



Communicating Climate Change Impacts with Stakeholders on the Coast of Connecticut- Stewart B. McKinney National Wildlife Refuge

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Communicating Climate Change Impacts with Stakeholders
On the Coast of Connecticut-Stewart B. McKinney National Wildlife Refuge

A Project Presented

By

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DEDICATION

To my loving partner Tifani Holt for her patience and continuing support.

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ABSTRACT

COMMUNICATING CLIMATE CHANGE IMPACTS WITH STAKEHOLDERS ON THE COAST OF CONNECTICUT- STEWART B. MCKINNEY NATIONAL WILDLIFE REFUGE

MAY 2011

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This research project consists of two parts, a scientific analysis of potential impacts of climate change on a coastal wildlife refuge, Stewart B. McKinney National Wildlife Refuge, and its surrounding area and a summary of the response by stakeholders to the information. The refuge with headquarters in Westbrook, CT consists of eleven units that span 70 miles along the coast of CT and include habitats such as saltmarsh, tidal flats, deciduous upland, rocky island, and barrier reef. Projected impacts over a span of 100 years include a projected loss of one quarter to one third of the dry land (which composes 40 percent of the refuge), between 30 and 90 percent loss of brackish marsh and up to 90 percent loss of the saltmarsh under the worst case scenario. Implications of the impacts include shift in diversity of species, decreased buffer zones to minimize storm impacts to the surrounding community, loss of key habitats for threatened and endangered species, and potential loss of key migratory bird habitats. The second portion of the project consists of a presentation of the data at two workshops held on March 9, 2011 in

Westbrook and Milford, CT and follow-up email responses from those unable to attend.

The outcome of the workshops and follow-up responses, include reactions from stakeholders, knowledge gained, and a summary of their key concerns, strategies for adaptation, and suggestions for continued partnership with each other and the refuge. Responses from stakeholders includes an acceptance of impacts from sea level rise and extreme weather events but a lack of knowledge about other impacts including habitat shifts, mismatched vegetation and breeding periods, and long term implications of loss of valuable wetlands and barrier reef habitats. No significant suggestions were made by stakeholders to improve communication. However, staff who participated recommended utilizing more information on economic impacts to communities as a result of habitat loss to foster greater support of the refuge. Additional research was recommended including a review of recently released studies on piping plovers and more information on the impact of climate change to human populations and how that will affect wildlife.

During the process of implementing this project there were many lessons learned that have broader implications for the refuge, the national wildlife refuge system, and for planners. Among these lessons is the importance for aggressive measures to be taken for land loss that is already being recorded as a result of climate change. In addition, it is important for the refuges to not plan or manage their refuges in isolation from the communities that surround them. Degradation of the habitats have long term consequences for the surrounding communities including a loss of buffer zones to protect against storm damage and a loss of ecological services that these habitats provide. Effective planning includes putting climate change impacts as a forefront issue that will serve to engage stakeholders in assisting to adapt to those impacts over the long term.

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CHAPTER I

CLIMATE CHANGE IMPACTS-COMMUNICATION AND DECISION MAKING

A. Introduction

In decades to come, coastal communities face an increasing need to adapt to climate change and impacts resulting from those changes (International Resources Group, 2009). The most recent International Panel on Climate Change (IPCC) report predicts a range in sea level rise from .18 meter to .59 under the various scenarios presented (IPCC, 2007). The literature suggests that with rising sea levels there will be increased coastal erosion, saltwater intrusion and loss of marsh and wetland, and storm damage from flooding (IPCC, 2007). With the current pressure to adapt to climate change and variability, communities and resource managers must find effective measures to offset impacts that could be both widespread and costly. Because of financial constraints of local, state and federal government entities and the unpredictability of climate change, it is imperative that communities and government organizations examine alternatives that are fiscally efficient, balance aesthetic and economic values along with environment concerns, and will be accepted by the community and various stakeholders. Partnerships and effective communication with stakeholders are necessary to aid these coastal agencies and communities in developing choices that are effective in outcome for both the natural processes and social impacts.

This project presents the outcomes of a participatory process with stakeholders of a wildlife refuge that is currently studying and making adaptive management decisions to address the impacts of climate change. The site chosen is a part of the Steward B.

McKinney National Wildlife Refuge in Connecticut that spans over 70 miles of the coastline. The refuge's barrier island, saltmarsh habitats, and rocky shorelines are being impacted by sea level rise, habitat shifts, and public use changes as a result of climate change. This project begins by utilizing models that project habitat shifts over time using current sea level rise model data. Using this as the base information, I identified key stakeholders within the region that are impacted and/or concerned with the changes and developed a communication plan with them that is informative, transparent, and adaptable to address the ongoing changes at the refuge. The final product is a summary of that process including the results from two workshops that can be used as an initial scoping process to identify issues and alternatives for current and future planning related to climate change.

B. Role of Author

This author is currently a planning intern for the planning team for the National Wildlife Refuge System for USFWS. The role this author has in the Service is to review and edit comprehensive conservation plans and assist with outreach during the planning process. Stewart B. McKinney National Wildlife Refuge will be initiating a 15 year comprehensive plan in the summer of 2011. The activities within the scope of this academic project were not part of the comprehensive planning process but the results of this study will contribute to both the content of the refuge plan and the approach the team will take in formulating habitat and public use management goals. Because of my role as an intern, I have attempted to identify any inherent bias I may have had toward the refuge's perspective that may have prevented me from fostering an inclusive participatory process with the stakeholders. However, after careful examination, I

recognized that my bias was more in line with the stakeholders than the refuge. I have long supported a less isolative approach to planning that the refuges, in general, have taken in the recent past. The Discussion portion of this report identifies some of the implications of this project for the refuge in terms of fostering a more inclusive process.

C. Purpose of the Research and Contribution to the Field

Agencies and organizations are currently faced with decision-making and planning that include land use impacts, resource constraints, environmental and public use tradeoffs related to climate change. As U.S. Fish and Wildlife Service engages in their comprehensive planning process for this refuge and other locations, it is especially important for them as well as their partners to understand both the short term and long term implications of the effects of climate change. In the recent past, the comprehensive plans have introduced the concepts of climate change but have only just begun identifying the potential impacts such as sea level rise, habitat loss, and storm damage. Although the Service is mandated by the NEPA (National Environmental Policy Act) to identify issues with the public and stakeholders related to management decisions on the refuge, there has not been extensive data collection, research, or collaborative communication with the diverse individuals and groups that are especially concerned with climate change. A majority of all scholarly literature on issues of climate change and resource management dates back to the late 1990's and reappears again within the last few years as a result of increasing concern and acknowledgment of climate change and its impact on coastal regions. This project plays a role in filling the gap of information available to the Service and its partners. It gives the associated planners, resource

managers, researchers, and collaborating participants a forum for effective communication regarding land use issues as they relate to both current and future predicted climate change impacts. Given the increased stressors on environmental resources induced by climate change and sea level rise, it is important for resource managers and stakeholders to have effective communication and partner to effectively adapt and mitigate the impacts. By examining a specific National Wildlife refuge and its surrounding environment including communities in proximity to the refuge sites, this project initiates a process for communicating key climate change concerns that should inform the full participation process for the comprehensive plan.

C. **Goals and Objectives**

The primary goals of this project is to identify key stakeholders who are involved in the research, mitigation, and adaptation to climate change impacts along the coast of Connecticut; to develop a communication plan for the refuge to address the impacts of climate change for the refuge; and to foster partnerships with those identified stakeholders to participate in the decision-making and adaptation to those impacts.

Objectives for this project include:

1. Communicate effectively with stakeholders regarding climate change and its impact to the region.
2. Identify key issues, current research, future research needs for the region.
3. Identify the reaction from stakeholders on the information given and the extent to which the information was received.

4. Make recommendations how both the stakeholder participatory process and the outcomes of the workshops could be improved.

D. Research Questions

The primary research questions as it related to this project include:

1. What individuals, organizations, agencies, and communities will be most impacted by land use decisions as it relates to climate change near the Stewart B. McKinney refuge and how can they play a partnership role in addressing the issues with the refuge?
2. What are the impacts that the refuge and its surrounding area can anticipate based on the literature and modeling of climate change impacts?
3. What concerns do the stakeholders have regarding climate change, what information is new to them after material is presented, and what research is needed to address their concerns?
4. How can the Service improve their communication with stakeholders and their approach to planning considering the impacts of climate change?

CHAPTER II.

