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Climate Change, Community Resilience, and Restoration in the Gulf of Mexico

Lauren Ward

MAS Marine Biodiversity and Conservation

Capstone Project

Capstone Advisory Committee

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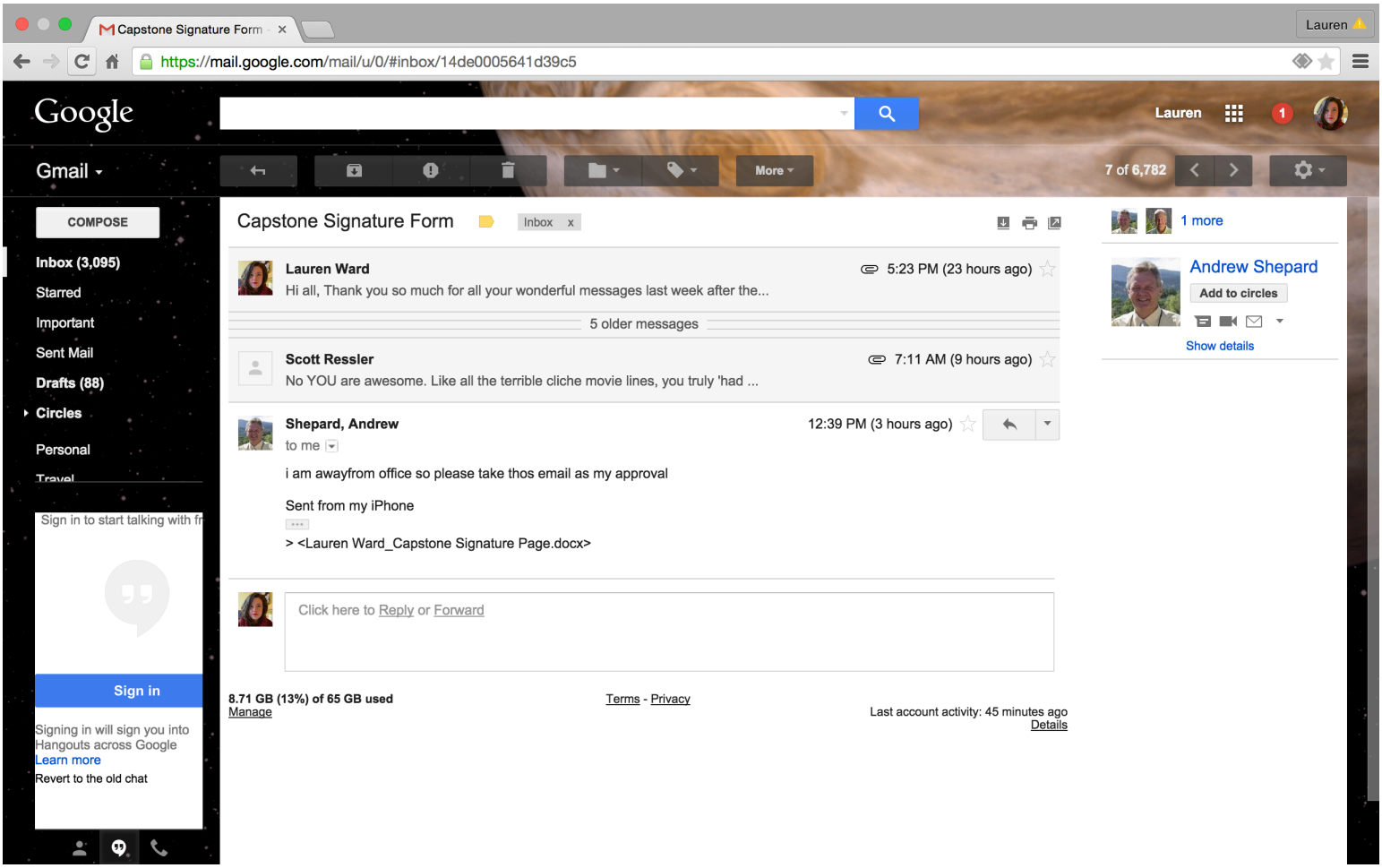
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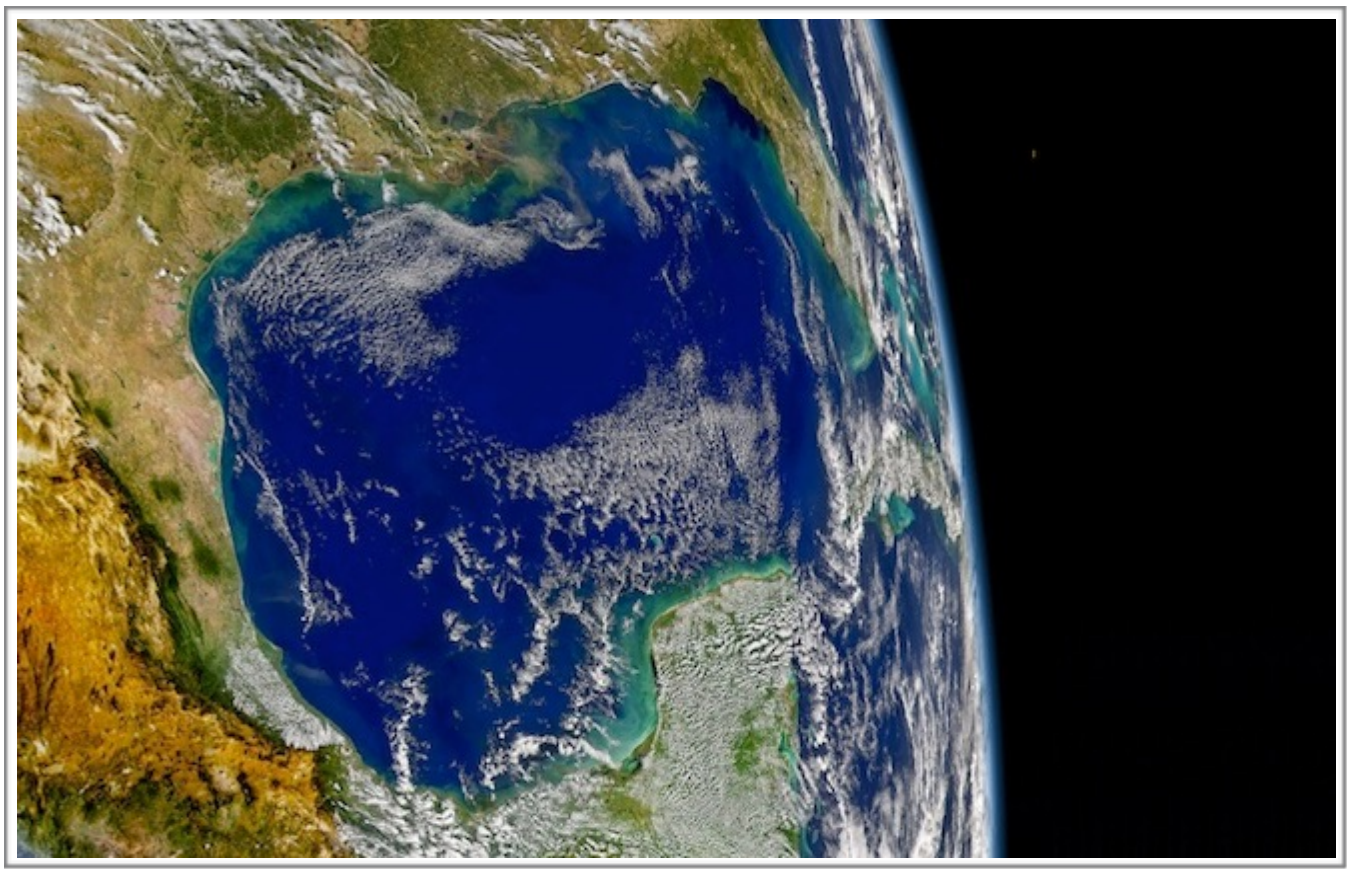
Climate Change, Community Resilience, and Restoration in the Gulf of Mexico

