

**THE CLIMATE AROUND CLIMATE CHANGE ON FLORIDA'S REEFS:  
IN ACTION OR INACTION?**

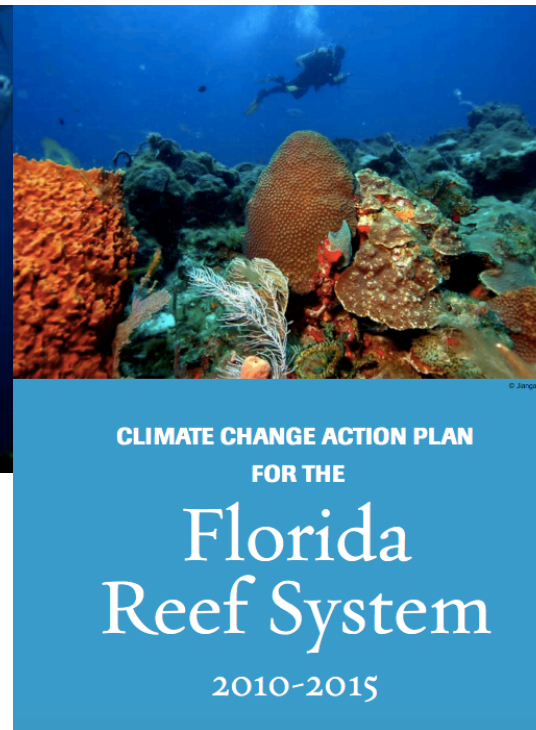
*A Qualitative Evaluation of the Climate Change Action Plan  
for the Florida Reef System 2010-2015*

by MALLORY MORGAN



Photo Credit: NOAA

SCRIPPS INSTITUTION OF OCEANOGRAPHY  
M.A.S. MARINE BIODIVERSITY AND CONSERVATION  
FINAL CAPSTONE REPORT - JUNE 11, 2015



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for the Florida Reef System 2010-2015*

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**M.A.S Marine Biodiversity and Conservation  
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## **PREFACE**

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*My hometown of Cocoa Beach, Florida is projected to be permanently inundated at high tide with 1m of SLR by 2100 (NOAA, 2015). It is in my opinion that my generation's greatest challenge will be in dealing with the myriad of climate change impacts and the contributing stressors to both natural and human systems. Climate change is global, but the impacts are local and immediate. It is my hope through this project attention will be refocused to the plight of one of my personally most valued ecosystems, and a subsequent climate action plan be produced with lessons learned from this evaluation.*

*I would like to specially thank those who guided me through this project and provided valuable input to formulate this report. First, thank you to my committee chair Alessandra Score, lead scientist for EcoAdapt. Mrs. Score spearheaded the collaboration effort in the drafting of the Action Plan in 2009 and provided the idea of this evaluation; I am honored to follow in her footsteps. Next, thank you to Dr. Ayelet Gneezy from Rady School of Management at University of California, San Diego. Dr. Gneezy is a social/behavioral scientist who provided guidance on the survey and scorecard development. Also, Dr. Jennifer Smith from Scripps Institution of Oceanography-the resident coral reef expert with experience in reef community planning and management. Lastly, thank you to Levi Lewis for his help in connecting the scattered dots in my head; your help was pivotal.*

## **ABSTRACT**

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This project seeks to evaluate the success and degree of implementation of the *Climate Change Action Plan for the Florida Reef System 2010-2015* (referenced hereafter as Action Plan, and cited as CCAPFRS). This Action Plan identifies interdisciplinary actions to be incorporated into reef management plans in order to address a myriad of climatic and non-climatic stressors to the reef system, minimize risks to coral reef dependent people and industries, and target scientific research priorities for strategic management.