LITERATURE REVIEW

There are a multitude of management decisions that can be made in regarding coastal zones because of sea level rise. Choices made by both communities and resource managers include strategic retreat (relocation), the use of natural or living shorelines and soft structures, the use of hard structures for stabilization, and/or some combination of each. Decisions are made utilizing the best management practices, stakeholder input, cost-benefit analysis, and review of intended outcomes. This literature review will present the many factors involved in decision-making and their implications. It will also include an examination of the varying coastal management techniques (hard, soft, staged retreat); types of stakeholder involvement; communicating climate change to the public; the history behind current practices; the regulatory factors, mandates, and limitations of stakeholder involvement, and current information on sea level rise and its impact on the natural processes.

Strategic Retreat

Strategic retreat involves the landward relocation of structures (Beatley et al. 2002). Policies and programs that promote retreat include increased setback requirements, restrictions on rebuilding after storms, and ones that promote relocation such as incentives or cost savings. Some coastal management programs within the United States prevent construction of immovable structures in high erosion zones. The argument for such management is the ongoing costs of managing areas that will eventually secede to saltwater intrusion, erosion, and irreversible damage. Strategic retreat is often considered

a last resort because of the considerable controversy and costs associated with such action (Beatley et al. 2002). One successful relocation effort cited by Beatley et al. (2002) was the moving of the Cape Hatteras Lighthouse in North Carolina Outer Banks to a more landward location. In refuge management, translocation of species or inward migration of habitat would be the equivalent of strategic retreat. Although not often utilized, depending on the severity of climate change impacts, this is one option the refuges may need to consider.

Hard Structure-Techniques, Strengths and Limitations

Structural approaches to property and resource protection include the use of hard structures such as seawalls and revetments, groins and jetties, offshore breakwaters, and other shore protection devices. These devices are often effective in temporarily blocking flooding and erosion but their environmental and economic impacts are substantial (Beatley 2009). Seawalls can exacerbate erosion, change the natural processes of barrier islands and eventually result in highly engineered shorelines. This process has been dubbed “New Jersification” by researchers (Bush et al., 1996).

Coastal impoundments are freshwater wetlands that utilize hard structures to retain their freshwater environment. They are utilized by U.S. Fish and Wildlife Service as a management technique for target species such as freshwater waterfowl that follow the migratory route along the coastline (USFWS 2010). There are other examples of freshwater impoundments that provide drinking water for communities (i.e. pond dams, man-made lakes). As defined by the U.S. Army Corps of Engineers (ACOE) (1999), impoundments for wetland wildlife are shallow-water areas impounded by levees, which

contain water structures that enable flooding during fall and winter and dewatering during spring and summer. This water control ability allows for coastal wildlife areas to support specific wetland species during their breeding seasons. It also maximizes the production of naturally occurring wetland vegetation in declining wetland areas to increase those habitats for wildlife (ACOE 1999). Additional hard structures include the use of riprap along shorelines for erosion protection.

Living Shorelines

Soft techniques or commonly named “living shorelines” (International Resources Group –IRG 2009) have been cited as a preferred method of coastal management in specific circumstances including low and medium energy shorelines (IRG 2009). These types of shorelines are located in areas other than open ocean areas and include such places as gulfs, bays, and estuaries. Soft structures include beach nourishment, marshland restoration, mangrove or other vegetation restoration and/or stabilization, and natural reefs. Several case studies support this notion as a means of increasing coastal stabilization, protecting communities better from storm damage and erosion than hard structures, saving costs, and reflecting broader community representation (IRG 2009, . The literature also supports the incorporation of living shorelines as a viable means for increasing shoreline stabilization; protecting and enhancing biodiversity; and protecting communities from storm damage, erosion and saltwater intrusion. In comparison to hard structures, there is often a cost savings, an aesthetically pleasing outcome, and an increased respect for natural processes (IRG 2009, NOAA 2010, Kelly and Adger 2000). On a social level, the use of soft techniques often reflects a broader community representation than other management strategies (Kelly and Adger 2000). This is

especially true with mangrove restoration because not only are inhabitants protected from storm surges, but the mangrove habitats often provide goods and services that sustain a local, traditional, and indigenous population (Kelly and Adger 2000).

Significant literature on the use of soft techniques comes out of international areas of study including the Fiji Islands, Vietnam, and the United Kingdom. One example of successful stabilization of coastal erosion occurred in the Fiji islands. In the mid-1990s, students from the University of South Pacific participated in a study of villages of the Fiji Island to survey residents on the effectiveness of various methods for coastal erosion that had increased as a result of both human-induced changes and sea level rise (Mimura and Nunn 1998). The people of Fiji had tried various types of structures ranging from simple lines of poles and piles of stones to concrete seawalls. The varied impermeable structures generated unfavorable results including seawall collapse and ecological damage. Many of the walls needed rebuilding and expensive maintenance. Of the twenty-nine villages studied, only one did not experience beach erosion, the village of Vunibau. This village utilized dredge sand from a nearby river to protect the coastline. Erosion was less where more traditional methods were used of lining shorelines with vegetation. Vegetation fringe was maintained along the shorelines separating other villages from the sea. Shoreline erosion was less in these areas compared to where vegetation had been disturbed or removed (Mimura and Nunn 1998).

Another example of beneficial vegetation restoration exists in Vietnam. Where mangrove restoration occurred in Gia Luan, the value of the shrimp farms increased up to \$15,000 per hectare compared to losses observed in areas where mangroves were destroyed (Thinh 2008). There are several areas within the United States that have

mangrove habitats including Louisiana, Texas, and Florida (Beatley et al. 2002). In more northern parts of the coastal regions of the United States, other types of vegetation can be used for stabilization.

Examples of innovative projects of shoreline protection that have occurred within the United States include the Presque Island State Park along the Lake Erie shoreline (Comoss et.al. 2002) and beach nourishment in Miami (Phillips and Jones 2006). In the Lake Erie area, the project combined vegetation with hybrid structures. The results of the project included an increase in hectares of stabilized vegetation, a decrease in soil and nutrient runoff, increased shoreline fishing, and improved habitats for waterfowl. At a cost of only \$33,000, the project was less costly than more conventional techniques and provided a more aesthetic and natural alternative (Comoss et. al. 2002). The case study in Miami utilizing beach nourishment (Phillips and Jones 2006) also demonstrated how living shorelines could be more economical. This study that looked at tourism and beach erosion impacts suggested that beach nourishment created more in annual revenue than the cost to maintain (Phillips and Jones 2006). Miami Beach had virtually no beach in the 1970's. Through a \$52 million, 20 year project of beach nourishment, Miami Beach's annual revenue increased to \$2.4 billion and the foreign tourists who visit pay more in Federal taxes than the Federal government pays for beach nourishment projects. The article suggests that new wider beaches as a result of beach nourishment served as shore protection from the impacts of storms and increased recreational benefits with new tourism opportunities.

Beach nourishment can be an expensive because it commits a community to a never-ending process (Beatley et. al. 2002) and depends on nearby sources of sand from

dredging waterways for navigability (ACOE 2010). However, it is regarded as a defensible practice in communities such as Virginia Beach, Virginia and Ocean City, Maryland where millions of dollars worth of property in terms of recreational resources such as hotel and boardwalk businesses are at risk from storm surges and sea level rise. These areas provide recreational beaches and serve as economic drivers for both the local communities and state for which they exist. In light of the immense cost estimates for strategic retreat and use of hard structures, beach nourishment may be a viable alternative despite high costs.

Additional vegetative restoration and stabilization occur among non-mangrove species in communities that set vegetative standards that provide for a vegetative curtain to surround any development. This in turn provides a wildlife habitat and corridor around a constructed area to reduce visual impacts of development, sustain the ecology, and provide a buffer for storm impacts. Vegetation types are determined based on geography and climate conditions. Examples include the use of native species along dunes and the maintenance of forests along coastal shorelines.

Marshland (Saltmarsh) Restoration

Coastal marshes are a class of wetlands classified according to their salinity regime or levels (Beatley et al. 2002). There are four types identified according to Beatley: salt marshes, brackish marshes, intermediate marshes and freshwater marshes (2002). The types of vegetation found in marshes are dependent on those salinity levels and can include mangroves and cordgrass which have high resistance to salinity. Other species such as sawgrass and water hyacinth are not as resistant to saline conditions (Beatley et

al. 2002). Marshes are highly productive and serve many functions that benefit both the environment and humans. They are home to a variety of wildlife, are an important food source for fish and shellfish, and help reduce shoreline erosion. Marshes also serve as filters for high volumes of water to absorb pollution and wastewater (Beatley 2009).