Lauren Ward
Capstone Final Report
June 11th, 2015

Capstone Committee Chair: Dr. Kathryn Mengerink
Capstone Committee Members: Mr. Andrew Shepard, Dr. Richard Somerville, and Scott Ressler



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Preface

This report is the combined effort of independent research and an informational webinar co-hosted by the Environmental Law Institute, the Gulf of Mexico University Research Collaborative (GOMURC), and the Mississippi/Alabama and Louisiana Sea Grant programs. Held on April 10th, 2015, this webinar brought together a panel of experts to discuss the complex intersection of climate change, community resilience and Gulf of Mexico restoration. Panelists focused on challenges and opportunities for creating restoration projects that both incorporate climate change considerations and are responsive to the needs of coastal communities.

Independent research and key message synthesis was conducted to supplement information provided by each panelist as part of this Master's Capstone Project. A companion video was also produced in conjunction with the report. The video can be found at: https://vimeo.com/128644900

Executive Summary

Purpose Statement: Promote understanding of known and potential impacts of climate change in Gulf-wide ecosystem restoration and community resilience.

The Deepwater Horizon oil spill devastated the Gulf Coast in 2010 and was the worst spill in U.S. history. However, the disaster has given rise to an unprecedented amount of restoration funds. Five primary programs, backed by nearly $5 billion to date, will fund a variety of restoration projects, most of which will be administered at the state and regional level. While some approaches exist on how to integrate climate change into restoration decision-making, many post-Deepwater Horizon restoration projects fail to adequately address climate change impacts. This report will discuss how to consider the known and potential impacts of climate change on restoration efforts in order to build resilience in coastal communities.

Climate change can affect restoration efforts in many ways. Sea level rise threatens coastal infrastructure and possesses the ability to contaminate fresh groundwater supply. Hazards like storm surge and flooding could result in loss of property or even life. Climate change may also cause serious drought other regions. Ocean acidification caused by increasing CO2 emissions depletes the ocean of carbonate compounds that clams, oysters, coral, plankton, and other creatures need to build shells and skeletons; many of these species are commercially valuable in the Gulf of Mexico. At-risk communities are often at the frontline of these major changes and are directly tied to the resiliency of the natural environment. By protecting the natural environment, coastal communities and important sources of economic development can be more resilient.

Key Considerations:

- **Sea level rise is happening now**: Sea level rise often takes a back seat to mitigating for hazards like storm surge and flooding. However, long-term decision-making must ensure that infrastructure in the near-term path of sea level rise is reconsidered.
- **Preparation today means savings tomorrow**: FEMA estimates that $1 of mitigation today results in $4 of future savings[1]
- **Avoid quick fixes at the expense of long term solutions**: Conflicts may arise when considering quick fixes, such as hardening shoreline (building seawalls) to hold off the sea, versus more environmentally friendly solutions that are longer lasting.[2] Additionally, long term monitoring programs must be implemented to better understand and prepare for new climate trends.
- **Restoration efforts must be tailored to specific regions, but in the context of the entire Gulf Coast**: Overall, post Deepwater Horizon restoration funds are focused more on the state and regional levels providing the opportunity to adapt unique guidelines for each area's

[1] *Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities*.
[2] Currin, C.A. W.S. Chappell, and A.Deaton. "Developing alternative shoreline armoring strategies: The living shoreline approach in North Carolina." (2010): 91-102

(counties) different coastal processes; however, this should not occur at the expense of ecosystem-level restoration efforts.

- **Achieving a healthy coastal environment requires healthy coastal communities**: Sustained health of the Gulf environment and economy relies on creating opportunities for at-risk communities to become more resistant and resilient to disaster events and long-term climate changes that impact Gulf coasts..

I . Introduction

The Gulf of Mexico is a dynamic ecosystem that is further complicated by human activities and the widespread effects of climate change. As one of the most ecologically and economically valuable marine ecosystems in the world, the fate of the Gulf is globally significant, particularly after natural and human-caused disasters.[3] Climate-related stressors such as ocean acidification, land subsidence, sea level rise, and storm surge conspire to make it challenging to manage marine resources.

The 2010 Deepwater Horizon oil spill exacerbated an already difficult situation in the Gulf. Coastal communities find themselves at the frontline of monuments changes but are sometimes over looked by post-spill restoration projects.[4] Long-term efforts are needed to service the people and environment impacted by the Deepwater Horizon oil spill.

The relationship between post-Deepwater Horizon restoration and climate change adaptation is complicated. The spill dealt a debilitating blow to the Gulf's ability to bounce back from ecological, economic and social hardship. The disaster shifted attention back to the Gulf and to the way "the Mississippi River Delta is being managed into oblivion."[5] Over the last several generations, coastal communities developed a unique relationship to the wetlands. However, for the last few decades residents are moving away from the coast because of massive disruptions to the wetlands by human-induced and natural processes.[6] The oil spill and any future oil spills seriously cripple the natural system's ability to be resilient against previously mentioned phenomena like sea level rise and storm surge.

An example of this comes from Cat Island, a once critical habitat for the four largest rookeries in Louisiana for brown pelicans, snowy egrets, roseate spoonbills, and lease terns. Prior to the oil spill, the island was largely a pristine nesting habitat.[7] After the spill, encroaching oil killed most of the root system holding the island sediment together. Scientists estimate this bird sanctuary will last for around one year more before it is completely disintegrated which is devastating not only for birds that nest there, but for the coastal communities who have lost another line of protection against powerful storms.[8]

This report will discuss how to consider the known and potential impacts of climate change on post-spill restoration efforts in order to build resilience in coastal communities.

