified by participants in the Water sector. *Accessible information* needs were generally related to the quality and decision-relevance of data. Precise and reliable downscaled climate information was the most frequently cited data and information need. Participants were primarily interested in downscaled precipitation projections and secondarily interested in temperature and evaporation parameters at the “watershed” scale. This need was especially articulated by water resource engineers. Engineers consistently expressed concerns regarding both the availability of downscaled projections of precipitation for the Southeast and the lack of agreement among models. Participants also expressed the need for models that translate future precipitation into changes in daily stream flow or lake levels. Such information could be used to develop planning tools to assist public drinking water providers in long term planning and capacity development. These concerns are especially well articulated by a water resource engineer, who stated:

All we know is that there may be greater extremes and more frequent flooding, more frequent droughts, more severe floods, more severe droughts. To me that paraphrases everything that I have heard in the last 10 years about climate change. Can somebody tell me that we are going to have ... [a] 24 hour storm event of 10 inches in the future...I have not heard anybody that succinct about it, and that is the kind of information that we need to plug into the models.

Participants also expressed the need for quality control on sea level rise data. Although this was not perceived as an absolute barrier to moving forward, metadata on the margin of error surrounding projections was perceived as important in framing recommendations and conclusions.

Collaboration and coordination among federal agencies and across sectors was identified as a critical step in moving forward by a water utility manager, who is very active in many efforts to

address climate change. Increased collaboration was identified as an important factor in maintaining and strengthening existing *networks* and convening multiple actors to identify shared priorities. An engineer working at a Carolinas firm stated that inter-agencies and inter-organizations are critical in coordinating these efforts.

The document analysis revealed similar needs as those identified in the interviews. Both identified needs relating to *accessible information*, best practices, water supply, and enhanced *collaboration and coordination*. However, there were two subtle differences. First, the document analysis emphasized the need for data, information, and knowledge on climate change impacts to water resources, supplies, and best practices, while the interviews focused more specifically on the need for downscaled precipitation information and how these influence stream flow. Second, the document analysis identified the need for formal institutions, such as state-level *laws, policies, and regulations*, to provide more oversight into water use.

9 Wildlife

9.1 Introduction and Sector Overview

Wildlife and habitat protection play an important role in the regional economy and conservation of natural resources and ecological systems. Within the Carolinas there are several state- and federal-level management areas dedicated to conservation of national resources. At the state-level, these areas include state parks, state recreation and natural areas, state forests, and wildlife management areas. At the federal level, these areas include National Parks, National Forests, National Wildlife Refuges, National Estuarine Research Reserves, Wilderness areas, and Wild and Scenic Rivers. For example, there are 18 National Wildlife Refuges in the Carolinas, which seek to maintain the ecological integrity of natural resources and provide opportunities for recreation and environmental education. Fifteen of these refuges are located along the coast. The management of these wildlife areas is coordinated through several state agencies, federal agencies, and non-profit and non-governmental organizations.

Climate change is expected to impact many aspects of wildlife and natural habitat management, including species distribution and range shifts, permanent and episodic flooding of coastal marshes and forests, saltwater intrusion, more intense wildfires or pest outbreaks due to lower soil moisture and higher temperatures, declines in dissolved oxygen, and increased fish kills (Karl et al. 2009; Scavia et al. 2002; NRC 2009; Titus et al. 2009a; Ingram et al. 2012). The loss of marshland and flooding of peat soils may also lead to the release of greenhouse gases. It is important to mitigate potential losses as these ecological changes could lead to a loss of biodiversity and recreational and economic losses. In order to address wildlife management and biodiversity concerns, several climate change adaptation strategies are being developed. Such strategies include protection of land and water resources, species management, monitoring, and laws and policies (Hansen and Hoffman 2010; Mawdsley et al. 2009). However, the effectiveness of some existing planning and management strategies remains inconclusive. For example, establishing biological corridors between and among isolated habitats is often recommended to conserve isolated populations in fragmented landscapes, yet the effectiveness of this strategy is widely debated (Gilbert-Norton et al. 2010; Falcy and Estades 2007).

Several new wildlife and conservation initiatives in the Southeast provide an opportunity to examine climate-related activities and networks. For example, natural resource agencies in both North and South Carolina are working to revise their state wildlife strategies to include consideration of climate adaptation, although South Carolina has not indicated this as a priority. North Carolina conducted an introductory workshop in September 2010 entitled “Incorporating Climate Change into North Carolina’s Wildlife Action Plan” in partnership with the North Carolina Wildlife Resources Commission (lead agency), North Carolina Wildlife Federation, National Wildlife Federation, and The Defenders of Wildlife. Through activities of the South Atlantic Landscape Conservation Cooperative, the U.S. Fish and Wildlife Service will partner with other federal, state, and regional organizations to facilitate conservation planning and habitat and species protection in the South Atlantic region. These projects, which will address climate change as well as other challenges such as competition for water, wildlife diseases, and invasive species, are intended to supplement State Wildlife Action Plans. They also emphasize current efforts to mainstream climate change adaptation into existing planning processes.

These conservation initiatives highlight the diversity of actors and organizations involved in climate change adaptation planning in the Wildlife sector. For this research, the Wildlife sector included the broad network of planners and managers working for NGO/NPOs, state- and federal-level agencies, and regional planning organizations. This chapter discusses key concerns and interests among the Wildlife sector; activities that organizations are involved in to address climate change; barriers and enabling factors; needs; and the overall capacity of the Wildlife sector to adapt. This chapter was informed by a literature review of 25 documents related to climate change and wildlife and analysis of web-based questionnaires and semi-structured interviews. Twenty-five opinion leaders participated in the study of which five individuals completed the online questionnaire only and twenty individuals completed both the online questionnaire and the follow-up interview. Study participants represented academia (1), NGOs/NPOs (14), and federal agencies (10).

9.2 Key Decisions, Climate Information Use, Climate Change Concerns and Framing

9.2.1 Key Sector Decisions

Participants in the Wildlife sector are predominantly interested in conservation planning and management. Participants consistently expressed the need to maintain the ecological integrity of existing holdings by monitoring them, managing invasive species, controlling the distribution and allocation of water, implementing prescribed burns, and managing coastal erosion. Longer-term efforts also focus on acquiring new land to provide wildlife and plant assemblages time and passageways to migrate. These concerns require that planners and managers prioritize resources for existing holdings and new acquisition efforts.

9.2.2 Climate Information Use

Weather and climate conditions influence many decisions ranging from daily *operational* decisions to *long term* planning decisions. For example, *operational* decisions about fire management, sampling protocols, and how many people to have on staff are all potentially influenced by relative humidity, soil moisture, and wind speed. Temperature and rainfall are also important factors in the control of invasive species because changes in these factors influence the effectiveness of control strategies. For these *operational* decisions, managers often used hourly and daily data on temperature, relative humidity, and precipitation. *Seasonal* decisions on when and how much water to release from impoundments is also important because management can account for the ratio between brackish and freshwater, which affects the distribution of food sources and species. *Seasonal forecasts and outlooks* are used to predict water supply and manage the release of water from impoundments.

9.2.3 Climate Change Concerns

Participants also expressed concern about longer-term changes in climate. For example, a National Wildlife Refuge manager stated that sea level rise and long-term erosion will eventually lead to the conversion of a freshwater impoundment to a saltwater impoundment. This change may lead to shifts in agency management strategies from managing water fowl to managing shorebirds and other species. Other *long-term planning decisions* include abandoning vulnerable infrastructure and deciding where to place new infrastructure.

Sea level rise, temperature change, and increasing frequencies and magnitudes were identified as the primary climate concerns among interviewees and within the document analysis. Participants were also concerned about direct effects such as droughts, flooding, and the response of ecological communities to shifting environmental conditions. Along the coast, participants expressed concern that sea level rise and changes in precipitation would lead to salt-water intrusion, coastal erosion, loss of estuarine habitat, fragmentation of salt-marshes, and conversion of fresh to saltwater habitats. Participants were especially concerned about salt-water intrusion because increases in salinity would likely lead to vegetation shifts and consequent changes in species distribution along the coast and in tidal freshwater marshes and forests. Other coastal concerns included tropical hurricanes and tropical storms, which lead to significant impacts to estuarine systems and infrastructure, and the impacts of ocean acidification on oysters, scallops, and sea grass.

Concerns about the impacts (direct and indirect) of climate change were not limited to the coastal region. Participants also expressed concern that plant and animal communities in the southern Appalachian Mountains, such as spruce fir and the species dependent on spruce fir communities, may not have room to migrate between different conservation areas. Species, such as the northern flying squirrel, which is closely tied to spruce fir and northern hardwoods, may be especially vulnerable because it has a limited habitat range and may not have necessary corridors to facilitate migration. On the other hand, species such as the black bear and white-tailed deer have a large habitat range and are likely to adapt well. Participants were especially concerned about the impacts to brook trout in the Appalachians due to water temperature rise.

Although participants were concerned about the magnitude of climate change regarding the validity of predicted changes and whether they are within a range that allows for adaptation, they are also concerned about the rate at which these changes are occurring. Understanding the rate of change is critical in understanding if species will be able to adapt fast enough to the shifting environmental conditions. For example, participants raised concerns regarding whether marshlands could accrete fast enough to transgress landward in response to changes in sea level.

Climate change models and *historical climatology* sea level rise data were the most commonly cited types of climate information used for wildlife management and conservation. Managers were also interested in *climate change models* relating to projected sea level rise, flooding, salt-water intrusion, and shoreline erosion. Participants predominantly obtained climate information from individuals and organizations within the Wildlife sector, and conferences and workshops are especially important in facilitating the exchange of information. IPCC documents were the single most utilized source to obtain information on long term projections of climate change and sector-specific impacts. Trust, credibility, and legitimacy were the most frequently cited factors influencing information use.

9.2.4 Framing Climate Change

Multiple framings are used in the Wildlife sector to discuss climate change stressors and justify activities to primary audiences. The terms “global warming” and “climate change” are generally not used by organizations in external communications as this approach is not effective in engaging audiences. Many participants began using the term climate change but shifted their messages to themes that resonated with their audiences. Furthermore, many wildlife participants do not focus on the science or driving factors behind the causes of the change but instead focus

on providing opportunities for people to see observed changes across the landscape, how these changes are affecting wildlife and human populations, and what actions and activities need to be taken to address these concerns. Although many participants do not focus primarily on the drivers of climate change during presentations, participants do feel that it is still important to address some of the science.

Framing climate change issues in the context of existing land management challenges (*ecological conservation*) is commonly used among participants of the Wildlife sector. Participants frequently provide audience members first-hand examples of long-term change. For example, one participant showed audience members cement markers located in the middle of a creek, which were once located in the middle of a field used to delineate property boundaries. Other examples include dune erosion and loss of barrier islands and the submergence of land on National Wildlife Refuges. “Talking to them about climate change is not a real good door opener, but if we talk to them about flooding and we talk to them about inundation, they understand that their wastewater treatment plant floods more now than it used to” (Program Director, Albemarle-Pamlico National Estuary Program).

Enhancing the *green economy and developing jobs* is framing used by participants of the Wildlife sector. This framing includes sub-frames of *energy efficiency*, economic development related to renewable energy, and commercial business. For example, the Energy and Climate Director for the South Carolina Coastal Conservation League linked changes in estuarine habitat to losses in oysters and shellfish and losses of commercial fishery jobs in order to motivate action on mitigating climate change. The Outreach Coordinator for the National Wildlife Federation discussed the economic advantage of transitioning into a clean energy economy because this approach would create multiple jobs and save millions of dollars.

Other framings include discussions of *energy efficiency/national security* and *public health issues*. “*No regrets*” and resiliency approaches to decision-making underlie the above climate change framings. These approaches emphasize the importance of taking actions to enhance the quality of life for humans and wildlife, regardless of what changes occur.

9.3 Climate Change Activities

9.3.1 Types of Climate Change Activities Occurring in the Sector

The three most commonly referenced activities related to *ecological protection and conservation, education and outreach, and infrastructure and ecological alterations*. Many of these activities are concentrated along the coast. The majority of climate change related activities in the Wildlife sector deal with species and *ecological protection and conservation*. The majority of interviewees indicated that they are involved in activities related to these themes. These activities include *data collection and monitoring of climate change impacts* on ecosystems and the development of *resource management* plans. Most activities that monitor the impacts of climate change on ecosystems are concentrated along the coast. These activities seek to understand the response of marshes, wetlands, and estuaries to climate-related stressors, such as salt-water intrusion and sea level rise and are important for enhancing the resilience of coastal ecosystems to climate change. For example, the National Estuarine Research Reserve is seeking to develop issue-driven sentinel sites that will provide place-based data and information on tidal data, sea level rise, and other habitat information and ecosystem models to understand and

mitigate the ecological impacts of climate change. Study participants frequently cited SLAMM, which models wetland responses to changes in sea level, salinity, and elevation change. These *data collection and monitoring* activities are important for identifying areas most suitable for investing resources to establish corridors and ensure long-term conservation success.

An argument can be made that one should not be buying coastal low-lying properties, be they highlands or mainland sites, that are in the coastal zones that are likely to be impacted by sea level rise. A contrary argument is, well, we need to be acquiring those properties for conservation purposes for the medium-term so that it provides a bridge to the future distribution of those habitats under whatever scenario of climate change or sea level rise ultimately does occur. (Wildlife sector participant)

Activities that are *monitoring* the response of vegetation under changing environmental conditions may be used for informing management decisions. For example, there are five-acre test plots in the Alligator River National Wildlife Refuge, where managers have planted different species, such as cypress, black gum, and palm pine, to see which species are the most salt-tolerant. These monitoring activities are important to understanding conservation methods that can sustain forested communities the longest. For example, a coastal refuge complex manager stated:

I may be making a bad choice by saying, 'hey, my palm pines are dying, I'm going to go plant more palm pines'...My first choice would have been palm pine, because that is what I'm losing, but I have to face reality, the sea is rising and that species won't make it in the new environment created by sea level rise. Then what species will? If I want forest, then plant the forest type that I think will persist. So that's the input that I get from this data.

There are also *operational* activities, which have *seasonal* components. For example, the summer months are a critical time for staff in the National Wildlife Refuges to repair dikes and replace old water control structures in order to prepare migratory waterfowl habitat for the wintering season (November – February). During the winter months, refuge staff monitor release schedules in order to plan when to fill and draw down water impoundments. Monitoring water impoundments is important because management can account for the ratio between brackish and freshwater, which affects the distribution of food sources and species.

A second major type of activity is altering existing *infrastructure and ecological structures*. For example, the Alligator River National Wildlife Refuge is involved in two projects managed by The Nature Conservancy to address current climate impacts. One project has built oyster reefs to dampen wave energy and slow erosion and support diverse fish communities adjacent to the reef. The second project built water control structures in ditches to impact water quality issues. These structures slow the flow of water across the land, which is loaded with tannins and has a high pH, and mitigate the plume of black water that is low in dissolved oxygen and creates dead zones at the mouth of the ditch in the sound. Each of these projects has been effective in reducing shoreline rates and improving water quality, respectively.

An upcoming 14,000 acre hydrologic restoration project will take place in Hyde County, North Carolina, a county with low elevation and flat topography and extensive ditches and drainage. This project seeks to buffer ecological systems to climate change, protect farmers' fields from salt-water intrusion, and restore ecological structure and function. The project is an example of a *win-win* adaptation strategy. From an ecological perspective, farmers will be encouraged to hold

agricultural drainage on their lands, which are too wet for farming. This will allow the water to infiltrate back into the system, rather than be directly channeled back into the Pamlico Sound. Canals will also be fitted with flap-gates to reduce saltwater intrusions. These changes will improve water quality and habitat enough such that oyster reefs may be built offshore, which can help mitigate storm surge impacts. Holdings of agricultural drainage waters will also provide an extra source of irrigation for farmers and provide water impoundments for ducks and other wildlife, which farmers may lease out for hunting in the wintertime.

When I talk about sea level rise in this area, and climate change, that [project mentioned above] is what I talk about because there [are] plenty of doom and gloom stories out there and we are trying to get out a story that there are some adaptation measures that are possible.
(study participant from North Carolina Coastal Federation)

Participants in the Wildlife sector are also engaged in climate-related activities, such as promoting alternative energies and *greenhouse gas emission reduction* strategies. These activities range from outreach efforts to mobilize support for national level climate energy policy, to workshops with foresters and landowners to discuss the benefits of carbon credits, or opposition for the development of new coal-fired power plants. Interviewees consistently frame these discussions in the context of economic growth and national security.

9.3.2 Factors that have Facilitated Planning and Implementation of Activities

Establishing *networks and collaboration* were identified as the most important facilitating factors in the planning and implementation of climate change activities and a critical first step in planning. Several interview participants indicated that these factors are critical in facilitating adaptation planning efforts. Participants noted that climate change adaptation projects require collaboration among many agencies in order to leverage funds to address common concerns, share information, and communicate project benefits with individuals and communities. Conferences and workshops were identified as important opportunities for participants to network.

Partnerships are also important in framing climate change issues because they facilitate connections with more isolated communities and bolstered trust. For example, the Director of the South Carolina Wildlife Federation stated that religious leaders were important in establishing connections with some communities because these leaders were respected in the community and could link climate change to moral issues of concern. The Energy and Climate Director of the South Carolina Coastal Conservation League has found that partnering with the private sector bolstered credibility by making sure the right people are co-delivering the economic message.

Early and consistent communication to develop *political and public support* also facilitates climate change activities because this process enables community members to understand what activities are taking place, how these activities will affect their property, and how these activities will provide near and long-term benefits. For example, in the Hyde County hydrologic restoration project discussed above, the potential personal and economic benefits of changing management strategies were discussed with farmers, so they might understand why such changes were in their best interest. The importance of networks and partnerships is illustrated by a manager at a coastal refuge complex, who stated:

You can't always manage the same way. If the change is occurring and you accept it, then you must accept that you will have to adapt to it and adapt your management. And if you do that and you do it with partners,... there is no one entity, no one organization that has the resources or the wherewithal to deal with an issue like climate change. You must come together as a conservation community and everybody has something to offer.

9.3.3 Factors that have Constrained Planning and Implementation of Activities

Participants in the Wildlife sector discussed several factors that constrain the development and implementation of activities that addressed climate change. Limited or uncertain *resources and funding* was the most frequently discussed constraint, though it was not considered an absolute constraint to moving climate change activities forward. Funding challenges including cutbacks to existing projects and acquiring funding for upscaling pilot projects were among the greatest challenges associated with budgets. Long-term planning and decisions are also tightly coupled with annual budget cycles, especially for federal agencies. This makes long-term planning difficult because recipients of federal funds must reapply for grants annually. Participants also linked funding constraints to inadequate staff time and resources and political will.

Political and public support, particularly the political will of elected officials, was the second most cited constraint. Specifically, participants stated that political support for climate change activities had declined in the past two years in both local and national elections. Information or *data and information* uncertainty on how wildlife and ecosystems will respond to climate change was generally not considered a constraint in the Wildlife sector. Although study participants indicated that providing feasible, tangible, and robust management solutions often allowed them to overcome constraints associated with perceived uncertainty, they also suggested that perceived uncertainty is a constraint for Wildlife sector constituents and other sectors.

I was not expecting just how paralyzed people felt by the uncertainty of climate change predictions ... People feel very overwhelmed and say, 'well I get this, I get that this is a problem, but there is too much uncertainty.' (Wildlife sector participant)

9.4 Adaptive Capacity

This study identified several aspects of the adaptive capacity of the Wildlife sector to incorporate climate change into management decisions. First, participants are interested in managing the long-term resilience (greater than 50 years) of wildlife and habitats, which facilitates the integration of climate change into decision-making. For example, many participants are interested in creating corridors that will allow wildlife to migrate to more suitable ecosystems. These longer-term outlooks require that managers incorporate projections of sea level rise, temperature change, and other climate signals and adopted *flexible and incremental* implementation strategies to adjust to ecological responses.

Secondly, participants in the Wildlife sector are consistently interested in acquiring more information on how climate parameters are likely to change and how these changes are likely to affect management strategies. Information-sharing has been enhanced by the existence of effective *networking* among managers at workshops and conferences and significant interest among many managers to provide information on climate change and impacts.

Thirdly, participants are already discussing the consequences of shifting environmental conditions for current management strategies. For example, refuge managers are discussing how

the conversion of fresh- to salt-water impoundments may change management strategies from those that address waterfowl to shorebirds. A robust system of *consistent and valid data collection and monitoring* is already informing these discussions.

Finally, the Wildlife sector has effectively harnessed *financial, social, human, and natural resources* through the development of *partnerships and networks*, which is critical in obtaining resources necessary to fund, implement, and manage adaptation strategies. For example, the Nature Conservancy, U.S. Fish and Wildlife Service, and Duke Energy are collaborating to evaluate how different adaptation strategies may increase the resilience of coastal ecosystems to sea level rise, salt-water intrusion, and coastal erosion in Alligator River National Wildlife Refuge. This collaboration has enabled the partnering of climate scientists and wildlife managers (*human capital*); financial support to implement adaptation strategies (*financial capital*); and a natural setting upon which these strategies can be implemented (*natural capital*).

9.5 Needs and Recommendations

Analysis of documents and interview transcripts revealed similar information needs and recommendations. Needs centered on *accessible information* on downscaled climate trends and wildlife responses to changes in climate and the establishment and maintenance of *collaboration and coordination* networks. Information on climate projections and downscaled climate data were the two most frequently cited information needs. Participants are interested in projections of sea level rise, future shorelines, temperature change, future variability of annual and seasonal precipitation, and drought at the “county-level”, “watershed-scale”, and 1:100,000 scale.

Obtaining downscaled climate information is an important factor in understanding potential impacts to wildlife, including habitat ranges for individual species and changes in ecosystems, such as food chains. For example, information on climate change impacts is important to understand how ocean acidification affects mortality and morbidity of oysters, sea scallops, sea grass, and coral reefs. Climate information is also important for understanding how changes in water quality and quantity affect species distribution and habitat. A greater understanding of how these factors are likely to change is needed because they will enhance the ability of managers to develop strategies to facilitate migrations of individual species and complexes. As one Wildlife sector study participant stated, “We trust that wildlife will adapt, our question is, how will they adapt and how can we meet their adaptation needs.” A project leader for a US FWS National Wildlife Refuge System in the Carolinas reiterated the importance of using science to inform management decisions. “We need good science that will help us predict what is going to happen in the future, so that we can make decisions from that great science.” In addition to information on future changes, participants also expressed interest in monitoring existing conditions, such as the state of shellfish sanitation (impact of fecal coliform levels on oyster beds), existing erosion maps, historical climate change over the past 100 years, and more locally-specific tidal gauge data.

Interviewees consistently stated that greater *collaboration and coordination* networks are needed to enhance the success of projects. The partnerships include both formal and informal partners, as well as nontraditional partners, such as religious leaders. Greater collaboration is important for improving data and information management, obtaining resources for planning, and implementing and monitoring activities. Several aspects of data and information use are enhanced by greater collaboration including: identifying relevant sources and types of

information; improving access and availability of data; and facilitating sharing, processing and analysis, and use of information to inform decisions. Projects are also more likely to be developed and implemented through partnerships because individual organizations typically do not have the staff, budgets, or expertise to address all facets of the project. Other identified benefits of enhanced collaboration include standardization of climate-related protocols, greater visibility and understanding of projects aimed at addressing climate-related issues, and a reduction of duplication in efforts.

Needs identified from the documents were consistent with the interviews, which included improved and *accessible data*, information, and understanding of climate change impacts on environmental resources, improved technical tools (*resources*) and methods to communicate climate, enhanced education efforts for resource managers and government officials, and enhanced *collaboration and coordination* across public and private agencies to enhance resource protection and conservation efforts. Additional information on the effectiveness of recommended approaches to adaptation (e.g., promotion of biological corridors), is also needed to enhance the capacity of the Wildlife sector to effectively plan for climate change.

10 Networks

10.1 Introduction and Chapter Overview

Social capital and networks are important components of adaptive capacity (Yohe and Tol 2002; Adger et al. 2007; Brooks and Adger 2005). Elements of social capital include “...relations of trust, reciprocity, and exchange; the evolution of common rules; and the role of networks” (Adger 2003). Networks can have many different functions and facilitate a wide range of activities that enhance adaptive capacity. For example, information-sharing and knowledge exchange, distributing risks, resource mobilization or allocation, conflict resolution, consensus building, and work towards a common or collective goal are all potential advantages of networks (Adger 2003; Bodin & Crona 2009).

Identifying networks and understanding where and how they operate is a critical step in improving understanding and future efforts to provide climate science and climate information and to support climate change activities. The purpose of this chapter is to identify existing networks across the Carolinas and examine how they inform climate-related decisions, support climate change activities, and foster capacity-building efforts in the region. Improving understanding of existing patterns of knowledge exchange can help to inform the development of more effective tools and processes for disseminating climate information and supporting adaptation (NRC, 2010). This investigation provides insights into the particular places and pathways through which climate science and information is accessed and disseminated. We focused on two aspects of climate networks in the Carolinas: 1) the information networks that disseminate climate information and data to decision-makers and 2) the role of networks in building regional capacity to cope with and address climate change risks and concerns.

The first section of this chapter:

- Examines which types and sources of climate information are used by decision-makers throughout the Carolinas;
- Identifies key climate information brokers for the region and for the five study sectors; and
- Discusses why particular sources of climate information are useful or relevant to decision-makers.

The information and findings discussed in this first section are derived from online questionnaires (Appendix F) and follow-up semi-structured interviews (Appendix G). NVivo was used to code and analyze the interview transcripts for themes related to why particular resources were useful or relevant (see Appendix K).

The second section of this chapter identifies:

- The types of networks, partnerships, or interactions related to climate change activities that exist in the Carolinas
- How networks have facilitated engagement in climate change activities
- The primary actors, agencies, organizations, or groups that interviewees consult or work with on climate change activities; and
- Key partners or networks within each sector across the Carolinas.

This analysis is based on NVivo coding and analysis of interview transcripts for themes related to the significant processes through which knowledge and resources are shared, the opportunities for partnerships and joint projects that exist, and the ways in which networks have supported the development or implementation of climate activities. For a detailed description of this methodology, see Chapter 3.

10.2 Sources and Use of Climate Information

This section reports the primary sources and types of climate information used in the Carolinas and the factors that influence why specific sources or types of information are used.

10.2.1 Primary Sources of Information

The study questionnaire asked participants to indicate from where they obtain climate information in a series of questions that listed twenty-seven individual sources, including government agencies, documents, and other sources. The list of information sources offered in the questionnaire focused mainly on physical climate information and less on climate-related impacts or responses. Accordingly, although some respondents included the use and need for information on societal impacts, response and activities, this aspect of climate-related information was not assessed directly via the questionnaire. The need for information about societal impacts, response and activities, however, was indicated by study participants throughout personal interviews and is discussed further in Chapter 12.