Coastal marshes have been heavily modified by humans resulting in marsh loss and destruction. Sea level rise is the most current threat to marshes with potential inundation faster than they can migrate landward. As defined by the Society of Wetland Scientists:

“Wetland Restoration is defined as: actions taken in a converted or degraded natural wetland that result in the reestablishment of ecological processes, functions, and biotic/abiotic linkages and lead to a persistent, resilient system integrated within its landscape.”

(2000 http://www.sws.org/wetland_concerns/docs/restoration.pdf)

J. Patrick Doody, in his book *Saltmarsh Conservation, Management and Restoration*, explains the benefits and limitations of restoration activities. The benefits of restoration of saltmarshes, in particular, include securing sea defense, landscape and recreational, wildlife conservation, biodiversity, energy and nutrient recycling mechanisms, and water quality improvement. Restored or stabilized marshlands also contribute positively to geomorphologic and ecological studies and provide a buffer for sea level rise. When flood protection is a key issue, salt marsh restoration appears to be a positive action (Doody 2008). Preventing damage or loss of habitat also becomes a key reason for restoration. The literature suggests that saltmarsh restoration purely for preventing erosion presents questions around sustainability, especially in the face of sea level rise, adverse hydrological conditions, or depleted sediment supply.

Techniques of Saltmarsh Restoration

The most common technique for restoration is repairing or restoring saltmarsh vegetation. The methods include activities such as erecting protective structures seaward of any remaining saltmarsh and replacing lost saltmarsh through sediment replacement and planting (Doody 2008). Additional measures include bay bottom terracing, use of dredged material, and planting Cord-grass. Bay bottom terracing is common in North America, especially in the Gulf of Mexico. The process involves creating terraces by using material dredged from the bottom of bays and planting on the terraces. According to Doody, restoration using this technique may be useful in shallow waters such as the northern portion of the Gulf of Mexico. Dredging is commonly performed in coastal estuaries and bays where navigation channels are required for ships. The use of dredged material became popular in the United States when environmental issues became important and using dredged material in a beneficial manner was more important than discarding or solely for building or expanding land. The methods of using dredged material vary based on quality or quantity of material available and distance to disposal site. Upon disposal and de-watering of material, vegetation can be planted (Doody 2008; URI 2010). The final technique, planting cordgrass, has been used since the early 1950's in such areas as the Chesapeake Bay. Native plants such as *Spartina spp* (cordgrass) are commonly used in areas that are concerned with extensive saltmarsh loss and require re-creating of marshes. Areas where growing conditions were favorable (higher tide zones) have produced positive, sustainable results (Gulf of Mexico, North Carolina, and Narragansett Bay, Rhode Island) (Doody 2008). Saltmarsh restoration is often associated with local community involvement in such initiatives as "Save the Bay" of Narragansett

Bay where community groups work with Bay staff to plant a variety of plants at several sites (URI 2010). Tampa Bay, Florida has also had successful restoration initiatives with high community involvement (Doody 2008; NOAA 2010). Living shorelines, such as saltmarsh restoration projects have become more successful with innovation and are increasingly more popular with concern over wetland losses (NOAA 2010).

ICZM as a Coastal Management Process

The concept of living shorelines originated in the Mid-Atlantic region of the United States where additional studies and plans for climate change have been implemented (International Resources Group, 2009). The report, *Adapting to Coastal Climate Change: A Guidebook for Development Planner*, suggests the use of living shores are most practical in low or medium energy areas along sheltered coastlines. This report also suggests involving community stakeholders from the beginning in planning for actions to protect and restore shorelines (International Resources Group, 2009).

Education on maintenance of living shorelines and provision of incentives for property owners was recommended. In its conclusion, this report promotes the use of integrated coastal management (often referred to as coastal zone management or integrated coastal zone management). It suggests with accelerating coastal changes, communities will have to adopt and promote new adaptive management priorities and which will require increased cooperation among multiple agencies and stakeholders. It recommends integrated coastal zone management (ICZM). ICZM is a process of governance that ensures that the process for development and management of coastal zones are implemented with environmental and social goals (Post and Lundin, eds. 1996). The purpose of ICZM is to maximize the benefits provided by the coastal zone and minimize

conflicts and harmful effects of activities on each other, on resources, and on each other. The strength of ICZM is that it is organized through a participatory and collaborative process that is tailored to the needs and context of individual places and assists to achieve balance across the coastal zones. ICZM programs give attention to the protection of important coastal features, while democratically defining and socially and environmentally sustainable forms of development (International Resources Group 2009).

Additional literature also supports the use of integrative coastal zone management as a way to increase community acceptance and long term sustainability. Three studies in the United Kingdom (Edwards, et.al. 1997, Milligan, et.al 2009, and Tompkins, et.al. 2008) cite case studies where lack of community participation resulted in mistrust, miscommunication about allocation of resources, and less support for the coastal management techniques including natural measures. Edwards suggests that traditional approaches of community participation were not as effective. The traditional approaches included preparation of strategies, policies and plans through consultation exercises with key interested parties then brought to wider audiences for public comment. Comments were then analyzed and revisions were made until a reasonable level of agreement was reached. This approach was criticized by user groups and local residents who argued that they should have been included earlier in the process (Edwards et. al. 1997). The article presents an example of a “Campaign for a Living Coast” that primary purpose is to achieve the sustainable use of England’s estuaries through the preparation and implementation of an integrated management plan that has been supported by the users and authorities that created it. Milligan et al. (2009) also promotes the use of public

involvement as a method of promoting sustainable shorelines. This article suggests going beyond the consultative process and give stakeholders genuine opportunity to construct, discuss, and promote alternatives. Similarly, Tompkins, et al. (2008) article recommend preference identification by stakeholders that increase the range of acceptable decisions as opposed to finding one optimal solution. This method promoted the necessity of adaptive management where decisions may need to change as conditions change. (Tompkins 2008). This method of stakeholder participation did not stress any particular preferred management technique.

The three articles mentioned above cited cases where the lack of community participation resulted in mistrust, miscommunication about allocation of resources, and less support for coastal management techniques including natural (soft) measures. An additional study in Morocco (Snousi, et al. 2006) concluded that ICZM promoted community participation and that soft measures were most suited for that area including beach nourishment.

In the United States, integrated coastal zone management was formalized through the Coastal Zone Management Act of 1972 in which Congress authorized the federal government through the National Oceanographic and Atmospheric Administration (NOAA) to administer management of the coasts through a voluntary effort by states who participate. The principles under the Act are similar to ICZM and allow the states to approve and manage resources in their own manner in accordance with those principles (Beatley et al. 2002). Administered by the federal government (NOAA 2010b) states can voluntarily participate and design their own coastal management programs following the guidelines and principles of the Coastal Zone Management Act of 1972. Thirty four out of the 35 coastal states (including the Great Lakes), in partnership with the federal

government and local communities, have chosen to participate (NOAA 2010) in this Coastal Zone Management Program (CZMP).

One area cited for use of coastal zone management has been Chesapeake Bay (Bower and Turner 1996). In the Bower and Turner article, the authors compare the use of ICZM with trend management (without ICZM) and illustrate the benefits. As in other articles, the authors suggests that because of necessary adaptation to changing conditions of climate change, ICZM results in a positive net benefit for communities that implement them. The State of Maine has adopted some of the nation's strictest coastal management laws. Through the voluntary participation in the CZMP, the state has chosen to ban all new construction of hard structures in Maine. North Carolina and South Carolina have also chosen this route in their own coastal management programs (Beatley et al. 2002). Federal agencies such as U.S. Fish and Wildlife service are mandated, to the extent practicable, to follow the guidelines outlined by the CZMP. This legal mandate is called the consistency doctrine (Beatley et al. 2002).

Stakeholder Involvement-Federal Methods

In 1970, for the first time in federal government history, public participation was considered a valuable part of land use decisions with the passage of the National Environmental Policy Act (NEPA). Its intent was to incorporate human values and place-based identity into the decision-making process. NEPA was to give voice to the public who must bear the social, economic, and environmental consequences of government actions (Hendry 2004). After thirty years of implementation, studies have found several problems with the public scoping part of the process including:

1. Citizens felt they were treated as adversaries;
2. Citizens felt they were invited into the process too late, when the projects were already well-developed;
3. And, citizens felt their input was not reflected in the changes to the proposals (Hendry 2004).