As we are now in the final year of the Action Plan, the status and degree of implementation of the plan's 40 recommendations has been unknown until now. A qualitative evaluation was designed due to a lack of monitoring, established benchmarks, and specific measures in the plan. Through stakeholder interviews, surveys, and independent Internet research this project assessed to what degree the recommended actions had been implemented and developed a scorecard to consolidate information on management strategies underway that contribute to the general success of the Action Plan. The scorecard enhances communication among stakeholder groups and various governmental and state agencies regarding collective progress, and serves as a blueprint for a subsequent plan moving forward. This review process demonstrated the great benefits and value of monitoring and evaluation of action plans with application worldwide.

Overall, it was found the plan is in a fairly good degree of implementation, with 80% of the plan's 40 action items addressed to some degree. The most success was found in research goals, and the area most in need regards fisheries management. Some priorities changed over time. There has been a strong monitoring and reporting network built in the region, with several programs utilizing "eyes and ears on the water". The capacity to respond and monitor coral bleaching events has also greatly increased.

## ACRONYM LIST

CCAPFRS	The Climate Change Action Plan for the Florida Reef System 2010-2015
CRCP	Coral Reef Conservation Program
FDEP	Florida Department of Environmental Protection
FKNMS	Florida Keys National Marine Sanctuary
FRRP	Florida Reef Resilience Program
FWC	Florida Fish and Wildlife Conservation Commission
NGO	Non-government organization
NOAA	National Oceanic Atmospheric Administration
SEAFAN	Southeast Florida Action Network
SEFCRI	Southeast Florida Coral Reef Initiative
SLR	Sea level rise
TNC	The Nature Conservancy

## **BACKGROUND**

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According to the U.S. Census Bureau, 39% of the nation's total population lived in coastal counties in 2010 (U.S. Census Bureau, 2011). These communities, as well as many others around the world, are highly vulnerable to climate change impacts such as sea level rise (SLR), increased storm intensity, and increased temperatures - threatening their social, economical, and ecological resilience. The Reef Resilience Program defines resilience as "the ability of a system to maintain key functions and processes in the face of stresses or pressures by either resisting to or adapting to change" (Reef Resilience Program, 2014). The White House Office of the Press Secretary recognizes the particular vulnerability of Florida. The White House reports:

"The Southeast and Caribbean region is exceptionally vulnerable to sea level rise, extreme heat events, hurricanes, and decreased water availability. Sea level rise presents major challenges to South Florida's existing coastal water management system due to a combination of increasingly urbanized areas, aging flood control facilities, flat topography, and porous limestone aquifers. Drainage problems are already being experienced in many locations during seasonal high tides, heavy rains, and storm surge events. Coral reefs are susceptible to climate change and impacts exacerbated when coupled with other stressors." (The White House Office of the Press Secretary Fact Sheet, 2014)

More specifically, the preservation and health of the Florida reef system is vital to the sustainability of Florida's economy, marine ecosystems, and safety of its people. The Florida reef tract provides specialized habitat, recreation, and coastline protection. It functions as the foundation of Florida's economy through the tourism industry it supports.

Florida's reef system supports over 71,000 jobs annually, attracts millions of visitors to Florida each year, and has an estimated asset value of \$7.6 billion (Johns et al 2003). The physical reef structure serves to dissipate wave energy and reduce coastal erosion thereby protecting coastal infrastructure, beaches, and communities (Cesar and Beukering, 2004). Unfortunately coral reefs worldwide are in decline, and the reefs of Florida are no exception. In fact, monitoring data from 105 stations in the Florida Keys has revealed a 44% decline in coral cover between 1996-2005 (Florida Department of Environmental Protection, 2014).

### The Action Plan

City planners, natural resource managers, politicians, and community members are responsible for mitigating and adapting to negative impacts associated with human stressors as well as climate change. This can occur with guidance from interdisciplinary action plans such as the *Climate Change Action Plan of the Florida Reef System 2010-2015* (See Figure 1). The Action Plan primarily aims

to reduce local impacts to Florida's reefs in order to increase reef resilience to the negative impacts associated with climate change, and ensure the longevity of the ecosystem and the services it provides.