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[3] Karnauskas, Mandy et al. "Evidence of climate-driven ecosystem reorganization in the Gulf of Mexcio" Global Change Biology doi: 10.1111/gcb.12894 (2015): 1-15. Print.
[4] Shepard, Andrew, personal communication, April 15, 2015
[5] Cheong, S. "From frequent hurricanes to the Deepwater Horizon oil spill in coastal Louisiana: The impact of regulatory change." *Ecology and Society* 19.2 (2014): 29.
[6] Id.
[7] "The Gulf Oil Spill Disintegrated This Island." *National Geographic.* N.p., 14 Apr. 2015. Web. 27 May 2015.
[8] Id.

II. Unprecedented restoration opportunities post-Deepwater Horizon oil spill

The Deepwater Horizon Oil Spill

Until 2010, the Exxon Valdez oil spill in 1989 was the largest spill ever to take place within U.S. waters after a tanker released 11 million gallons of oil into Alaska's Prince William Sound.[9] Twenty-five years after the disaster, several fishing communities in one of the largest and most productive estuaries in North America have yet to recover.[10]

The BP oil spill, also called the Deepwater Horizon oil spill, surpassed Exxon Valdez in 2010 when a damaged oil well spewed 134 million gallons of oil into the Gulf of Mexico.[11] Several investigations, government reports, and impact statements later, faulty infrastructure and an underprepared crew were revealed to be the causes of the accident.[12]

The spill lasted for 87 days as engineers frantically searched for a solution to cap the gushing well. Although a final total is disputed, scientists estimate 4-5 million barrels of oil were released into the Gulf.[13] The BP oil spill is recognized as the worst oil spill in U.S. history.[14]

In September 2014, District Court Judge Carl Barbier stated that the company "was aware that its crews lacked training about the proper use of diverters," one of the company's main criticisms.[15] This came after the Court ruled that BP's actions amounted to "gross negligence" and "willful misconduct," which resulted in the massive Gulf spill.[16] Investigation into BP's well design and Halliburton's cementing work uncovered problem after problem.[17] As a result, BP's penalties under the Clean Water Act alone could be as much as $14 billion (Figure 2.1).[18]

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[9] Short, Jeff. "The Exxon Valdez Oil Spill: How Much Oil Remains?" The Exxon Valdez Oil Spill: How Much Oil Remains? Web. 17 Dec. 2014. <http://www.afsc.noaa.gov/Quarterly/jas2001/feature_jas01.htm>.

[10] Elliot, Debbie, and Marisa Penaloza. "Exxon Valdez Oil Spill Brings 'Bad Juju' And Pain 25 Years Later." NPR. NPR, 26 Mar. 2014. Web. 17 Dec. 2014. <http://www.npr.org/2014/03/26/294709397/exxon-valdez-oil-spill-brings-bad-juju-and-pain-25-years-later>.

[11] Oil Spill by the Oil Rig "Deepwater Horizon" in the Gulf of Mexico, on April 20, 2010. 1-44. UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF LOUISIANA. 15 June 2015. *U. S. Courts*. N.p., n.d. Web. 27 May 2015.

[12] Barstow, David, David Rohde, and Stephanie Saul. "Deepwater Horizon's Final Hours." The New York Times. The New York Times, 25 Dec. 2010. Web. 18 Dec. 2014. <http://www.nytimes.com/2010/12/26/us/26spill.html?pagewanted=all&_r=0>.

[13] Gulf Coast Restoration & Recovery 101. Environmental Law Institute, 2014. Print.

[14] "Gulf Oil Spill." Smithsonian Ocean Portal. Web. 18 Dec. 2014. <http://ocean.si.edu/gulf-oil-spill>.

[15] Mufson, Steven. "BP's 'gross Negligence' Caused Gulf Oil Spill, Federal Judge Rules." Washington Post. The Washington Post, 4 Sept. 2014. Web. 18 Dec. 2014. <http://www.washingtonpost.com/business/economy/bps-gross-negligence-caused-gulf-oil-spill-federal-judge-rules/2014/09/04/3e2b9452-3445-11e4-9e92-0899b306bbea_story.html>.

[16] Id.

[17] Barstow, David, David Rohde, and Stephanie Saul. "Deepwater Horizon's Final Hours." The New York Times. The New York Times, 25 Dec. 2010. Web. 18 Dec. 2014. <http://www.nytimes.com/2010/12/26/us/26spill.html?pagewanted=all&_r=0>.

[18] Schwartz, John. "Judge's Ruling on Gulf Oil Spill Lowers Ceiling on the Fine BP Is Facing." *The New York Times*. The New York Times, 15 Jan. 2015. Web. 1 June 2015.

New Opportunities

Given the unprecedented size of these restoration monies, there is enormous opportunity to build a healthy Gulf environment economy. Although there are several other restoration programs active in the Gulf, this report will focus on those formed after the BP oil spill.