Graham (2004) suggests using a social communication perspective toward public participation. Instead of public participation treated as an opportunity to gather data or to inform the public, the author suggests collaborative participation, including developing a framework that allows for openness to the knowledge, experience, and perspectives of all participants including general citizens, tribes, environmental groups, and industry. Graham also suggests that a social communication perspective on public participation would allow for all parties involved to work together and develop a sense of shared responsibility. Graham recommends that creating interpersonal relationships with stakeholders allows for mutual respect and understanding and creates a larger capacity for positive action. Ideally, incorporating the principles of integrated coastal zone management would compare to the values set forth by Graham regarding social communication. The federal government has a long history of implementing government actions with minimal public participation (Hendry 2004). This project will be unusual in creating a communication forum based on best practices identified in this literature review for stakeholder identification, engagement, and collaborative decision making.

Communicating Climate Change Impacts

Literature suggests that in 2007, two thirds of the American people believed that climate change was already occurring and 40 percent believed it will pose a serious threat to them (Roser-Renouf and Maibach. 2010). The authors suggest that people who do understand the risks and dangers of climate change are more willing to make personal changes and support aggressive policy actions (2010). For effective communication to occur, information should not only include the risks but also clearly communicate solutions that are not only effective but ones in which the audience can perform or support (Roser-Renouf and Maibach. 2010).

Susanne Moser, one of the leading experts on communicating climate change identifies three categories of communication purposes: 1) to inform and educate individuals about climate change, 2) to achieve some type of social engagement and action, and 3) to bring about changes in social norms and cultural values (2010). The second purpose requires that climate change and the actions required to address it are made local and urgent (Moser 2010). Climate change communication also requires that the presenters understand and identifies their audience. Moser states that recent case studies and research in climate change communication suggests that different audiences require distinct frames, goals, and messages (2010). Tailored communication can bring together different audiences to work in coalition towards a desired common goal. Messages must resonate with the target audience through the language used, the values to which the message appeals, and the social aspirations of the audience (Moser 2010). Messages must also keep the attention of the audience through the use of humor, compelling images, or intriguing facts. Message should also include information on immediate

impact and not just future losses (CRED 2009). Center for Research on Environmental Decisions in their report *The Psychology of Climate Change Communication* (2009), suggests that people perceive immediate threats as more relevant and tend to discount future risks. By including facts on the currently existing impacts of climate change, people are more likely to make behavioral changes and take action. CRED also suggests that messages need to be broader than just climate change but also include other interconnected issues (2009). Examples relevant to the refuge in the communication process could include stating the importance of considering land uses surrounding the refuge and invasive species management as exacerbating factors for climate change impacts. By identifying methods for formulating messages and the ultimate goals of communication, communicating climate change can be more effective.

Significance of Project Based on Literature Review

The Stewart B. McKinney will have to face many decisions regarding habitat management and public use of the refuge to address the impacts that may potentially occur as a result of climate change and sea level rise. Some of those decisions including the use of hard structures, living shorelines, and strategic retreat have been addressed in this literature review. Similar decisions will be needed to be made by planners and community leaders that could have significant economic and social implications. Therefore, it is important to engage stakeholders early in the participatory process for many reasons. Communicating effectively with stakeholders will assist in identifying key concerns that decision makers will need to address, identify additional needs for research or investigation, and foster partnerships that will help address adaptation needs.

The literature suggests that effective communication of climate change not only identifies potential impacts but also provided effective solutions (Moser 2010, Roser-Renouf and Maibach. 2010) . Messages that are included in climate change planning should emphasize that climate change is real, that adaptation and mitigation is possible, and there are risks to doing nothing (Department for Communities and Local Government 2007). The literature also states the importance of collaborative communication where citizens and stakeholders can play a significant role in planning for and adapting to climate change right from the beginning and not after many decisions have already been made (Roser-Renouf and Maibach. 2010). By providing forums such as talks and events, individuals and small groups can receive advice and have questions answered about specific topics relevant to their concerns (Department for Communities and Local Government 2007). This promotes a “safe” environment for trust to be fostered. This project responds to the recommendations of the literature on communicating climate change by identifying key stakeholders, providing a mechanism for initial communication, and engaging stakeholders to foster a participatory process in future planning.

CHAPTER III.

PROJECT COMPONENTS

For this research, with input from Service staff, this author identified the key stakeholders impacted by climate change within the region of the refuge sites and presented components of a communication plan designed for the refuge to those stakeholders. The outcome of the project is a summary of issues related to climate change that were presented at two workshops, a communication plan included in this report, suggestions made by stakeholders to improve communication, and a discussion of the results and its broader implications to coastal refuges and planners. A summary of the database of key stakeholders identified is also included. These stakeholders were identified as potential partners in both the planning process for the refuge and for future partnerships to address the potential impacts of climate change.

A. Site Selection Criteria

Sites were chosen based on the following criteria:

1. Along the Connecticut shoreline as part of the Steward B. McKinney National Wildlife Refuge and its surrounding areas..
2. Contain coastal impoundments, saltmarshes, and/or barrier island habitats.
3. Are publicly owned as part of the refuge system but have private stakeholder implications.
4. Coastal conditions impacted by climate change (experienced salt water intrusion, or wetland destruction, , sea level rise impacts, and public access concerns).

I have chosen Stewart B. McKinney National Wildlife Refuge (NWR) as the focal point of the project because it spans over 70 miles of the Connecticut shoreline and has a diversity of coastal habitats and is close to several communities and therefore any planning decisions effect a variety of stakeholders. The refuge consists of eleven separate units along the coast from Westbrook to Greenwich. It includes eight islands, barrier beaches, tidal saltmarshes, shrublands, and uplands. Communities in proximity to the refuge lands include Westbrook, Norwalk, Milford, and Greenwich, CT. Potential stakeholders include environmental groups such as the National Audubon Society and The Nature Conservancy; research institutions along the coast such as Yale University or Connecticut College; user groups, especially private boat owners; and representative s from the communities including elected officials, planners, and/or residents.

B. Methodology

The project methods include:

1. Identifying stakeholders through collaboration with Service staff, existing partners, user groups, and communities near the refuge.
2. Creating a database of the stakeholders, their missions or interests in the area, contact information, issues and concerns identified during the participatory process.
3. Development of a plan for communication including telephone, email, newsletter, and/or face to face contact.
4. Site visits to understand current site conditions and key issues related to climate change.

5. A facilitated workshop to elicit additional information, concerns, and land use decision-making that is occurring regarding climate change. The workshop itinerary include presentation of the potential climate change impacts and discussion of the implications of those impacts in regard to additional research needed, opportunities for partnerships, methods for improving communication, and the level of awareness that participants had regarding climate change.

Potential questions will elicit information about the following topics:

1. What are the key issues of concern at each site or its surroundings (i.e. species of concern, public access and use, hydrology, sea level impacts)?
2. What information is new to the stakeholders regarding climate change and what research or ideas can they contribute to the communication and planning process?
3. How can the refuge continue to improve communication and partnerships to address climate change?
4. What research and/or decision-making is currently happening as a result of climate change impacts in the area that will affect the refuge, identified stakeholders, and the area surrounding the refuge.

Upon completion of data collection, a detailed analysis was performed that summarizes the results and presents the key factors.

CHAPTER IV

RESULTS

The final product of this project includes the climate change impacts that were part of the PowerPoint presented at the workshops and to various stakeholders via email, a communication plan for the Stewart B. McKinney NWR, a stakeholder database that is summarized in this report, and the results of stakeholder participation in providing feedback from the presentations.