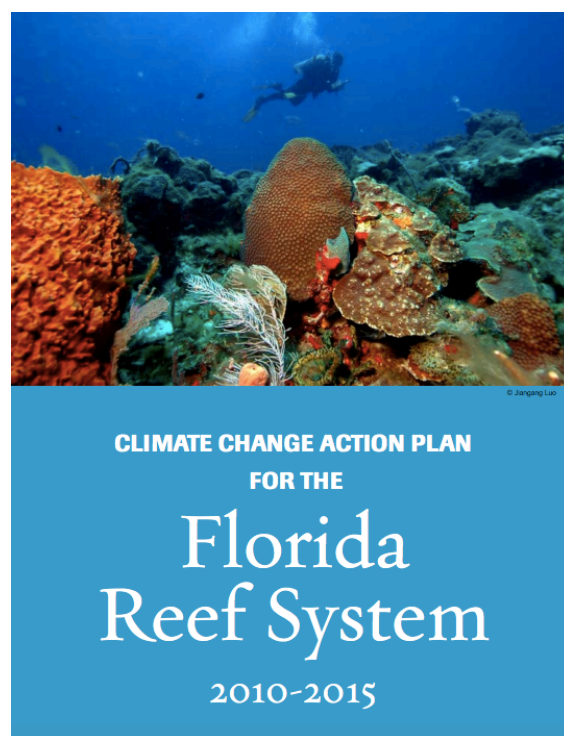
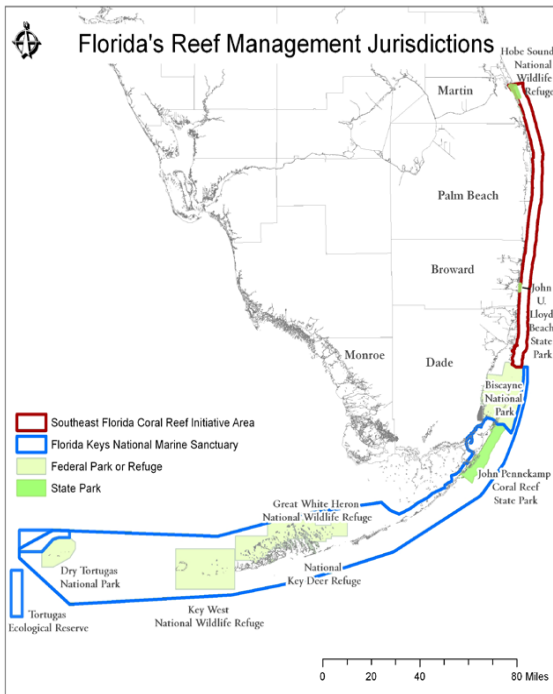


Figure 1: The cover of the Action Plan. (FRRP)



In 2008 the Florida Reef Resilience Program (FRRP) held a conference “Coping with Climate Change” in response to the obvious declining coral cover and increasing stressors on Florida’s reef tract previously mentioned. This Action Plan is a product of a series of small working groups taking place during that conference. Stakeholders including coral reef scientists, managers, research institutions, and various regional user groups worked together to develop and rank ideas and approaches coral reef managers and users could employ to protect the region’s reefs from the threat of climate change (Florida Reef Resilience Program, 2010). These recommendations and priorities were synthesized to produce this Action Plan, and then disseminated through media, the Florida Keys National Marine Sanctuary (FKNMS) Advisory Council, the Southeast Coral Reef Initiative (SEFCRI), and various conferences (per comm. Alex Score, via email 7/1/2015).

This was a stakeholder-supported document intended to encourage voluntary action and implementation, though it was not mandated or passed as regulation. Additionally, no benchmarks, indicators of success, or timeline was included to track efficacy. As such, no known monitoring or follow-up of the Action Plan was completed until now. This project filled that gap and collected necessary information that will be needed if there is a subsequent, updated plan.