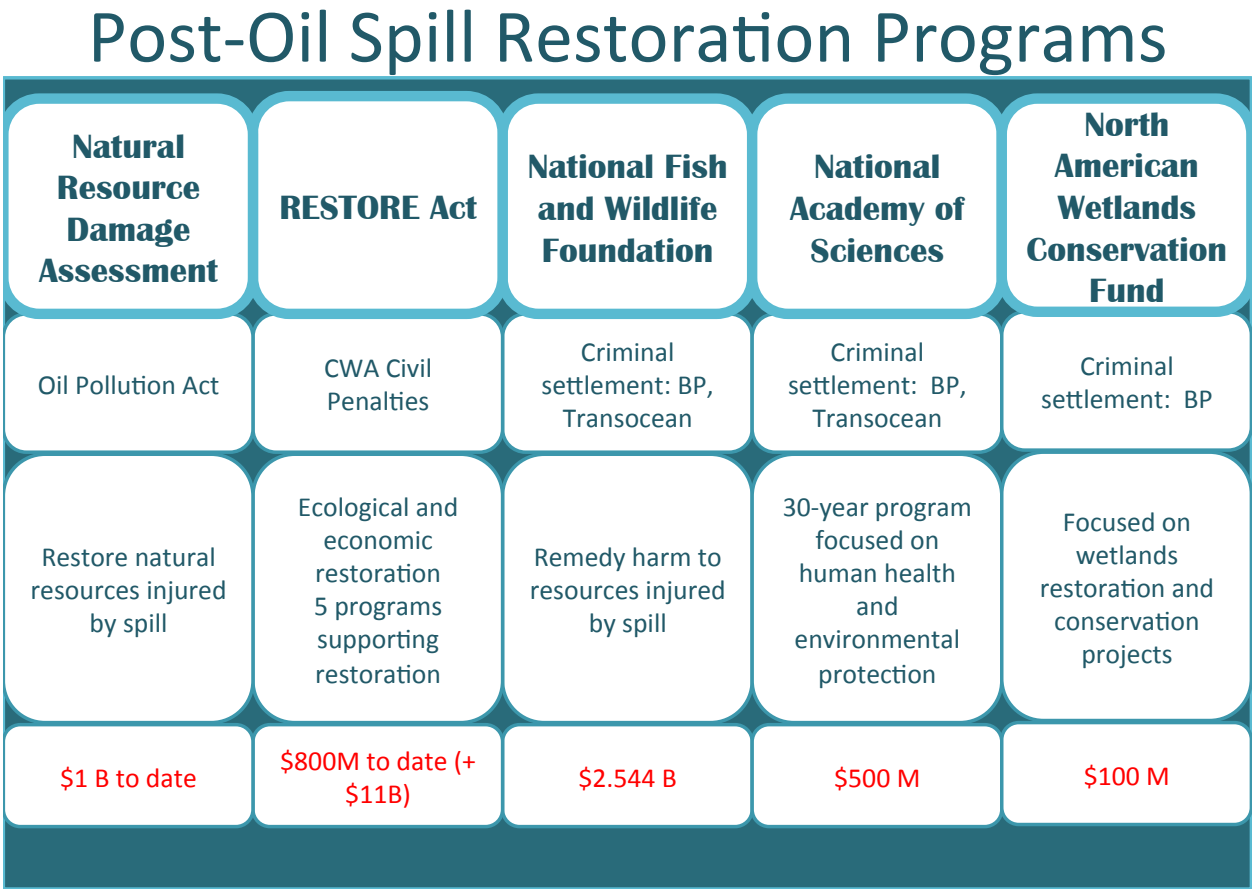


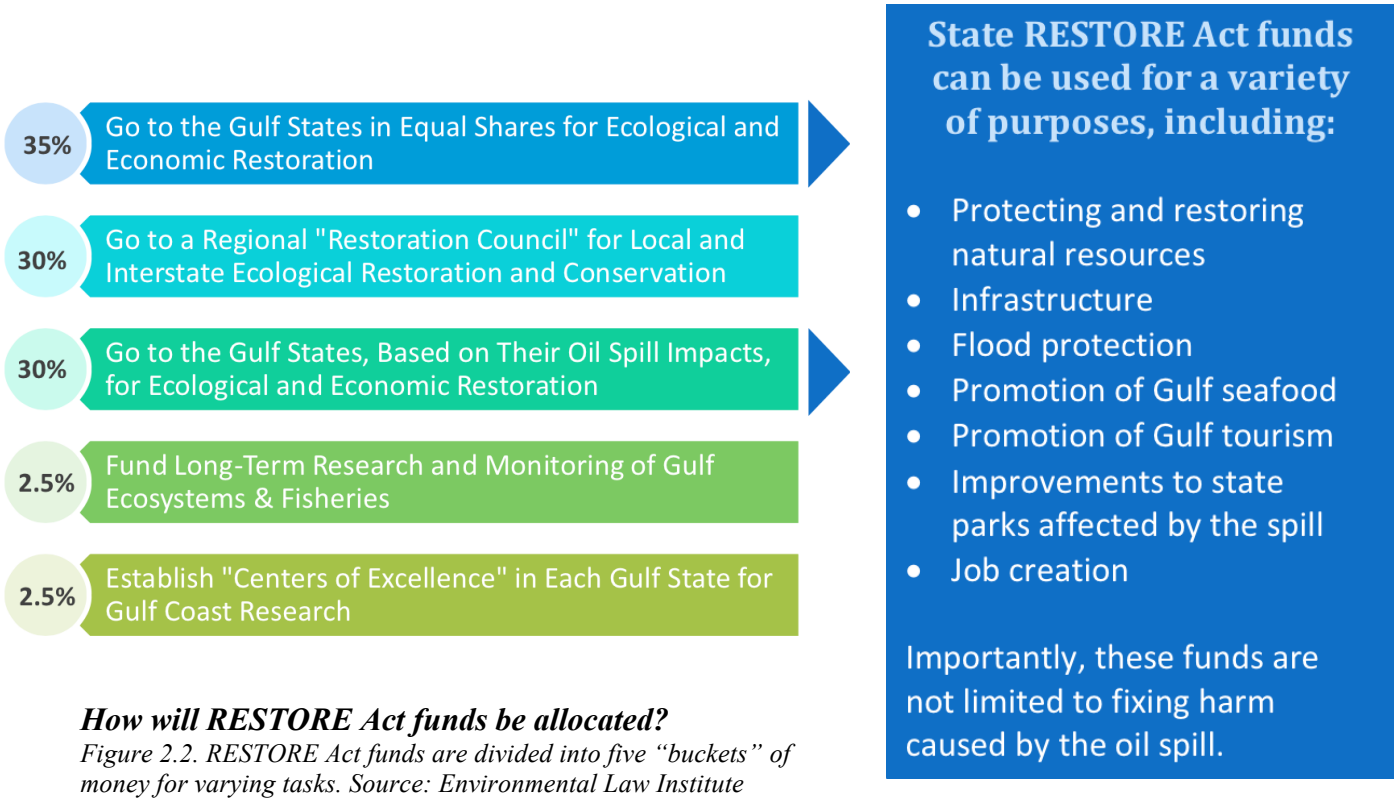
Figure 2.1. The five post oil-spill restoration programs. Source: Environmental Law Institute

As of June 2015, post-oil spill penalties include support for five key programs (Figure 2-1). The sum of these monies is substantial and provide an opportunity to address climate change impacts and promote community resilience. First, the National Resource Damage Assessment is a required program under the Oil Pollution Act which provides that the party responsible for the oil pollution must also pay for damages incurred.[20] To date BP has committed to $1 billion in early restoration with substantial additional resources to follow. The second pot of money comes from the RESTORE Act. The program ensures that 80% of the Clean Water Act civil penalties are directed to the Gulf of Mexico for ecological and economic restoration. Transocean has

[20] "Oil Pollution Act Overview." EPA. Environmental Protection Agency, n.d. Web. 27 May 2015.

committed $800 million to the RESTORE Act and another $11 billion from BP to follow after further litigation.

The third program is represented by the National Fish and Wildlife Foundation as a result of the criminal settlement with BP and Transocean. The purpose of this program is remedy harm to resources injured by the spill, a program backed by over $2.5 billion to date. The fourth program is the National Academy of Sciences Program, established as part of the criminal settlement with BP and Transocean. Funded to date with over $500 million, the 30-year program focuses on human health and environmental protection. The fifth and last program is the North American Wetlands Conservation Fund, also the result of the criminal settlement with BP and Transocean. This program focuses on wetland restoration and conservation project funded by $100 million to date. Restoration funded by the RESTORE Act will likely be the largest recovery program based on likely Clean Water Act fines. The Act establishes five funding programs, often referred to as "buckets" of funding (Figure 2.2).



How will RESTORE Act funds be allocated?

Figure 2.2. RESTORE Act funds are divided into five "buckets" of money for varying tasks. Source: Environmental Law Institute

How do these programs address climate change?

Although there is no explicit language in the RESTORE Act or other spill-related settlement documents that requires projects to undertake actions that address climate change impacts, climate change should be considered to achieve the program's ultimate goals. Specifically, activities that address the direct and spill impact components (buckets 1 and 3 in Figure 2.2) are eligible to include: restoration and protection of coastal natural resources, mitigation of damage

to these resources, and flood protection, All of these issues correlate with sea level rise, a direct consequence of climate change.