A. Climate Change Impacts As Presented to Stakeholders

During the workshop portion of the project, this author presented a PowerPoint that contained information on the potential impacts of climate change to the refuge and its implications for the surrounding area. It included both general impacts of climate change and specific impacts to the habitats that could potentially occur based on literature and modeling. General impacts from climate change include increased temperatures, increased precipitation and periods of drought, earlier springs, increased runoff in winter and early spring, and sea level rise (IPCC 2005). Changes that are projected for the Stewart B. McKinney NWR include those presented in the SLAMM (Clough and Larson 2010). The Sea Level Affecting Marsh Model (SLAMM 5.0) is a model used by the refuge system to identify habitat shifts across a time span using the A1B scenario from the IPCC. The model was completed for the refuge in 2010 by a consulting firm. This author analyzed the results and presented it to the stakeholders. The A1B scenario is based on the premise that population will significantly increase until the middle of the century and then experience a decline and that there will be a balance between new and

existing technology that impacts greenhouse gas emissions (IPCC 2005). The results of the SLAMM indicate a projected loss from one-third to one quarter of the dry land (which comprises 40% of the refuge) on the refuge by 2100. An additional loss of 30-90 percent of brackish marsh is projected and a significant portion of saltmarsh loss under the worst case scenario (Clough and Larson 2010). The table below shows a summary of the projected losses under the A1B scenario over the span of the next 90 years:

Table 1: Changes in habitat over span of years-A1 B Scenario

Combined NWR
1.5 Meters Eustatic SLR by 2100

Results in Acres

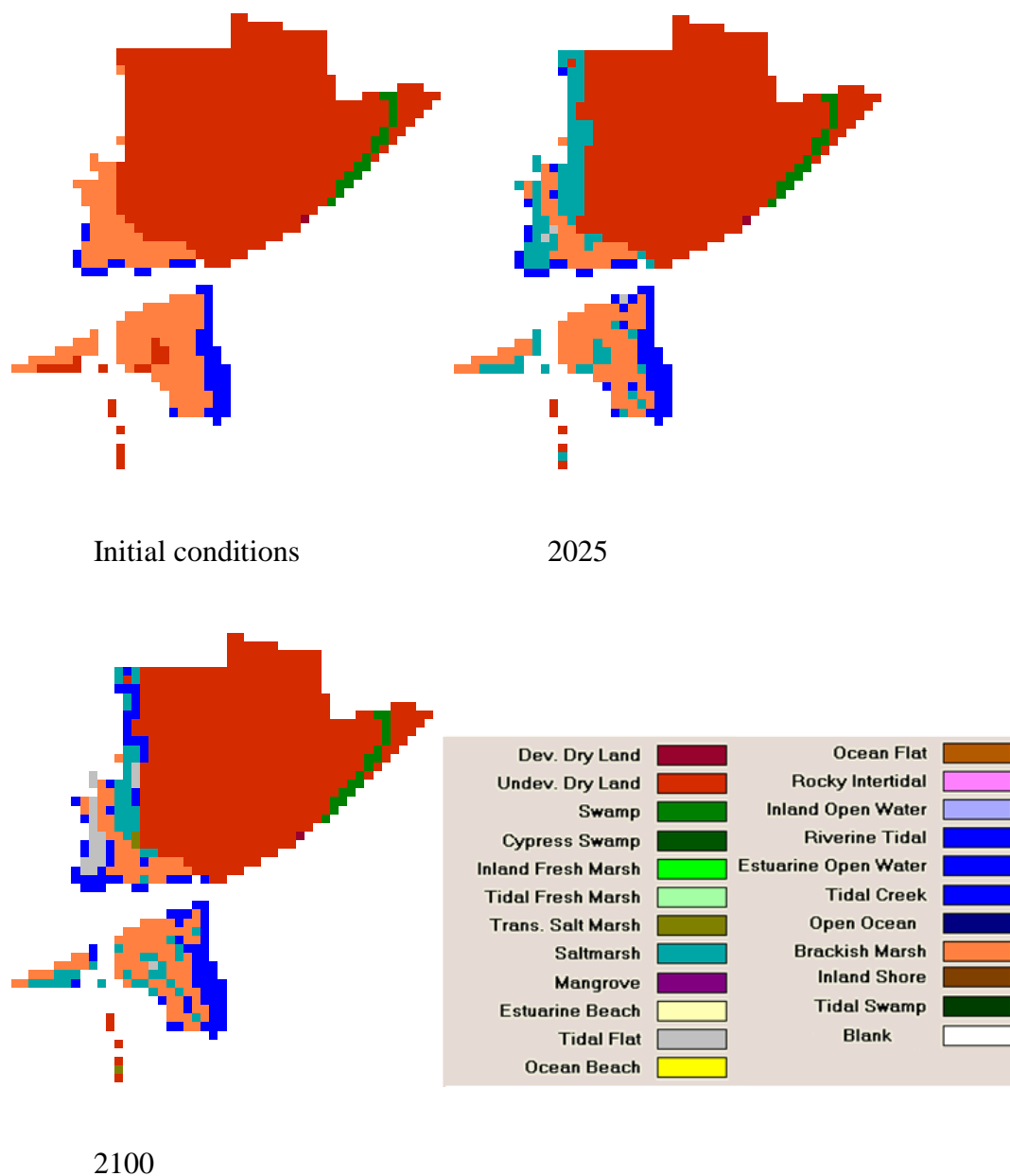
	Initial	2025	2050	2075	2100
Dry Land	427.4	348.1	314.8	302.7	287.1
Brackish Marsh	348.7	251.6	113.1	5.2	3.5
Saltmarsh	121.9	201.9	364.5	266.2	88.5
Estuarine Beach	137.9	105.1	73.4	29.1	0.2
Estuarine Open Water	45.8	81.2	117.4	184.3	293.7
Trans. Salt Marsh	0.0	78.7	40.6	13.5	16.7
Dev. Dry Land	39.8	17.0	15.2	13.3	11.5
Tidal Flat	0.0	38.2	83.4	308.8	422.4
Inland Fresh Marsh	4.4	4.4	4.4	4.4	4.4
Swamp	4.0	4.0	4.0	4.0	4.0
Rocky Intertidal	3.1	2.9	2.1	1.5	1.0
Total (incl. water)	1133.1	1133.1	1133.1	1133.1	1133.1

Source: Clough and Larson 2010

As noted in the table, the most significant changes are projected for the brackish marshes as saltwater intrudes and more open water is created by sea level rise. In addition to the table, the SLAMM report provides visual models of changes in habitat over time. Below

is an example from the model reflecting changes over time for the Salt Meadow Unit of the refuge (Figure 1).

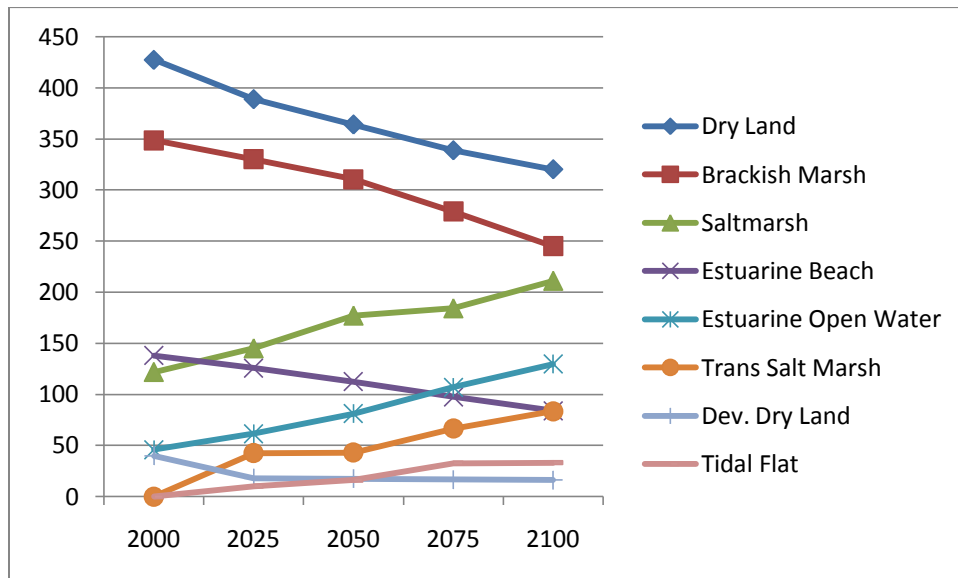
Figure 1. Model for habitat changes over time for Salt Meadow Unit of the refuge.



Source: Clough and Larson 2010

Figure 2 is a graph representing the change in acreage of the different habitats for the entire refuge.

Figure 2. Graphical representation of habitat shifts over time.



Source: C. White based on data from Clough and Larson 2010

The graph indicates the significant loss of both dry land and brackish marsh over time resulting from sea level rise as the saltwater intrudes and more open water becomes present. Because there is a degree of uncertainty in all of the climate models, it is difficult to predict exact changes that may occur on or near the refuge.

Refuge staff members have indicated current loss of land on the island sites due to sea level rise and erosion, specifically at the Faulkner Island site (personal communication with Richard Potvin, USFWS Refuge Manager 2011). The refuge manager indicated that they are experiencing over 300 square feet a year of loss of land on the island as a result of erosion. Mr. Potvin indicated that as part of the comprehensive planning process, the refuge will need to determine some erosion control measures for the island including

whether a hard structure will be need to protect the lighthouse on the island from erosion that is eliminating the land surrounding it (2011). One potential solution to the erosion problem is to backfill the southern portion of the island with a mixture of gravel, cobbles and boulders to create additional habitat for the endangered roseate tern. One management decision that may need to be made for another island, Chimon, is to reduce public use to ensure that invasive species control can be successful (personal communication with Richard Potvin, USFWS Refuge Manager 2011). Chimon Island is one of the larger islands and its land base will last longer as a result of sea level rise. Therefore, one of the adaptation strategies that are recommended is to foster increased habitat resilience by managing other problems such as invasive species. Additional projected impacts could include shift in habitats for land and coastal birds, temporal mismatches between migratory bird and vegetation source availability, changes in breeding patterns, and increased invasive and predatory species.