**Figure 2: Map depicting jurisdictional boundaries of Florida's reef tract. (from the Action Plan)**

As is the challenge with many ecosystems, Florida's 300 nautical-mile-reef tract is overseen by a multitude of management layers including Federal and State agencies, five counties, and hundreds of municipalities (CCAPFRS p. 3)(See Figure 2). Jurisdictional boundaries frequently overlap with the large number of state parks, national wildlife refuges, and national parks established in this marine ecosystem. Management is further complicated by input from user groups such as

the boating, diving, recreational and commercial fishing industries, and conservation organizations. Major players in the region include the FKNMS, SEFCRI, Florida Department of Environmental Protection (FDEP), and The Nature Conservancy (TNC).

It is worthwhile to note, the Action Plan is the first of its kind to look at the Florida reef tract as a whole ecosystem and attempts to connect climate change adaptation and mitigation efforts from the municipal to the federal level. It is highly interdisciplinary with heavy stakeholder involvement.

The comprehensive document calls for action on a wide variety of issues, both climate and human induced, including but not limited to:

- Coordination of research
- Coral bleaching
- Ocean acidification
- Threatened & Endangered species
- Sea level rise
- Climate impacts to fisheries
- Water quality impacts to reefs
- Beach renourishment
- Dredging prohibition
- Assess range shifts and habitat transitions
- Coastal development
- Climate change training for ecosystem managers
- Ghost fishing
- Climate science integration into school curricula
- Business adaptation plans
- Climate-smart business recognition
- Irreversible damage thresholds
- Novel intervention measures

Broken down into three major outcomes, the Action Plan contains 40 action items total that aim to:

1. Increase coral reef resilience to climate change through effective management strategies and actions,
2. Identify the risks climate change poses to Florida's coral reef-dependent people and industries, communicate those risks to affected parties and work with them to develop adaptation strategies that minimize those risks, and,
3. Strengthen the scientific foundation supporting strategic management of the Florida Reef System through targeted research, long-term monitoring, and forecasting climate change and ocean acidification impacts. (CCAPFRS pp. 9,11,13)

There is considerable timeliness for this project as we are in the final year of the plan and approaching the tenth anniversary of the committee responsible for its direction, the FRRP. Perhaps more importantly, Florida's reefs are vulnerable to a back-to-back severe bleaching event with the anticipation of an El Nino in 2015 (Climate Prediction Center, 2015). In 2014, the Florida Keys experienced the worst bleaching event since the El Nino of 1997-1999 (Kennedy, 2014). Severe bleaching occurred from Broward County all the way through to the southernmost region of the tract in the Dry Tortugas (Johnson, 2014).

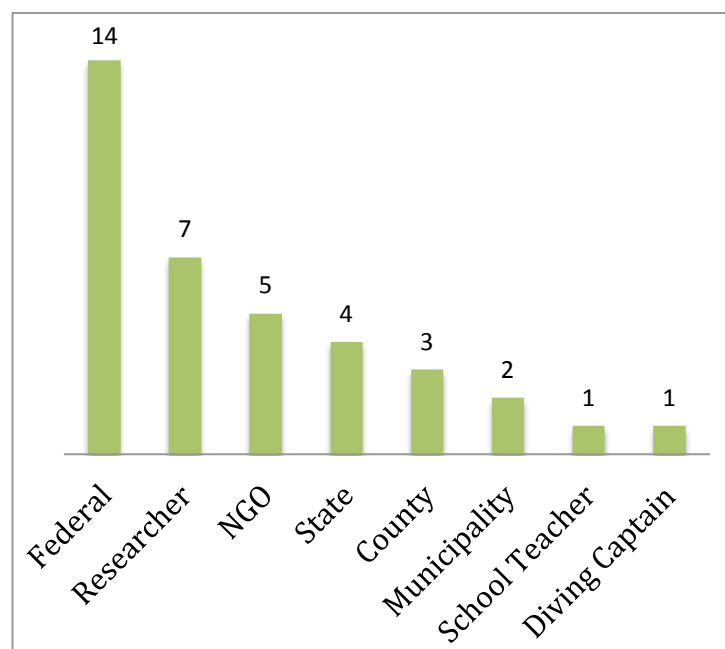
El Nino will bring warmer water temperatures, and thus a higher likelihood of bleaching.<sup>1</sup>

Reengagement of this Action Plan is needed to reduce the impacts of localized stressors addressed in the plan and to promote and facilitate coral reef resilience.