Survey questions included yes or no format responses for:

- Do you obtain climate information from the following:
 - state agencies at least once a year?
 - federal agencies at least once a year?
 - documents?
 - other sources such as colleagues, friends, conferences, and Listservs?

The questionnaire allowed participants to list “Other” sources of information. The original list contained 27 sources, and 8 additional sources were added from the “Other” category for a total of 35. The raw data from the questionnaire were downloaded from Survey Monkey into an Excel spreadsheet. The data was normalized in order to compare across sectors. Within each sector, the number of positive responses for each information source was divided by the total number of participants in that sector.

A cluster analysis was conducted using SPSS to identify the groups of information sources most commonly referenced by participants and to examine differences across sectors. The complete linkage (or “farthest neighbor”) method was used to develop the clusters and Euclidean distance was used to measure the distances across clusters. Multiple iterations of cluster analysis were run using different cluster sizes. We chose a cluster size of six because this level of segmentation corresponded most closely to interview findings. While the snowball sampling approach used to identify sector leaders may have contributed somewhat to the results of the cluster analysis, it also helped to discover the most significant linkages within the sectors. Figure 10.1 and Table 10.1 provide information about cluster membership and the extent to which individual sectors use the sources identified in each cluster. Clusters 1 and 2 represent the most frequently referenced climate information sources, which are widely accessible and broadly relevant to multiple decision-makers. Both “colleagues and organizations in your sector” and “conferences

and workshops” appear in Cluster 1, suggesting the importance of informal connections and professional networks and events in the dissemination of climate-related information across all sectors. These data are consistent with findings from the interviews that conference and workshops provide access to the most current information about climate-related topics and a venue for participants to share information and interact with colleagues who are addressing similar issues. For example, a study participant from the SC Coastal Conservation League stated:

Most conferences that we go to are educational-based. It is both a networking opportunity for people that work in the energy field either in our state or our region. We tend to go to at least a handful of state-level conferences and one or two national conferences a year to learn. I think it is an easier way to get up-to-date information on what is happening around the country or around the world as it relates to climate policy and energy policy.

Printed documents and publications provided by government agencies, professional organizations, and scientists were the other most commonly referenced sources in Clusters 1 and 2. NOAA is the only government agency that appears in the two top clusters.

The information sources belonging to Clusters 3-6 are generally used by a smaller number of decisions makers in each of the five study sectors. These clusters represent more region-, decision-, or sector-specific information sources and therefore are not used by a broad range of decision-makers. Cluster 6, in particular, consists primarily of agencies or organizations designated by the participants in the “Other” option on the questionnaire. These sources typically provide issue-specific information. For example, many Forestry sector participants referenced the U.S. Forest Service and state forest agencies as important sources of information.

Individual sectors are generally consistent with the overall findings, although a few points should be highlighted.

- In some instances, high percentages of specific sector participants within each cluster represent use of a single source of information. For example, participants in the Government sector frequently referenced the EPA (Cluster 4).
- The Tourism sector uses climate information less frequently than the other sectors.
- The Wildlife sector consistently has the highest, or among the highest, percentage of participants within each cluster.
- The Water and Wildlife sectors use climate information from NWS, NOAA Climate Services, and USGS more frequently than other sectors.

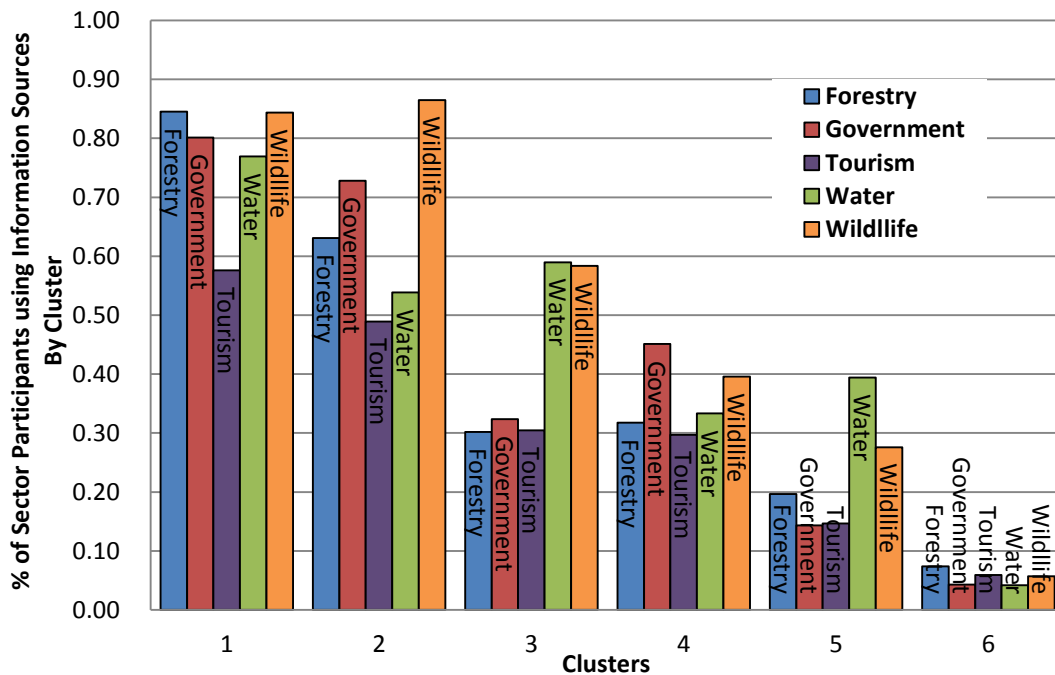


Figure 10.1 Most Commonly Used Sources of Climate Information as Indicated by Study Participants

Table 10.1 Cluster Membership

Cluster 1	Cluster 2	Cluster 3
<ul style="list-style-type: none"> • Colleagues or organizations in your sector • Conferences or workshops • National-level reports • Professional journals or publications 	<ul style="list-style-type: none"> • International-level reports • NOAA • Scientific literature • State-level reports 	<ul style="list-style-type: none"> • NWS, Regional-Local Offices • NOAA Climate Services • USGS
Cluster 4	Cluster 5	Cluster 6
<ul style="list-style-type: none"> • EPA • Friends • Listservs • NCDC • NCDENR • NCSCO 	<ul style="list-style-type: none"> • CPC • NASA • NIDIS • NWS-CS • SCDNR • SCSCO • SERCC • USFWS 	<ul style="list-style-type: none"> • NC Forest Service • NGO/NPO • Internet sources: news, webinars, social media • Popular press, mass media, local media • SCDHEC • SC Forestry Commission • USACOE • US Department of Energy • USFS • Universities-academic

10.2.2 Government Agencies as Information Source

Questionnaire respondents were asked to: “Please list the top three types of climate information provided by state or federal agencies that you use for your job.” This was an open-ended question and respondents were not required to enter information. Ninety-four (83%) of the

respondents provided a total of 268 “types of climate information.” Responses were categorized into nine types of climate information (Table 10.2) and are summarized in Figure 10.2, Table 10.3, and Table 10.4. Key findings for the top climate information types include:

- 71% of reported types of information used across all sectors were climatologies, specific climate variables, and forecasts and outlooks.
- Climate information use varies across each of the sectors and is influenced by specific management concerns and responsibilities.
 - The Forestry sector is particularly interested in forecasts and drought information. Fire managers in the Forestry sector use humidity, temperature, wind direction, and precipitation data as well as seasonal outlooks to schedule prescribed burns, hourly forecasts to monitor wildfire conditions, and climatology information to conduct longer-term planning, resource assessments, and research.
 - The Government sector indicated interest in information about climate extremes and societal response and activities. This sector uses weather data and weekly and seasonal forecasts to make operational decisions regarding water and wastewater treatment operations, severe weather preparedness efforts, and public health intervention services. Long-term climate information is used for hazard mitigation planning, infrastructure design, zoning, resource demand management, environmental protection, and budgeting for increased adaptation and response costs.
 - The Tourism sector uses forecasts-outlooks and a wide range of climate variables that might affect outdoor recreation. This sector uses weather data to make decisions related to outdoor activities and provide weather and climate data to visitors, often to promote the Carolinas as a tourist destination. Information about climate extremes is used for emergency preparedness, and climate forecasts and climate models are used in decisions related to long-term land, forest, and habitat restoration and management.
 - The Water sector is particularly interested in hydrological information and data and drought indices. This sector uses streamflow data to make the incremental adjustments necessary to accomplish the long-term goal of water reliability. Streamflow data is used at multiple time step intervals, including hourly interval data and peak flows, daily flows, and monthly flows. Few interviewees indicated that they used long-term projections of climate change. These findings suggest that most interviewees in the Water sector are using the historical record as a guide for future planning and management, rather than managing for non-stationarity.
 - The Wildlife sector indicated interest in information about climate change and climate impacts on environmental resources. This sector used several sources and types of weather and climate information – including models and forecasts related to sea level rise projections, flooding, saltwater intrusion, and shoreline erosion – in order to inform long-term wildlife management and conservation decisions.
- Participants obtain climate information from a variety of sources. A wide range of federal and state-level sources are utilized, among other non-government entities. Although there is no single “go-to” source for climate information, a few general trends emerged:
 - participants obtain information primarily from NOAA-affiliated offices,
 - certain agencies may be preferred for certain types of information, and
 - some sectors may use or rely on particular agencies for information.

For example, NOAA and NOAA-affiliated agencies primarily provide information related to sea levels, climatology, and other climate variables. In terms of linkages between agencies and type of information provided, the questionnaire data suggest that decision-makers use state agencies and NIDIS for drought data, the EPA for information about societal response, the NWS for forecasts-outlooks and precipitation information, and the USGS for hydrological data. Many sources are used for climate change information. The questionnaire data also suggest linkages between sectors and particular agencies, such as the Forestry sector and the USFS, the Government sector and EPA, the Tourism sector and the NWS, the Water sector and USGS, and the Wildlife sector and the USGS and USFWS.

Table 10.2 Types of Climate Information Used by Participants

<p><i>Climatology</i> Historical characteristic values of climate variables for the Carolinas, represents the average weather over at least a 30-year time period and includes:</p> <ul style="list-style-type: none"> • Climate Normals: long term averages of meteorological factors • Climate Summaries: summary data for daily, monthly, seasonal, or annual time periods • Climate Extremes: the minimum and maximum values for a given phenomenon
<p><i>Specific Climate Variables and Events</i> Information specific to a particular climatic variable, including historical and current data and observations, tools to monitor existing and developing conditions,</p> <ul style="list-style-type: none"> • Temperature • Precipitation • Other climate variables of interest, includes 1) data regarding wind, wave, tide, evapotranspiration, ocean temperature, ocean and atmospheric conditions and 2) indices (e.g., heat stress, ENSO) that are derived by combing multiple data sets into a single measurement • Storms, such as tropical events and hurricanes, includes tracking models, event projections and summaries • Drought, includes drought indices, monitoring tools and maps, information updates • Hydrology, includes streamflow data, lake and water table levels
<p><i>Forecasts-Outlooks</i> Information or products that provide a forecast or outlook about expected weather and climate conditions, time frames range from several days to monthly to seasonal</p>
<p><i>Weather</i> Observations or information about current or expected (short-term) conditions <i>*Although questionnaire instructions specified interest in climate information, some respondents did indicate the use of weather information in this section.</i></p>
<p><i>Climate Change</i> Models, projections, or studies that demonstrate long term (several decades or longer) changes in climate</p>
<p><i>Sea Level/Sea Level Rise</i> Data or reports that provide information about historic and existing sea levels as well as sea level trends and sea level rise projections</p>
<p><i>Interacting factors</i> Data, information, or predictions that depict environmental (e.g., habitat, species, forest) conditions that are influenced by or interact with climate</p>
<p><i>Impacts</i> Information or studies that show adverse effects of climate conditions or events, specific topics address:</p> <ul style="list-style-type: none"> • Observed or current impacts to coastal, ecological, or forest resources • Potential or expected impacts of climate change
<p><i>Societal Responses and Activities</i> Data, information, case studies, or reports that indicate or address how humans influence and respond to climate, relevant topics include emissions, mitigation, adaptation, and vulnerability assessments</p>

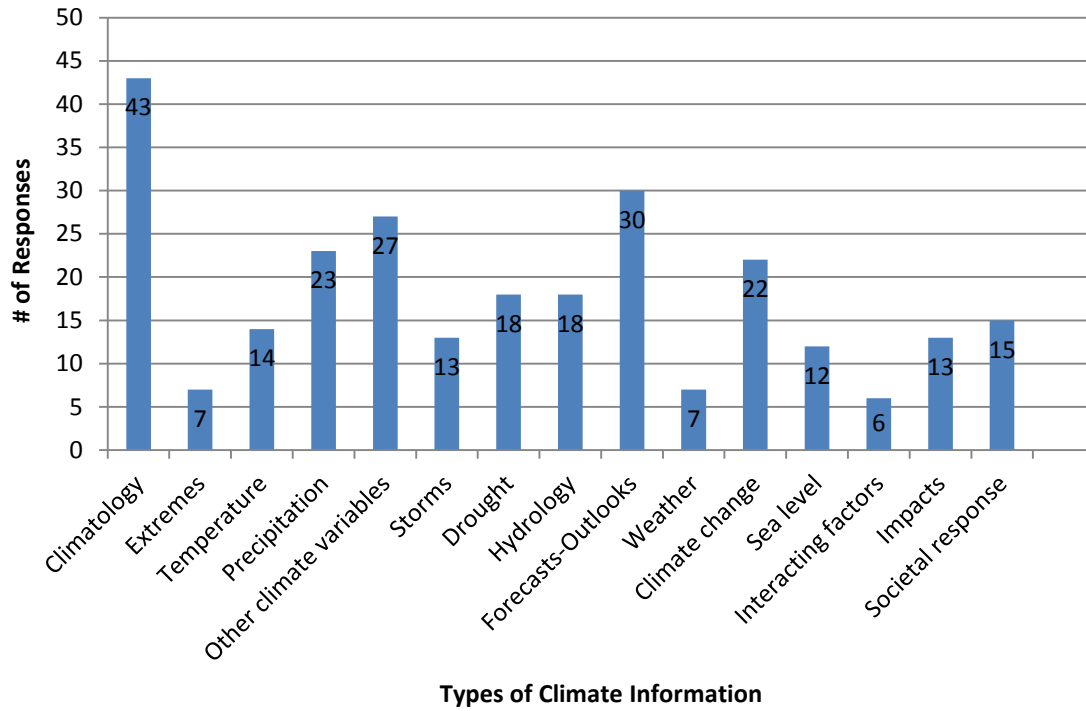


Figure 10.2 Top Three Types of Climate Information Obtained from State and Federal Agencies

Table 10.3 Top Three Types of Climate Information Obtained from State and Federal Agencies, By Sector

	Total	Forestry	Government	Tourism	Water	Wildlife
Climatology	43	9	14	6	6	8
Extremes	7	1	5	1	0	0
Temperature	14	3	3	3	3	2
Precipitation	23	4	5	5	6	3
Other climate variables	27	1	7	9	3	7
Storms	13	2	1	5	1	4
Drought	18	5	2	4	5	2
Hydrology	18	1	1	3	10	3
Forecasts-Outlooks	30	5	10	10	3	2
Weather	7	0	1	2	0	4
Climate change	22	6	2	1	0	13
Sea level	12	0	3	3	0	6
Interacting factors	6	3	0	0	0	3
Impacts	13	1	1	3	0	8
Societal response	15	3	9	1	0	2

Table 10.4 Top Three Types of Climate Information Obtained from Agencies/Information Sources Used, By Sector

(*Includes responses to open-ended questions)

		Climatology	Extremes	Temperature	Precipitation	Other Climate Variables	Storms	Drought	Hydrology	Forecasts-Outlooks	Weather	Climate change	SL/SLR	Interacting Variables	Impacts	Response	Total	Forestry	Government	Tourism	Water	Wildlife
State Agencies	NCDENR	-	-	-	-	-	-	4	-	1	1	-	1	-	4	1	12	-	1	4	1	6
	NCSCO	3	-	1	1	-	1	1	-	1	1	1	-	-	-	-	10	2	4	-	4	-
	SCDNR	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2	-	-	-	2	-
	SCSCO	2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	3	1	2	-	-	-
Federal Agencies	CPC	1	-	-	-	2	2	-	-	3	-	-	-	-	-	-	8	2	1	1	4	-
	EPA	2	-	-	-	2	-	-	-	-	-	2	1	-	1	7	15	2	8	2	-	3
	NASA	-	-	-	1	2	-	-	-	-	-	1	-	-	-	-	4	-	-	2	-	2
	NCDC	9	4	4	4	1	-	1	-	2	-	3	-	-	-	-	28	6	11	5	4	2
	NIDIS	-	-	-	1	-	-	5	-	-	-	-	-	-	-	-	6	3	-	-	2	1
	NOAA	6	1	1	3	6	3	1	-	6	-	2	7	-	-	2	38	6	11	8	3	10
	NWS-S	2	-	1	2	-	1	1	-	1	-	-	-	-	-	-	8	1	5	4	3	7
	NWS-Regional-Local Offices	3	1	5	9	5	3	-	-	9	3	-	-	-	-	-	38	2	2	1	1	2
	NOAA Climate Services	6	-	1	1	3	1	1	-	3	-	3	1	-	-	-	20	6	8	15	3	6
	SERCC	4	1	-	1	-	-	-	1	-	-	3	-	-	2	-	12	3	3	4	-	2
	USACOE	-	-	-	-	2	-	-	2	-	1	-	-	-	-	-	5	-	-	-	2	3
	USFWS	-	-	-	-	1	-	-	-	1	-	-	-	2	3	-	7	-	-	-	-	7
USGS	4	-	-	-	-	-	1	14	-	1	2	-	-	1	1	24	1	2	2	8	11	
Other*	Congressional Research Service	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
	National Hurricane Center	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-
	NOAA-Regional Coastal Observation System	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	2	-	2	-	-	-
	SERFC	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	1
	USDOE	1	-	-	-	1	-	-	-	1	-	-	-	-	-	-	3	-	-	3	-	-
	USFS	-	-	-	-	-	-	-	-	-	-	3	-	3	1	-	7	3	-	-	-	-
	University Research	-	-	-	-	-	1	-	-	-	-	-	1	-	1	-	3	5	-	-	-	2
USGRP-NCAR-NSF	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	1	-	-	-	

10.2.3 Documents as Information Source

Questionnaire respondents were asked “What are three key printed documents that you use to obtain information about climate. These documents may include books, journals, reports, or articles.” This was an open-ended question and respondents were not required to enter information. Seventy respondents (60%) provided a total of 187 document references. The answers ranged from specific titles of documents to general references (e.g., “journals,” “reports,” and news sources). The responses were classified into five categories in order to better display results and discern trends (Table 10.5). Categories were based primarily on the type of expertise represented by the document sources (e.g., general, climate specific, sector-specific, scientific journals, government or agency reports) and also include counts of the most frequently referenced individual documents or sources. Key findings include:

- A wide range of documents are used within and across each of the sectors.
- Governmental, intergovernmental, and agency reports are the most frequently used documents among the five sectors. 16% of participants (n =30) used IPCC documents; 12% (n = 23) used reports focused on the United States; and 11% (n = 22) used other government sources from agencies such as NOAA, EPA, USGS, and state wildlife agencies. Such documents are viewed as general references, as they provide synthesis and are often written in a non-technical way and easier to understand than scientific documents.
- Sector-specific sources appear to be important for the Water, Forestry, and Wildlife sectors. Responses from the Government sector suggest a greater use of sources explicitly focused on climate and climate impacts.

Table 10.5 Key Printed Documents Used By Study Participants

	Total	Forestry	Government	Tourism	Water	Wildlife
General (includes news sources, popular press)	16	3	5	3	0	5
Climate-specific sources (includes references to journals, scientific documents, general publications or reports that are focused on climate)	27	2	10	7	4	4
Sector-specific sources (includes publications or journals from professional associations, general reports targeted to the sector)	36	9	5	4	10	8
Scientific journals (not climate- or sector-specific)	22	3	7	3	3	6
Government or agency reports	22	4	3	2	4	9
Specific sources or titles (responses > 1)						
<i>America's Climate Choices</i> (National Research Council 2011)	3	0	2	0	0	1
<i>Final Report to the General Assembly and the Environmental Review Commission</i> (North Carolina Legislative Commission on Global Climate Change 2010)	6	2	3	0	0	1

<i>Global Climate Change Impacts in the United States</i> (Karl et al. 2009)	13	2	7	2	0	2
IPCC reports	30	6	8	3	4	9
<i>South Carolina Climate, Energy, and Commerce Committee Final Report</i> (2008)	2	1	1	0	0	0
<i>Understanding the impacts of climate change on fish and wildlife in North Carolina</i> (DeWan et al. 2010)	3	0	0	2	0	1
United States Climate Change Science Program reports	7	0	1	1	0	5

10.2.4 Factors Influencing Use of Information Sources

Findings from the questionnaires and interviews indicate that decision makers use and rely on a wide range of sources for climate data and information. This section discusses the factors that influence the use of certain sources and provides insights as to why a given decision maker’s information network may be so diverse. Relevance to decisions and job responsibilities is the primary driver of why certain climate information sources are used. Selection of information source is also conditioned by trust and credibility, accessibility and convenience, and the spatial and temporal scale of the data.

Participants use a variety of climate information sources to support decisions that occur on different time scales (e.g., operational to long-term planning). Decision activities and needs may vary by sector and time scale – and thereby shape the types of information used. However, some sources – such as those identified in Cluster 1 and 2 – appear to be broadly applicable and relevant across sectors. As one participant stated, each source of information “has kind of a different niche to provide us with the different kinds of weather information that we are going to need.” (Participant from the National Weather Service) A participant from the Wildlife Sector admitted that they would “jump around a bit” when looking for climate information. Sources of information include NASA for satellite imagery, USGS for flow data, NOAA Coastal Services Center for Digital Coast information, as well as the Google search engine for other inquiries. Likewise, two examples from the Water sector illustrate the multiple factors and time scales that water managers must consider which requires different types and sources of information:

[I]f you think of climate information, in terms of streamflow or lake levels, we track points of interest on a daily basis. So from the USGS, we are getting actual stream gauge daily streamflow data from their stream gauge network, or from the Corps of Engineers we are getting daily lake levels and inflow estimations as well as dam releases and so forth. Like the climate office, we get daily precipitation data from rain gauge or weather stations in which we are interested... We look at the US Drought Monitor and then we also look at the National Weather Service forecast, either near-term as well as seasonal. (study participant from local NC municipality)

[E]ach provides I guess pieces of information that we use to help us run our utility and to make especially long-range water planning decisions. Our primary product is water. We have to make sure we understand what impacts that there are to the water supplies and then as we’re cleaning wastewater to get those back into the streams, ... to make sure we understand what impacts could happen within those watershed basins. Between SCDHEC, SCDNR, and the SCSCO information that we have, I would say we have pieces to the puzzle that we put together. Some of it is affirmation of the other information, kind of like a validation process, but most of it is to take apart the information and to synthesize that into our decision-making and our operational strategy. (study participant from a SC water utility)

Findings from the questionnaires and interviews also suggest that certain types and sources of information might be more useful or relevant to particular sectors or for particular decisions. Several factors that influence use of particular climate information sources were consistently discussed across all sectors. These factors relate to the credibility and trustworthiness of the source, the accessibility and convenience of the information provided, and whether the scale of information is appropriate. Trust (Malka et al. 2009; Bier 2001; Rabinovich et al. 2012), credibility (Bier 2001), and accessibility (Romsdahl 2011) of easy-to-understand information about climate change have all been suggested as significant aspects of climate information use and acceptance in existing literature.

First, the extent to which a source is viewed as credible and trustworthy strongly influences whether that source is consulted over others. Related factors include the perceived objectivity and legitimacy of a given source. Some agencies are recognized as being the key sources of certain data and information because of their long-standing expertise and authority. For example:

It's [USGS] pretty much the only network of stations and it's also the gold standard. Other organizations on occasion do install gauges for some particular purpose, but the USGS is the gold standard. Their results are accepted by everybody. (water resource engineer)

And that would be using formulas [regarding energy and energy use] largely developed by EPA and USDOE, to answer your question about where the information comes from. ... They tend to be the standards; they tend to be the definitive across the board. ...they are commonly used and accepted. (Forestry sector participant)

Issues of trust centered on perceived bias and conflict of interest. Interviewees indicated that government agencies and scientific and professional sources are viewed as more credible than the private sector or advocacy groups, because they were not perceived as having ulterior motives or agendas. For example,

We try to go to what we perceive to be the most credible sources ...[where] there is not necessarily a perceived bias from a particular private sector interest like renewable energy interest or coal or nuclear interests.... I think everybody has problems with government data in some ways but it tends to be viewed as more credible than what comes out of the private sector. (study participant from USFS)

I would say that certainly those entities [NCDENR, NOAA, USGS, FWS] are respected sources of credible knowledge. They are not likely to be organizations that are sort of pushing particular agendas necessarily. They are going to be, you know, they have governance structures that are designed to ensure that the information that they are sharing is credible and therefore can be useful in helping us shape our approach to learning about and dealing with climate change... And we do have a fair amount of overlap in our goals and priorities with those organizations; you know wildlife conservation is certainly integral to many of the organizations that I listed. (Wildlife sector participant)

They [NCSCO, NOAA, NWS] tend to be a little more unbiased. The whole climate change, global warming issue has become very well-politicized. Often a lot of the people behind the issue have other agendas. So right now the kind of information that I am looking for tends to be temperature, rainfall, trends, stuff that is easily verifiable and documented. (study participant from the NC Forestry Association)

Second, interviewees indicated that familiarity and accessibility influence which information sources are used, although participants used the terms in various ways. “Familiarity” and “accessibility” referred to the source of the information (e.g., professional associations, personal relationships with colleagues, previously-used agency or organization), to the type of information or data provided (e.g., has the decision maker previously used this information), and to the format in which information is provided (e.g., through a web interface, translations or summary reports). Interviewees also used “accessibility” to describe the ease of accessing (e.g., online sources) and understanding information (e.g., is a report written in a non-technical manner). Furthermore, familiar sources that provide accessible information are valued because of their convenience. Many interviewees reported that time constraints prevent them from conducting their own extensive queries of climate information and reports:

I'm not a scientist, so I'm not out there doing original research myself and I'm not keeping up with the literature as it evolves. I want to go to a place that summarizes the information that's out there and I think those are good sources for it. (Government sector participant)

[T]here are likely to be far more sources that are available that I in particular have not used or do not know about, just as a function of my own capacity to read unlimited amounts of documents and integrate those to program level efforts that we are engaged with. So, for example, I might be far more likely to consult and review and utilize a document about climate change from the NCDENR organization. I mean, NCDENR has an interagency climate team that produces documents and other information that I may be far more likely to read because it is part of a collaborative effort that our agency is engaged in with other agencies on, as opposed to sort of on the other end of the spectrum just going online and doing general searches of all articles about climate change that might exist. There is likely to be thousands of articles out there on the Internet and in published literature about climate change in a whole variety of things but I do not generally have time to just peruse all available literature from all sources. So the qualifier that I would put on that is, I tend to only be aware of and therefore utilize documents that come through either from my staff or get passed to me from higher levels of my own organization, as a result of the collaboration that we have with these organizations. (Wildlife sector participant)

Third, the ability of decision-makers to obtain local- or regional-specific information is critical. Federal sources are good for climate information on ENSO, longer-term and larger-scale climate patterns, trends, and predictions. In contrast, state, regional, and local sources and information are viewed as more relevant to decisions, planning, and policy making. Several interviewees indicated that local decision-makers have more trust in information developed at the state- or local-level, rather than the federal-level. Not only do state and local officials “understand the local concerns and issues” (study participant from a NC local municipality), but local decision-makers also “know how their [state agency] processes work and we understand their processes for gathering information” (study participant from a SC water utility). While many federal agencies were cited as sources of information in both questionnaires and interviews, it should be noted that the type of information provided by those agencies are often regional or local in scale. Such agencies include the NWS Regional-Local Offices, Southeast Regional Climate Center, USGS, USFS-SRS), in addition to the state climate offices and resource agencies. Personal relationships and temporal aspects of planning also affect how and when sources of information are used:

[W]hen a hurricane is out in the Atlantic a good ways away from us, we focus pretty much entirely on the National Hurricane Center's work. But as the storm approaches and gets much closer to us, we switch our attention to the local weather service office as our primary source of

information because those are the guys who are more acutely aware of any climatic abnormalities here or anything that is unique to this community that the Hurricane Center might not be so much focused on. So our attention is with them. Same is true day in and day out with any kind of weather events. We have a great working relationship with our local National Weather Service office. I probably see those guys or talk to them not less than once a week. (study participant from NC local municipality)

As is demonstrated in the following section, existing climate information sources and networks have potential to inform climate change activities and enhance cooperation and collaboration between and across sectors.