At the workshop, this author also presented some resources that may prove useful for various stakeholders to identify the impacts of climate change on bird species and recommended adaptation strategies based on an extensive literature review by the authors of one article. The citations for the resources are listed below:

Heller, N.E. and E.S. Zavaleta. 2008. Biodiversity management in the face of climate change: A review of 22 years of recommendations. *Biological Conservation* 142:14-32

Matthews, S.N. , O'Connor, R.J., Iverson, L.R. and A.M. Prasad. 2004. Atlas of Climate Change Effects in 150 Bird Species of the Eastern United States. USDA-FS General Technical Report NE-318

Some of the top adaptation strategies from Heller and Zavaleta (2008) that were presented at the workshop are listed as follows: 1) Increase connectivity 2) Integrate climate change into planning 3) Mitigate other threats (i.e. water pollution, development, or other land use conflicts 4) Study responses of species to climate change 5) Practice intensive management to secure populations 6) Translocate species if necessary 7) Increase and expand acreage of the refuge area 8) Improve interagency and regional coordination, and 9) Increase and maintain basic monitoring programs.

After presenting the climate change information to the stakeholders, discussion occurred regarding their concerns, ideas, and need for more information. The results of those discussions and the feedback from email communication are summarized in another section.

B. Communication Plan

The presentation at the workshop was one component of a much broader communication plan created for the Stewart B. McKinney NWR to address climate change. This author collaborated with the refuge staff to develop this plan to be used in the future. The final product is included in this section:

COMMUNICATION PLAN FOR THE STEWART B. MCKINNEY NATIONAL WILDLIFE REFUGE COMMUNICATING CLIMATE CHANGE TO STAKEHOLDERS

OUR OPPORTUNITY FOR EFFECTIVE PUBLIC OUTREACH

As a complementary component to launching the Comprehensive Conservation Planning (CCP) process to guide management of the Stewart B. McKinney National Wildlife Refuge (SBMNWR) over the next 15 years, this plan will provide the refuge and refuge system, a delineated plan for communication of climate change issues and land use implications with key stakeholders. Stakeholders include conservation and natural resource agencies and organizations, research institutions, adjacent landowners, municipalities, and public users of the refuge that may be impacted or are currently investigating the impact of climate change in the surrounding areas of the refuge.

Goals of Public Outreach and Communications

Public outreach and communication are an integral part of both the CCP process and the planning for adaptation to climate change. Communication goals include:

1. Inform the public about the SBMNWR, its mission and purpose.
2. Inform the public about anticipated impacts of climate change including sea level rise, wetland loss, habitat shifts, and potential changes in species numbers and distribution due to storm damage, reduction in quality of habitat, and temperature changes.
3. Identify key research that is being conducted in the region as it relates to climate change and land use implications.
4. Identify key concerns of citizens, agencies, organizations, and research institutions as it relates to climate change.
5. Dispel myths and identify areas of scientific uncertainty as it relates to climate change.
6. Receive input from stakeholders as it relates to the short and long term planning of the refuge and its surrounding area in regard to adapting to climate change and its impact.
7. Build long term community support for programs to address climate change.
8. Continue to strengthen partnerships with the refuge.

AUDIENCE/INTERESTED PARTIES

Internal Audiences

Key persons to keep informed include upper management within Region 5 (Marvin Moriarty, Wendi Weber, and Andrew Milliken). Scientific information will be shared with the Landscape Conservation Cooperative staff, SBMNWR staff including refuge manager, Richard Potvin, Silvio O. Conte National Fish and Wildlife refuge management

including Andrew French-Project Leader. Other refuge managers, biologists, visitor services, and planners may use information that can be generalized to other refuges and surrounding regions.

External Audience

The list below is a summary of kinds of entities that will be key target during outreach for the CCP and climate change information. The mailing list provides more details.

- Local governments including municipalities such as Westbrook, Stratford, Milford, Branford, Guilford, Westport, and Greenwich.
- State agencies including the Connecticut Department of Environmental Protection.
- Federal agencies including the Natural Resources Conservation Service and the Army Corps of Engineers.
- Indian tribes and bands, including the Mashantucket Pequot Tribal Nation, Mohegan Tribe of Indians, Stockbridge Munsee Community Band of Mohican Indians, and Shinnecock Indian Nation
- Neighbors and landowners.
- Conservation organizations including The Nature Conservancy, Connecticut Audubon and Potapaug Audubon Society, Sierra Club.
- Local interest groups of recreational organizations including boating clubs, hunters, fishing groups, and bird watching groups.
- Land trust organizations such as Trust for Public Land

- Friends groups for SBMNWR including Calf Island Conservancy, Friends of Norwalk Islands, Friends of Outer Island.
- Other interest groups including Faulkner’s Light Brigade and Norwalk Seaport Association.

Key Messages (Public Briefing Statements)

Key messages may be delivered as part of public presentations, in fact sheets, or as answers to questions asked by the public at meetings, as appropriate.

Key Messages About Stewart B. McKinney NWR

The refuge was established in 1972 under the name Salt Meadow National Wildlife Refuge. It was redesignated by Congress as the Connecticut Coastal National Wildlife Refuge in 1984. The refuge was then renamed again in 1987 to honor the late U.S. Congressman Stewart B. McKinney, who was instrumental in the establishment of the refuge. The 11 units of the Stewart B. McKinney National Wildlife Refuge span 70 miles of Connecticut coastline.

Located in the Atlantic Flyway, the refuge provides important resting, feeding, and nesting habitat for many species of wading birds, shorebirds, songbirds and terns, including the endangered roseate tern. Adjacent waters serve as wintering habitat for brant, scoters, American black duck and other waterfowl. Overall, the refuge encompasses over 800 acres of barrier beach, tidal wetland and fragile island habitats.

Salt Meadow Unit, in Westbrook, CT, and Falkner Island Unit, three miles off the coast of Guilford, CT, have both been designated as an "Important Bird Area" by the National Audubon Society. Falkner Island Unit is home to over 124 pairs of nesting Federally Endangered Roseate Terns and over 3,000 nesting pairs of common terns. Salt Meadow Unit is used by over 280 species of migrating neotropical birds during the spring and fall migrations.

The mission/goals of the Stewart B. McKinney National Wildlife Refuge are:

- 1) To enhance the populations of herons, egrets, terns, and other shore and wading birds within the refuge.
- 2) Encourage natural diversity of fish and wildlife species within the refuge.
- 3) Provide for the conservation and management of all fish and wildlife, within the refuge.
- 4) Fulfill the International treaty obligations of the United States respecting fish and wildlife.
- 5) Provide opportunities for scientific research, environmental education, and fish and wildlife dependent recreation.

Climate Change and the Stewart B. McKinney National Wildlife Refuge

ANTICIPATED ISSUES RELATED TO CLIMATE CHANGE IMPACTS

Because of the level of uncertainty that is inherent in the impacts of climate change the issues presented here are represented as potential impact to the SMBNWR. Key issues include both specific impacts already occurring at the refuge and issues that have the potential to occur over a long period of time based on recent literature written about the

habitats that are represented on the refuge. These messages may be adapted at any time upon monitoring and evaluating the actual impacts occurring on the refuge. This communication plan, therefore, can be considered a working document and subject to change based on the best available science, time and resources available to the refuge, and other unanticipated events.

General Impacts from Climate Change

- Increasing Sea Level Rise
- Increased winter precipitation and/or summer drought.
- Increase in stochastic events (storm surges) and severity of damaging rainstorms.
- Altered hydrology due to earlier spring flows, reduced snowpack, and summer droughts.
- Increasing frequency of extremely hot days.

Issues that may occur on or near the refuge:

1. **-Increasing Sea Level Rise due to climate change resulting in loss of habitat, erosion, wetland, and salt marsh loss**

Key Messages:

- Across all scenarios, between one quarter and one third of the dry land (which comprises roughly 40% of the refuge) is predicted to be lost by 2100. Between 30% and 99% of the refuge's brackish marsh (irregularly flooded marsh) -- which comprises nearly one third of the refuge -- is expected to be lost (or converted to

regularly flooded marsh) by 2100. Overall loss of salt marsh (regularly flooded marsh) is only predicted to occur in the most severe sea level rise scenario.