## METHODOLOGY

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Since no benchmarks or indicators were included in the Action Plan, this evaluation was inherently qualitative. The methodology to inform the scorecard was carried out through 3 main steps: 1) personal interviews, 2) online surveys, and 3) independent Internet research. Interviewees were selected based on their professional occupancy of positions most familiar with action in the Florida reef tract and included state and federal managers,



**Figure 3: Coupled with independent Internet research, the source of supporting evidence for the scorecard came through interviews and online surveys of these groups, 37 individual respondents total.**

fishers, divers, NGO's, and other stakeholders in the community. As seen in Figure 3, most participation in this study was seen at the federal level. This is due to the fact that 2/3 of Florida's reef tract is managed by the FKNMS, a division of NOAA, thus the majority of the survey trip was spent in the Florida Keys (Gregg, 2013).

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<sup>1</sup> Coral bleaching is defined by NOAA and the National Ocean Service as the the process that occurs when corals are "stressed by changes in conditions such as temperature, light, or nutrients and they expel their symbiotic algae which is their food source, causing them to turn white. Although when coral bleaches it is not dead yet, it is under high stress and is more vulnerable to mortality." Visit [http://oceanservice.noaa.gov/facts/coral\\_bleach.html](http://oceanservice.noaa.gov/facts/coral_bleach.html) for more information.

## **In-person Interviews**

I traveled to South Florida to personally meet with various stakeholders in the region in order to collect information for the scorecard on the wide variety of topics in the Action Plan. Thirteen face-to-face interviews took place from Big Pine Key in the south, to Dania Beach to the north (*see Appendix 3*). Interviewees included MOTE Marine Laboratory, TNC, FKNMS, Florida Fish and Wildlife Conservation Commission (FWC), NOAA's Coral Reef Conservation Program (CRCP), Monroe County, the City of Marathon, the Coral Restoration Foundation, and Keys Diver Dive Shop. Subjects were given specific instructions to 1) only provide information relevant to the Action Plan's time frame, between the years of 2010-2015, 2) provide specific names of projects and examples how the action item has been addressed with the date, and 3) to what extent did the respondent feel the action had been addressed: fully, partially, or not yet addressed. Interviewees reviewed each action item one by one in most cases, whereas some interviews only discussed a subset of actions when time was limited.

This was the most productive source of information for the project, and of monitoring and evaluation strategies in general, in my experience. It was initially assumed most information would come from online surveys, but once the project commenced it quickly became apparent valuable information and deeper insights were facilitated through conversation not otherwise revealed through online surveying. Issues were explored in further depth, and complexities were clarified through discussion. Because of this, resources for on-the-ground surveying should be budgeted into a project's design whenever possible.

## **Phone interviews**

Phone interviews were conducted with participants when there were conflicting schedules, or when the participant was not physically present in the project study area. Six phone interviews were conducted with the FDEP, Florida SeaGrant, FKNMS, FWC, and the National Park Service (NPS). Interviewees were emailed a list of the 40 action items prior to the call and the same instructions were given as the in-person interviews as previously discussed.

Unfortunately, I was unable to find a free telephone call recording program. If this project is to be continued or repeated, calls should be recorded for reference during data synthesis. With full permission, all in-person interviews were recorded with a GoPro and personally transcribed to create the final report and analysis. This would have been helpful with the phone interviews as well, rather than personally transcribing notes during the call.

## **Online survey**

Three surveys were developed using an online service called surveymonkey.com. The survey was “live” from April 12-June 2, 2015. The separate formats were dependent on the respondent’s demographic group. Taking into consideration the scope and breadth of the 40 action items, it was unfavorable to include all actions into one general survey. Rather, actions were grouped into general reef management, fisheries management, and research. The goal was to facilitate greater participation by creating a shorter, more concise survey.