The Gulf Coast Ecosystem Restoration Council (bucket 2 in Fig. 2.2 and responsible for oversight of bucket 3) will prioritize projects that address one of four criteria related to restoration and protection, including "restore long-term resiliency of the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches and coastal wetlands most impacted by the Deepwater Horizon oil spill." The RESTORE Act Science Program (bucket 4 in Fig. 2.2) is charged with supporting marine and estuarine ecosystem research and monitoring.. Lastly, each state Center for Excellence funded under bucket 5 (Fig. 2.2) will focus on science, technology, and monitoring in one of 5 disciplines, which include: coastal and deltaic sustainability, restoration, and protection; sustainable and resilient growth and development; and comprehensive ecosystem observation, monitoring, and mapping.

III. Climate change's effect on restoration and the health of Gulf communities

The U.S. coastline bordering the Gulf of Mexico extends nearly 1,631 miles[21] incorporating vastly different ecoregions (Figure 3.1). Restoration should be administered with these differences in mind based on the understanding that a blanket restoration approach may not serve every region of the Gulf appropriately. Each region should adapt unique design features for their coastal settings.[22] Additionally, land use change and other human modifications to coastal processes (and their watersheds) change the features of ecosystems in coastal settings. This could include agriculture in the upper watershed or urban development in coastal watersheds.

[21] "General Facts about the Gulf of Mexico." EPA. Environmental Protection Agency, n.d. Web. 27 May 2015.
[22] Twilley, R.R., E.J. Barron, H.L. Gholz, M.A. Harwell, R.L. Miller, D.J. Reed, J.B. Rose, E.H. Siemann, R.G. Wetzel and R.J. Zimmerman (2001). Confronting Climate Change in the Gulf Coast Region: Prospects for Sustaining OurEcological Heritage. Union of Concerned Scientists, Cambridge, Massachusetts, and Ecological Society of America, Washington, D.C.

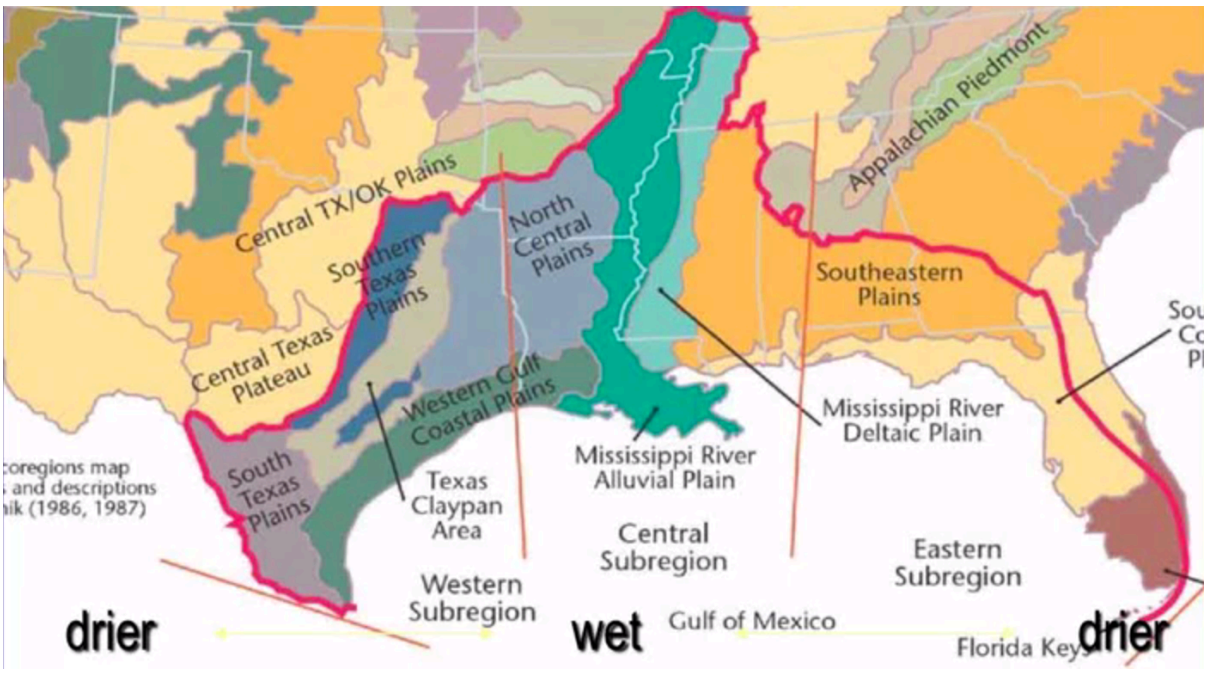


Figure 3.1. The gulf coastline is characterized by several different ecoregions with varying climates.

Climate change will amplify the effects of land use change on coastal processes and coastal ecosystem stability.[24] Restoration plans must account for the interactive effects of both impacts (land use and climate change) to ecosystem services.

One way in which climate change can compromise resiliency is by influencing the net balance of water. Water is a critical design feature related to ecosystem restoration. It appears in several forms (Figure 3.2): evapotranspiration, precipitation (runoff), sea level, and glacier melt (land ice to ocean).[25] These elements exist in a balance that is disrupted by climate change.[26]

Evapotranspiration, the sum of evaporation and plant transpiration from the Earth's land and ocean surface to the atmosphere, affects the salinity of a system. A proper balance in salinity is imperative to ecosystems that rely on a specific ratio of salty to fresh water to support the organisms that live in it. An example of this occurs when rising sea level inundates previously fresh or brackish water systems that contain species like oysters reliant on low salinity. Related, the amount of precipitation from upstream (drought or inundation) also greatly influences the amount of freshwater introduced into a system.[27]

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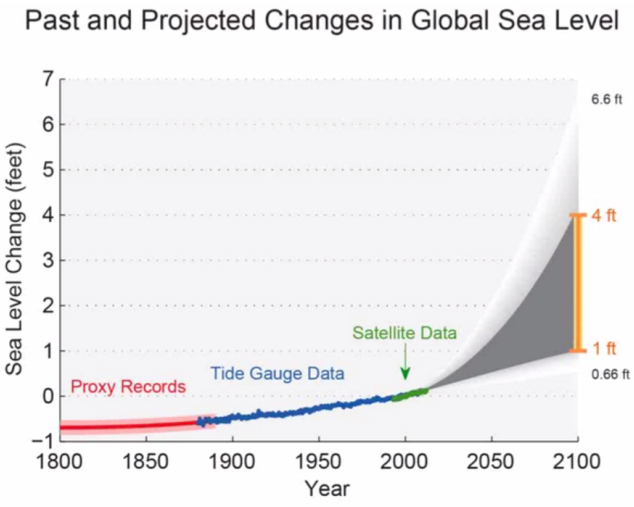
[24] Id.
[25] Id.
[26] Twilley, Robert. (2015, April 10). Climate Change, Coastal Resilience, and Restoration [Webinar]. Environmental Law Institute Webinar Series. Retrieved from URL.
[27] Twilley, R.R., E.J. Barron, H.L. Gholz, M.A. Harwell, R.L. Miller, D.J. Reed, J.B. Rose, E.H. Siemann, R.G. Wetzel and R.J. Zimmerman (2001). Confronting Climate Change in the Gulf Coast Region: Prospects for Sustaining Our Ecological Heritage. Union of Concerned Scientists, Cambridge, Massachusetts, and Ecological Society of America, Washington, D.C.