- Coasts are projected to be exposed to increasing risks, including coastal erosion, due to climate change and sea-level rise and the effect will be exacerbated by increasing human-induced pressures on coastal areas.
- Coastal wetlands are projected to be negatively affected by sea-level rise.
- Salt marsh dieback is characterized by the death and disappearance of marsh grass in coastal wetlands. It has been found in coastal Connecticut. One hypothesis for dieback is rising sea levels. Although SBM salt marshes are healthy, they are at risk for salt marsh dieback due to climate change and sea level rise.
- Saltmarshes not only provide a habitat for rare plants and migratory birds but are also important natural dissipaters of tidal currents and waves, thus protecting landward sea defenses from scour and wave erosion. Adaptive management to saltmarsh loss includes saltmarsh restoration by increasing sediment budgets to raise the elevation and promote the establishment of pioneer plants, if necessary by increasing seed availability.
- The USFWS Refuge System has completed recent saltmarsh restoration at the Steward B. McKinney NWR. These efforts are critical to the long term resilience of this habitat in the face of climate change. Continued monitoring and restoration efforts as needed will be important steps to addressing sea level rise and climate change impacts on the wetlands of SBM.
- Storms can cause a beach to erode, and can result in a uniformly seaward-sloping beach. This typically occurs during the winter months. During the

calmer summer months, the beach gradually accumulates sediment as the result of currents, produced by low waves that return sand landward to the foreshore, or emergent, portion of the profile. If there is long-term erosion of a beach, it may be due to a variety of phenomena, including storms, high rates of sea level rise, interruptions in the longshore transport system along the beach, or inappropriate construction practices along the shoreline area that function to interrupt the longshore movement of sand. With the predicted sea level rise and increased risk for extreme weather events, beach erosion is a concern for the refuge.

- The sands of a barrier beach can absorb the force of storm waves. The reshaping of beaches and dunes by waves provides the material to beaches down-current and eases the effects of erosion. Barrier beaches are also important recreational areas and provide nesting and resting sites for many species of shore and migratory birds. Loss of barrier beaches impact animal species such as the endangered piping plover and humans due to loss of protection from storm damage and erosion. Stewart B. McKinney currently is host to piping plover. Potential loss of their habitat would be a concern especially in regard to their endangered status. Every effort possible will be made to address this issue should it occur including habitat protective measures and increased communication with relevant stakeholders.

2. Issue-Habitat quality

Poor habitat quality due to invasive species. Increase in prey species. Suitability of habitat for migratory stopover.

Key Messages:

Adaptive management includes increasing resilience to the impacts of climate change.

Reducing invasive species, restoring habitats, and minimizing loss of quality habitats are keys to improved resilience.

- Climate envelope models suggest that for some species predicted changes in climate may significantly reduce the suitability of currently occupied habitats. Such threats are likely to be most keenly felt by species with limited dispersal ability. Two primary options exist under these circumstances: improve the connectivity of habitats to facilitate natural dispersal, or translocate species to appropriate habitats.
- Best practices for climate change adaptation and resilience includes ensuring quality habitat. Many of the units at the Refuge including Norwalk Islands and Chimon Islands have invasive species that degrade the quality of habitat. Invasive species management is a priority throughout the refuge.
- Invasive species are a major problem on public lands throughout the United States, including National Wildlife Refuges. Some invasive species are so well established that eradicating them completely, using existing technology is impossible. Therefore, controlling invasive species to obtain wildlife management goals is critical.
- Invasive species on the refuge compete with native species for food and space, and decrease the quality of habitat for native species.
- Most habitat management activities on Stewart B. McKinney involve control of invasive species. A large percentage of the annual operating budget goes towards

these activities which include mowing, chemical spraying, disking, and hand grubbing.

- Existing budgets and staffing levels do not allow as many acres to be treated as would be desirable. The refuge uses volunteers to perform some invasive species management on the refuge, however the number of volunteers willing to do this physically taxing work is limited. Engagement with stakeholders allows for the potential to recruit volunteers for such efforts.

Issue-Changes in Habitat and Animal Behavior

Habitat shifts, changes in migration patterns, changes in breeding patterns, Inter-specific relations as habitat shifts, Density dependent population processes for species as habitat shifts, Temporal mismatch between migrating birds and vegetation/food source availability.

Key Messages:

- The impacts of climate change on shifting habitats increase the importance of monitoring and evaluation of species responses, practicing more intensive management of targeted species, and increasing land conservation to accommodate changes in migration patterns. The refuge will consider future acquisition of land to address both habitat connectivity and loss of land due to climate change and sea level rise.

Issue-Land Use

Competition of land uses. Over exploitation of resources and habitat destruction.

Prevailing land uses that constrain adaptation and/or exacerbate problems.

Key Messages:

- Cooperative relationships with stakeholders is key to minimizing conflicts related to land use and competition.
- Identifying key partners in conservation will increase the likelihood of successful habitat protection for the future with competing interests.
- To increase habitat connectivity for many species, conservation of lands inward is critical. Land uses in proximity to the refuge such as development reduce the likelihood of habitat migration inward such as marsh accretion in response to sea level rise. The refuge will consider future acquisition of land to address both habitat connectivity and loss of land due to climate change and sea level rise.

COMMUNICATION TOOLS

a) Planning Updates

Planning updates for the CCP process will be completed at pertinent point in the planning process and will be mailed out to all persons on the mailing list.

Specific information about climate change will be addressed in these planning updates as is relevant.

b) Internet Presence

The USFWS regularly updates the national website and issues related to climate change. In following with this practice, the SBM NWR will update its website and include relevant climate change information as deemed relevant. Update will occur at least every 6 months as staffing permits.

- c) Powerpoint Presentation- USFWS will provide a PowerPoint presentation at its workshop on March 9, 2011 to present current general information about climate change and its impact on habitats. With the summary of results from the workshop, the PowerPoint will be updated.
- d) Video Production-Refuge Visitor Services staff will create video modeled after Prime Hook NWR video to demonstrate the impacts of sea level rise and climate change on the refuge and potential adaptive management techniques to foster resilience (i.e. invasive species control, saltmarsh restoration, erosion control).
- e) Media Outreach

Opinion Pieces

Opinion pieces will be sent occasionally to the local newspapers as listed in the stakeholder database as needed. The purpose of these pieces will be to inform the public of adaptive management decisions as it relates to climate change, to head off misinformation about potential conflicts, and to perform outreach about the Refuge system mission.

Press Releases

Press releases will be prepared simultaneously with any notice in the Federal Register and will be sent to media as represented on the mailing list. Press

releases will also be prepared in advance of any public meetings, and after any significant meetings or workshops. The press releases will concisely summarize the event and will be accompanied by photos when appropriate.

Press Interviews/Stories

Media attention and any requests for more in-depth stories or interviews will be accommodated. The Refuge Manager will be the key responsible official to coordinate media interview and story requests.

C. Summary of Stakeholder Database

An Excel formatted database was created for the refuge to utilize for further communication. It included a list of 60 local elected officials, state and congressional officials, tribal representatives, Connecticut Department of Environmental Protection representatives, environmental organizations such as Connecticut Audubon, and the various Friends groups of the refuge including Calf Island Conservancy, Faulkner Island Lighthouse Brigade, and the Friends of the Outer Island. Based on the choice of the various Friends groups, the database did not contain the names of individual members of each group. Those groups elected to maintain those lists themselves and communicate directly through their organization any information relayed by this author. The database contains contact information, the role or interests they have with the refuge, and best methods for communicating. This database was utilized to communicate with the stakeholders for invitations to the workshops and follow-up email communication.

D. Stakeholder Responses to Climate Change Information

Two workshops were held on March 9, 2011 at the Westbrook Library in Westbrook, Connecticut and at the Connecticut Audubon Center in Milford, CT. The workshops were publicized through the use of a mailed newsletter and email and telephone communication. Follow-up emails with the PowerPoint presentation from the workshop were sent to stakeholders who were unable to attend. There were eleven participants that submitted comments regarding the information presented to them regarding climate change, six from the workshop and the remaining via email. Those stakeholders were primarily representatives from other environmental organizations or agencies including

the Audubon Society, the Calf Island Conservancy (a Friends group of the refuge), and the Connecticut Department of Environmental Protection-Wildlife Division. Other stakeholders including representatives from the nearby municipalities, elected officials, and research institutions did not attend nor submit comments to the presentation via email.