However, I only received 13 completed surveys with over 150 participants directly emailed. I received far less participants in the online survey than expected, and I believe this is due to an overload of correspondence in one's inbox daily. Survey fatigue is a common barrier to an evaluation survey, and follow-up reminders for the survey should be sent. Unfortunately, only about 10 people were contacted personally prior to the survey to solicit participation. A lack of time was a barrier in this study and reminder emails could have produced more participation. Although, one prominent leader in the management community in South Florida emailed one format of the survey to his professional network after my initial ask, so that served as a refresher. Five additional responses were received after that occurred.

This phase of the project undoubtedly required the most time. The goal of this analysis was to produce the most unbiased, objective analysis as possible. Careful consideration was given to question formatting, survey techniques, priming, and design in both the interview and online survey process. Dr. Ayelet Gneezy, a social scientist from the University of California San Diego, was enlisted for guidance. Ultimately, survey responses and interviews are inherently subjective. However, the information solicited came from those with extensive history and professional experience working on Florida's reef tract.

Considering only 9% of people who were directly emailed in turn completed the survey, there is a clear need to better understand willingness to participate. If this project is to be replicated or applied elsewhere, there should be further time invested in securing greater online survey participation and sending follow-up emails. A \$50 Visa gift card

was initially offered as an incentive, but we were unable to deliver due to legal constraints on behalf of the participants' employers. Interviewees were instructed not to complete the online survey so there was no overlap of respondents.

## Internet research

Finally, information was collected from the Internet by reviewing meeting agendas, bulletins, news archives, various agency websites, etc. As seen in Figure 4, this information was mostly used in the appendices section of the scorecard in order to provide specific URL's to various documents and projects.

## Scorecard Development

Finally, a scorecard was developed from this information collected to provide an overview of the status and degree of implementation of the

40 action items in the Action Plan. The purpose of the scorecard is to communicate successes and failures of the Action Plan and call to action issues still requiring attention. Ideally this would catalyze a subsequent Action Plan in the near future, although the likelihood of this is unknown to date. Lessons learned could be applied to make a succeeding Action Plan more efficient and detailed. These suggestions are outlined in the section titled "Recommendations".

- Compact: **NS-4** "Quantify monetary values of hazard mitigation and adaptation provided by natural systems" **NS-10** "Advocate for funding to identify economic and physical linkages between marine systems and hazard risk/damage claim reduction"
- TNC's [Coastal Resilience Mapping Tool](#) "helps communities understand their vulnerability from coastal hazards, reduce their risk, and determine the value of nature-based solutions." ([coastalresilience.org](#))
- [FKNMS Socioeconomic Fact Sheet](#) (2/2012)
- [National Geographic Socioeconomic Case Study of Florida](#)

**ACTION 2.2.1** Develop scientifically based climate change fact sheets tailored for reef users, community members, visitors, elected officials, business and industry to increase the understanding of and support for actions to increase resilience. Use multiple outlets (news media, radio brochures, community forums, social networks, blogs and websites) to communicate the facts.

- Waterways episodes on TV and Youtube (276 episodes to date)
- FL DEP CRCP Earth Month 2015: Offered several free education classes (Stony Coral ID, SEAFAN/BleachWatch Training, Marine Invertebrate ID Training, REEF Fish ID Training)
- Disturbance Response Monitoring reports publicly communicated through websites and FM radio
- FKNMS is active on Facebook, Twitter, Instagram, FM radio, Internet, community forum meetings, open advisory council meetings, etc.
- [The White House Fact Sheet: Climate Change in Florida](#) by the Office of the Press Secretary (May 2014)
- [Natural Resources Defense Council Fact Sheet](#) (July 2011)
- [FKNMS Fact Sheet on Climate Change Vulnerability](#) (November 2011)
- [Our Florida Reefs Fact Sheets](#) cover a range of topics including but not limited to:
  - [Estuarine, Coastal, and Ocean Habitats — Essential for a Productive Coral Reef Ecosystem \(PDF\)](#)
  - [Fish — Marine Life Depends on Healthy Coral Reefs \(PDF\)](#)
  - [Management — An Essential Part of Healthy Reefs \(PDF\)](#)
  - [People — Everyone Depends on Our Healthy Coral Reefs \(PDF\)](#)

**ACTION 2.2.2** Involve community members, elected officials, visitors and Florida diving, fishing, and other maritime industries in climate change science and monitoring efforts on the Florida Reef System.