10.3 Networks and Climate Change Activities

Study participants indicated that many different groups and organizations within the Carolinas are addressing climate-related concerns through diverse activities. Many of these projects and programs are discussed in detail in Chapters 5-9. This section discusses results from the interview transcripts regarding the role of decision maker networks, partnerships, and interactions in supporting climate-related activities in the Carolinas. NVivo was used to code and analyze the interview transcripts in order to 1) identify the types of networks, partnerships, and interactions that exist and examine how those networks have facilitated climate change activities and 2) identify the primary actors, agencies, organizations, or groups with whom interviewees consult or work with on climate change activities and examine how key partners or networks in the region contribute to regional capacity.

It is clear from interview data that a broadly inclusive and readily apparent climate change network does not currently exist in the Carolinas. The interview data does indicate, however, that decision-makers are utilizing existing networks (including climate information networks) to 1) incorporate climate change issues into existing projects or programs as well as 2) take advantage of new or emerging opportunities. Such networks range from formal to informal and entail a variety of activities.

10.3.1 Key Partners and Networks within Sectors

Interviewees in the Forestry sector highlighted actors with specific roles or interests in forest resource management and land conservation issues. Frequently referenced actors and organizations included the Forest Service, state forestry agencies, non-profit and non-governmental agencies such as land trusts, and local decision-makers (e.g., landowners, farmers, and communities) in the vicinity of managed forests. While many forestry issues are related to climate, the primary functions of forestry networks and interactions entail sharing information about fire risks and disseminating information, data, and tools to inform land and forest management projects and practices. Interviewees involved in energy-related projects (e.g., developing biomass energy sources and technologies) worked within a somewhat narrower network including research and development organizations, private landowners, and state energy offices.

The key partners and partnerships within the Government sector were found on the local and regional level. Interactions within the local community (e.g., with other agencies, businesses, civic groups, constituents) and with neighboring (local or regional) entities (in regional or cross-government agency groups) are particularly significant for interviewees affiliated with local governments. Interactions on the local and regional-level frequently involve not only information

sharing, but the development and implementation of plans and projects related to a wide range of topics, including sustainability and energy efficiency as well as regional environmental- and resource planning. Federal and state agencies were frequently referenced as providers of information and technical assistance, rather than as project partners.

Interviewees from the Tourism sector were engaged in two different types of networks. Study participants involved primarily with the “hospitality” aspects of the sector were frequently involved in local or regional activities with visitors’ bureaus or chambers of commerce that promoted tourism or highlighted initiatives related to sustainability and green business practices. Study participants involved with outdoor-dependent recreation activities were more frequently involved in regional and cross-agency collaborations concerned with land conservation, and resource and environmental protection. Relevant organizations include the National Park Service, the USFS, state parks, and environmental NGO/NPOs.

Networks in the Water sector appear to revolve around sharing technical expertise to address specific needs and tasks related to the provision of clean water. Engaged actors and organizations include the water-wastewater utilities, engineers and consultants who work for utilities in designing water infrastructure, professional associations that provide technical-professional education, and federal and state agencies (e.g., USGS, NOAA) that monitor and provide hydrological data. Most references to collaboration entailed information sharing and research activities.

The Wildlife sector demonstrated a variety of multi-agency and multi-organizational partnerships that are engaged in many activities: pooling resources and expertise to develop and implement conservation projects, conducting research, and sharing information across similar interests. Restoration–conservation projects and environmental collaborations often entailed regional coalitions. Examples include the Albemarle Pamlico Conservation in Communities Collaborative, Cape Fear Arch, Uwharrie Conservation partnership, and the Southern Appalachian Forest Coalition. A wide range of federal, state, and local government agencies as well as NPOs/NGOs and academics are involved in Wildlife sector activities.

While many different activities, collaborations, and partnership opportunities have been identified in this chapter, it appears that climate networks exhibit a range of characteristics. In the Forestry and Water sectors, climate change issues are addressed within existing management and network structures. These sectors have specific missions and tasks related to resource management, decades of experience managing climate-related risks, and established information and monitoring networks to support decision-makers. Networks around climate change issues appear to be an emergent property of the Government and Wildlife sectors. However, we also found that many of the newly developed and evolving collaborations are tied to broader interests in promoting community sustainability, energy efficiency, or environmental protection. Projects focused on other topics do allow for interactions regarding climate-sensitive topics that may not have occurred otherwise. We also found that many of the collaborations in the Government and Wildlife sectors are working to address regional issues, bridge cross-sectoral interests, and promote interactions across different decision-making and organizational levels. Because climate impacts span regions with similar ecosystems and economies, region-focused efforts that entail

pooling together a broader set of resources and expertise could be an effective strategy for – and a significant first step towards – enhancing adaptive capacity.

10.3.2 Existing networks to support climate change activities

Education and outreach activities initiated by existing partnerships have served primarily to increase awareness of climate-related issues or promote related initiatives within a sector's primary clients, audiences, or constituent groups. One effort in the Wildlife sector has centered on advocating the active participation of sportsmen in the climate discourse. By utilizing the membership lists of organizations like Trout Unlimited, Ducks Unlimited, National Wild Turkey Federation, and other hunter and angler groups, existing networks “are easily capable of disseminating a lot of information to citizens in the states.” (study participant from the NC Wildlife Federation) A Listserv linking the members of local and regional land trusts and conservancies provides information and educational opportunities to that group of Forestry stakeholders. Forestry extension and outreach agents advise landowners and other forestry stakeholders about best practices related to climate change issues, such as urban tree management.

Collaborative research has brought together academic colleagues as well as researchers from government agencies and other organizations. Specific projects mentioned by interviewees included the NC Sea Level Rise Impact study, climate impact assessments, developing strategies for adaptation or resilience, and the gathering of information and data to aid resource management and planning. Frequently identified research activities include making knowledge about climate change science available to those that may be interested or need to remain abreast of new information for their jobs. Going forward, grants and other financial incentives will continue to be important components of creating and maintaining research partnerships across the Carolinas.

The USFS Southern Research Station (SRS), located in Asheville, North Carolina, is a key provider of information to Forestry stakeholders and decision-makers in the region. Established in 1921 (Josephson 1989), the SRS has a long history of conducting research and working with forest managers and landowners. The specific research mission and tasks of the SRS are to develop information, assessments, and tools about forest conditions, disturbances, and health issues that are relevant and useful to forest resource management. Having a specific focus on forest management lends itself to interactions with decision-makers that focus specifically in this area. SRS personnel interact with and provide information to a wide group of forestry stakeholders, including, the Southern Group of State Foresters, state agencies, forestry schools, academic and government researchers, stakeholders and decision-makers in USFS Region 8 (national forest system representatives, land managers, private stakeholders/landowners). Researchers connect with decision-makers through reports, conferences and workshops, and personal contacts. One role of the SRS is to develop decision support tools for forest resource and land managers. Specific examples include the Southern Forest Futures Project and The Template for Assessing Climate Change Impacts and Management Options (TACCIMO). The Southern Forest Futures Project looks at multiple scenarios, including climate, timber prices, market, and land use to assess future conditions for forest resources. TACCIMO is a web-based tool that includes a searchable database of forest management options and climate change impacts to forests and provides corresponding scientific literature and references. The Eastern Forest Environmental Threat Assessment Center (EFETAC) is a research unit within SRS. This

center conducts research to look at environmental threats (including air pollution, disease, climate change, land use change) to forests.

While many of the decisions made in the sector are related to climate, one participant who works with the USDA Forest Service SRS noted: “we are less about monitoring impacts and atmospheric things like that than we are managing the landscape”. However, this participant also recognized that they have “a built-in clientele” to extend existing research and outreach activities to include climate change and related topics. Their “clarity of mission” (e.g., regarding forest management) also makes it easier to focus on new research efforts or activities. Providing climate change information and related expertise is an increasingly important activity, as national forest managers have been mandated to incorporate climate change impacts into strategic plans and as other agencies and landowners frequently request the most current information about future change for their long-term planning. SRS clients also confirmed why the organization is a trusted and credible source of information for the sector. One participant noted that working with the SRS has “...opened a line of communication between the National Forest and the SRS. I feel much more comfortable now calling up some of these research folks and going, hey, can you look at this, so I think in that aspect it has been very helpful.” A participant from the South Carolina Forestry Commission indicated “...we have had some good research [about the value of fire prevention] coming out of the SRS of the forest service that has helped us justify what we are already doing, but really quantifies it in a way that we can use it.” Other interviewees emphasized the role of SRS in providing tools and data.

Interviews indicated the value of other venues for information-sharing, disseminating climate information, understanding concerns and interests of other groups, and learning about climate change activities occurring in the region. Several interviewees highlighted participating on advisory committees – with some serving on more than one. Many times advisory committees are comprised of diverse individuals to ensure that various interests are well-represented. Convening different groups and organizations can serve a bridging function within and across sectors. Similarly, efforts to improve interagency coordination have led to opportunities to address climate change concerns and incorporate climate change issues into existing management structures. Interagency coordination often involves information sharing, collaboration to reduce duplicative activities, and the pooling of resources or expertise. The sharing of success stories can help illuminate best practices, tools, or methods that are being utilized to achieve goals. Such efforts aim to ensure that “the staff of our program have and are working on, or are least informed and aligned with, other organizational priorities and working in a collaborative fashion” (Wildlife sector participant).

The North Carolina Interagency Leadership Team (ILT) is an example of an interagency collaboration that has influenced the climate discourse across North Carolina. The team is comprised of six state agencies (North Carolina’s Departments of Agriculture and Consumer Services; Commerce; Cultural Resources; Environment & Natural Resources, and Transportation; and the North Carolina Wildlife Resources Commission) and five federal agencies (USACOE, NOAA Fisheries Service, Department of Transportation, EPA, and US Fish & Wildlife Service). The ILT has been a “leader” in building capacity to address climate change issues in North Carolina. The initial driver to form the group was to facilitate the implementation of transportation projects in the state. Bringing together multiple agencies in a collaborative manner would ensure that any concerns would be resolved and that highway projects would be

supported by the different member agencies. One member in particular advocated that this multiple-agency group provided a unique opportunity to consider – in a collaborative manner – how climate change would affect transportation projects, as well as other agency interests and programs across the state.

In March 2010 the ILT with NCDENR sponsored the conference: “Planning for North Carolinas’s Future: Ask the Climate Question” – the most widely referenced conference among study participants across all sectors in North Carolina (NCDENR 2012). The intent of the conference was to encourage planners and resource managers to incorporate climate change into their long-term planning decisions. The workshop convened state-level and nationally-known scientists and over 400 decision-makers. Many interviewees discussed the significance of the event. One government planner stated that “...it was probably the most significant conference on climate change adaptation for non-technical personnel ever held” (study participant from a local NC municipality). A representative from the Tourism sector found that the conference provided “an opportunity for us to talk to emergency response organizations, transportation organizations, regional planners, local planners, and kind of learn what they are doing. Those are organizations that do not typically interact with the tourism industry.”

Meanwhile, in 2010, NCDENR was charged with coordinating a state agency effort to identify key climate change concerns and assess what plans or programs need to be in place to prepare for expected effects of climate change (NCGA 2010b). The intent of the effort is for every agency to incorporate climate change concerns and information into their regulatory and planning programs. Agencies were asked to assess what they are doing to adapt to climate change, if what they are doing is sufficient, and if not, identify possible actions. This information was compiled into a report for the North Carolina Environmental Review Commission in November 2011 (NCDENR 2011). NCDENR continues to provide information to interested decision-makers through a Listserv and information on the Climate Change Initiative website (NCDENR 2012). One member of the ILT stated that these various activities have “...really morphed into an integrated planning effort” (Participant from the Government sector).

10.3.3 Activities and Resources That Help to Build Networks

Interviewees highlighted two key factors that have helped to build and support climate networks and activities in the Carolinas: 1) conferences and workshops, which were revealed as a primary source of climate information in the cluster analysis (see Section 10.2.1) and 2) access to funding opportunities and partners.

While a search for broad- or cross-scale events that specifically addressed climate change science, impacts, or societal responses revealed very few examples (see “Ask the Climate Question” conference described above), conference and workshop references were prominent in the interviews and discussed consistently across all sectors. Many of the events discussed in the interviews, which included climate-related topics, occurred within sectors or on smaller-scales. Examples include the National Estuarine Research Reserve Coastal Training Program workshops, specific sessions at annual meetings of professional associations, and special events that addressed energy, biomass development, green business, or sustainability topics. Conferences and workshops are considered beneficial because they not only provide education and training (e.g., regarding best management practices) but also provide participants with access to diverse organizations within their sectors and generate opportunities for them to network and

foster relationships with scientists, climate information providers, and other local and regional groups outside their sector. Such events also facilitate information sharing. One interviewee from a North Carolina state park noted that “most of the information and contacts I have received originated from that conference [Southern Appalachian Man and Biosphere workshop].” Specific contacts obtained from the workshop included representatives of the NCDP, NOAA, and the USFWS. Several conservation groups in North Carolina developed a workshop for “...a workgroup of all the organizations working on climate and there were probably 36 leads in that workgroup representing 12 to 16 organizations” (study participant from the NC Wildlife Federation). Connections to professional networks, collaborations, and conferences outside of the Carolinas allowed some interviewees to obtain new information about tools and strategies to address climate concerns which they subsequently applied to their work or disseminated to others.

Many interviewees involved in project development and implementation highlighted the importance of funding in supporting local and regional partnerships involved in those projects. While the federal government appears to be a main funding source for climate related projects, interviewees also referenced grants from private (Duke Energy) and non-profit (The Nature Conservancy (TNC), Ducks Unlimited) organizations. Grant programs may encourage or even require that regional collaborations or partnerships be included in project proposals. Two examples from the Government sector and one example from the Wildlife sector illustrate how funding opportunities are instrumental in providing incentives for local and regional partners to address climate concerns in a collaborative manner.

The Energy Efficiency and Conservation Block Grant (EECBG) Program, initially funded by the American Recovery and Reinvestment Act of 2009, has been a major source of funding for government entities to invest in energy efficiency and GHG emission reduction projects. According to the US Department of Energy, the program is “intended to assist US cities, counties, states, territories, and Indian tribes to develop, promote, implement, and manage energy efficiency and conservation projects and programs designed to: Reduce fossil fuel emissions, Reduce the total energy use of the eligible entities, Improve energy efficiency in the transportation, building, and other appropriate sectors, and Create and retain jobs” (USDOE 2012). In addition, one of the desired outcomes highlighted in the EECBG application process involves “improved coordination of energy-related policies and programs across jurisdictional levels of governance and with other local and community level programs in order to maximize the impact of this program on long term local priorities” (USDOE 2012). Overall, the Carolinas have received \$89,499,500 in EECBG funding (See Table 10.6 below for details). Numerous interview participants stressed that this funding was essential in allowing their communities to conduct energy efficiency and emissions inventories that likely would not have happened without the financial resources.

Table 10.6 EECBG Funding Allocations in the Carolinas

	North Carolina	South Carolina	Total EECBG Funding Allocated to the Carolinas
# of Cities Receiving Funds	22	10	
Total Funding Allocated to Cities	\$28,461,700	\$6,220,500	
# of Counties Receiving Funds	10	10	
Total Funding Allocated to Counties	\$8,663,300	\$15,635,200	
State-Level Funding Allocated (In addition to city and county funding)	\$20,925,300	\$9,593,500	
Total Funding Allocated	\$58,050,300	\$31,449,200	\$89,499,500
Source: http://www1.eere.energy.gov/wip/eecbg.html			

The US Department of Housing and Urban Development’s Sustainable Communities Regional Planning Grant (SCRPG) Program has been another influential motivator for regional cooperation to address community priorities related to sustainability. The SCRPG Program “supports metropolitan and multijurisdictional planning efforts that integrate housing, land use, economic and workforce development, transportation, and infrastructure investments in a manner that empowers jurisdictions to consider the interdependent challenges of: 1) economic competitiveness and revitalization; 2) social equity, inclusion, and access to opportunity; 3) energy use and climate change; and 4) public health and environmental impact” (US HUD 2012). In particular, the program places a high priority on collaborative partnerships at the regional scale and emphasizes the desire to incorporate a diverse range of public and private sectors in proposed sustainability efforts (e.g., arts and culture, recreation, public health, food systems, regional planning agencies and public education entities). Four successful SCRPG awards have been allocated in the Carolinas (See Table 10.7 below). Study participants noted the role of the program in instigating collaborative planning activities: “The grant became available in 2010 and we formed real quickly in 2010 to get an application in. We were not funded but we continued to meet over the course of the year to strengthen our partnership and become more prepared whenever the 2011 application was available” (Participant from county government, NC).

Table 10.7 SCRPG Grantees in the Carolinas

Partnership Name	State	Year Awarded	Amount Allocated
Land-of Sky Regional Council (www.landofsky.org)	North Carolina	2010	\$1,600,000
Piedmont Authority for Regional Transportation (www.partnc.org)	North Carolina	2010	\$1,600,000
Centralina Council of Governments (www.centralina.org)	North & South Carolina	2011	\$4,907,544
Cape Fear Council of Governments (www.capefearcog.org)	North Carolina	2011	\$1,130,000
Total Allocated in the Carolinas			\$9,237,544

Source:

http://portal.hud.gov/hudportal/HUD?src=/program_offices/sustainable_housing_communities/sustainable_communities_regional_planning_grants

* For project descriptions please see this website.

The Alligator River National Wildlife Refuge project illustrates how access to networks and funding can directly lead to capacity-building efforts. The refuge spans 154,000 acres in the Albemarle-Pamlico Estuary in North Carolina. TNC and the USFWS are collaborating to evaluate how different adaptation strategies may increase the resilience of the refuge and other coastal ecosystems to sea level rise, salt-water intrusion, and coastal erosion. While TNC and USFWS are directly involved in the adaptation initiatives and provide the necessary human resources and expertise, the participation of funding partners and other organizations were critical in obtaining the resources to implement and manage the project. Funding partners include Duke Energy which donated \$1.25 million to the project and a private donor who contributed \$250,000. Other funding sources include a Southeast Aquatic Resources Partnership/NOAA Community-based Restoration Program grant, a TNC/NOAA Community-based Restoration Program grant, the Albemarle-Pamlico National Estuary Program, a Wildlife Conservation Society Wildlife Action Fund grant, and several other smaller donations. In addition, the project also required permits from the USACOE because the refuge is located in a wetland environment. Permits were required through the state's Coastal Area Management Act (CAMA) for project activities (e.g., oyster reef construction) occurring in the sound.

11 Cross-Sector Comparison

11.1 Introduction and Chapter Overview

This chapter assumes a broad systematic approach towards analyzing the similarities and differences that exist among the five sectors reviewed for this study. It compares and contrasts climate concerns and critical decisions, major areas of climate change activity and the framing of these activities, factors that constrain and facilitate climate change action, and prominent needs and recommendations across all sectors of this study. A focus on these broader themes and trends provides insight into the major climate concerns, current levels of action, and future capacity of the Carolinas region to adapt to future climate change.

11.2 Climate Change Concerns

Key climate-related events and impacts most often cited by interviewees included sea level rise and flooding, drought, temperature-related concerns, and hurricanes and tropical storms. Climate-related concerns are general in nature in terms of future climate scenarios, while concerns regarding the direct and indirect impacts caused by these phenomena are more sector-specific. There are distinguishing similarities between various sectors in regards to specific climate-related events and impacts of interest, namely the need for increased regional modeling to improve climate change projections, which would in turn provide more regionally specific information about potential impacts. Participants often described a linkage from these concerns to potential economic repercussions in their sector. The set of concerns reflects the cross-cutting issues in the Carolinas regarding land management, water resources, and coastal management and the impacts a changing climate will have in future planning for these areas.

Concerns about sea level rise and coastal flooding centered on impacts to infrastructure, runoff and drainage issues that would in turn affect water quality and quantity, saltwater intrusion, ecosystem transition, and loss of land due to erosion and flooding. Impact concerns highlighted within the Government and Water sectors were more focused on infrastructure, degradation of water quality, and runoff and drainage issues. Forestry, Tourism, and Wildlife interviewees more often voiced concerns regarding land-use planning and management in preparation for ecosystem transitions caused by sea level rise and flooding.

Drought was the second most often cited climate change concern among study participants. Here there was a more pronounced distinction among sectors. Government and Water sector interviewees tended to emphasize the impact of drought on the availability of water resources for various consumption needs, e.g., human, agricultural, and industrial. On the other hand, the Wildlife and Tourism sectors were focused more on the impact of drought on wildlife habitats. Drought impacts on forests and consequent increases in the availability of wildfire fuels were major concerns within the Forestry and Tourism sectors. All sectors shared concern over the impacts on ecosystems and population centers from hurricanes, tropical storms and severe weather.

Temperature-related concerns were highlighted mostly by the Tourism and Wildlife sectors, both emphasizing impacts on ecosystems but for different reasons. The Tourism sector was more concerned with the availability and appeal of tourist events, programs, or destinations due to colder winters and hotter summers. Wildlife sector interviewees focused on ecosystem response. A participant from the Wildlife sector stated specific concern regarding “temperature change as

it relates to potential shifts in either species distribution of animals and plants, or habitats or biomes, depending on what scale you want to go to.” Forestry and Wildlife sector interviewees raised similar concerns regarding the importance of improving understanding of rates of ecosystem change and the ability of plant and animal species to adapt to a changing environment. A sub-sector of the Government sector (public health and hazard management) expressed concern that temperature changes would increase heat threats and illness.

Government sector interviewees consistently raised concerns regarding mitigation of emissions and demonstrated an emerging awareness of societal adaptation. Although sustainability initiatives to reduce energy consumption, often framed in terms of cost savings and economic benefit, were noted by other sector interviewees, efforts to measure GHG emissions and develop action plans for emissions reductions were unique to the Government sector.

11.3 Decisions and Climate Information Use

Decision planning horizons and the geographic scope of participants’ responsibilities influenced the types of decisions and information needs identified by study participants. Many of the participants reported actively seeking weather and climate information. Analyzing the climate-related decisions by time scale revealed similarities and differences among sectors. For example, decision-making in the Forestry sector tends to involve more long-term planning horizons because of the resource being managed. Other sectors, whose activities are more event- or seasonally-specific, such as the ski season, make decisions and plan annually.

Short-term planning across sectors involves *operational* decision-making such as staffing needs and budgets. Prescribed burning, a climate-related decision of importance within the Forestry, Tourism, and Wildlife sectors is dictated by weather predictions and influenced by relative humidity, soil moisture and wind speed. Therefore, the timing of this activity includes weekly, monthly and *seasonal* planning time frames. The Government sector has a *seasonal* orientation towards emergency management planning and preparedness driven by hurricanes, tropical storms, nor’easters, and winter weather. Emergency management was a minor topic within the Tourism sector and voiced by interviewees who work with organizations focused on tourism promotion and marketing. *Operational-level* decisions in the Water sector entailed monitoring water levels, river inflows, and pumping rates.

Interviewees who discussed using climate information for longer-term planning processes did so if climate related-information was considered relevant to their decisions. Forestry, Tourism, and Wildlife sectors highlighted long-term planning horizons for land management and conservation. These decisions included the ability of the forest resource to provide carbon sequestration sinks, wildlife corridors for migrating species, and preservation of threatened and endangered species. Long-term planning for the Water sector emphasized engineering design parameters of water systems and the assurance of providing reliable water supplies. One Water sector participant voiced the need for “information that...can help make policies and decisions on water management in the face of climate change.”

Although activities to mitigate GHG emissions and reduce energy consumption were widely discussed among Government sector interviewees, study participants noted that efforts to create long-term action plans are still in the early planning stages.

11.4 Climate Change Activities Across Sectors

Study participants indicated action across a broad range of activities to address climate change concerns in the Carolinas. Both mitigation and adaptation activities have received attention within the region, although adaptation efforts generally appear to be in an earlier phase of planning and preparation. With the exception of professionals within the Wildlife sector and those involved in coastal communities within the region, most study participants in the Carolinas noted that in the absence of a strong and publicly important climate signal, immediate adaptation efforts are neither feasible nor prudent. Overall, the sectors shared three general activity areas. These activities include *GHG emission reduction* efforts (mitigation), *education and outreach* initiatives, and *data collection and monitoring of climate impacts*.