Figure 3.2. Net balance of water is impacted by simultaneously occurring events. Source: Source: "Confronting Climate Change in the Gulf Coast Region: Prospects for Sustaining Our Ecological Heritage"

One of the most critical changes to coastal settings will be future sea levels, which will increase the environmental and human risks along the coast. According to the 2014 National Climate Assessment, global sea level rise is projected to fall somewhere between one foot and four feet in the next 85 years (Figure 3.3). Higher water levels are especially significant for Gulf states, which are expected to undergo extreme changes (Figure 3.3). In some places, where land is subsiding, such as in the MS River Delta, the relative sea level rise might be even more extreme. Restoration plans should include adaptation measures for coastal areas proportional to predicted changes in elevation.



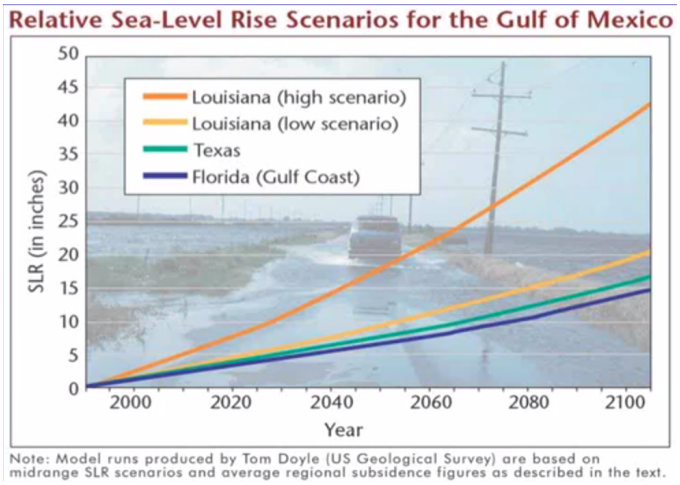


Figure 3.3. (Left) Satellite data predicts that global sea level rise will fall somewhere between one and four feet by 2100. Source: National Climate Assessment.
Figure 3.4. (Right) Project sea level rise across Louisiana, Texas, and Florida. Source: US Geological Survey.

Increased ocean acidification presents another challenge. Increasing anthropogenic carbon dioxide in the atmosphere causes oceans to become acidic, reducing the calcium carbonate saturation state for organisms that build their shells and skeletons from this mineral.[29] Decreased ability to produce carbonate shells will continue to significantly damage some commercially viable fisheries such as crabs, clams, lobsters, shrimp, scallops, and oysters.[30]

Additionally, fish and other organisms can develop metabolic, immune, and reproductive issues. These effects ripple through food webs as ocean acidification decreases the food source of animals at higher trophic levels.[31]

To promote Gulf coast community resilience, ecosystem restoration programs need to plan for future scenarios and create aggressive implementation plans that account for storm surges, ocean acidification, and other climate change-related issues.

IV. Communities most impacted by climate change and other disasters

Coastal communities of all economic classes and ethnicities are vulnerable to climate change impacts; most at risk are poor/low income families, the elderly and disabled, those coming from cultures that rely heavily on coastal resources to survive, citizens who speak English as a second language, and communities located near extractive industries.[32] Poor communities who subsist off of seafood they catch themselves struggle significantly after a major storm or oil spill. Eighty percent of the Vietnamese community, for example, is involved in the fishing industry and is therefore also disproportionately affected by hurricanes and oil spills.[34] The Gulf states have the highest percentage of Black Americans and people living below the poverty line making resilience in the face of environmental disasters extremely difficult.[36]

In order to lessen and dissolve the unequal burdens created by climate change on poor communities, restoration projects must take extra steps to engage with at-risk communities, including providing them with employment opportunities in the restoration efforts.[38]

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[29] Ries, Justin B., Anne L. Cohen, and Daniel C. McCorkle. "Marine calcifers exhibit mixed responses to CO2-induced ocean acidification." *Geology* 37.12 (2009): 1131-1134.
[30] Id.
[31] Twilley, Robert. (2015, April 10). Climate Change, Coastal Resilience, and Restoration [Webinar]. Environmental Law Institute Webinar Series. Retrieved from URL.
[32] Battle, Colette Pichon. (2015, April 10). Climate Change, Coastal Resilience, and Restoration [Webinar]. Environmental Law Institute Webinar Series. Retrieved from URL.
[34] National Ocean Service, NOAA. 2011. The Gulf of Mexico at a Glace: A Second Glace. Washington, DC: U.S. Department of Commerce.
[36] Rastogi, Sonya, Tallese D. Johnson, Elizabeth M. Hoeffel, and Malcolm P. Drewery, Jr. "The Black Population: 2010." 2010 Census Briefs (2011): 1-20. Census.gov. Sept. 2011. Web. 27 May 2015.
[38] Beatley, Timothy. *Planning for Coastal Resilience: Best Practices for Calamitous Times.* Washington, D.C.: Island Press, 2009. Print

V. Integrating climate change into local and regional restoration decision-making

Several good examples already exist of communities integrating climate change resilience into local and regional restoration decision-making. The Alabama-Mississippi Sea Grant Office has developed several key visual tools to help start a conversation around climate change with city officials. By asking them how they interpret strategically selected pictures presented to them during focus groups, they can assess whether they are seeing climate stressors in their cities.

Sea Grant assists cities with completing a community self-assessment to identify vulnerabilities and strengths with a resiliency index. It also uses visualization tools, such as NOAA's sea level rise viewer and the Community Health and Resource Model (CHARM). Through these different tools, Sea Grant has found that communities are relating climate change to increases in hurricanes, sea level rise, storm surge, and in some areas, drought, based upon what they are experiencing on the ground.

Case Studies: How are communities adapting?