- [Our Florida Reefs](#) is a new community planning process for southeast Florida's reefs launched by SEFCRI in 2013. "This planning process brings together the community of local residents, reef users, business owners, visitors and the broader public in Miami-Dade, Broward, Palm Beach, and Martin counties to discuss the future of coral reefs in this region. This process is designed to increase public involvement in the future management of southeast Florida's coral reefs by seeking input from community members on the development of recommendations that can become part of a comprehensive management strategy to ensure healthy coral

**Figure 4: A page from the Appendix section of the technical scorecard. Seen in blue are various URL's and websites the reader can view more information about the projects and efforts listed to address each action item.**



Following the field trip to South Florida, I attended the *National Adaptation Forum* in St. Louis, Missouri in May 2014 to engage in collaboration with professionals around the nation in climate change adaptation. I gave a talk and presented a poster to showcase preliminary results of the analysis, and used this platform as an opportunity to discuss scorecard frameworks with other professionals. The focus of my presentations was to promote the value of monitoring and evaluation, an often disregarded or unfunded activity. I received feedback from several people suggesting scorecards used in the field, such as those from the Great Barrier Reef Marine Park Authority and the San Francisco Bay. These scorecards were reviewed, but ultimately were too complex as a template for this study.

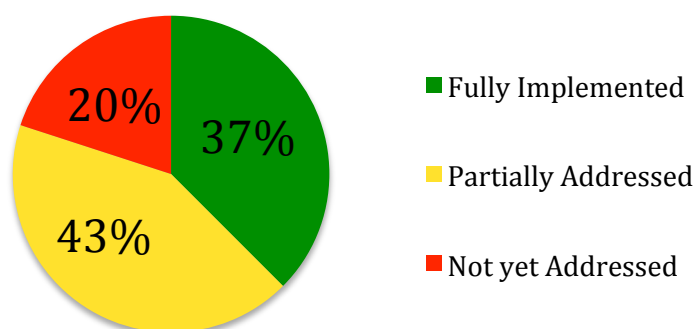
Two scorecard formats were created to communicate to different audiences. The first format is a colorfully intriguing and visually stimulating infographic produced from [piktochart.com](http://piktochart.com). This format creates public interest and awareness, serving as an outreach tool to the general public. Reef user groups such as divers, fishers, and tourists can easily and readily understand this version with a quick look. The second format is a multipage, highly detailed version circulated to the reef management and scientific community. Here, each action item was categorized into three grades and corresponding colors. Green signifies the action has been completed, yellow signifies the action has been partially addressed but requires more attention, and red signifies the action has not yet been addressed. Three degrees of confidence represent the number of sources and level of agreement amongst those respondents for that particular action item. Three asterisks signify high confidence, and one asterisk signifies low confidence. (*See appendix 1*)

## RESULTS

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Overall, it was found the Action Plan is in a fairly good degree of implementation with 80% addressed to some extent. This means 15 action items have been fully implemented and 17 action items have been partially implemented.

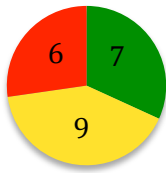
### Status of Action Plan



**Figure 2: Overall it was found 15 of the plan's 40 action items have been fully implemented, 17 action items are partially addressed, and 8 action items still require attention.**

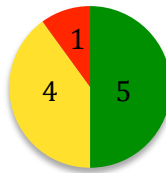
Many successes as well as areas of opportunity were revealed throughout evaluation. This is one of the most valuable outcomes of monitoring and evaluation. Identifying successes and failures can enable us to learn from the experiences of others and invest valuable resources in the most efficient manner possible. By understanding what works in a particular system, there may be a domino effect with benefits spilling over to other parties. One community may reap the benefits of lessons learned from another agency's trial and error, and vice versa.