Study participants reported many long-standing efforts to mitigate climate change via reducing energy consumption and associated *GHG emissions*. This was particularly apparent within the Government and Forestry sectors, where activities focused on reducing municipal and community energy consumption and promoting bioenergy. However, the Tourism, Water, and Wildlife sectors also indicated numerous activities to address infrastructure, facilities, and equipment management in order to reduce energy consumption and emissions. All of the sectors indicated an interest in energy-related action as a strategy to mitigate climate change impacts. Participants across all sectors suggested that energy issues often are “low-hanging fruit” activities that have “*win-win*” outcomes that ultimately reduce emissions and costs simultaneously.

Alongside mitigation activities, *education and outreach* efforts represented a large portion of climate change activities. Although each sector has tailored outreach efforts to connect with its most salient issues, study participants indicated several common themes. These include providing basic information about climate patterns, climate science and indicators, and the potential impacts of long-term climate changes or increases in extreme weather conditions or events. In almost all cases, participants indicated education activities focused on specific issues of concern to the community, such as drought, severe weather, and public and environmental health. Outreach efforts centered on informing citizens about how climate impacts these relevant issues and sharing information about how changes in climate patterns might impact these concerns. Furthermore, study participants from all sectors indicated that education activities are designed to provide citizens/stakeholders with tangible and feasible “take-away” messages that include information about what can be done to address climate concerns both on an individual and collective level. All but one sector (Water) indicated a strong emphasis on education and outreach as a first step to inform and engage citizens in ongoing dialog about the relevance of climate to human and ecological communities. Study participants suggested that such efforts are designed as an essential component to enhance public support for both mitigation and adaptation activities occurring within the region. Water sector interviewees stressed the importance of interactions with colleagues or similar decision-makers rather than communications to the general public.

Finally, *data collection and monitoring of climate impacts* was a high priority for four of the five sectors within this study (although Tourism is involved in monitoring efforts, it is not a major activity area currently). Study participants emphasized the range of uncertainty associated with potential climate change and associated impacts as the primary driver of the focus on data collection and monitoring. The need for region-specific information to document “baseline”

conditions and impacts associated with changes to both ecological and social systems has prompted a host of efforts to study climate-related impacts within the Carolinas. These socio-ecological monitoring efforts include studies on coastal erosion and salt-water intrusion in hydrologic systems, range preferences of land and aquatic species, and public perception and attitudinal measures to assess concern about specific environmental variables.

Study participants clearly communicated that activities related to climate in the Carolinas are highly influenced by public support and the political climate. This was especially important in sectors that are responsible for activities that involve public welfare and financial support like Government and Tourism. Interview participants across sectors noted a shift in the political climate at local, state, and federal levels in 2010 that created the need to reevaluate climate action and frames utilized to justify such action.

I think that the politics and dynamics have shifted dramatically in North Carolina and I think climate change is a dirty word right now in the political environment of the state. (study participant from the Southern Alliance for Clean Energy)

[T]he political winds have shifted in North Carolina and it is no longer really a good idea for anyone to openly talk about carbon or our legislature will shut them out. (study participant from the NC Sustainable Energy Association)

Well the political climate at the state level and the federal level are affecting it [types of activities to address climate concerns]. There's been a strong reaction to cap and trade, climate debate has become highly politicized, there are a lot of people in government who question the science at all. It's not just action at the federal level, I'd say it's all across the board. (study participant from Duke University Nicholas Institute for Environmental Policy Solutions)

The main constraint is, well of course money is always a constraint, time is also a constraint, but the big constraint is the political atmosphere, it is just such a regressive anti-science, antigovernment, sort of anti-everything atmosphere that is very difficult, almost a paranoid sort of situation that is very difficult to get some people in some groups to take this stuff seriously and I think that is the biggest hurdle. (study participant from SC Wildlife Federation)

In many cases, study participants indicated that among a range of potential activities, public and political support often would drive the activities selected for action, especially given recent changes in the political climate. With renewed scrutiny in public and political circles about activities to address climate concerns, the economic and political palatability of actions must be considered. Issues with broad support – like reducing costs via energy efficiency – received attention, as did education-outreach and data collection-monitoring activities that were part of efforts to enhance public understanding of such concerns and the need for action.

11.5 Framing of Climate Change Activities Across Sectors

Concern for the level of political and public support was further illustrated by the dominant frames developed to communicate climate change activities to the public. All sectors indicated careful attention to framing issues. At times, sector leaders emphasized the influence that perceptions of public and political support have on the framing of activities that have already been implemented. In other cases, leaders suggested that after recent political changes in the

2009 and 2010 elections, the selection of future activities to pursue may be influenced by what is considered more politically acceptable.

Knowing that we had this city council that had been elected in 2009 that was extremely tight fiscally, plus being in the economic recession and then also knowing that these people were not going to vote for any sustainability measure that costs anything, so our plan at this point is just to get things going. It's stuff that has little or no upfront cost. It was designed to be budget-neutral the first year. (study participant from a local government sustainability council)

Table 11.1 summarizes the key framing categories utilized to communicate climate change activities across all five sectors. Table 11.2 outlines the dominant frames as indicated by study participants in each of the sectors.

Table 11.1 Climate Change Activity Framing Categories

<i>Green Economy/Developing Jobs</i>
Activities are framed as economic investments or beneficial market opportunities for innovation and global competitiveness to bolster the economy or create new jobs.
<i>Ecosystem Conservation</i> (resource management, land management, ecosystem services)
Activities are framed as components of existing land or ecological resource conservation practices and not as additional efforts to manage climate change impacts. Conservation is presented as essential to ensure the availability of resources for future generations and may include an ethos of preservation for intrinsic value.
<i>Emergency Management/Hazard Mitigation</i>
Activities are framed as components of risk management to prepare for emergencies, address threats to socio-ecological systems, and reduce the impacts of hazards. Precaution in the face of significant threats is emphasized.
<i>Public Health/Prevention</i>
Activities are framed as strategies to improve quality of life by reducing environmental health threats and preventing future public health challenges. This may include air and water quality, pollution prevention, and the spread of infectious disease.
<i>Energy/Energy Security & Efficiency/National Security</i>
Activities are primarily framed to focus on concerns about GHG emissions and energy resources. This includes discussion about energy security, supply reliability, and national security. Concerns about costs and financial efficiency are also part of this frame.
<i>Moral or Ethical Imperative/Social Duty/Responsibility</i>
Activities are framed as strategies to fulfill a social duty to conserve ecosystems and protect human systems in the face of potential climate change. Responsibility for the collective well-being of all members of society is reinforced within this frame.
<i>Planning and Preparedness</i> (municipal and urban planning, transportation, resource needs)
Activities in this frame are generally presented as elements of broader comprehensive planning and preparedness projects aimed at guiding communities to negotiate competing interests so that mutual benefits are obtained for both human and ecological systems.
<i>Sustainability for Future Generations</i>
Activities within this frame are presented as part of larger processes to ensure that economic, social, and environmental needs are advanced simultaneously (triple bottom line). Actions to address climate change are often framed as meeting needs within each aspect of sustainability.

Table 11.2 Dominant Activity Framing Categories, By Sector

Climate Change Activity Framing Category	Forestry	Government	Tourism	Water	Wildlife
Green Economy/Developing Jobs	x	x			x
Ecosystem Conservation			x		x
Emergency Management/Hazard Mitigation			x	x	
Public Health/Prevention		x			x
Energy/Energy Security & Efficiency/National Security	x	x			x
Moral or Ethical Imperative/Social Duty/Responsibility			x		
Planning and Preparedness		x		x	
Sustainability for Future Generations	x	x			

As Table 11.2 demonstrates, each sector displayed unique framing strategies given the particular characteristics of audiences and specific activities within the sector. While very few specific frames were consistent across all five sectors, sector leaders did use similar strategies in framing current activities related to climate change. Notably, a strong majority of participants indicated that they rarely focus on the phenomenon of climate change in and of itself with public constituents or stakeholder groups. In fact, many study participants clearly stated that they have been instructed by senior leaders within their organizations not to talk about the issue publicly given the public sensitivity about the topic. Instead, participants explained that they more frequently raised the impacts of climate changes (e.g. drought, sea level rise, and extreme heat events) via frames like *public health/prevention* and *emergency management and hazard mitigation* instead of focusing on the causes.

There's the obvious one [constraint] about the political environment surrounding the term 'climate change.' We talk a lot on the planning team about a strategy to reduce risk and increase community resilience. Because there's a lot of concern given the turnover in the [North Carolina] General Assembly that we don't want to call unnecessary attention to what we're doing. (Engineer)

The range and diversity of framings revealed in this study is further evidence that sector leaders often situate climate change activities within broad and extensive framing for the public instead of addressing climate change directly and independently. The potential impacts, consequences, and avenues to address the negative aspects of the phenomenon of focus is central in many framing strategies. Frames that directly connect action on climate change with dimensions of societal well-being were most prevalent. These include frames that focus on the ecosystems services to society (*ecosystem conservation*), the health risks posed by changes in climate

variables (*public health/prevention*), the importance of addressing climate change within *emergency management and hazard mitigation* efforts, and, more recently, opportunities associated with *green jobs* and the new *green economy*. One broad frame that appeared to be gaining momentum integrated climate change within the context of greater *sustainability*. Many study participants indicated a focus on the “triple bottom line” of sustainability that includes consideration of economic, social, and environmental dimensions. Emphasizing the need to consider sustainability in decisions that impact socio-ecological systems was underscored as the best way to ensure that the needs of future generations are met.

Our members, we survey them every year to ask about what we need to focus on and what is important to them and our members rank key things. They rank growing the economy at the same level as they rank protecting the environment so we really try to work towards that balance of sustainability in everything we are doing as well. (Tourism sector participant)

Much of the existing *education and outreach* activity within the Carolinas has been designed to facilitate a deeper understanding of these socio-ecological connections. Within these efforts, climate change was often portrayed as one issue along with numerous other environmental stresses including environmental pollution, land management, and the equal distribution of global resources. This framing supported arguments for the *data and monitoring* activities enacted by the sectors examined. Additionally, participants discussed efforts to personalize climate action by focusing on potential impacts and the individual and collective benefits of action in order to increase resonance with stakeholders.

Study participants across sectors indicated that frames like *energy/energy security* and *planning and preparedness* that include concepts of civic responsibility, economic efficiency, and ethical, equitable, and transparent management were important dimensions to enhance communication and acceptance of climate change activities. Again, such themes served to enhance the ability to connect climate change activities with topics that resonate with the current concerns and priorities of public and political constituents. Subjects like efficiency (e.g., for water and energy management), moral civic obligations (e.g., domestic and international), responsible resource management (e.g., forests, ecosystems, wildlife habitat), and planning and development (e.g., municipal planning, transportation, population management, energy security) all relate to this framing area. Numerous study participants spoke of a sense of duty and responsibility to address climate change (*moral/ethical imperative*) as a motivating internal factor behind the activities revealed in this study and as an external framing perspective. Mitigation activities that involve energy and emission reductions are frequently included within this area of emphasis.

11.5.1 Factors that Have Facilitated or Constrained Activities Across Sectors

Table 11.3 displays influential factors expressed by interview participants that have either facilitated or constrained activities to address climate change across all sectors of this study. Information from interviewees has been utilized to provide examples of how each factor can either facilitate or constraint climate action. The availability of each factor influences whether the factor enables or impedes action to address climate concerns, and thus influences the overall adaptive capacity of each sector to cope with climate change. For a discussion about how adaptive capacity was conceptualized in this report, see Chapter 4.

Table 11.3 Factors that Facilitate or Constrain Activities to Address Climate Concerns in the Carolinas

Influential Factor	As a Facilitator	As a Constraint
<p><i>Resources/Funding</i></p> <p>The degree to which resources (e.g., financial, human, time) are available to implement climate action.</p>	<p>Resources are available to advance existing or novel activities to address climate concerns. These may come in the form of grants, capital funds, or in-kind contributions. This includes the presence of market or government incentives (tax breaks, refunds) or threats (costly regulation compliance).</p>	<p>Resources are lacking so that activities to address climate concerns are not adequately supported. This may take the form of financial support, a lack of staff to manage activities, or insufficient infrastructure.</p>
<p><i>Laws/Policies/Regulations *</i></p> <p>The degree to which laws, policies, and regulation target climate action.</p>	<p>Regulations or policy mandates encourage activities to address climate concerns. Support is allocated in the form of resources (grants, information, coordination) or as top-down guidance. Policy windows provide opportunities for action.</p>	<p>Regulations or policies impede activities to address climate concerns or slow progress because of regulatory complexity or overlapping authority. Top-down guidance or direction is experienced as insufficient, counterproductive, or overreaching.</p>
<p><i>Data and Information</i></p> <p>The degree to which valid, scientific data is available to inform decisions and provide details about the likelihood and certainty of outcomes.</p>	<p>Information is available that provides relevant insight into the climate variable of concern, assists in weighing various options for action, and guides intervention strategies. Data is easy to access and understand.</p>	<p>Gaps exist in the information available about a climate variable of concern, leading to the inability to determine the pros and cons of action or uncertainty about intervention outcomes. If information is available, it is hard to access or understand.</p>
<p><i>Key People, Groups, Partners, Experts</i></p> <p>The degree to which influential people, groups, partners, or experts are available or willing to serve as a champion or leader of climate action.</p>	<p>Key people, groups, partners, or experts serve to focus attention on climate challenges, spearhead support for climate action, build partnerships and consensus, and influence critical legislation or funding sources to implement a course of action.</p>	<p>Key people, groups, partners, or experts minimize climate challenges, redirect support or concern away from climate action, and block critical legislation or funding for climate action.</p>
<p><i>Networks/Collaboration</i></p> <p>The degree to which opportunities exist to form multi-party networks or collaborative initiatives where climate action can be planned, coordinated, and implemented across geographic scope or issue area.</p>	<p>Partnerships exist or are developing which allow multiple agencies to collaborate on climate action initiatives that meet shared goals, are supported cooperatively, increase community support, and reduce overlap or competition for resources.</p>	<p>Partnerships are not available or are disjointed, thus limiting the potential to develop collaborative climate action initiatives. Opportunities to meet shared goals are minimal or are hindered due to differences in organizational cultures.</p>
<p><i>Political/Public Support</i></p> <p>The degree to which the general public, prominent advocacy groups, political bodies of</p>	<p>Sufficient or high levels of public support exist to address climate challenges or specific climate activities or programs. Public constituents are knowledgeable about</p>	<p>Insufficient or low levels of public support exist to address climate challenges or specific climate activities or programs. Public constituents demonstrate little</p>

government or elected officials understand, support, or advocate climate action. This includes the level of understanding and acceptance of climate information and general trust in science and environmental action.	climate phenomenon, involved in climate action initiatives and contribute resources. Political leaders and bodies of government demonstrate support for climate action and allocate resources consistently.	knowledge, involvement or interest in climate action initiatives. Lack of support exists among political leaders and bodies of government to implement climate action or allocate resources appropriately.
<i>Economic Incentives</i> ** The degree to which an economic incentive exists to initiate, implement, or sustain climate action to address a private or public need.	A market or government economic signal exists that encourages climate action to meet a private or public need. Signals could be incentives (tax breaks, refunds) or threats (costly regulation compliance).	A market or government economic signal does not exist to encourage climate action to meet a private or public need or a disincentive is present (resources would be lost with action).
<i>Non-Climate Stressors</i> The degree and extent to which non-climate concerns are present within the sector and the level of sector priority assigned to these concerns.	Other concerns within the sector (e.g., population growth, development, pollution) coincide with challenges presented by climate variability or change so that synergy exists around activities that address these variables simultaneously. Strategies to address these multiple concerns may include “win-win” and “no-regrets” actions.	Other concerns within the sector (e.g., population growth, development, pollution) surpass challenges presented by climate variability or change so that activities to address climate concerns become lower-level priorities.
<p>* This category includes laws, policies, and regulations at all levels of government. However, a difference was noted among participants who distinguished between the general presence of these legislative directives at local or state-level scales and the presence of federal-level guidance, support, or resources that might inform consistent practices across regional or multi-state scales.</p> <p>** This category was added after a review of interview transcripts due to an emphasis on this particular issue in discussions about the deployment of biofuels and renewable energy.</p>		

Table 11.4 highlights the top four factors *facilitating* climate activities in the Carolinas and how this is distributed across the five sectors of this study. Overwhelmingly, study participants underscored opportunities to engage in *networks/collaborative* projects and research that involves multi-agency or organization efforts as essential for advancing action on climate change in the region. Participants across all sectors indicated the importance of opportunities to join coordinated, multi-party efforts and organizations and to share management and cost responsibility. Respondents noted that in addition to collective cost-sharing, such opportunities provided avenues to enhance interagency collaboration, build networks and new lines of communication, and assemble professionals with diverse backgrounds and expertise around common problems and concerns. Furthermore, within the Carolinas, participants noted that activities supported by multiple groups and constituents generally were less politically polarizing and garner broader support among public groups.

Table 11.4 Top Four Factors Facilitating Climate Activities in the Carolinas

	Forestry	Government	Tourism	Water	Wildlife
Networks/Collaboration	x	x	x	x	x
Data & Information			x	x	x
Laws, Policies, Regulations	x	x	x	x	
Resources/Funding	x	x			x

Given the current economic and budgetary circumstances in the Carolinas, the three sectors that depended most heavily on public funds (Wildlife, Government, and Forestry) all indicated *resources/funding* as a key factor in facilitating action. Study participants in these sectors identified many areas of need and ideas for action, but emphasized the implementation of projects ultimately depends on the availability of resources. Resources include funding as well as the availability of staff and expertise.

The availability of relevant *data and information* was also a key facilitating factor for three sectors (Wildlife, Water, and Tourism). Within the Water and Wildlife sectors, study participants suggested that as more information, such as management and planning models that incorporate climate change become available, they will be able to take action quickly. At the same time, Tourism sector leaders noted that as connections between changes in climate and threats to the tourism industry (coastal erosion, snow and rainfall amounts) become available, support for action might develop.

Study participants within the Forestry, Government, Tourism, and Water sectors highlighted the essential role of *laws/policies/regulations* in facilitating action to address climate change. This category included state and federal institutional requirements to consider both mitigation and adaptation activities. Respondents indicated that these top-down approaches have been particularly important within this region where there has been limited motivation and support for action on climate change issues. Federal guidance and mandates were very influential in supporting multi-party, region, or state efforts. Many respondents who manage state and federal lands or natural resource areas explained that organization-wide policies and protocols played a critical role in ensuring that adaptation management and mitigation planning addresses climate change. Other study participants mentioned that federal, state, or regional grant programs were primary factors in efforts to incorporate climate issues into sustainability programs (e.g. USDOE Energy Efficiency and Conservation Block Grant program). Participants also perceived federal and state actions to incentivize behaviors that reduce GHG emissions, like REPSs and zero-carbon energy incentives, as essential motivators of climate action.

Table 11.5 highlights the top five factors *constraining* climate activities in the Carolinas and how this is distributed across the five sectors of this study. The top constraint suggested by study participants in all five sectors involves a *lack of resources and funding* to advance effective climate change action. Many participants listed state or local budget cuts as an additional compounding stressor on an already low cache of resources to address climate in the region. This was seen as one of the greatest hurdles in addressing climate change issues over the past couple of years because it has prevented sufficient implementation of programs and slowed progress

towards mitigation or adaptation goals. In particular, a number of participants indicated that organization leaders or elected officials cited difficult economic conditions as a justification to halt resource- or time-intensive programs intended to address climate change, although it was unclear whether such cuts were a reflection of economic reality or ideologically-motivated actions. This participant from a North Carolina nonprofit organization was speaking about changes in political leadership and environmental governance in the state.

The reality is for the first time in 150 years both houses in the legislature are Republican for the first time. Well, all of a sudden, every environmental law and regulation we have is under attack. They are trying to, on the basis of saving money - because like every state we have a severe economic problem and they're trying to make up deficits like the nation is - but unfortunately a lot of other things are being tied in with that as an excuse or whatever to try to change the laws. So people are pretty much on the defense in any kind of agency, public lands agencies, environmental organizations, science teachers, you name it.

A lack of resources jeopardizes continuity within data collection and research studies, incentive programs to encourage sustainable practices, and pilot projects to test novel methods or procedures. It was clear from participants in all sectors that a lack of basic resources to support action has been a significant barrier to action.

Table 11.5 Top Five Factors Constraining Climate Activities in the Carolinas

	Forestry	Government	Tourism	Water	Wildlife
Lack of Resources and Funding	x	x	x	x	x
Lack of Data and Information		x		x	
Lack of Political and Public Support		x	x	x	x
Laws, Policies, and Regulations		x			x
Non-Climate Stressors	x	x	x		x

Four sectors (Government, Tourism, Water, and Wildlife) noted that a *lack of political or public support* is a primary constraint in realizing climate change action. Many study participants noted a shift in political support away from engaging in climate change activities. Several sectors commented that key groups, elected leaders, or campaigns that discredit climate science played a significant role in curtailing climate-related activities. Reflecting on the reaction of local leaders upon the release of a report on sea-level rise in a Carolinas coastal community, this study participant noted:

The reaction was, this is going to damage real estate property values, not how are we going to, as responsible human beings, address the issue. It was, this is going to affect our economy,

we are already having problems with our state department of insurance. You are going to damage our economy at this vulnerable stage talking about 3 feet of sea level rise. So that was their reaction and of course the next step was to cast doubt on any of the information in the study and to basically attack the messenger. (Government sector participant)

As illustrated by the study participant above, not only did study participants communicate that activities are constrained due to a lack of support but that in some cases, information to support the need for activities that address climate change is actively targeted for attack. Consequently, the focus on education, outreach and appropriate framing as outlined above was seen as essential to building support for climate change activities.

Four of five sectors (Forestry, Government, Tourism, Water, and Wildlife) indicated that *non-climate stressors* compete with climate concerns for time, attention, and resources (see related discussion in Section 11.7). The Water sector did not indicate this constraint, likely because this sector demonstrates a narrow focus on a defined area of responsibility. Even though many study participants noted that climate change has the potential to exacerbate existing ecological and social stresses, participants suggested that among public groups and officials, climate change is perceived as one among a diverse and growing list of concerns tackled by organizations represented in this study. Limited financial resources and multiple areas of concern constrain the type and extent of climate-related activities supported within the Carolinas. This constraint illuminates why climate-related activities that can provide multiple socio-ecological benefits like cost reductions, infrastructure updates, and ecological health have been emphasized in the region.

Although a lack of *data and information* was listed as a top constraint in two sectors (Water and Government), it was not the top constraint overall. This is in contrast to study documents which indicated the lack of relevant, locally-scaled information as a major constraint of climate-related action in the Carolinas. As noted above, many study participants indicated that a lack of *political or public* support for climate change activities was more of a hindrance than the *lack of data or information*. When an information gap was emphasized it was not only the lack of data but also the uncertainty of existing information on climate change impacts that participants noted as a constraint to action. However, a number of participants noted that uncertainty alone was not an absolute constraint.

My approach has been risk management. Uncertainty is not the same as the total lack of knowledge and so it's about thinking through different scenarios and the costs and benefits of various adaptation options down the road. And it's about working with communities to make sure we take on the issue. (Government sector participant)

We make our decisions under uncertainty from the best information that we can with full knowledge and awareness that that information is not perfect. We need to look at the range of possible outcomes, but that does not mean you discount your best sources of information. (Tourism sector participant)

Furthermore, various types of uncertainty were discussed by study participants. While some participants noted uncertainty in physical climate models and associated impacts, others were more concerned about regulatory or resource allocation uncertainty than about concerns about a lack of certainty in the science models. Given these various sources of ambiguity, participants emphasized the need to remain cautious and prudent when it comes to expending large amounts

of public funding and resources on activities that may not address the most pertinent issues in an efficient or effective manner.

Finally, study participants within the Government and Wildlife sectors indicated that a number of existing *laws, policies, and regulations* constrained climate-related activities within the region. Most often, participants noted that the lack of authority to manage or enforce policy and laws constrained movement on activities. A lack of comprehensive federal legislation to address problems like invasive species, permitting procedures and requirements for building, and pollution regulation all hindered progress towards holistically addressing socio-ecological challenges that span local and state jurisdictional boundaries. Additionally, the complexity involved in navigating topics like water management, air quality, and multi-scale transportation initiatives can be daunting and stifling.

11.6 Cross-Cutting Issues

This section discusses three main areas where the interests and activities of all five sectors come together. Questionnaire and interview data revealed that concerns relating to water resources, coasts, and land management activities present unique challenges to all sectors analyzed for this study. Details are provided to stress the challenges presented by these issues, efforts to address the direct and indirect effects of climate change within these areas of concern, and opportunities to increase adaptive capacity within the Carolinas around common areas of emphasis.

11.6.1 Water Resources

The hydrological impacts of climate change were a key concern across all sectors. Climate across the region is influenced by a number of factors, including latitude, topography, proximity to large water bodies, positioning of the Bermuda High, and oscillations such as the AMO and ENSO. These interacting factors and conditions already contribute to considerable climate variability at multiple time scales (e.g. across weeks, seasons, years, and decades). Climate models do not agree on the direction of change in overall precipitation totals, although there is greater confidence in some projections (Konrad et al. 2012). Climate change is generally expected to lead to increased temperatures across the region, particularly during the summer months, and to increased variability in precipitation patterns, with more extreme rainfall and drought events likely to occur (Karl et al. 2009). Interviewees expressed concern that such changes are likely to affect water supply, water quality, and thereby the social and environmental systems that use and rely on clean and readily available freshwater resources. Their responses also indicated many ways in which climate is “interwoven” with management issues related to water quality, stormwater runoff, and the impacts of pollution on soil and broader environmental conditions. For example, both too much and too little water can affect water quality, i.e., heavy rainfall events that lead to flooding, more suspended material, and pulses of pollutants and drought events that lead to low flows and elevated stream temperatures.

Some interviewees also noted concerns regarding the effects of future temperature trends and conditions on water resources. For example, higher air temperatures may lead to increased evaporation and the loss of surface water resources, particularly during summer months. Many ecosystem communities and animals (e.g., brook trout) are sensitive to water temperature changes or extremes. Energy producers who operate power plants with discharge permits based on water temperature parameters may find their ability to discharge water into streams limited under changing water temperature conditions.

While all sectors were broadly concerned about water supply-availability and water quality, their central issues varied. Forest sector concerns focused on the linkages between water resources and forest health. Drought can make forests more susceptible to pests or wildfire. Forests in low-lying, coastal areas may experience inundation and higher-than-normal salinity levels during extreme rainfall events. Representatives of the Wildlife sector report related concern about how changes in water quality and environmental conditions might affect ecosystem communities and animals that rely on particular temperature and precipitation regimes. Coastal ecosystems are particularly vulnerable to saltwater intrusion, upstream movement of the saltwater wedge, and relative sea level rise and tidal impacts. Tourism sector interviewees associated with natural resource- or environment-based recreation voiced similar concerns to those in the Wildlife sector, e.g., the impacts of changing and more variable water temperature, water quality, and water supplies on wildlife, habitat, and biological diversity. Water-based recreational activities, such as kayaking or canoeing, need adequate water levels and flows. Local tourist-based economies based on ski or beach activities are also vulnerable to climate variability and any potential changes to precipitation patterns and water resources.