Questions included what concerns they had with climate change, what information was new to them, what measures was their organization and/or community taking to address climate change and in what way could the refuge or U.S. Fish and Wildlife Service partner with them to address climate change.

Concerns Indicated

The top three concerns listed by partners and stakeholders were habitat shifts, flooding, and loss of land. Additional concerns included that both communities and organizations are not doing enough to address climate change and that many people and leaders refuse to acknowledge the issues. Participants also expressed concern about identifying appropriate land to acquire to compensate for land loss and the uncertainty and severity of extreme weather conditions.

New Information and Awareness

Most people were aware of the basic impacts of climate change including increased temperatures and precipitation. Information that was new to the majority of respondents included increased wind throw due to severe storms and the temporal mismatch between migrating species and vegetation availability.

Current Actions to Address Climate Change/Fostering Partnerships

There was little response to what actions their organization and/or community was doing to address climate change. However, a few responded positively to proactive habitat management and fostering resilience. There was also very few responses to how to foster partnerships except to continue with the current efforts. One participant suggested that when presenting information to highlight the economic impacts because it will most likely elicit a greater response. In addition, the same respondent suggested that when discussing habitat changes, address the ecological services that those particular habitats provide. An example given by the person was that within the region, commercial shell-fishing and fishing for recreation played an important economic role in the community and citing how those activities could change would be important to stress. An additional example could be the role that the marshes and barrier beaches serve to protect the abutting residential and business areas from storm surges. One stakeholder from Audubon, who will be active in assisting with habitat goals, included a desire to address habitat needs for the saltmarsh sparrow and preserve upland habitats near the Great Meadows Unit for other endangered species such as the Cerulean Warbler. This same stakeholder offered current research being completed by their organization for the planning process.

Additional Research

Follow-up email communication included one respondent's comments to the PowerPoint on how to present the information to stakeholders without having a facilitator present. Another stakeholder expressed concern regarding specific species she sees at the unit of

the refuge she represents. She was referred to by this author to the atlas on climate change impacts to birds. Additional email feedback included recently released research on piping plover that would prove useful for the refuge since this is an endangered species supported by the refuge habitat.

Despite the small number of participants, the overall response to the information was positive. Participants wanted to know how impacts to human populations could further affect wildlife (i.e. land use conflicts, overcrowding and development pressures, water restrictions). They acknowledged the importance of continued communication and the need for more research.

Next Steps in Communication

Since the initial workshop and follow-up emails, this author has had multiple email communication with four of the eleven respondents and additional communication with two other stakeholders who did not initially participate who would like to be included in the planning process. During this author's role as a planning intern, further communication will be fostered to assist in the comprehensive conservation plan for the refuge.

The Stewart B. McKinney National Wildlife Refuge will be initiating a two year planning process to complete a Comprehensive Conservation Plan (CCP) that will guide habitat management, public use, and partnership actions over a 15 year time frame. Information within the plan will address the various climate change impacts presented in this project and the adaptation strategies necessary to foster resilience. Upon completion of the CCP, the refuge will undergo a land protection planning process that will identify key areas

desired for acquisition. This plan will also include habitat needs to compensate for projected losses due to climate change. Both of these planning processes present opportunities for the refuge to utilize the information in this project including material on the impacts of climate change and communication strategies outlined in the communication plan. The refuge has received a copy of the stakeholder database, the communication plan, and the PowerPoint to utilize as needed.

CHAPTER V.

DISCUSSION

A. Refuge Specific Implications

One factor in communication is ensuring significant participation in the opportunities presented including the two workshops. The workshops were located to address geographical distances from the various refuge units. Despite invitations for the workshops being sent to all the listed stakeholders, attendance was minimal. Factors that could have contributed to the poor attendance include the season of the year during which this was conducted. Most of the stakeholders that represent the island and mainland sites are active during the spring and summer, therefore, representation from these groups was limited. In addition, due to scheduling conflicts, this author could not coordinate with some of the various stakeholders and their regular meetings. Recommendations for improvement on attendance to refuge sponsored events include coinciding presentations with current stakeholder meetings such as the monthly or quarterly Friends group meetings, create a list of abutting landowners during the CCP process to promote local outreach to neighboring residents, and track visitor data through surveys and log books at the refuge site locations. Currently, the Stewart B. McKinney NWR is undergoing a Visitor Services Review and the outcome of this study should provide additional tools for improved communication. The refuge could use the tools suggested by the visitor's service review to increase visitor awareness of the issues participation in the adaptive measures to address changes.

Another key factor in communication is to not only address refuge specific impacts of climate change, but also its implications on the surrounding communities. Suggestions made during the outreach efforts included the importance of the refuge habitats to serve as buffers from storm damage due to extreme weather events. This information could serve as a tool to engage neighboring residents into participating in activities to improve the resilience of the habitats including invasive species control. An additional recommendation made during the outreach process was to identify how the habitat degradation and shifts could potentially impact the economies of the surrounding communities. Examples of this include the loss of both commercial and recreational shell fishing at the refuge due to increase hypoxia in the waters of the refuge. Additional economic impacts could include the loss of tourism due to shifts in habitats of favorite bird species of an ever-growing bird observation community in the area. This is particularly significant because two of the stakeholders involved in the project represented the Audubon Society and two other Friends groups promote bird and other wildlife observation in their work with the refuge.

One of the key lessons in developing this project that could be useful for the refuge is that climate change impacts will affect all almost aspects of the refuge and, therefore, the analyses needs to be undertaken in the beginning stages of planning. There is often resistance on the part of the refuge system to comprehensively address climate change impacts into a 15 year plan because many of the impacts will occur during a much longer timeframe. However, as already stated by the refuge staff, the refuge is already experiencing a significant and measurable land loss due to erosion and sea level rise. They are also experience extreme weather events and habitat degradation due invasive

species and water pollution that only be exacerbated with climate change. By putting climate change and sea level rise at the forefront of the planning process, stakeholders can be engaged now to address long term changes that have significant implications for future conditions.

B. Refuge System Implications

Given the current level of habitat loss that is measurable on this specific refuge and losses that are being seen system-wide across many coastal and inland refuges, this author recommends that USFWS take a comprehensive review of its land acquisition initiatives and begin aggressive efforts to obtain habitats to support species at risk due to climate change. Many of the refuges are currently faced with conflicts with stakeholders, especially landowners and public users surrounding the refuges due to storm damage from extreme events. As a result, refuges are now developing strategies to best communicate the purposes of the refuges, the significance of climate change, and the impacts that stakeholders can expect to come. This author recommends that the Service mandate communication plans to address these concerns to both educate the public about the refuge and climate change and mitigate potential conflicts that may occur.

As an observer in the duties of a planning intern, this author has noted how very often the refuges act in isolation to the communities that surround them. By effectively engaging residents and communities through stressing the importance of ecological services, acknowledging economic impacts, and identifying common concerns, the refuge system will become more recognized than it is currently. Effective communication and outreach will also assist in fostering partnerships to address the adaptation strategies needed.

C. Implications for Planners

Climate change threatens to impact all aspects of our environment including our natural environment and our economic livelihoods. As demonstrated in this project, addressing climate change upfront and during the initial stages of planning is critical because of its deep reaching implications for all other aspects of planning. Communicating both the impacts and effective strategies and solutions assisted in engaging key stakeholders that will remain engaged throughout the comprehensive planning process. Goals of communication should include securing commitments from relevant partners, work in partnerships for solutions, and provide user-friendly information. By providing relevant information to key stakeholders, planners may find an important tool to foster partnerships that will serve useful for long term planning.

D. Conclusion

Climate change impacts are already being noted both on the Stewart B. McKinney NWR and its surrounding areas. Despite the growing amount of research information available to the public, very little planning is occurring in this region. This project, therefore, was received as a good first step on the part of the refuge to identify potential risks and impacts and to begin planning for such changes. Based on participant input, communication can be improved by demonstrating a more ecosystem approach to planning in terms of regarding the refuge as a connected part of the community and promoting the ecological services that it provides. Further planning and communication is needed and the opportunity to utilize already engage partners for the planning process has presented itself through this initial project. As part of the communication plan, it is

recommended that the Stewart B. McKinney NWR consider developing various media to both promote the refuge and identify key impacts that may become significant points of concern for the partners and communities in proximity to the refuge. Through various media and by identifying key statements to utilize during communication with stakeholders, conflicts may be reduced, misconceptions may be cleared, and partnerships may be strengthened.

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