Communities often interpret climate change based on their localized impacts.[39] One city that has seen major local impacts is Waveland, Mississippi. In 2005, Waveland was Ground Zero for Hurricane Katrina, receiving 26 feet of storm surge. Instead of creating a separate Sea Level Rise Action Plan, city planners integrated climate information into their Hazard Mitigation Plan including vulnerable nuisance flooding areas. This approach allowed the City to participate in the National Flood Insurance Plan, a program that incentivizes sea level rise and storm surge preparedness with discounted flood insurance rates.[40]

In addition, Waveland created an index of potential loss estimates that includes percent of land inundated and structural damage at various levels of flooding. The index helps city officials calculate how much one, three, and six feet of sea level rise will cost them in future damage if they don't take action.[41]

Another community taking steps towards resilience is Orange Beach, Alabama. City planners use the Vulnerability and Consequences Adaption Planning Scenario (VCAPS) to facilitate discussion with interactive concept mapping to create visual summaries of local knowledge and vulnerability and resilience.[42] VCAPS is a tool to help decision-makers in small municipalities explore the potential outcomes and consequences of climate change in their town, along with pathways through which they and individuals may respond. First, the city identifies a management concern and the climate stressor that's impacting it. Assuming no mitigation is conducted, they then look at the outcomes of the climate stressor on the management concern as well as the consequences.

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[39] Sempier, Tracie. (2015, April 10). Climate Change, Coastal Resilience, and Restoration [Webinar]. Environmental Law Institute Webinar Series. Retrieved from URL.
[40] Id.
[41] Id.
[42] Id.

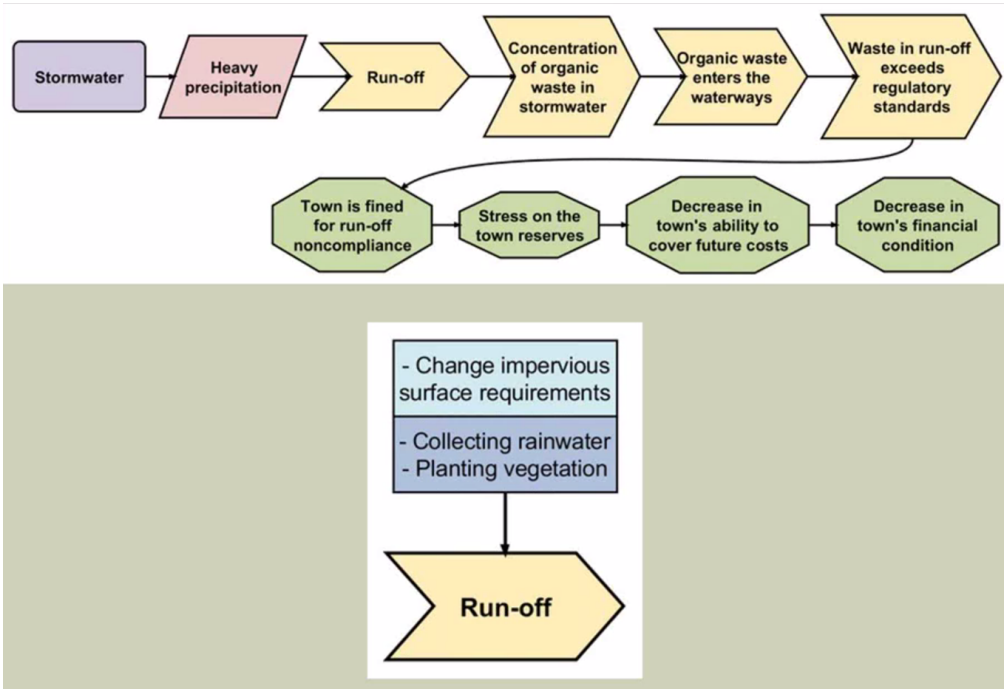

Figure 5.1. The VCAPS mental model helps planners avoid consequences from unattended management concerns. Source: City of Waveland Local Hazard Mitigation Plan.

By using this mental map, planners can determine what type of actions should be taken to avoid the aforementioned consequences.

The last case study comes from Ocean Springs, Mississippi where the town uses flood inundation maps to determine where the greatest damage will occur due to stormwater inundation through storm drains. As the city explored different mitigation strategies, they discovered that implementing living shorelines in place of riprap was not only less expensive , but also more effective at slowing erosion.[43]

Incentives for taking action

There are a number of financial incentives for communities to take action. The National Flood Insurance Program Community Rating System rewards cities for including future scenarios in their hazard mitigation plans, such as improving storm water management or creating and implementing watershed plans. There are also significant potential savings by using the program- Federal Emergency Management Agency (FEMA) estimates that $1 spent on mitigation can yield over $4 in future savings.[44]

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[43] Sempier, Tracie. (2015, April 10). Climate Change, Coastal Resilience, and Restoration [Webinar]. Environmental Law Institute Webinar Series. Retrieved from URL.

[44] "Protecting Yourself Through Mitigation | FEMA.gov." Protecting Yourself Through Mitigation | FEMA.gov. FEMA, 23 Apr. 2015. Web. 28 May 2015.

As communities take action to protect their built infrastructure, there are also opportunities to save the natural infrastructure. For instance, careful stormwater management planning could help or prevent outfall pipes from becoming inlets and pushing stormwater further inland. Additionally, preservation of trees and vegetation on uninhabited properties can improve stormwater management and flood control. Ecosystems, communities, and the economy all affect each other, and disasters and climate change have a significant impact on all three areas.

VI. Creating restoration programs to help the communities most at-risk for climate change and other regional disasters

Creating restoration programs to help at-risk communities requires a multi-pronged approach. From an economic standpoint, there could be several avenues towards resiliency. Economies that are diverse while allowing money to stay in local circulation offer a greater chance of "bouncing back" after a disaster.[45] Green and sustainable industry that uses local materials and laborers also provides a greater opportunity for resilience. Leadership at the Gulf Coast Center for Law & Policy has offered several suggestions for restoration programs. The Center proposes to set aside funds for workforce development rooted in renewable energy with appropriate labor practices. By doing so, at-risk communities can move away from harmful extractive industries.[46] As the likelihood of climate refugees becomes more real, restoration must also consider creating plans for controlled migration as well as building the capacity of neighboring communities to handle an influx of residents in the coming years.

The natural environment is both catalyst and moderator of coastal vulnerability. Although storms have the capability to undermine built environments, natural solutions like living coastlines can mitigate the affect of erosion.[48] The likelihood and magnitude of loss may be reduced by coastal vegetation, especially when those habitats fringe vulnerable communities and infrastructure.[49] The number of people, poor families, elderly and total value of residential property that are most exposed to hazards can be reduced by half if existing coastal habitats remain fully intact.[50]

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[50] Id.

Conclusions: Spill Restoration Action Plan in an Era of Abrupt Climate Change

The Gulf of Mexico is entering a period of new and uncertain norms. Weather patterns, climate, and ecosystem function are rapidly reorganizing emphasizing the importance of adaptive and agile management. Restoration managers must understand the intersection between communities, climate, and economy. Disasters and climate change affect all three areas and therefore maintaining a healthy environment for sustainable development and robust coastal communities is dependent on intelligent, preventative restoration design.