The Government and Water sectors shared concerns related to drinking water treatment and provision, wastewater treatment, and stormwater management. Local government utilities and agencies have primary responsibility for these activities, and interviewees from these organizations discussed a number of inter-related concerns. More variable precipitation may affect streamflow trends, inflows, and lake levels and thereby the quantity and availability of raw water supply. Extreme events also affect water quality characteristics, which affects the resources required to treat and deliver clean water to water customers. Saltwater intrusion into water sources was of particular concern to coastal communities. Utilities responsible for wastewater must understand the assimilative capacity of the receiving stream as water quality is affected during low flows. Wastewater treatment and discharge processes may need to be adjusted to cope with altered stream conditions. Government officials were also concerned about the ability of existing infrastructure (including storm sewer systems, transportation systems) to handle extreme rainfall events and increasing volumes of stormwater. Public health officials highlighted a potential increase in water-borne, vector-borne illnesses. Government sector and water-wastewater utilities suggested that an increase in extreme events may stress existing systems. Any upgrade to existing capacity (e.g. new infrastructure, treatment processes to remove waste materials or contaminants) would entail additional costs to customers and tax payers.

Interviewees identified opportunities for proactive management and planning to help to mitigate or ameliorate climate and water-related concerns. Many new practices and projects (either proposed or ongoing) to ensure water availability and quality were identified. For example, by reducing runoff and erosion in forested areas, forest management can benefit water quality, water supply, biodiversity, and other ecosystem services. Wetlands restoration and adaptation projects on the coast include actions to counteract salinity problems, restore wetlands, improve water quality and quantity, and provide and protect habitat. Interviewees from the Tourism, Government, and Water sectors discussed projects occurring in a variety of venues (e.g. paper mills, hotels and others in the hospitality industry, and water utilities) that were intended to increase water use efficiency and reduce water demand. In the Wildlife sector, advocacy groups reported working on water quality and environmental protection issues, and the research

community highlighted the importance of understanding water allocation and use, establishing ecological baselines, and supporting water quantity-quality and ecological monitoring systems.

Although many potential interconnections and interests related to water across sectors are evident, existing water management practices might increase the potential for secondary problems to occur or inhibit actions to address problems. Many interviewees acknowledged that water management plays a significant role in determining the timing, flows, and duration of water releases and downstream water availability and quality. Yet, many different water management “silos” exist, with potentially competing uses and interests (e.g. upstream-downstream, development-conservation). Future water availability is expected to be stressed not only by increased climate variability, but also by factors such as development, population growth, and aging infrastructure. Furthermore, while efforts to develop more comprehensive systems of surface water allocation and management are occurring in both North Carolina and South Carolina, the uncertainty of future climate change in the Carolinas makes it difficult to incorporate climate change information into these efforts.

11.6.2 Coasts

Future change within Carolina coastal areas is inevitable, although the magnitude and extent could be significantly increased under numerous climate change scenarios. Sea level rise is predicted to contribute to the loss of infrastructure, important ecological areas, and agricultural and residential land. Additional economic loss may result from increased major hurricanes, droughts, and floods, all impacting the critical coastal tourism and recreation activities the Carolinas. As such, coastal management issues occupy a large portion of climate action in the Carolinas, particularly action geared towards adaptation measures.

While mitigation activities (e.g., energy conservation programs, transportation initiatives) are concentrated in urban municipal areas, current adaptation planning and action in the Carolinas is occurring predominantly along the coast. The efforts are driven by concerns about sea level rise and potential impacts on human and ecological systems. Within the Government sector, climate change is being incorporated into emergency management preparations, zoning board changes that incorporate accommodations for rising seas, and financial accounting for increased costs associated with climate hazards to public and private property. Members of the Water sector are actively working with government officials to understand how rising sea levels, saltwater intrusion rates, and coastal groundwater depletion will impact water/wastewater facilities, treatment, and dispersal.

Due to the economic importance of tourism in the Carolinas, there is considerable pressure and demand to protect tourism-related infrastructure, recreation opportunities, and economic development along the coast. Because much of the coastal tourism and recreation in the Carolinas is dependent on natural resources (beaches, marshes, inter-coastal waterway), any climate-related impacts on such resources will impact the health and sustainability of the tourism economies of North and South Carolina. Therefore, coastal tourism agencies, officials, and members in private industry have increased efforts to educate the public about the need to conserve and protect the aspects of the coastal tourism economy that are at risk to changes in future climate. Furthermore, the Tourism sector has identified the need to coordinate broader-scale efforts to address climate change collectively within the region and to coordinate multiple individual and local-level efforts.

In addition to preparations within the Government and Tourism sectors, both the Forestry and Wildlife sectors are active in negotiating climate adaptation strategies within coastal communities in the Carolinas. Federal and state agencies that manage land in coastal zones are preparing for change by enhancing data collection and monitoring programs and piloting innovative strategies to adapt to the impacts of climate change on coastal communities. The NERRS sites in the Carolinas have established a sentinel sites program to enhance understanding of coastal processes and habitats in these critical ecosystems. This information will be used in projects that seek to reduce future climate impacts and facilitate appropriate adaptation measures for the long-term ecological health of such systems. NPO/NGOs like the NC Coastal Federation are engaged in major hydrologic restoration projects that aim to restore natural processes and enhance ecosystem resilience to future change. Adaptation efforts at the Alligator River National Wildlife Refuge (NC) include installing oyster reefs and salt-tolerant trees and plugging ditches to address issues of salt-water intrusion and erosion in the area. All of these projects are designed to add to the growing body of knowledge about climate change and coastal systems.

Multiple synergies exist among the study sectors to advance knowledge about coastal zone management. Joint efforts to enhance understanding of coastal processes and the level of risk to socio-ecological systems in the Carolinas were recommended by many study participants. Needs for tidal gauge studies, monitoring of habitat range shifts, drought impact studies, and erosion dynamic studies were indicated by a range of participants. A few large-scale experimental studies are ongoing within the Carolinas to address these gaps in knowledge, although numerous questions still remain. Additionally, opportunities to incorporate concerns about future climate changes into holistic strategic planning efforts exist. Several study participants within coastal communities discussed ongoing efforts to update or initiate large-scale community strategic planning processes. Comprehensive strategic planning processes provide a means for communities and sector representatives to negotiate goals and priorities and address tensions associated with zoning and transportation regulations, risk and hazard mitigation planning, ecological management and conservation, and economic growth and development.

The significance of coastal regions in the Carolinas, however, assures that conflicts do exist about how, when, and where to address climate concerns. This potential for conflict is exacerbated by the lack of available resources to invest in costly large scale climate mitigation or adaptation projects. For example, the requirements of managing water to meet growing human demand and consumption may conflict with strategies to mitigate the impact of drought on coastal species of concern. Hazard mitigation regulations that alter coastal building regulations and construction processes may interfere with efforts to boost tourism and recreation opportunities. Projects that, for example, seek to replace outdated municipal infrastructure to cope with enhanced flooding often compete for funds with efforts to restore and preserve areas of ecological importance.

One significant example of this type of conflict exists in North Carolina, where in 2010 a group called NC-20 was formed to emphasize economic development with the twenty coastal counties that fall under the CAMA of the state (see www.nc-20.com for more). One primary focus of the group is to concentrate “on actions to prevent regulation and rule making not based on science,” although how “science” is defined within this group is often influenced by the organization’s “science advisor,” an outspoken climate change skeptic. The group consistently targets environmental regulations that limit development along the coast (e.g., buffer rules, zoning

regulations), insurance costs and regulations for coastal development (arguing for low premiums, incentivizing coastal development), and state mandated hazard mitigation and planning procedures (most notably the organization fought against the NC Coastal Resources Commission's Sea-Level Assessment Report and recommendations for coastal policy in 2011). With a focus on economic development, the group often conflicts with long-term environmental management and hazard mitigation processes that necessitate precautionary policies and short-term compromises to ensure long-term sustainability.

Coastal zone management in the Carolinas is an area wrestling on the front lines of climate change preparation, planning, and adaptation. Each sector of this study has a large role to play in addressing climate change concerns to ensure the sustainability of these areas in the future. Among all study participants, those involved in coastal zone work indicated the highest level of awareness and interest in tackling climate adaptation concerns in the Carolinas, although disagreement and . Many have decided to launch comprehensive data collection and monitoring programs. Others are engaged with experimental action or in long-term planning initiatives that incorporate adaptation behaviors and projects. Because the coastal region has a strong sea-level rise climate signal, long-term strategies to facilitate socio-ecological adaptation within the Carolinas will be essential to enhance the ability of coastal communities to cope with changing climate conditions.

11.6.3 Land Management

Land use planning and management decisions are cross-cutting issues among the various study sectors. Because of the nature of land management and growing populations – which call for multiple land uses in areas around population centers – cross-sector collaboration has emerged as a key facilitating factor in incorporating climate change into land-use planning and related decisions. Various stages of these collaborations exist that are working to address the multiple challenges presented by land-use management and planning in the Carolinas.

Land management concerns within the Forestry and Wildlife sectors focused on preservation and conservation planning. Practices, such as prescribed burning, to maintain the health and productivity of the forest resource are central to forest land management. Data collection and monitoring of climate impacts on seasonal growth rates and migratory patterns are intended to improve understanding of potential impacts to various ecosystems and wildlife species, which can in turn be used to support management decisions. Questions regarding the use of forest lands for alternative energy production are being raised by various organizations within the Forestry sector, and research is being conducted to determine sustainable practices for biomass energy production. Forestry sector interviewees working with land trusts emphasized the importance of developing conservation easements that did not restrict the use of a parcel of land in such a way that might raise problems with maintaining a specific use under future climate scenarios. Because of impending landscape changes due to sea level rise, land use planning in coastal areas was a particularly pressing issue for the Wildlife sector. Coastal erosion and forest fragmentation, which threaten ecosystems and wildlife habitat, have led many in the Wildlife sector to prioritize land acquisition in order to provide corridors for plant and animal migrations as ecosystems begin to shift.

Tourism sector representatives indicated interest in opportunities for preserving ecosystems and wildlife habitat in order to maintain the integrity of tourist destinations in the Carolinas. Land-use planning often focuses on development of these destinations in order to realize economic

opportunities presented by the Carolinas' diverse range of scenic places. Land-use planning decisions within the tourism industry are made mostly by organizations managing public lands such as state parks and national forests, while land around population centers is largely managed through private ownership or local municipalities. Here, collaboration of the Tourism sector with local governments and regional planning groups has been pivotal in considering the impacts of climate change to these locations. Both the Tourism sector and local governments are motivated to provide healthy ecosystems and wildlife habitats to draw tourists, as well as capitalize on the economic benefit of the tourism industry to their cities and towns.

Land management within the Government and Water sectors largely involves urban planning and decision-making related to infrastructure development, building codes, zoning codes, shoreline erosion mechanisms and emergency management. Incorporation of future climate change scenarios into these planning efforts provides an opportunity to increase the life of infrastructure, diminish repair and replacement costs, decrease impact to surrounding watersheds and ecosystems, and improve public health and safety in population centers. Interviewees indicated that the capacity of the Government sector to develop comprehensive plans that address climate change impacts is in the very early stages of development. A planner from a North Carolina municipality discussed the importance of required planning to initiate the process among municipalities and the role that the CAMA has played in developing plans for 20 counties in the eastern portion of North Carolina. Counties outside of this requirement lag much further behind in their commitments to land-use and development planning. Government sector interviewees highlighted the lack of funding and resources, as well as political pushback, as constraints to efforts addressing climate change. Interview data generally suggests that the majority of adaptive planning is occurring in the coastal regions of the state (see also Section 11.6.2).

All sectors revealed a strong need for stakeholder collaboration in order to develop comprehensive land management plans that address the needs of various groups and identify shared priorities. Continued monitoring activities and data collection across sectors will inform decision-makers about potential outcomes of various land use decisions as well as which future climate scenarios should be included in planning. Information sharing regarding how various climate scenarios may affect individual sectors and how land management and use decisions might improve or disadvantage a particular resource or ecosystem will increase capacity to develop comprehensive regional plans that address multiple interests. In addition, creating and strengthening networks across sectors will contribute to the success of such collaborations. Interagency and interorganizational partnerships were identified as critical assets in coordinating these efforts.

11.7 Non-Climate Stressors

I guess my answer is that, at the regional scale, climate change adaptation is still down the list in terms of priorities and what kinds of issues people are concerned about...Climate change has not been at the top of the list; it's been job creation, air quality and so on. (Government sector participant)

As the quote above demonstrates, leaders in the Carolinas have multiple concerns, interests, and challenges that vie for attention among concerns about climate. Although opportunities to develop adaptive capacity across sectors do exist, they are often complicated by current stressors. While many of these areas of concern will arguably be compounded with changing climate

conditions in the future, the major impacts of such changes are yet to be seen. As such, climate change is currently not the greatest priority for leaders in the Carolinas.

Several of these additional stressors have already been addressed in this report (see discussions about constraints Chapters 5-9) and will not be explored in depth in this section. These include general complications regarding the lack of effective or efficient environmental governance *laws, policies, and regulations* in the region as well as major problems related to the economic recession of the past several years. Both of these issues present enormous challenges for leaders among the five sectors reviewed for this report. Environmental governance laws that are not effective at negotiating the mutual needs of human and wildlife populations place resource managers and public officials in circumstances that do not produce long-term sustainable results for either constituent group. Concurrently, budget cuts and reduced *resources and funding* have forced organizations to scale back activities, reduce programming, and cease management of regulatory processes associated with these stresses.

High priority non-climate stressors did emerge for several sectors. Forestry and Wildlife sectors noted a demand to maintain functioning ecosystems and biodiversity under threats of invasive species, fire suppression, deforestation, and altered hydrological landscapes. Participants from the Water and Tourism sectors both reiterated how recent budget constraints have forced local governments and private businesses to abandon projects or programs intended to reduce resource demand and depletion and encourage sustainable tourism practices in favor of efforts to simply meet the basic needs of constituents and keep businesses open.

Participants in all sectors highlighted key stresses related to the relationship between increasing human populations, development, and the associated environmental impacts. Many of these challenges stem from decisions about the use of land and resource use and management. As Table 11.6 demonstrates, public, private, and nonprofit organizations in the Carolinas are wrestling with record population growth, land-use change, and ecosystem alterations. These processes have far-reaching impacts on the quality of natural resources like air and water, social services and local economies, and endangered species and ecological communities. Many of these stressors interact in complex and disjointed ways.

Comprehensive land-use planning is a salient example. Regional or community land-use plans must consider zoning regulations and changes that impact rates of urbanization and sprawl, thus influencing where and how development can occur, utility and transportation infrastructure, and habitat and resource conservation. The rate of development in an area impacts demand and use of resources like water and affects storm water run-off and sewage treatment which in turn impacts water quality. Transportation infrastructure design and management has significant implications for water and air quality as well as the quality of life in a region. Habitat and resource conservation often involves critically sensitive areas like estuaries and hydrologic features which play an essential economic role in the region. These are only a few of the host of considerations that are involved in land-use planning, emphasizing the number and scope of the socio-ecological stressors leaders within the Carolinas must balance. Climate change adds another stress that may interact with these other processes.

Table 11.6 Land and Resource Use & Management and Examples of Associated Socio-Ecological Considerations

<p>Urban Sprawl</p> <ul style="list-style-type: none"> • loss of wildlife habitat and natural spaces • impacts on natural resources (air, water, timber) (priority within Forestry and Wildlife sectors) • infrastructure costs (public utilities, transportation etc.) • congestion and quality of life
<p>Coastal Development</p> <ul style="list-style-type: none"> • impact on tourism and the economy • contributions to enhanced coastal erosion • impact on livelihoods (e.g., degraded estuaries resulting in diminished fish stock) • impacts on natural resources (air, water, timber)
<p>Habitat Loss and Fragmentation</p> <ul style="list-style-type: none"> • loss of wildlife habitat and natural spaces • management of endangered and threatened species • impacts on ecosystem services and biodiversity • impacts on recreation and tourism • influence on climate change mitigation (carbon sequestration) • invasive species (priority within Forestry and Wildlife sectors) • increased fire suppression activities (priority within Forestry and Wildlife sectors)
<p>Hazard Mitigation</p> <ul style="list-style-type: none"> • costs to consumer and business • impacts on natural resources (sea-walls, shoreline hardening) • mitigate what, for who questions? • trade-offs between mitigation strategies today and adaptation capacity tomorrow
<p>Public Infrastructure Updates and Construction (roads, energy transmission, utilities)</p> <ul style="list-style-type: none"> • impacts on air and water quality • impacts on economy and businesses • influence on location of growth and development • age, longevity, and sustainability of infrastructure (safety, upkeep costs, etc.) (priority in Government sector)
<p>Building Codes and Regulation and Property Rights</p> <ul style="list-style-type: none"> • energy use and efficiency (community co2 emissions) • water quality (runoff, pollution retention, etc.) • loss of wildlife habitat and natural spaces • individual vs. collective responsibility for common pool natural resources

12 Adaptation and Adaptive Capacity in the Carolinas

The Carolinas face a combination of climate-related stresses. This research project examined activities in five major sectors - forestry, government, tourism, water, and wildlife - in order to better understand and assess regional capacity to adapt to the challenges of climate change. Document analysis followed by questionnaires and interviews with decision makers engaged in climate change activities informed an actor-based assessment of the critical decisions being made, the factors that facilitate and constrain activities, and the needs and recommendations to enhance adaptive capacity. These decision-makers were selected for their exceptional level of involvement in climate change issues and the insight their experiences offered into activities in the region. Their reports indicate the types of activities taking place at the leading edge of climate rather than in the sectors overall.

The purpose of this chapter is to highlight several key findings from the study, focusing on 1) regional climate decisions, concerns and information, 2) activities that are occurring, 3) existing adaptive capacity, and 4) needs and recommendations to build capacity as articulated by study participants.

12.1 Climate Concerns, Decisions, and Information Use

It is evident that climate plays a significant role in the decisions and activities occurring across all sectors. The region as a whole experiences considerable climate variability, and many existing decisions and activities entail measures to adapt to that variability. Study participants reported concerns about many aspects of climate change. The most frequently identified potential impacts included sea level rise and coastal flooding, increased occurrence and severity of drought, increased temperatures, and changes in the frequency and intensity of hurricanes and tropical storms. In the face of these concerns, decisions must be made that span across areas of hazard and emergency management, economic development, energy use and policy, natural resource management and allocation, transportation planning and infrastructure, and environmental preservation.

While the study participants acknowledged the potential risks and impacts associated with climate change, they also indicated that climate change is primarily addressed within the context of many other stresses affecting their sectors. Population growth coupled with development and associated demands for energy, infrastructure, and amenities are generally higher priorities than climate change.

A broad range of federal and state-level sources are utilized, among other non-government entities, to inform major climate-related decisions and address salient concerns. Some respondents reported using older research reports than others suggesting that some are better able to keep up with the rapid production of new information. Attending conferences and building networks of colleagues to enhance knowledge and understanding about climate change risks was a top strategy for study participants in all sectors. The heterogeneity of information sources used by study participants underscored the lack of a centralized source of climate information for the region or for any one sector. It was not clear whether or not a central information source would be utilized consistently across sectors if it were available, given the diverse set of established and influential information networks that already exist.

Despite the competing issues, first steps toward adaptation are taking place in all sectors and some are more advanced. However, the activities pursued in the Carolinas are currently highly influenced by public support and the political climate. With the exception of some representatives from the Wildlife sector and coastal communities, many study participants indicated that in the absence of a strong and publicly recognized climate signal, major adaptation efforts are not politically viable.

12.2 Activities and Communication Frames

Participants identified activities ranging from climate-focused data collection and monitoring, to adaptive management experiments in coastal land use, emissions reduction (mitigation), education and outreach, risk and vulnerability assessments for emergency management purposes, and habitat protection and conservation. In general, efforts in North Carolina have advanced further than those in South Carolina. North Carolina also has a greater number of people overall in the sectors analyzed for this report. Despite efforts to identify people and obtain referrals, this study includes fewer participants from South Carolina. All of the sectors analyzed are pursuing efforts in GHG emission reduction, education and outreach, and data collection on climate impacts. Emissions reduction and education-outreach efforts have been adjusted to include some information about climate within broader messages about conservation and the environment.

Baseline GHG emission inventories have been conducted across the Carolinas to give local governments an informed understanding of current emission levels, upon which to measure the progress of reduction strategies which are most often framed in terms of fuel efficiency, energy conservation, waste reduction, and improved public health and well-being. Data collection and monitoring efforts respond to the need for region-specific information on baseline conditions in order to address uncertainty about potential impacts. Decision support tools developed by the USDA Forest Service SRS provide a single go-to source of information for forested land managers, where data on potential affects to forest ecosystems under various climate scenarios can be used to support long-term planning decisions.

Adaptation related research and pilot projects are receiving greater, although not universal, support along the coastal areas where there is observational evidence of sea level rise and ecological impacts. Adaptation related interests also intersect around topics of water resource and land-use management. Water utility engineers are working to develop strategies to meet future demand under changing hydrological conditions, under the auspices of ‘no regrets’ or ‘win-win’ strategies. The Bald Head Island Conservancy is using its education and outreach center to inform residents and visitors on the impacts sea level rise will have to the island ecosystem and ways in which personal choices and actions might support mitigation efforts. Providing information to the public about issues such as salt-water intrusion, coastal land erosion, and ecosystem degradation is also a starting point in developing proponents to advocate for larger scale mitigation and adaptation efforts.

Specific *framing mechanisms* were utilized within each sector to communicate information about climate change activities to constituent or interested groups. The majority of participants reported that they avoid using the phrase “climate change” and that the elections of 2010 and 2011 were turning points in the approach to climate change in the region. As a result, many of the existing or planned climate change activities described by study participants were scaled back and/or are being integrated into existing projects or planning processes.

In addition, sectors tend to focus their public communications and efforts on climate within the context of one or several well-established topics of concern. Frames that directly connect action on climate change with dimensions of societal well-being were most prevalent. These include frames that focus on the ecosystems services to society (*ecosystem conservation*), the health risks posed by changes in climate variables (*public health/prevention*), the importance of addressing climate change within *emergency management and hazard mitigation* efforts, and, more recently, opportunities associated with *green jobs* and the new *green economy*.

12.3 Current Adaptive Capacity

Interviews and discussions of adaptation activities yielded a number of insights into the existing adaptive capacity in the Carolinas as well as needs and recommendations. Adaptive capacity is a set of resources and assets from which adaptation actions and investments can be made (Yohe & Tol 2002; Adger & Vincent 2005). Therefore, while specific adaptation measures may not be enacted in a system that has yet to experience significant pressure to adapt, existing resources, knowledge, or networks within that system can be examined to assess the potential of adaptive capability under future stressors. At this stage, mobilization is limited in the Carolinas, but within the current activities some aspects of capacity are being engaged. These early expressions of capacity indicate elements of the foundation for future efforts. Such efforts also demonstrate emerging strategies to build capacity and overcome constraints. These observations are organized according to the major categories of adaptive capacity identified in Chapter 4 and they provide additional context for the needs and recommendations that follow.

Participants highlighted two issues in *governance* that affect their adaptive capacity. Many participants noted that the federal mandates for adaptation-related activities were valuable in promoting adaptation as a priority, particularly in the face of resource constraints. Federal guidance and mandates supported the creation of multi-party, region, or state efforts. Those managing state and federal lands or natural resource areas pointed to the positive influence of organization-wide policies and protocols in ensuring that climate change is addressed in adaptation management and mitigation planning. Federal, state, or regional grant programs to enhance sustainability efforts, such as the USDOE Energy Efficiency and Conservation Block Grant Program were mentioned by many study participants as the primary factor contributing to action on climate change. Federal and state actions to incentivize GHG reductions, like REPSs and zero-carbon energy incentives, also were viewed as important motivators of climate action. The Water, Wildlife, and Forestry sectors shared many adaptation concerns and potential strategies related to land use management. In this area, the diversity of uses and the increasing fragmentation of lands due to development and urbanization pose greater challenges for governance. Given these changes, there are more stakeholders in the sector and achieving desired results requires greater levels of collaboration. These large complex processes are more difficult and time-consuming to manage successfully.

Building *human and social capital* through networks and partnerships were consistently identified as major assets and needs, particularly under fiscal constraints. Participants provided examples of networks and partnerships as important resources in allowing groups to overcome limits to support, regulatory and administrative jurisdiction, and resources. Networks and partnerships were used to demonstrate the broader range of support for efforts on climate change that made local efforts politically acceptable. Some climate adaptations require the coordination of activities across multiple jurisdictions and partnerships facilitate the necessary coordination.

Having a diverse set of partners also allowed groups to bolster their credibility by having the partner most trusted by a particular group engage with them on the topic. Partnerships were also a strategy for overcoming resource constraints. In some instances, groups brought different types of resources and expertise to their collaborations and therefore were able to widen the scope of their efforts.

As discussed in Chapter 10, there are similarities as well as significant differences in the networks utilized by the sectors. The Water sector has a strong professional network that is well supported by conferences and professional education opportunities. Within the Water resources sector, there is a group of early adopters engaged in adaptation. These include water resource engineers attempting to integrate climate change impacts into their hydrologic models and inform their design standards. The Forestry sector also has a strong professional network which builds from shared training and the tendency for many to have long careers in the field.

These professional organizations and networks both include and draw on a wide array of sources for *knowledge and information production and use*. Attending conference and building networks of colleagues were consistently identified as important opportunities to build accessible, relevant, and trusted sources of information sharing for all sectors. These partnerships are helping to build data collection and monitoring systems and local and regional baselines that many sectors want to use in documenting changes. Some of the *information needs* extend beyond the current capacity of these partnerships. The Water and Forestry sectors have well-established professional organizations to support ongoing education and research. In the Forestry sector, there is ongoing research to support the development of a biofuels industry within the Carolinas. Water utilities have also identified no-regrets options that address adaptation and provide cost-effectiveness. Participants identified these attributes as important to their increasing engagement in adaptation planning.

Institutional practices and decision-making strategies are supporting greater engagement with climate adaptation in the Forestry, Water, and Wildlife sectors. Due to the nature of the resources they manage, all of these sectors have greater experience with long-term planning including different scenarios. Their respective mandates to exercise foresight in managing forest resources, assuring public water supplies, and planning for habitat conservation all involve planning horizons that include potential climate impacts and related concerns. In addition, planning processes involving the Government sector often extend out far enough so that climate impacts are considerations. In that sector, the professional commitment to protect the public through demonstrating foresight and anticipating problems means that participants consider topics, like climate change, despite surrounding uncertainties and controversy.

In some sectors, the current capacity within institutions tied more closely to public engagement. Within the Tourism sector, the existing practices of education and outreach and direct personal engagement are being leveraged to increase public awareness and support for greater action on climate change mitigation and adaptation. The professional organizations within the Tourism sector often have an existing focus on sustainability that can include climate concerns. In addition, The Center for Sustainable Tourism at East Carolina University is a resource that provides new information and supporting conferences and networking. Participants from the Forestry sector noted that it has a well-developed urban forestry network that can be used as a vehicle for public outreach into communities with less direct connection to forest resources.

New tools and technology can support adaptation efforts. Individuals from the Forestry sector identified the ‘Template for Assessing Climate Change Impacts and Management Options’ (TACCIMO) and ‘Comparative Risk Assessment Framework and Tools’ as readily available tools for managers. Others pointed to guidance documents on conducting vulnerability assessments for wildlife. Additional tools related to knowledge and decision-support are discussed under those headings.

12.4 Needs and Recommendations for Supporting Adaptation

Sector respondents identified a variety of needs and recommendations to support adaptation and build adaptive capacity. The needs are described briefly in Table 12.1 below. A more detailed discussion of needs and recommendations follows.

Table 12.1 Needs to Address Climate Concerns in the Carolinas

<p><i>Programmatic Resources</i></p> <p>Sector leaders need adequate resources and support to implement activities at their local level and to engage in regional coordination. These needs include financial resources and staff to support travel, research programs, monitoring efforts and maintenance issues.</p>
<p><i>Governance</i></p> <p>Jurisdictional or regulatory barriers that prevent comprehensive climate action need to be removed or revised. Sectoral and political leadership is needed to provide guidance regarding climate action priorities, “no-regrets” solutions, and related regulations.</p>
<p><i>Human and Social Capital</i></p> <p>Although activities can progress in the absence of resources and support, participants expressed that ultimately substantial private and public support as well as collaborations and networks are needed to adequately address climate concerns within the Carolinas.</p>
<p><i>Institutional Practices and Decision-Making</i></p> <p>Respondents pointed to the need for better communication across organizations and sectors of government as well as improved systems to connect practitioners with providers of science, research, and decision support tools. They also expressed needs for guidance on aspects of adaptation planning.</p>
<p><i>Knowledge & Information Production and Use</i></p> <p>Sector leaders need information that is easy to find and easy to understand. Such information will not be utilized if it does not come from sources that are trusted by sector leaders or constituents. There is a strong need for more coordination of information dissemination and sources, synthesis documents and industry specific guidance. This includes specific needs from downscaled information. They also need more applied research and risk and vulnerability assessments to expose details about climate effects on site or issue-specific phenomenon.</p>
<p><i>Technology</i></p> <p>Major needs here fell within information and decision-making and are addressed under those headings, <i>Knowledge & Information Production and Use</i> and <i>Institutional Practices and Decision-Making</i>.</p>

Under the current economic circumstances, limited budgets and resources are a consistent theme. That limitation affects the status of many other *existing resources* in both the public and private

sector including staffing levels, research programs, ability to travel, support for existing monitoring programs, and ability to replace aging infrastructure. Funding was called for in order to support research and development of management strategies, programs, and projects. The sectors also identified specific needs related to public health and safety and economic opportunities. In the Forestry sector, these included enhancing the capacity to respond to fire risks, increasing their ability to respond to changes in air quality regulations, and building a capacity to initiate biomass manufacturing.

In addition, for most of the sectors, the demands of non-climate stressors compete for time, attention, and resources. Climate change is sometimes perceived as just another item on a growing list of concerns. Participants note that climate-related activities could provide multiple social and ecological benefits such as cost savings, infrastructure improvements, and improved ecological conditions, but these connections are not always made or pursued.

Under *governance*, participants expressed several needs around the development or revision of laws, policies, and regulations that encourage or mandate climate-related activities, as well as remove barriers to advance comprehensive climate change planning and action across multiple jurisdictional or regulatory boundaries. Building codes, resource management plans, and energy regulation and incentives are just a few of the areas where participants identified room for improvement. Although policy mandates are not always the first choice for public officials because of negative perceptions of such laws, participants underscored the significant role mandates have played in advancing methods to address concerns related to changing climate conditions. In keeping with that experience, many study participants saw a need for state or federal legislation that enforces the incorporation of climate-related concerns into planning and decision-making processes.

Across sectors, participants expressed a desire to engage in collaborations and multiagency projects but felt that the formal systems needed to facilitate those collaborations were lacking. Many suggested efforts to replicate success of incentives for collaboration, such as the energy grants which motivated new partnerships. These structures and incentives could build on existing regional networks. When opportunities for collective action have been available, existing regional entities including Councils of Governments and research institutes have often facilitated successful regional projects.

Within several sectors, participants identified specific governance actions they believe would be helpful at the federal and state level. Respondents in the Forestry sector requested more certainty from the federal government regarding anticipated rule-making and regulations related to climate change, including monetary valuation of carbon and regulations around carbon credits. Publications in the Water sector called for state-level legislation and policies to provide more guidance and oversight into resource management.

At the same time, several study participants recommended that the development of such policies include agency representatives, managers, and end-users. They also cautioned that utilizing existing policies that were not designed to include climate change considerations can be detrimental. For example, one participant noted the problems incurred by state governments when the Clean Air Act is used to regulate GHG emissions instead of implementing legislation specifically designed to address emissions.

Sector leaders identified needs and offered recommendations for building *human and social capital*. Above all, the most frequent and forceful recommendation among study participants was the creation and support of *collaboration and coordination networks*, projects, and multi-dimensional research frameworks. This recommendation is consistent with responses regarding factors that have facilitated climate-related action. Even in the absence of sufficient resources or political support, participants explained that collaborative opportunities for action can provide the necessary motivation for organizations to commit to address climate concerns. Joint efforts have multiple benefits, including the opportunity to share costs and expertise, mutual ownership and responsibility, enhanced credibility among the public, and the ability to leverage existing institutional networks and cross-sector connections. These networks may assist in bridging across agencies at different scales and support regional coordination. Participants from all five sectors noted this as a primary need and recommendation to move climate action forward in the Carolinas, especially given significant reductions in the available resources and public support for such action over the past several years.

Within the realm of *institutional practices and decision-making*, respondents identified a need for greater coordination and collaboration among government agencies. The conflicts, lack of coordination and communication pose barriers to activities. Government and Water sector respondents stated that a major need is formal organizational structures to enhance coordination and collaboration across multiple scales. The Tourism sector identified the need for more state-level engagement in developing comprehensive and flexible adaptation policies, strategies and planning processes.

Another set of recommendations focused on informing different aspects of the adaptation process. Respondents were interested in guidance on effective ways to communicate and frame climate information. Others were specifically interested in strategies for leveraging resources to support climate adaptation activities.

In the area of *Knowledge & Information Production and Use* a widely-reported need is for accessible information. When asked what types of climate information might be most useful or relevant in the future, participants identified three traits. First, participants indicated that information that is difficult to obtain is not likely utilized. Participants expressed frustration at the disjointed and overwhelming nature of publically accessible climate information. The need for information that is easy to access was a consistent theme. Furthermore, although a plethora of climate information may be available, participants suggested that only information that comes from trusted sources is beneficial. This is an important factor in regulating both what sources sector leaders consult, but also what sources constituents and stakeholders find credible and trustworthy. Finally, study participants underscored a strong need for the “translation” of climate information and data into non-technical and issue-relevant language. They also reported a desire for succinct information.

Sector leaders recommend continued and enhanced efforts to provide constituents with relevant and timely information about climate phenomenon and associated effects on socio-ecological systems. Outreach and education initiatives should be tailored to the needs and values of constituents so that support for activities to address climate challenges may increase. Greater availability of outreach tools and programs that connect climate characteristics to issues of broad public concern, such as the economy, public welfare, and environmental quality would be useful.

Respondents from the Government sector specifically suggested that these types of outreach materials should include training, guidance documents, and programs for agency staff, government officials, and other decision-makers.

Several specific requests focused on data. Respondents in the Forestry sector identified needs for long-term monitoring and assessment of forest species and populations and information on regional impacts along with accessible databases. These data sets are needed to inform the establishment of best management practices and programs for forest stewardship, climate adaptation and mitigation, restoration, reduction of threats and stresses on forest health, and the development of the biomass sector.

Many respondents in the Government sector identified the value of small-scale or locally specific climate data to guide them in making decisions about preparedness. This group is interested in local climate phenomenon as well as severe storms, drought, and sea level rise. There are some ongoing efforts to monitor and collect this type of information. Data on the effectiveness of management strategies for natural ecosystems under climate change scenarios would be useful in informing long-term adaptation planning. Data on the extent of infrastructure vulnerability to climate change was another specific request. Within the Tourism sector, several recommendations focused on improving understanding of potential impacts on social systems in order to improve business planning. For example, information on the role of climate-related factors among the influences on tourists' choices would be valuable. Within the Wildlife sector, respondents indicated that they would benefit from projections and more data on existing stresses such as the state of shellfish sanitation, existing erosion maps, and more specific local tidal gage data.

These sectors also identified a desire for specific types of data. In the Water sector, decision-makers could use greater quality control on sea level rise data and more specific metadata on the margin of error surrounding projections to help them in communicating their recommendations.

Several information needs specifically addressed regionally downscaled data. Representatives from wildlife conservation expressed interest in projections of sea level rise, future shorelines, temperature change, future variability of annual and seasonal precipitation, and drought at the "county-level", "watershed-scale", and 1:100,000 scale. Within the Water sector, respondents indicated primary interest in downscaled precipitation projections, followed by interests in temperature and evapotranspiration at the "watershed" scale. Respondents in this sector identified concerns both about the lack of downscaled information and the lack of agreement among climate models.

Some of the identified needs in the Wildlife sector raised questions about how downscaled information could be linked to understanding of water quality and quantity as well as impacts on species distribution and habitats. In the Water sector, respondents would like access to models that are capable of bridging future climate projections with changes in daily streamflow or lake levels.

Representatives of sectors also identified specific research needs. The Forestry sector sees need for continued work on the specific impacts which the forestry community in the Carolinas should anticipate and include in planning. Research on the potential value of peat soils in a future carbon market is also of interest. Groups with interests in the coastal areas specifically request

information on how ocean acidification may affect the mortality and morbidity of oysters, sea scallops, sea grasses, and coral reefs.

Several respondents recommended databases and portals to provide information on existing activities, such as education, where there is potential for avoiding redundancy, creating synergies, and sharing lessons.

Some interviews and documents focused specifically on support for adaptation planning activities. Recommendations in this area included development of information, tools, and techniques to help guide adaptation decisions, including guidance on impact and capacity assessments, cost-benefit analyses. Information to improve understanding on the social consequences and potential trade-offs associated with adaptation options were also identified. For instance, plugging ditches to prevent salinity intrusion and protect farmland may have consequences for other users.

All of these sectors have major interests related to resources, land-use, and coastal zone management. Improvements in factors influencing the overall adaptive capacity offer potentially broad benefits. The ability to recognize and capitalize on salient opportunities to address social and ecological needs presented by a changing climate is an essential aspect of adaptive capacity. Although study participants did not indicate a focus on the potential benefits climate change might present, the shared interests and overlapping responsibilities among study sectors create the prospect for expanding networks, partnerships and collaborations and may open doors to innovative multi-scalar initiatives.

Even still, the multiple viewpoints and interests within these sectors often mean that groups have different and conflicting interests. In these circumstances, increased capacity to conduct impact and vulnerability assessments; greater availability of information to evaluate the efficacy, cost-benefit, social consequences and trade-offs of adaptation options; and improved governance structures to address the multiple interests and jurisdictions are likely to become increasingly valuable to adaptation planning.

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Appendix A Organization and Decision Maker Search Protocol

Sector	Cross-cutting key words	Stakeholders and groups	
All	climate, climate change, climate variability, South Carolina, North Carolina, South, Southeast, adaptation, mitigation, sustainability, impact	<ul style="list-style-type: none"> Federal agency regional offices located in Southeast and/or Carolinas State and local agencies NPOs/NGOs 	
	Sector-specific key words used	Sector-specific stakeholders and groups	Sector-specific observations
Forestry	forest, biofuels, drought	<ul style="list-style-type: none"> Public and private landowners, foresters Industry (pulp and paper mills) NPOs/NGOs (working forests; protection and conservation) 	<p>Potentially a large sector, sub-sectors include:</p> <ul style="list-style-type: none"> Forest products as a crop or economic commodity Forests as an environmental resource
Government Planning	climate action, efficiency, energy, renewable, green planning, climate change mitigation plans, environmental planning, environmental advisory group	<ul style="list-style-type: none"> Sustainability coordinators and offices City and county planners Citizen Advisory Boards (environmental) NPOs/NGOs (sustainability) “Green” planning and development firms Scientists/Academics (city planning, urban development, sustainable design, climate hazards-mitigation-adaptation) 	<ul style="list-style-type: none"> Stakeholders focus on energy efficiency, renewable energy initiatives as mitigation strategy Focus narrowed by emphasizing efforts aimed at adaptation and planning and the governance structures for those activities
Tourism	sustainable tourism, Low Country, green	<ul style="list-style-type: none"> Industry and business (hotels, real estate, golf, ski, travel associations, visitors’ bureaus) Outdoor recreation (state and national parks, NPOs/NGOs) 	<ul style="list-style-type: none"> Sector is fragmented with many individual interests, no one overarching voice or representative Search started with regional-specific activities (golf-coast, state parks-mountains) and individuals with clear interest in climate, those individuals were used to locate organizations
Water-wastewater systems	water, wastewater, groundwater	<ul style="list-style-type: none"> Engineering firms, system consultants Professional associations NPOs/NGOs (water) 	<ul style="list-style-type: none"> Sector focuses on climate variability Used conference proceedings and abstracts to identify organizations and individuals (conferences, professional associations are the key forums for information-exchange)
Wildlife-habitat	wildlife, habitat, conservation	<ul style="list-style-type: none"> NPOs/NGOs (environment, conservation) Recreational users (fishing, hunting, paddling) 	<ul style="list-style-type: none"> Interest in climate change demonstrated by non-profits (organizations), academics (peer-reviewed articles)

Appendix B Document Coding and Review Protocol

Step 1: Record basic information about document and relevance to climate

Title/Author [lastname, first initial] /Date of Publication/Date Accessed/Web Address		Affiliated Organization/Author's Geographic Perspective (at what level does the author-affiliated organization primarily operate?)
Document Type/Document Length		
Type of source	Primary/first-person <ul style="list-style-type: none"> Document is an organization's "first-person" account of the climate-related plans, projects, actions, research, etc. directly undertaken by that organization 	Secondary/second-person <ul style="list-style-type: none"> Document summarizes, researchers, analyzes, reports on activities conducted by on-the-ground actors, e.g. case studies Research that investigates causes of, impacts of, possible solutions to climate-related concerns
Climate scope	Climate change/global warming	The main focus of the document is climate change and/or specific responses to or actions to mitigate climate change
	Climate variability/extremes	The document focuses on existing climate variability: natural fluctuations in climate that fall within the normal range of extremes for a particular region, as measured by temperature, precipitation, frequency of events
	Both climate change & climate variability	
	Climate mentioned – not primary	Climate (change &/or variability) may be one of many topics or issues discussed in the document; climate is mentioned but is not the primary focus of the document
	General (sustainability, green, environment)	Climate considerations are implicit; many organizations don't explicitly address climate but are interested in energy efficiency, green initiatives to reduce impacts on the environment, cut costs
Climate change focus	If yes to climate change, what does the document discuss? <ul style="list-style-type: none"> Future change (general) Specific observed or expected changes (which ones? temperature, precipitation, sea level rise) 	

Step 2: Document Characterization

- Purpose: to document the types of – and the level at which – adaptation &/or mitigation activities are occurring.

Level at which action is occurring →	Sector-National	Regional-Southeast	Carolinas (both NC and SC)	North Carolina	South Carolina	Local
Steps in the decision-making process ↓	Suggestions ...		<i>Mitigation</i> (for example...)		<i>Adaptation</i> (for example...)	
1. Acknowledge or understand threats, impacts, problems, risks	Document investigates or explains: Why is climate important?		Does the document seek to explain causes of climate change or how climate change relates to the sector?		Does the document seek to explain impacts of climate change or how those impacts relate to the sector?	
2. Deepen understanding	May include academic articles; research; presentation of findings		Does the document report on a: baseline emissions inventory or forecast, radiation budget, CO2 concentrations?		Does the document report on a: <i>risk assessment or analysis, vulnerability assessment or analysis, or impacts assessment or analysis?</i>	
3. Identify options (overview)	Document reviews current options or innovative strategies for the organization or sector; outlines best practices; may include planning documents, guidebooks		Establish GHG reduction targets, increase energy efficiency – through regulation, legislation, financial incentives?		Changing building codes, economic diversification, new coastal management laws or policies	
4. Assess options	Document considers the costs-benefits of various options – monetary &/or non-monetary					
5. Select option(s)	<ul style="list-style-type: none"> • Document includes an actual mitigation or adaptation plan; identifies goals and objectives • Does the plan highlight one specific area of climate change mitigation or adaptation (e.g. energy efficiency)? 		Improve air quality, reduce costs, reduce energy dependence, support the local economy (jobs), reduce GHG emissions		Build <i>resilience</i> , improve <i>preparedness</i> , <i>mitigate impacts</i> , reduce <i>vulnerability</i> of populations and/or places	
6. Implement plan	Document discusses actual implementation of policies, measures; has the plan been enacted?					
7. Monitor and evaluate	<ul style="list-style-type: none"> • relevant organization is measuring results • relevant sector or research is investigating outcomes; may include case studies of, “lessons learned” from implementation 					

Step 3: Need Articulation: Has the sector articulated any climate change needs and what are they?

- Purpose: to identify climate change-related needs articulated by the sector.
- Key words to search for: recommend[at ions], suggest[i ons], should, could, lessons, require[ments], resource- or capacity needs, challenges/constraints, information needs, uncertain[ties]

Questions about needs	Examples to guide selection of text
Need Identification Process: Does the document specify the data, information, or processes through which needs were identified or determined?	<ul style="list-style-type: none"> • Global Circulation Models (GCMs), climate change data sets, emissions inventories • Forecasts, scenarios, literature review, risk-vulnerability-impacts assessments • Consultants, meetings, workshops, surveys
Constraints and Barriers: Does the document articulate any constraints and/or barriers that prevent or hinder action?	Factors that impede or hinder efforts to implement mitigation or adaptation plans; action hindered because of unknown information, legislation, resources, etc.
Identified Needs: What specific types of needs, recommendations, &/or “possible solutions” are identified?	<ul style="list-style-type: none"> • Information (including research to address uncertainties) • decision-support tools (e.g. software) and processes (e.g. organization or integration of info) • legislation or regulation • financial resources • public education-awareness • government support
Need Characterization: Is the need related to mitigation, adaptation or both?	

Step 4: Network Connections

- Purpose: to identify networks

Questions about networks	Examples to guide selection of text
Information Sources: Does the document discuss what regional or local climate data is used and the sources of that data?	Indicate if these offices are used as sources of information: <ul style="list-style-type: none"> • “Southeast Regional Climate Center” “SERCC” • “state climate office” “South Carolina State Climatology Office” “State Climate Office of North Carolina” • “National Weather Service”
Authorship: Who was involved in developing the document?	A single organization or a collective of different stakeholder groups?
Partnerships: Does the document reference collaborating partners or agencies?	Does a plan or project involve or require the participation of or funding from more than one agency or organization? (e.g. habitat protection projects may involve federal-state agencies, NGOs, industry, private landowners)
Resources Cited: What groups, organizations, or people are recommended as resources?	“For more information, see the following...” for example, government agencies, non-profits, individuals, industry initiatives, member associations

Appendix C Initial Contact by Phone



Department of Geography, University of South Carolina
Columbia, SC 29208 (803) 777-2482 or 777-3463
<http://www.cas.sc.edu/geog/research/cisa/>

- 1) This is _____, I am a _____ in the Department of Geography at the University of South Carolina and a _____ for the Carolinas Integrated Sciences and Assessments.
- 2) I am requesting your help to participate in a research project “Engaging climate-sensitive sectors, decisions, and peoples in the Carolinas.” This is a federally funded project that seeks to understand how different sectors and regions in the Carolinas and elsewhere in the United States are planning for climate change and variability
- 3) For this project we are assessing climate-sensitive sectors and decisions in the Carolinas. We will be interviewing opinion leaders within the areas of recreation and tourism, wildlife management, water resources, forestry, and municipal government to identify their concerns, capacities, and information needs. Information obtained from these interviews will be used to inform the US National Climate Assessment in efforts to understand and address climate change in the US.
- 4) Your name was identified as a key decision leader in climate-related decisions based on your position with (fill in appropriate organization). You were identified after an extensive web search of climate related-documents and organizations involved in sustainability initiatives or climate change mitigation or adaptation activities.
- 5) For this project, we would like for you to fill out a brief online questionnaire and participate in an interview. The interview can be conducted in person or by phone, they will be recorded and then transcribed by staff working on this project. Interviews are expected to last between 45-60 minutes.
- 6) Of course, your participation in this project is completely voluntary and your answers will be kept completely confidential. You may withdraw at anytime and you may request that we not use the information you provided to us.
- 7) Do you have any questions?
- 8) Are you willing to participate in this project?
 - a. YES:
 - i. Thank you.
 - ii. We will email you
 1. Written Questionnaire: We will send you an email with a link to the brief online questionnaire. Or, would you prefer to receive the questionnaire in paper form?
 - a. PLEASE CONFIRM EMAIL: _____
 2. An informed consent form for your records that contains the information we just discussed including the research, your rights as a participant, and how the information you provide will be used in the study.
 - a. This form will be completed online – it is part of the questionnaire
 - b. On the Informed Consent Form you will be asked
 - i. Whether or not:
 1. we can use your name and organizational affiliation in our research report

2. we can only mention your organization name
3. or if you prefer full confidentiality.
 - ii. If you would like a copy of the final report.
 1. Printed or electronic?
 - iii. Once you have completed the online survey, we will contact you to schedule an interview. Would you prefer to be contacted by phone or email? Would you prefer an in person or phone interview?
 - iv. Or, would you rather schedule an interview date and time now?
 - v. Do you have any questions?
- b. NO
 - i. Is there someone else in your organization or sector that you would recommend we contact?
 1. If yes, obtain name and contact information
- c. Thank you

Appendix D Initial Contact by E-Mail



Department of Geography, University of South Carolina
Columbia, SC 29208 (803) 777-2482 or 777-3463
<http://www.cas.sc.edu/geog/research/cisa/>

Dear (name),

My name is (name) and I am a research assistant for the Carolinas Integrated Sciences and Assessments in the Department of Geography at the University of South Carolina.

Currently, we are conducting research to inform the United States National Climate Assessment, the national status report on climate change science and impacts. More information on the National Climate Assessment can be found at www.globalchange.gov/what-we-do/assessment.

Our research project, entitled “Engaging climate-sensitive sectors, decisions and peoples in the Carolinas,” is a federally funded project which seeks to understand how different sectors and regions in the Carolinas, and elsewhere in the US, are planning for climate change and variability. We are assessing climate-sensitive sectors and decisions in the Carolinas and will be interviewing opinion leaders within the areas of recreation and tourism, wildlife management, water resources, forestry, and municipal government to identify their concerns, capacities, and information needs.

Your name was identified as a key decision leader in climate-related decisions based on your position with (fill in appropriate organization name). You were identified after an extensive web search of climate related-documents and organizations involved in sustainability initiatives, climate change mitigation or adaptation activities. Therefore, we would like to request your participation in the project.

Participation will entail a brief online questionnaire and a follow-up interview. The interview can be conducted in person or by phone. All interviews will be recorded for accuracy and then transcribed by staff working on this project. We anticipate the interviews to last between 45 and 60 minutes.

Of course, your participation in this project is completely voluntary and your answers will be kept completely confidential based on your confidentiality preference. You may withdraw at anytime and you may request that we not use the information you provided to us.

Please let me know if you are interested in participating. I would be glad to provide any additional information you may need prior to making a decision. If I have not heard from you within two days, I’ll try to contact you again via phone.

I can be reached via e-mail at [\(address\)@email.sc.edu](mailto:(address)@email.sc.edu). Or, if you would prefer to speak over the phone, please let me know when you might be available for a call.

Thank you for your consideration. I look forward to hearing from you.

Appendix E Introduction Packet



DEPARTMENT OF GEOGRAPHY, UNIVERSITY OF SOUTH CAROLINA
COLUMBIA, SC 29208 (803) 777-2482 OR 777-3463
cisa@sc.edu

INTRODUCTION PACKET

“Engaging Climate-Sensitive Sectors, Decisions, and Peoples in the Carolinas”

Dear _____,

The Carolinas Integrated Sciences and Assessments (CISA) research team would like to thank you for your participation in the Engaging Climate-Sensitive Sectors, Decisions, and Peoples in the Carolinas research project.

Enclosed please find background information about CISA and the National Climate Assessment as well as a copy of the informed consent information. This copy of the informed consent is for your personal records. You will be asked to provide acknowledgement of receipt of this information and to choose the confidentiality option that best suits you when you complete the online questionnaire. **You do not need to return the enclosed informed consent.**

The first step of participation will be completion of a brief online questionnaire. Your answers will help us conduct the interview process efficiently and assure we understand your organization’s use of climate information, activities which address climate variability and change, and needs in terms of future climate information.

You can access the questionnaire through this link:

https://www.surveymonkey.com/s/National_Climate_Assessment_Project_Pre-Interview_Survey

Please copy the link above in your preferred internet browser. If you have trouble accessing the questionnaire, please call us at (803) 777-8977 or e-mail cisa@sc.edu.

Once you have completed the questionnaire, we will contact you to schedule an interview if this has not already been set. This interview may be conducted in person or over the phone and will be recorded in order that we are able to transcribe it for accuracy. We anticipate the interview lasting between 45-60 minutes.

Again, we greatly appreciate your participation in the National Climate Assessment research project. Your input will provide a deeper understanding of current efforts to address climate variability and change in the Carolinas and will help shape future research efforts.

If you have any questions or need additional information, please let us know.