Appendix

Companion video: https://vimeo.com/128644900

Recording of webinar: http://eli-ocean.org/gulf/climatechangewebinar/

Webinar panelist information:

MODERATOR
- **Andrew Shepard**, Florida Institute of Oceanography, Gulf of Mexico University Research Collaborative

SPEAKERS:
- **Dr. Kathryn Mengerink** (Director, Ocean Program, Environmental Law Institute) Overview of Gulf Restoration Programs
- **Dr. Robert Twilley** (Executive Director, Louisiana Sea Grant) Ecosystem Adaptation Climate Change Impacts on the Gulf Coast and Restoration Efforts
- **Colette Pichon Battle** (Executive Director, Gulf Coast Center for Law & Policy) Climate Impacts on Communities and Options for Response
- **Dr. Tracie Sempier** (Coastal Storms Outreach Coordinator, Mississippi-Alabama Sea Grant) Climate Change Decision-Making by Coastal Communities
- **Jonathan Porthouse** (Senior Manager, Coastal Habitat Restoration, Gulf Environmental Benefit Fund) Integrating Climate Change Impacts into Restoration Planning and Project

Webinar Q&A (Authored by GOMURC):

How do we achieve climate justice through the Deepwater Horizon *restoration processes and programs? What does that look like?*
Ms. Pichon Battle said that restoration programs need to devote resources to support not just natural resource restoration, but also jobs and workforce development for citizens of the Gulf coast, especially communities most at risk and in need. She said that we should invest in innovation rooted in renewable energy and/or labor practices that reduce inequities and promote justice. As an example, projects funded to date do not provide support for Native American communities and their land.

Some marsh restoration projects in New York/New Jersey did not take sea level rise into consideration. Are Gulf of Mexico marsh restoration projects being done with future sea level rise taken into consideration? If so, how?
Dr. Twilley said that that some projects may not have directly factored in sea level rise scenarios. He said that the master planning process in Louisiana has specifically looked at sea level rise relative to long term stability of wetlands systems. LA Sea Grant is now funding a project to predict how proposed river diversions to supply needed sediments to wetlands may be affected over time in the face of relative sea level rise and saltwater intrusions.
Mr. Porthouse said that NFWF projects are required to consider and monitor significant changes that may occur over the project design-life. As sea level rise continues in some of these areas, some wetlands may be cut off from sediment supplies and so impacted by saltwater that they may not be sustainable long-term, when viewed in a 50-60 year timeframe, while in the shorter

term, impacts can be monitored and controlled. He stated that NFWF may still fund projects that may be negatively impacted by changes if they provide needed benefits over the accepted project life.

How do you navigate the political context (especially in states where "climate change" is not recognized) in integrating climate change considerations into restoration projects?
Ms. Pichon Battle stated that the shift around the issue of climate change needs to come from having an informed community and constituency that can change and hold accountable decision makers. She said that we must connect people's everyday experiences to climate change and have them ask policy makers to put climate change on the agenda – an activity which many marginalized peoples have not been taught to do.
Dr. Sempier said that she was less concerned about what terms local communities use when describing climate change. She asserted that we should not care about labels as much as the outcomes and that changes in terminology will come as more communities become familiar with hazard mitigation strategies.

How much is long-term monitoring being incorporated into the restoration process? Are any funds being held over for longer term use or placed in a trust to bolster restoration in response to future change and/or for long-term management of restored sites?
Dr. Twilley emphasized the importance of monitoring, which is critical in any restoration project. With all the money invested in restoration, he stated that we have to have an adaptive management framework where we can learn from our mistakes and incorporate better designs as we move forward with the investments that we are making. Some programs have monitoring measures built in, but a lot of restoration money in Louisiana has not included an extensive monitoring program.
Mr. Porthouse stated that monitoring and adaptation is a central part of what NFWF is trying to accomplish. NFWF has specific monitoring requirements for all its projects, which are linked to specific goals and methodologies to track performance. Restoration requires an adaptive management approach based on ecosystem monitoring that assesses many relevant indicators over the many scales of this massive recovery effort. Mr. Porthouse said he spent a lot of time working with other programs to ensure that monitoring is as consistent across programs as possible, so that there may eventually be a region-wide assessment.

Is NFWF conducting or supporting social vulnerability analysis in the identification of priority projects for restoration? Not just understanding where communities are but understanding what communities are most vulnerable to impacts and in need of restoration?
Mr. Porthouse said that NFWF itself is not conducting those analyses, but is looking to the states to be in the forefront of prioritizing projects. He cited the state of Mississippi as an example of a state making a concerted effort to reach out to minority communities, especially the Vietnamese fishing community in the state, and to understand development patterns along the coast and what the community truly values and what to restore.

Where do SLR scenarios that communities are using (1 ft. vs. 6 ft. sea level rise by 2100) to plan for mitigation come from? Are there discussions between local experts and the community, or is it an internal government process?

Dr. Sempier said that data for SLR scenarios is readily available from a variety of academic and federal sources. The City of Waveland, for example, used Stennis Space Center GIS data developed for a NASA planning exercise. NOAA and USGS provide commonly used SLR viewers with predicted inundation levels. Local managers often utilize contractors to synthesize these data and products for local application and planning. The hazard mitigation planning process for many cities and counties includes engagement of steering committees that engage citizens and local stakeholders.

Louisiana has a massive amount of infrastructure (e.g., cities, oil/gas and ports) on the coast in harm's way. When will best practices for climate resilience for Louisiana be developed, and who is developing that plan? Are parish floodplain managers involved?
Dr. Sempier replied that, at the parish and the municipality level, the floodplain managers are usually involved in the hazard mitigation process. Sometimes comprehensive planning and hazard mitigation planning are not done at the same time, but some communities have both. A lot of times, if a municipality does not have enough funds to create a hazard mitigation plan, they will adopt the county's plan.
Dr. Twilley was unsure if large port systems factored in sea-level rise and climate change in their infrastructure needs over the life cycle of their port facilities. He noted that LA Sea Grant has been working to educate and assist parish managers through extension programs and materials (e.g., *Homeowners Handbook to Prepare for Natural Disasters*). One challenge is that most local plans do not look out far enough to handle expected changes; managers need tools to transition to longer range plans.

Do you see any potential conflicts between addressing both ecological and community resilience in restoration projects? If so, are there ways to mitigate these conflicts?
Ms. Pichon Battle said that they are closely aligned in scope and purpose and that strong and healthy local communities are the most important stewards for a healthy environment. Restoration programs need to engage and value local knowledge as well as high level scientific expertise. She also said that what is needed is a "both/and" approach. If we are working with ecosystems, then we need to have a new system of management; we need to have conversations about our economy and who drives it and who participates in it. Restoration programs should support activities that value and restore socio-economic conditions with a racial and social equity lens.
Dr. Twilley said he was trained that people are part of ecosystems. In coastal Louisiana, there was a coevolution of how the ecosystems developed and where people live and how they live. Saltwater intrusion affects all coastal species, whether we consider drinking water for humans or the survival of plants and trees. He said that conflicts may arise when we look for quick fixes, such as hardening shoreline (building seawalls) to hold off the sea, versus more environmentally friendly solutions that may be cheaper and longer lasting.

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