Sincerely,

_____, Research Assistant

Dr. Kirstin Dow, Principal Investigator



DEPARTMENT OF GEOGRAPHY, UNIVERSITY OF SOUTH CAROLINA
COLUMBIA, SC 29208 (803) 777-2482 OR 777-3463

PROJECT INFORMATION & INFORMED CONSENT

“Engaging Climate-Sensitive Sectors, Decisions, and Peoples in the Carolinas”

What is CISA? CISA is one of 11 regional teams funded by the Office of Climate Programs within the National Oceanic and Atmospheric Administration (NOAA). Our research projects aim to improve the relevance and accessibility of climate science for decision-making and resource management in North and South Carolina. We work with partners in government, non-governmental organizations, utilities, business, and universities to understand their scientific needs and develop information to meet those needs. We are based in the Department of Geography at the University of South Carolina. Other team members include the Director of the Southeast Regional Climate Center and the Regional Climate Change Specialist for North and South Carolina Sea Grant.

What is the purpose of this project? This project is designed to understand the various dimensions of regional capacity to cope with and adapt to climate variability and change. This will be accomplished by identifying current and future climate-sensitive decisions, examining the capacities and networks that currently exist to support decision-making, and documenting articulated needs to facilitate decision-making and adaptive actions. Our goal is to inform the [National Climate Assessment](#) (NCA) about these issues so that the NCA is able to consider them in preparing for their next report (due June 2013) to the President and Congress. The NCA aims to evaluate information regarding climate science and impacts, highlight key findings and significant gaps in our knowledge, and help the federal government prioritize future climate-related research and activities. (<http://www.globalchange.gov/what-we-do/assessment>).

How was I chosen? We are working with opinion leaders and decision-makers representing recreation and tourism, wildlife management, water resources, forestry, municipal government, and native peoples. You were chosen based on your knowledge and interest in the potential impacts of climate variability and change in the Carolinas or your sector. We will interview approximately 30 individuals from each sector.

What will be involved in participating? You will be asked to complete a brief written questionnaire (available online) and to participate in one interview. This interview can take place over the phone or in person. This session will last approximately 45-60 minutes. If necessary, we will schedule a short follow-up interview sometime after this initial meeting. We will record and transcribe the interviews. You will be asked questions regarding the climate information you use when making decisions and/or planning for future, climate-related issues faced by your organization, current or anticipated activities to address climate change concerns, issues that pose constraints to such activities, and the most effective resources and networks for the delivery and communication of climate information.

Will I be paid for my time? No

Who will know what I say? You have the right to choose full confidentiality, to have only your sector- or organization association included, or to have your name and organization association used in the report. If you prefer full confidentiality, only the project staff from the University of South Carolina will have access to the tapes and transcripts of your conversation, your name will not appear in the transcripts, and no identifying information will be associated with your comments in any publications or presentations. If you would like to have your name and/or affiliation associated with your statements in our publications and reports, please check the appropriate box on the informed consent portion of the online questionnaire indicating that you waive your right to confidentiality.

What risks and benefits are associated with participation? We do not foresee any risks to you due to participation in this study. We will be asking you to share knowledge and information regarding climate-related concerns to your

organization, community, or sector. We respect and encourage you to exercise your right to withhold any information you see as potentially sensitive or to ask us to not publish or present on specific information.

You may benefit directly or indirectly from this research. Information obtained in this project and reported to the NCA process will highlight regional needs and issues of concern. While we cannot guarantee federal response to the final summary report, the report may inform future efforts to improve climate research and facilitate adaptation activities. On a local and regional level, we will be pleased to share our knowledge of climate change research and resources. As a research team, CISA is willing to discuss collaborative research related to the needs you identify or help you make connections to people with the appropriate expertise.

What are my rights as a participant? You may ask questions regarding the research, and they will be answered fully. You may choose not to answer any question. You may withdraw from the study at any time without any penalty, and you may request that we not use the information you have provided to us. Your participation is completely voluntary.

What will be published or presented? We will make our findings known through a report to the National Climate Assessment. This report will also be freely available on our website. We will participate in lectures and conferences and plan to publish several article-length reports that will appear in professional journals.

If I want more information, who should I contact?

Dr. Kirstin Dow, PI
Department of Geography, University of South Carolina
Columbia, South Carolina 29208
Phone: 803-777-2482
E-Mail: KDow@sc.edu

Kirsten Lackstrom, co-PI
Department of Geography, University of South Carolina
Columbia, South Carolina 29208
Phone: 803-777-3463
E-Mail: Lackstro@mailbox.sc.edu

If you have any questions, concerns, or complaints about the research and wish to talk to someone other than the individuals on the research team, or if you cannot reach the research team, contact the University of South Carolina, Office of Research Compliance, 803-777-7095. (<http://orc.research.sc.edu/contact.shtml>).

THIS IS FOR YOUR RECORDS ONLY. YOU WILL BE ASKED TO COMPLETE THIS FORM ONLINE WITH THE SURVEY. YOU DO NOT NEED TO RETURN THIS FORM.

“Engaging Climate-Sensitive Sectors, Decisions, and Peoples in the Carolinas”

I have read **this entire form** and my questions about this study have been answered. I agree to participate in this research study.

Participant Name: _____

Participant Signature: _____ Date: _____

I waive confidentiality. You may use my name and identify me as associated with

Do not use my name, but you may mention that I am associated with

I prefer full confidentiality. Do not use my name or group affiliation in any reporting.

I would like to receive a copy of the report.

I prefer a _____ printed _____ electronic copy.

Appendix F Questionnaire

NCA Pre-Interview Questionnaire

1. Introduction

Thank you for your interest in our project "Engaging Climate-Sensitive Sectors, Decisions, and Peoples in the Carolinas." This federally funded project seeks to understand how different sectors and regions are planning for climate variability and change. Your perspectives are important to help inform the National Climate Assessment of the United States. We would appreciate it if you would take 15 minutes to fill out this brief questionnaire so we can understand what climate information you use and need, where you obtain your climate information from, and what activities you are engaged in that address concerns related to climate variability or change. We will revisit many of your responses provided in this questionnaire during a follow-up interview.

Questionnaire and interview participation is voluntary and greatly appreciated. As a volunteer, you may withdraw at any time and you may request that we not use the information you have provided to us. Only project staff will have access to original survey data, but summary of responses will be used in reports and presentations. Please contact us if you have questions or would like additional clarification about any part of this project.

Thank you,

Kirstin Dow
Principal Investigator
KDow@sc.edu, 803-777-2482

Kirsten Lackstrom
Collaborating Investigator
Lackstro@mailbox.sc.edu, 803-777-3463

2. Informed Consent

Before you can proceed with this survey, please ensure that you have read the project informed consent material and indicated your confidentiality preferences below.

***1. By clicking on the "Agree" button below, you acknowledge that you have read the informed consent information you received from the Carolinas Integrated Sciences and Assessments and agree to participate in this research, with the knowledge that you are free to withdraw your participation at any time without penalty.**

I agree to participate in the "Engaging Climate-Sensitive Sectors, Decisions, and Peoples in the Carolinas" research study.

***2. Please enter your name.**

First name

Last name

***3. Date (MM/DD/YYYY)**

NCA Pre-Interview Questionnaire

***4. Please select the appropriate box to indicate your preference for confidentiality in research reports or publications.**

- I waive confidentiality. You may use my name and identify my employer or affiliated organization.
- Do not use my name, but you may identify my employer or affiliated organization.
- I prefer full confidentiality. Do not use my name or identify my employer or affiliated organization.

5. If you are willing to be identified by employer or affiliation, please specify the name of the organization you would like us to use.

3.

***6. Please indicate whether or not you would like to receive a copy of our final research report.**

- Yes, I would like to receive a copy of the final research report.
- No, I would not like to receive a copy of the final research report.

7. If you answered "Yes" to receive a report, would you prefer a:

- Printed Copy
- Electronic Copy

4. Climate Information

Several of the questions in this survey address the types of climate information you use or would like to use. Because people have different understandings of what is meant by "climate information", we have included our broad definition and some examples.

NCA Pre-Interview Questionnaire

Climate information refers to the numerical values or qualitative terms that describe climatic conditions of a place or region. There are several types of climate information, which can be obtained from many different sources. Different types and uses of climate information include:

Indices: Values that are derived by combining multiple data sets into a single measurement.
Temperature and humidity data can be combined to create a heat stress index.

Climate Normals: Long term averages of meteorological factors.
Farmers use information on first and last freezing dates to make planting or harvesting decisions.

Climate Extremes: The minimum and maximum values for a given phenomenon or major extreme events.
The maximum amount of rainfall received for a time period of interest can be used for planning stormwater drainage systems.

Climate Summaries: Summary data for daily, monthly, seasonal, or annual time periods.
The number of heating days per year (days below 65° F) can be used by utilities to estimate expected energy use during the winter.

Forecasts or Outlooks: Seasonal, decadal, or centennial predictions and projections about future climatic conditions.
Soil moisture and snow pack conditions can be used to predict stream flow. Projections of longterm change in temperature or precipitation can be helpful in infrastructure planning.

5. Agencies

Climate information is provided by many state and federal agencies. We are interested in learning about the types and sources you find useful.

***8. Do you obtain climate information from the following state agencies at least once a year?**

	Yes	No
NC Department of Environment and Natural Resources (DENR)	<input type="radio"/>	<input type="radio"/>
NC State Climate Office	<input type="radio"/>	<input type="radio"/>
SC Department of Health and Environmental Control (DHEC)	<input type="radio"/>	<input type="radio"/>
SC Department of Natural Resources (DNR)	<input type="radio"/>	<input type="radio"/>
SC State Climatology Office	<input type="radio"/>	<input type="radio"/>
Other (please specify)		
<input type="text"/>		

NCA Pre-Interview Questionnaire

***9. Do you obtain climate information from the following federal agencies at least once a year?**

	Yes	No
Climate Prediction Center	<input type="radio"/>	<input type="radio"/>
Environmental Protection Agency (EPA)	<input type="radio"/>	<input type="radio"/>
National Aeronautics and Space Administration (NASA)	<input type="radio"/>	<input type="radio"/>
National Climatic Data Center (NCDC)	<input type="radio"/>	<input type="radio"/>
National Integrated Drought Information System (NIDIS)	<input type="radio"/>	<input type="radio"/>
National Oceanic and Atmospheric Administration (NOAA)	<input type="radio"/>	<input type="radio"/>
NOAA Climate Services	<input type="radio"/>	<input type="radio"/>
National Weather Service (NWS) Regional-Local Offices	<input type="radio"/>	<input type="radio"/>
NWS Climate Service Division	<input type="radio"/>	<input type="radio"/>
Southeast Regional Climate Center (SERCC)	<input type="radio"/>	<input type="radio"/>
United States Army Corps of Engineers	<input type="radio"/>	<input type="radio"/>
United States Fish and Wildlife Service (USFWS)	<input type="radio"/>	<input type="radio"/>
United States Geological Survey (USGS)	<input type="radio"/>	<input type="radio"/>
Other (please specify)	<input type="text"/>	

10. Please list the top three types of climate information provided by state or federal agencies that you use for your job.

Type of Information (A)

Type of Information (B)

Type of Information (C)

11. For each type of information you provided in Question #10, please provide: the primary agency where you obtain this information; how frequently you consult this source; and the primary way you access this source.

	Primary agency where you obtain this information	How often you consult this source	Primary way you access this source
Type of Information (A)	<input type="text"/>	<input type="text"/>	<input type="text"/>
Type of Information (B)	<input type="text"/>	<input type="text"/>	<input type="text"/>
Type of Information (C)	<input type="text"/>	<input type="text"/>	<input type="text"/>

6. Documents

There are many sources of climate information available. We are interested in learning which documents you find useful in obtaining climate information.

NCA Pre-Interview Questionnaire

*12. Do you obtain climate information from the following documents?

	Yes	No
Scientific literature (written by scientists)	<input type="radio"/>	<input type="radio"/>
Professional journals or publications (written by experts in your field)	<input type="radio"/>	<input type="radio"/>
International-level reports (e.g., Intergovernmental Panel on Climate Change)	<input type="radio"/>	<input type="radio"/>
National-level reports (e.g., Global Climate Change Impacts in the U.S.; America's Climate Choices)	<input type="radio"/>	<input type="radio"/>
State-level reports (e.g., final reports of the North Carolina Climate Action Plan Advisory Group; South Carolina Climate, Energy & Commerce Advisory Committee)	<input type="radio"/>	<input type="radio"/>

Other (please specify)

13. What are three key printed documents that you use to obtain information about climate. These documents may include books, journals, reports, or articles.

Document A

A

Document B

B

Document C

C

14. How frequently do you consult or use the documents provided in Question #13?

Please select only one per document.

	Daily	Weekly	Monthly	Semi-annually	Annually	One-time
Document A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Document B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Document C	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7. Other Sources of Information

Climate information can also be obtained through other sources, such as workshops, listservs, friends, and colleagues. This section seeks to understand which of these sources you consult.

*15. Do you obtain climate information from the following sources?

	Yes	No
Conferences or Workshops	<input type="radio"/>	<input type="radio"/>
Listsers	<input type="radio"/>	<input type="radio"/>
Colleagues or Organizations in Your Sector	<input type="radio"/>	<input type="radio"/>
Friends	<input type="radio"/>	<input type="radio"/>

Other (please specify)

NCA Pre-Interview Questionnaire

16. For each source that you consult regarding climate information, please provide the name(s) of the...

Conferences or Workshops	<input type="text"/>
Listserve	<input type="text"/>
Colleagues or Organizations in Your Sector	<input type="text"/>
Friends	<input type="text"/>
Other	<input type="text"/>

17. In general, how frequently do you consult each of the categories below for climate information? Please select only one per category.

	Daily	Weekly	Monthly	Semi-annually	Annually	One-time
Conferences or Workshops	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Listserve	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Colleagues or Organizations in Your Sector	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Friends	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (Listed in Question # 16)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. Providing Climate Information

The previous sections addressed questions relating to where you obtain climate information. As background to our future conversation, we are also interested in your role in providing climate information to other organizations.

***18. Do you provide climate information to others in your sector, including those within other sub-units of your organization?**

- Yes
 No

19. How often do you provide climate information to the following types of organizations?

	Frequency
Academic	<input type="text"/>
Non-governmental	<input type="text"/>
Non-profit	<input type="text"/>
Private	<input type="text"/>
Public/Government Agencies	<input type="text"/>

NCA Pre-Interview Questionnaire

9. Activities to Address Climate Variability or Climate Change

In this section, we are interested in learning about actions you are involved with that address concerns related to climate variability and/or change.

***20. Are you currently involved in actions related to climate variability and/or change that...**

	Yes	No
Expand Risk Management Activities for Climate-Related Events	<input type="radio"/>	<input type="radio"/>
Address Year-to-Year or Seasonal Variability in Weather and Climate Patterns	<input type="radio"/>	<input type="radio"/>
Address Increased Changes in Average, Long-term, Climate Conditions and/or Increased Frequency and Intensity of Extreme Events	<input type="radio"/>	<input type="radio"/>
Provide Education, Training, Workshops, and Conferences	<input type="radio"/>	<input type="radio"/>
Reduce Greenhouse Gas Emissions	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>

10. Activities to Address Climate Variability or Climate Change Continued

21. For each of the applicable categories below, please give a brief description of specific activities that...

Expand Risk Management Activities for Climate-Related Events	<input type="text"/>
Address Year-to-Year or Seasonal Variability in Weather and Climate Patterns	<input type="text"/>
Address Increased Changes in Average, Long-term Climate Conditions and/or Increased Frequency and Intensity of Extreme Events	<input type="text"/>
Provide Education, Training, Workshops, and Conferences	<input type="text"/>
Reduce Greenhouse Gas Emissions	<input type="text"/>
Other (listed in Question #20)	<input type="text"/>

NCA Pre-Interview Questionnaire

22. Please feel free to provide additional information about any of the activities you listed above.

11. Information Needs

In the next question, we are interested in the types of climate information that might be useful that you do not already have.

23. What climate information would be most useful to you, that you currently do not have?

12. Thank You

Thank you for taking the time to share your experiences regarding your use of climate information and activities that you are involved in that address climate-related concerns. We look forward to following-up with you on these responses in the next few weeks.

Appendix G Interview Protocol and Questions



DEPARTMENT OF GEOGRAPHY, UNIVERSITY OF SOUTH CAROLINA
COLUMBIA, SC 29208 (803) 777-2482 OR 777-3463

“Engaging Climate-Sensitive Sectors, Decisions, and Peoples in the Carolinas”

A. Interview Preparation

- 1) Review information about interviewee and interviewee’s organization, from previously collected documents and information entered into project database
- 2) Review information provided in online questionnaire

B. Questions about the Interviewee and his/her Organization

Applicable if this information was not already obtained from documents, webpages, or previous contact with the interviewee, or if additional clarification is needed.

As a reminder, I am recording this conversation to accurately document your responses.

- 1) *“Please tell me about yourself?”*
 - a) What are your job title and job responsibilities?
 - b) How long have you worked with this organization? What was your previous job?
- 2) *“Please tell me about your organization?”*
 - a) What is your organization’s mission or purpose?
 - b) Who are your primary clients or audience? With whom does your organization interact and how?

C. Climate Information and Decision-making

- 1) Follow-up to questions [**Agencies – 8,9; Documents - 12,13; Other Sources – 15,16**] about sources of information used (**go through each of the three areas separately**):
“In the questionnaire, we asked you to indicate the key sources from which you (or your organization) obtain climate information. You indicated that your organization obtains information from _____.”
 - a) Why are these particular sources of climate information useful or relevant?
 - b) Interviewer may want to distinguish between sources of information: agencies, documents, other sources (e.g. colleagues, friends)
- 2) Follow-up to question [**10**] about types of climate information used and how that information is used:
“In the questionnaire, we also asked you to indicate the types of information you obtain from those sources. You indicated that your organization is interested in _____.”
 - a) Are these your organization’s key climate- and weather-related interests and concerns?
 - b) If no, please identify your organization’s key interests and concerns.

- c) How is this information used: for making decisions, monitoring conditions, planning?
- d) How do these interests and concerns relate to key decisions made by your organization during the course of a year?
- e) Other Prompts:
 - i) What are your organization's key climate-sensitive decisions and when are they made?
 - ii) Can you identify key dates, seasons, or cycles when key decisions need to be made?
 - iii) Are climate concerns related to day-to-day or longer-term issues?
 - iv) When during the year, or how frequently, does your organization engage in longer-term planning (longer than a one-year cycle)?
 - v) Are there internal documents you use to assist you in the decision-making or planning process that you would be willing to share with us?
- f) Examples:
 - i) Operational use of climate/weather information (water, industry, municipality, tourism-water release)
 - (1) daily, weekly
 - (2) release schedules
 - ii) Seasonal decisions (planting, harvesting, water conservation, purchasing-inventory, maintenance)
 - iii) Annual planning (budgets, implementing or monitoring programs)
 - iv) Longer-term planning (determine reservoir safe yields, construction and upgrading of infrastructure, development of preparedness and response plans (extreme events, drought), address anticipated climate change impacts)

D. Providing Climate Information

- 1) Follow-up to questions [18, 19] if interviewee provides climate information to others:

“On the questionnaire you indicated that you provide climate information to others in your organization or sector and that you provide climate information to these types of organizations: _____.”

 - a) Could you provide more detail about these organizations?
 - b) What type of information do you provide?
 - c) How is that information used? For what purpose?
 - i) making decisions, monitoring conditions, planning

E. Framing of Climate Concerns and Activities

- 1) In general, how does your organization approach the issue of climate change or global warming?
- 2) How does this framing of climate change or global warming correspond with the primary responsibilities of your organization?
- 3) What is the relationship between “sustainability” initiatives and climate change?

F. Activities to Address Climate Variability or Climate Change

- 1) Follow-up to questions [20, 21] if interviewee indicated involvement with climate-related activities:

“On the questionnaire, you indicated that you (or your organization) is currently engaged in _____. Could you describe or provide more information about these activities?”

Activities may (**go through each area checked “yes” separately**):

- a) “Expand risk management for climate-related events” (infrastructure projects that reduce existing climate threats)
- b) “Place emphasis on year to year, or seasonal, variability in weather or climate patterns” (preparedness and planning for future events associated with climate variability, drought response plans, evacuation planning, communications protocols, evaluating risks)
- c) “Place emphasis on increased changes in average, long term climate conditions and/or increased frequency and intensity of extreme events” (planning for events associated with climate change, adaptation)
- d) “Provide education, training, workshops, conferences” (who is trained, who did the training, what was the focus of training)
- e) “Reduce greenhouse gas emissions” (mitigation)

Follow-up Questions:

- 2) *“When (in what year) did your organization begin to engage in this activity?”*
- 3) *“What motivated these activities?”*
 - a) Was there a specific event, threshold, or opportunity that triggered action?
 - b) Has the motivation for these activities changed over time?
- 4) *“Are these activities integrated into existing work or stand-alone projects?”*
 - a) Who in the organization is involved?
 - b) Do these activities relate to important organizational decisions you discussed earlier?
- 5) *“What progress has been made?”*
 - a) Is the project in the planning stages, ongoing, completed?
 - b) What specific outcomes have resulted from these activities? (if applicable)
 - c) Has your organizations monitored or evaluated progress?
 - d) Is this a pilot project? Have additional projects been implemented or knowledge been transferred?
 - e) Have there been “maladaptations” or unintended consequences?
 - f) What have you or your organization learned?
- 6) *“What factors were important in facilitating planning or implementation of the project(s)?”*
 - a) Key people, partners, sources of expertise, leadership
 - b) Funding
 - c) Data or information
 - d) Laws, regulations, or requirements
 - e) Networks (formal or informal, existing or emerging)
- 7) *“What factors were important in limiting or constraining planning or implementation of the project?”*
 - a) How have you addressed or resolved these constraints?

- b) What challenges or constraints are still in place? Would you classify any of these as absolute barriers to moving forward?

G. Information Needs

- 1) *“Specific to the activities (Questions 20,21) we have just discussed, what data and information would be most useful as your organization continues with the planning or implementation of projects?”*
 - a) Prompts: training materials, reports, consultations, scientific data
- 2) Follow-up to question [23] about information needs:
“On the questionnaire you indicated that _____ would be useful for your organization. Why?”
- 3) *Are there additional products, information, or tools that you or your organization would find useful?*

H. Additional Resources & Contacts

- 1) *“Are there documents produced by your organization that might be relevant to this study that you would be willing to share with us?”*
- 2) *“Are there people or organizations in your sector that you see as particularly important when it comes to climate change that you would recommend we speak to?”*
 - a) Why are these individuals important?

Appendix H Thank You Correspondence to Study Participants



Department of Geography, University of South Carolina
Columbia, SC 29208 (803) 777-2482 or 777-3463
<http://www.cas.sc.edu/geog/research/cisa/>

Dear (name),

The Carolinas Integrated Sciences and Assessments research team would like to extend our sincere thanks for your participation in the U.S. National Climate Assessment (NCA) research project, Engaging Climate-Sensitive Sectors, Decisions, and Peoples in the Carolinas! The information and perspective you provided in the online questionnaire and follow-up interview have provided valuable insight into how important organizations like yours are addressing climate variability and change in the Carolinas.

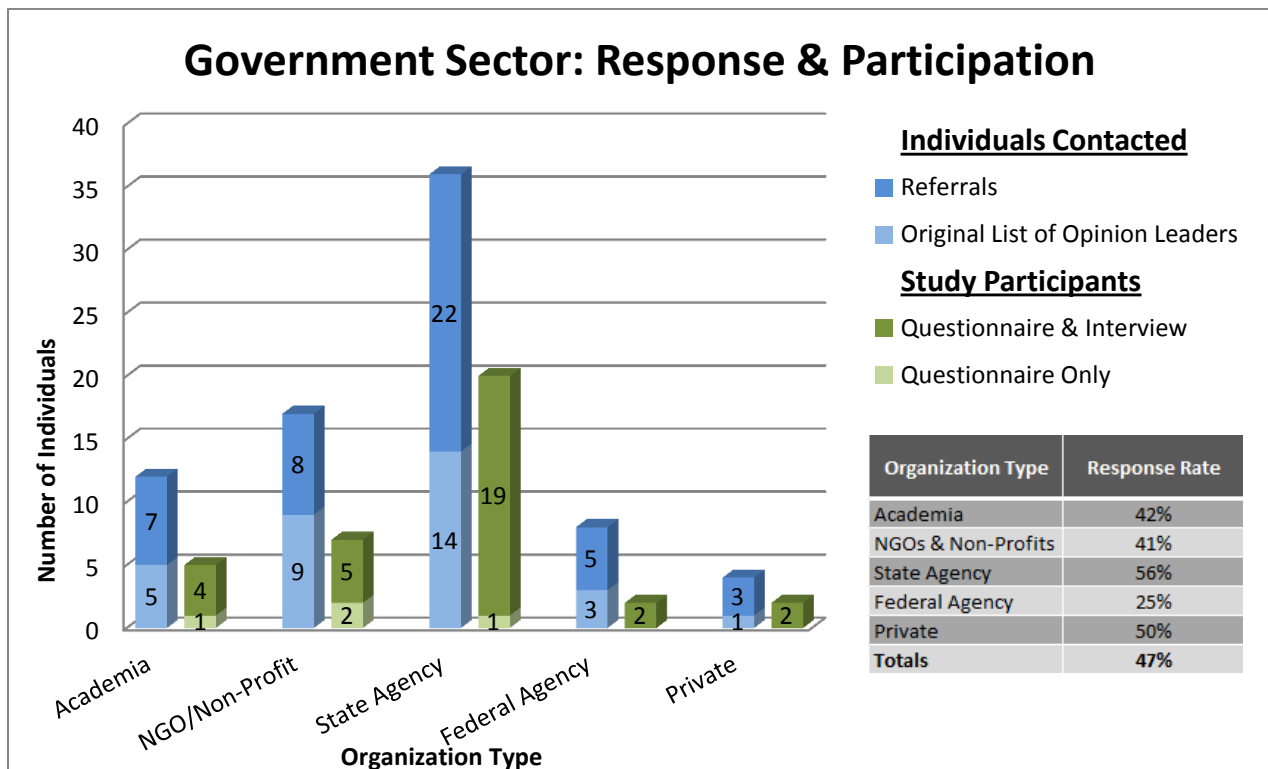
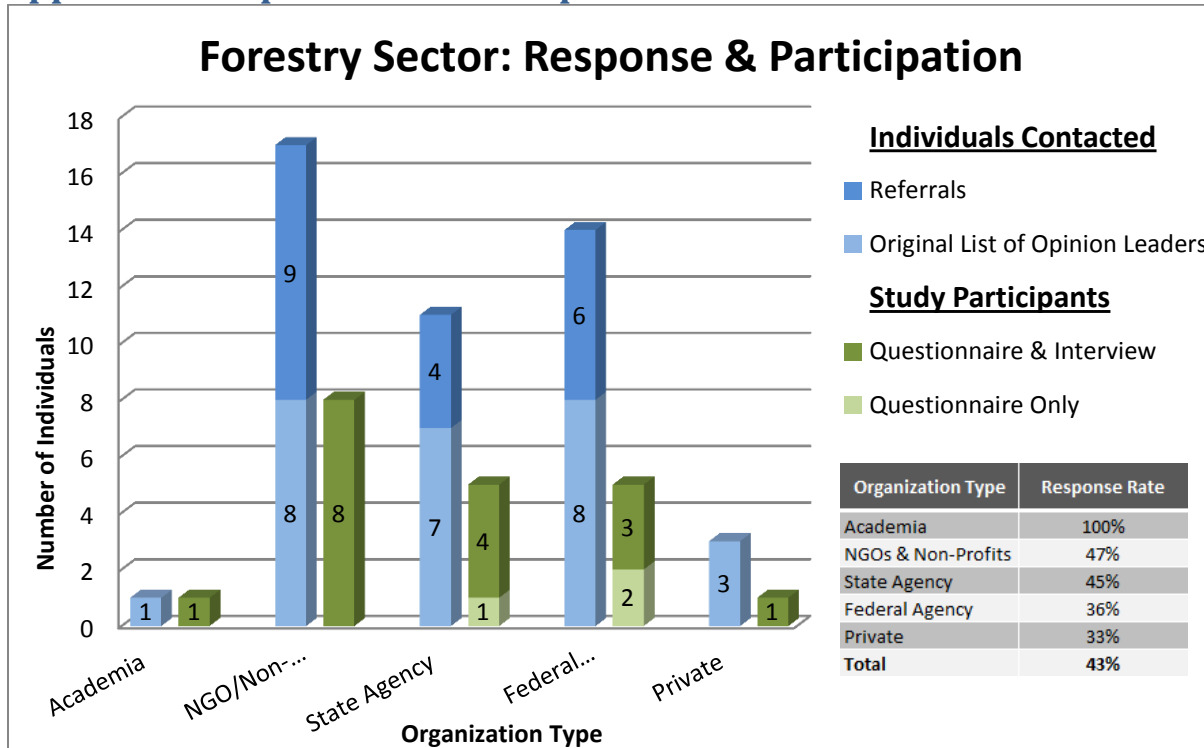
In the next several months our team will work to analyze the data we have collected to develop a comprehensive report that will inform the NCA. Your input will ensure that the interests, concerns, and needs of Carolina citizens are represented in the final NCA report. We look forward to continued work on this project and hope to maintain contact with your organization as we all work towards the shared goal of a successful, sustainable future.

Again, thank you for your time and information. Please let us know if we can ever be of service to you or your organization.

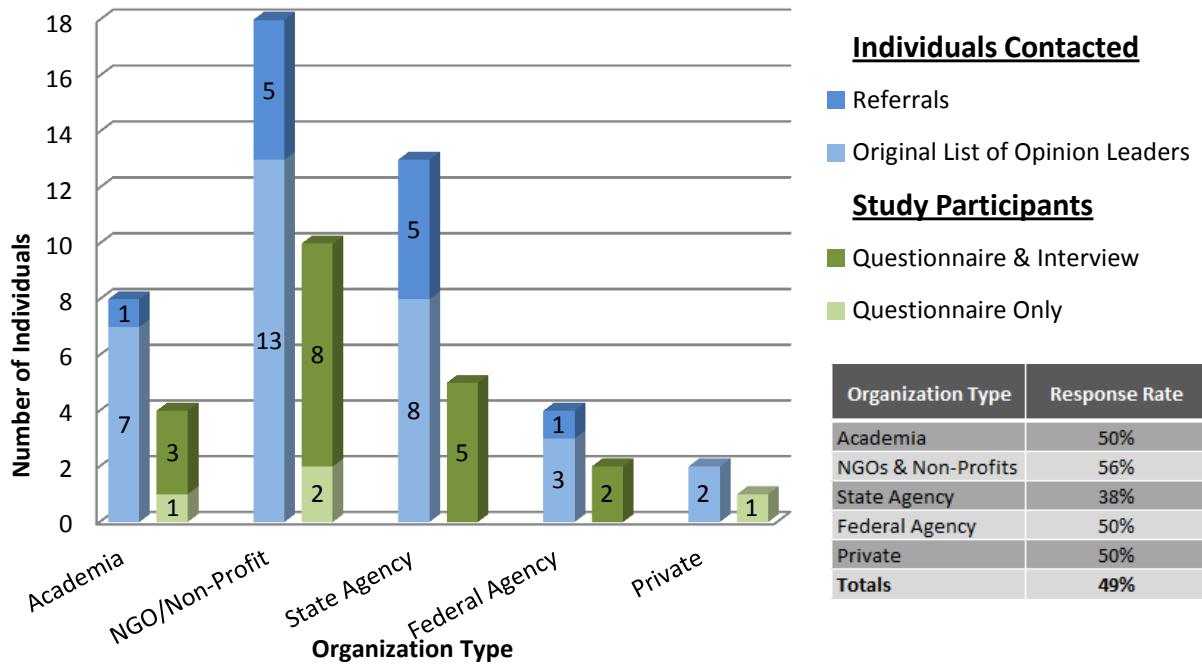
Sincerely,

(name), Research Assistant
& the CISA Research Team

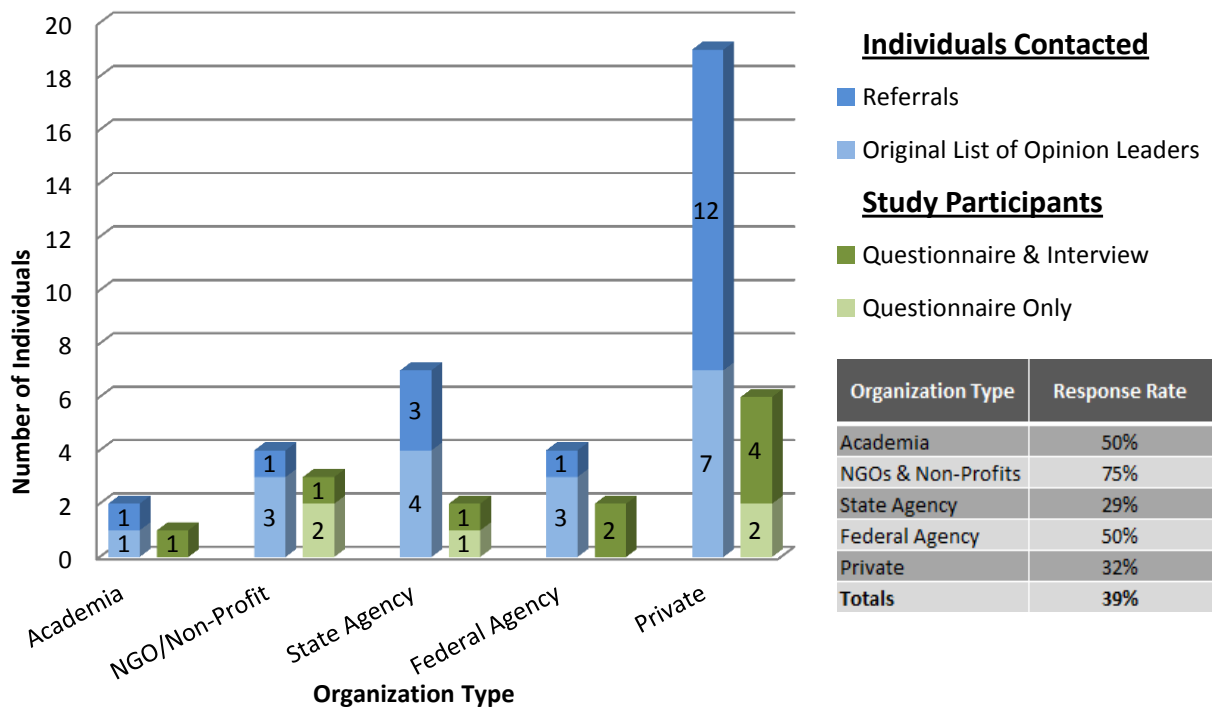
Appendix I Response and Participation Data



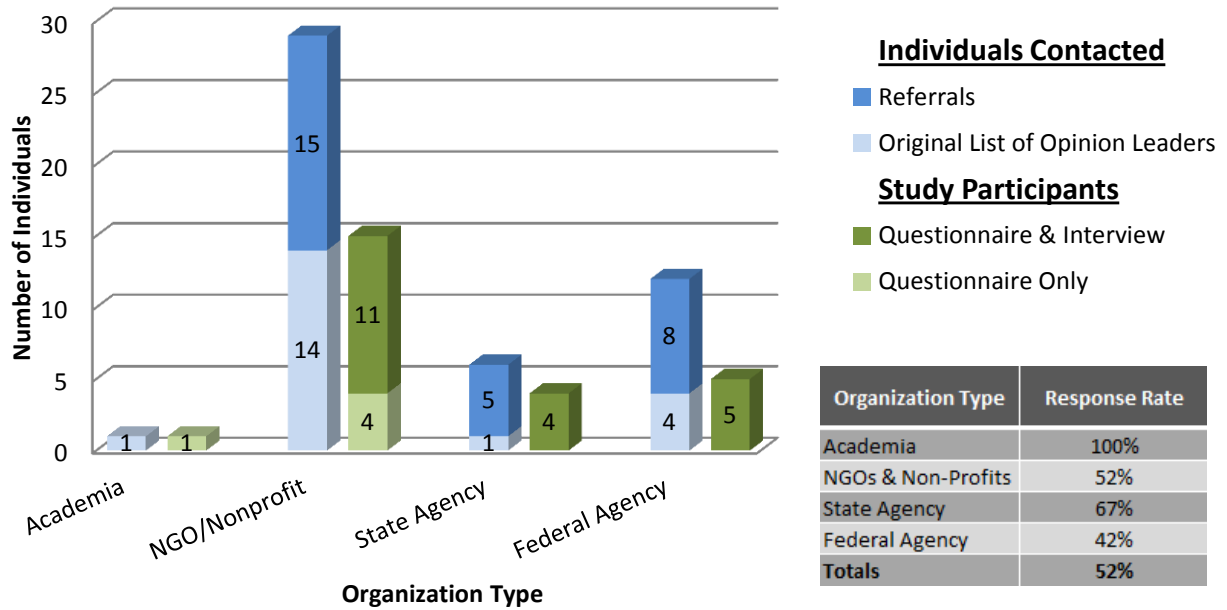
Tourism Sector: Response & Participation



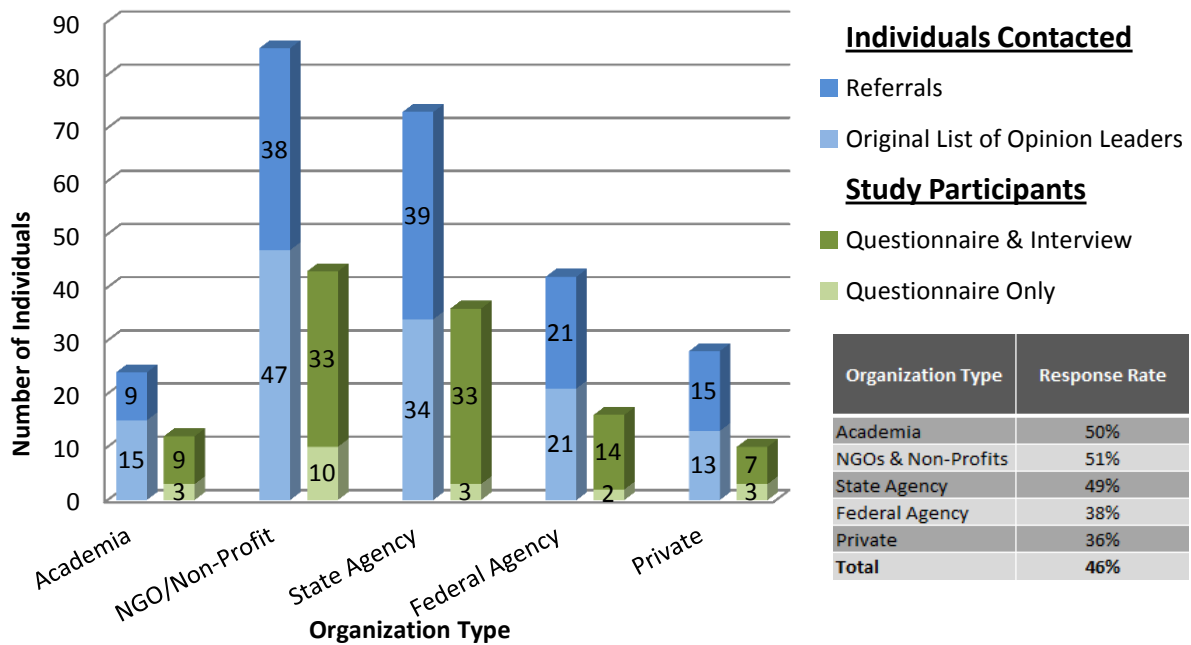
Water Sector: Response & Participation



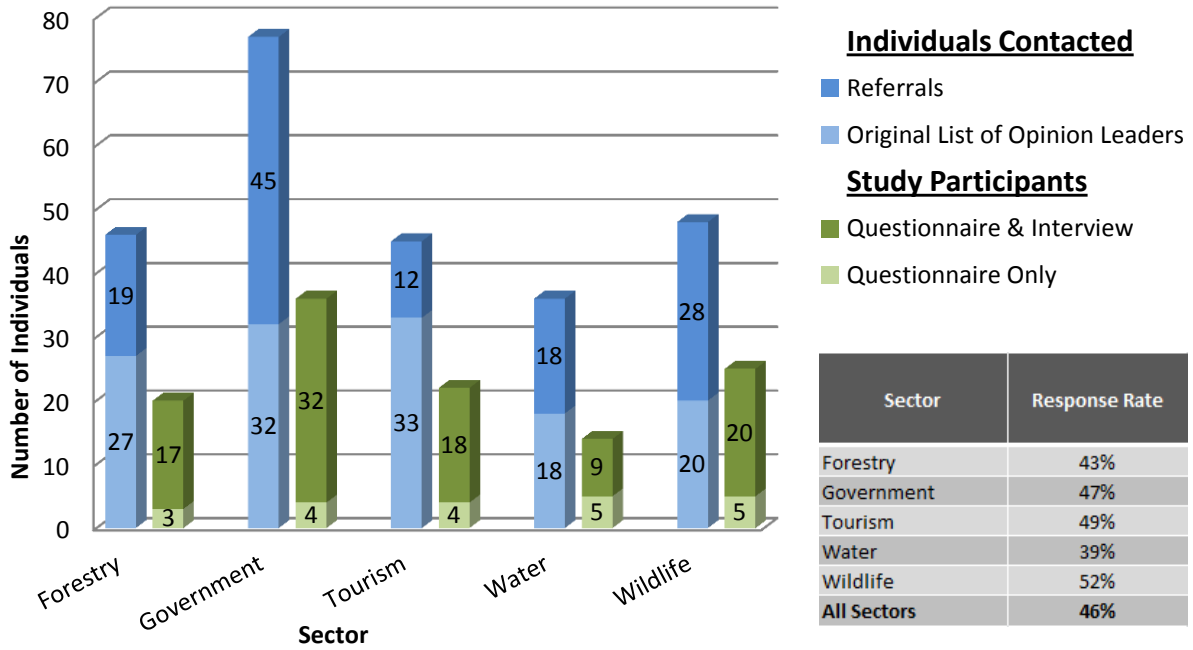
Wildlife Sector: Response & Participation



All Sectors: Response & Participation by Organization Type



All Sectors: Response & Participation by Sector



Appendix J Study Participant List by Confidentiality Preference

Level of Confidentiality – 1 – Confidentiality Waived, Permission to Use Both Name and Organization		
Robert	Abt	College of Natural Resources, North Carolina State University
Tom	Allen	Department of Geography, East Carolina University
Frederick	Annand	The Nature Conservancy, North Carolina Chapter
Luke	Appling	Grandfather Mountain State Park, North Carolina
Tim	Bennett	GreenCo Solutions, Inc
John	Bonitz	Southern Alliance for Clean Energy
Mike	Bryant	US Fish & Wildlife Service, National Wildlife Refuge System, NC Coastal Plain Refuge Complex
Catherine	Burns	The Nature Conservancy, North Carolina Chapter
Tom	Cecich	North Carolina Environmental Management Commission
Bill	Crowell	Albemarle-Pamlico National Estuary Program
Scott	Curtis	Center for Sustainable Tourism, Department of Geography, East Carolina University
Hamilton	Davis	South Carolina Coastal Conservation League
Jan	DeBlieu	North Carolina Coastal Federation
Suzanne	Dorsey	Bald Head Island Conservancy
Rebecca	Ellin	North Carolina National Estuarine Research Reserve, North Carolina Division of Coastal Management
Sean	Flaherty	Triangle J Council of Governments
Bob	Gale	Western North Carolina Alliance
Paul	Gayes	Center for Marine and Wetland Studies, Coastal Carolina University
Barry	Goldfarb	Department of Forestry and Environmental Resources, North Carolina State University
Brian	Graham	City of Greenville, South Carolina
Marisue	Hilliard	US Forest Service, Southern Region
Hugh	Irwin	Southern Appalachian Forest Coalition
Patrick	Jackson	South Carolina Rural Water Association
Darryl	Jones	South Carolina Forestry Commission
William	Kreutzberger	CH2M Hill
Warren	Lee	New Hanover County, North Carolina
Kathie	Livingston	South Carolina Nature-Based Tourism Association
Brian	McCrodden	HydroLogics, Inc.
Todd	Miller	North Carolina Coastal Federation
Sydney	Miller	Town of Cary, North Carolina
Richard	Mode	North Carolina Wildlife Federation
Alan	Moore	Urban and Community Forest Program, North Carolina Forest Service
Steve	Moore	South Carolina Wildlife Federation
Rua	Mordecai	South Atlantic Landscape Conservation Cooperative

Mary	Morrison	USDA Forest Services, Francis Marion & Sumter National Forests
Kevin	Mosteller	HDR Engineering
Alex	Naar	Center for Sustainable Tourism in partnership with The Office of Engagement, Innovation and Economic Development at East Carolina University and the North Carolina Division of Tourism, Film and Sports Development
Tim	Newman	Charlotte Regional Visitors Authority
Janine	Nicholson	North Carolina Department of Environment and Natural Resources, Climate Change Strategies Program
Raye	Nilius	US Fish and Wildlife Service, National Wildlife Refuge System
Sam	Pearsall	Environmental Defense Fund
Ben	Prater	Wild South
Heidi	Pruess	Mecklenburg County, North Carolina
John	Ramsburgh	Conservation Voters of South Carolina
Ulla	Reeves	Southern Alliance for Clean Energy
Charles	Roe	Land Trust Alliance
Brian	Roth	Town of Plymouth, North Carolina
Donald	Safrit	McKim & Creed, Inc.
Emily	Scofield	US Green Building Council, Charlotte Region Chapter
Scott	Shuford	City of Fayetteville, North Carolina
Robert	Slocum	North Carolina Forestry Association
Michael	Smith	Trout Unlimited
John	Stanton	US Fish and Wildlife Service, Southeast Region, Division of Migratory Birds
Ge	Sun	USDA Forest Service - Southern Research Station
Kenneth	Taylor	North Carolina Department of Environment and Natural Resources
Lauren	Thie	North Carolina Department of Health and Human Services, Division of Public Health, Occupational & Environmental Epidemiology Branch
Anna	Toline	American Fisheries Society, South Carolina Chapter
Maggie	Ullman	City of Asheville, North Carolina
Rebecca	West	Spartanburg Water
Kristina	Wheeler	South Carolina Nature-Based Tourism Association
Rhett	White	Town of Columbia, NC

Level of Confidentiality – 2 – Identification of Organization Only
Asheville Convention & Visitors Bureau
Central Midlands Council of Governments
Chimney Rock State Park
Congaree National Park
Duke University, Nicholas Institute for Environmental Policy Solutions
NOAA National Weather Service, NC

New Hanover County, North Carolina
North Carolina Division of Coastal Management
North Carolina Division of Parks and Recreation, South Mountain State Park
North Carolina Sustainable Energy Association
North Inlet Winyah Bay National Estuarine Research Reserve
Piedmont Triad Sustainable Communities Planning Project
South Carolina Department of Health and Environmental Control, Bureau of Air Quality
South Carolina Energy Office
Southern Center for Sustainable Forests (NC)
Trees SC
US Army Corps of Engineers, Charleston District
USDA Forest Service, Uwharrie National Forest
USDA Forest Service - Southern Research Station, Threats to Forest Health
USDA Forest Service - Southern Research Station, Coweeta Hydrologic Laboratory
USDA National Resources Conservation Services - South Carolina Office

Level of Confidentiality – 3 – Complete Confidentiality	
Sector	Number of Participants
Forestry	3
Government	9
Tourism	8
Water	6
Wildlife	8

Appendix K NVivo Interview Coding Protocol

1. CLIMATE		
<i>Primary Categories</i>	<i>Sub-categories</i>	<i>Sub-categories</i>
Climate Concerns	Current climate stressors and impacts	Stressors: droughts, floods, storms, temperature extremes, precipitation extremes, other
		Impacts: erosion, water supply, water quality, fire risks, public health, other
	Future climate stressors and impacts	Stressors: SLR, temperature change, precipitation change, change in extremes, other
		Impacts: erosion, water supply and availability, water quality, coastal resources, habitat changes, increased fire risks, economic costs, other
Key Climate Decisions/Decision Calendars	Operational (daily, weekly) use of climate/weather information (water, industry, municipality, tourism-water release)	
	Seasonal decisions (planting, harvesting, water conservation, purchasing-inventory, maintenance)	
	Annual planning (budgets, implementing or monitoring programs)	
	Longer-term planning (determine reservoir safe yields, construction and upgrading of infrastructure, development of preparedness and response plans (extreme events, drought), address anticipated climate change impacts)	
Information Use	Types of information used to make decisions	Indices, climate normals, climate extremes, climate summaries, forecasts, other
	Why these sources are used	Relevance, accessibility, trust, convenience, best expertise, best available, other
Climate Information Outputs	Primary Audience	Community members, ecosystems, other
	Type of information provided	Indices, climate normals, climate extremes, climate summaries, forecasts, other
	How that information is used by others	Short-term operations, seasonal management, annual planning, long term planning
2. FRAMING		
<i>Primary Categories</i>	<i>Sub-categories</i>	
Can/Do You Talk About Climate Change	To Your Primary Audience	
	Within Your Organization – includes Board Members, Trade Association Members, within a specialty field	
How Do You Frame Climate-Related Issues – Strategies to broach the topic with an audience	Developing Jobs or the Green Economy – Includes understanding economic impacts of climate change	
	Ecosystem Functions	
	Emergency Management or Hazard Mitigation – Includes potential risks associated with climate change, e.g., impacts of SLR on coastal real estate	
	GHG Emissions	
	Human Health and Epidemiology	
	Impacts Not Causes	
	Improvement to Organization/Operations	
	Increasing Energy Efficiency	
	Land Management Planning	
	Mitigation and Adaptation	
Moral/Ethical Imperative to Address Climate Change Impacts – Conserving our		

	natural resources for the ecological intrinsic value
	Municipal & Urban Planning – Local climate action plans, state plans
	National/Energy Security
	Personalization – Making the issue a more personal issue for the audience they are addressing, the impacts they will see in their lifetime and in their backyard
	Resource Management – Natural Resources, Water Conservation , Availability of resources for future generations
	Sustainability & Green Initiatives
Sustainability – Climate Change Linkages	Includes responses to the specific interview question “What is the relationship between ‘sustainability’ initiatives and climate change?”
Interviewee’s/Organizational Viewpoint	The “official” stance or position regarding climate change
3. ACTIVITIES	
<i>Primary Categories-Types of Activities</i>	<i>Sub-categories</i>
Data Collection & Monitoring Climate Impacts	Sub-categories of activities to be coded as they emerge
Education & Outreach	Activity
Emissions Reductions	Characteristics
Environmental Protection & Conservation	Facilitating factors
Hazard Mitigation & Emergency Management	
Infrastructure & Ecological Alterations	
Internal Policies, Practices, & Management	
Land Management	Constraining factors ...
Policies and Laws (General)	lack of:
Resource Management	
Risk & Vulnerability Assessments	
Strategic Planning (General)	
Sustainability	
	Motivation, trigger, threshold reached
	Lessons learned
	Key people, partners, sources of expertise or leadership
	Funding
	Availability of data, information
	Laws, regulations, requirements
	Opportunities, involvement with other planning processes
	Other (new categories to be coded as they emerge)
	Key people, partners, sources of expertise or leadership
	Funding
	Availability of data, information
	Laws, regulations, requirements
	Political support
	Public awareness, understanding
	Other (new categories to be coded as they emerge)
4. NEEDS	
<i>Primary Categories</i>	<i>Sub-Categories</i>
Accessible & Trusted Information	
Adaptation Planning	Understanding natural adaptations
	Resource management planning
Collaboration	
Consensus	In predictions of impacts
Education and Outreach	Internal Organization Education, Training
	Public Education
	Tools for Education and Outreach
Evidence of a Link between Human Activity and Climate Change	
Funding	
Human Resources	
Laws, Regulations, Policy	

Leadership	
Monitoring, Data, Models	Down-Scaled Information Models and Predictions for various climate scenarios Monitoring - Current trends and historical data Specific Data and Information Needs
Research	
Risk Assessments, Risk Management	
Systems Thinking	
Technology, Software	
Translations or Summary Documents	Cost-Benefit Analysis Specific to Decision-Making and Planning
5. NETWORKS	
<i>Primary Categories</i>	<i>Sub-categories</i>
Interactions and Networks	Advisory Committees
	Conferences-Workshops
	Education-Outreach
	Information-sharing
	Interagency Coordination
	Project Planning-Implementation
	Regional Collaboration
	Research Other (new categories to be coded as they emerge)
Partners and Partnerships	Academic
	Agencies (local, state, federal)
	Clients-Stakeholders
	Cross-scale
	Multi-agency
	Non-profits/non-governmental organizations
	Private (local business, industry)
	Research organizations, institutes
6. OTHER STRESSES AND CONCERNS	
<i>Primary Categories</i>	
Air Quality – Including air pollution, acid rain, ozone levels	
Development , Population Growth, Related Environmental Impacts – Including concerns about land use and land cover change, impervious surfaces, sprawl, urbanization, patterns of development, transportation patterns	
Disease & Invasive Species	
Economic Conditions – Including economic downturn, recession, financial constraints or limitations	
Existing Policies & Institutions – Including existing practices, regulations, and laws that contribute to social or environmental problems, fragmentation of management agencies and jurisdictions, lack of authority to act - or reliant on action from another entity – to address problems	
Fire – Including forest fire risks, fire management	
Infrastructure – Including aging or outdated infrastructure, more capacity or upgrades needed	
Water Quality	