### Management



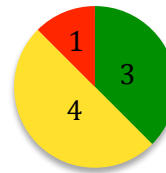
- 55% of the Plan
- 32% of management strategies fully implemented

### Community Awareness



- 25% of the Plan
- 50% of community awareness strategies fully implemented

### Research



- 20% of the Plan
- 38% of research strategies fully implemented

## Success

The most successful outcome of the Action Plan was in the research goals, with only one research action item not yet addressed in this section. Research is being undertaken to understand areas of high and low resilience, ocean acidification, and the relationship between stony coral, reef fish, and conditions. Lobster research also remains a high priority for FWC Research Institute. Additionally, water quality impacts are effectively being addressed throughout the FKNMS. For example, the centralized sewage system project for the Florida Keys was found to be near complete and a canal water quality project is underway. These programs contribute greatly to the resilience of the reef ecosystem and the other habitats connected to it. The strongest single goal achieved from the Action Plan has been the region's ability to respond to and monitor coral bleaching events. The very first action states:

**“1.1.1:** Continue and expand the FRRP disturbance response monitoring (DRM) and Mote Marine Laboratory's Bleach Watch activities throughout the entire five-county (Monroe, Miami-Dade, Broward, Palm Beach and Martin) Florida Reef System.” (CCAPFRS p.9)

This is an example of a green action. The Disturbance Response Monitoring Program and Bleach Watch programs have been fully implemented throughout the entire reef tract and are now expanding into other parts of the Caribbean including Puerto Rico and the Virgin Islands. Dr. Phillip Kramer, Director of TNC's Caribbean Program, credits these programs to "facilitating probably the most surveyed reef tract in the world" (per comm. Dr. Phillip Kramer, TNC Office Big Pine Key Florida 4/16/2015). Between 2010-2014, the life of the plan to date, there have been 863 reports on Florida's reef tract through BleachWatch and DRM (per comm. Cory Walter, via email 4/20/2015). The continued activity of the Marine Ecosystem Event Response and Assessment Program, the creation of the SeaFan program for mainland corals in the northern region, and FRRP's Our Florida Reefs program all aim to further enhance monitoring efforts, thus contributing to the success of this action item.

## **Opportunity**

The most attention still needed was found in the Action Plan's first outcome, management strategies. More specifically, the biggest area of opportunity is incorporating climate change science into fisheries management. For example, Action 1.4.2. states:

**"1.4.2:** Work with federal and state fisheries management agencies to evaluate the risks of climate change for the sustainability of Florida's reef fish and invertebrate populations and associated fisheries, for incorporation in management plans."

(CCAPFRS p. 10)

Dr. Bob Glazer of Florida Fish and Wildlife speculated there is a large potential for timely policy adaptation by utilizing the Magnuson-Stevens Act's goal of managing for

sustainability of the species and increasing long-term economic and social benefits of the nation's fisheries (Magnuson-Stevens Fishery Conservation and Management Act amended 2007). Although this is happening at the federal level, it was found it is not yet happening at the state level. The research still needs to be translated into management action. Similarly, opportunity exists in addressing the ghost fishing of abandoned lobster traps (*see "Discussion" section*), understanding potential range shifts of species outside of traditional zoning, and integrating crisis response strategies for infectious disease outbreaks, tropical storm impacts, cold snaps, and pollutant spills on the reef. Also not surprising was the region's inability to increase law enforcement presence due to a lack of funding and human resources.

Interestingly, a few priorities were identified to have changed since implementation in 2010. To manage an ecosystem, a holistic, comprehensive approach is required to address impacts irrespective of jurisdictional boundaries. If there were one distinct Florida reef system council, it is speculated many political and administrative processes could be streamlined and more efficient than what currently occurs today. For example,

**"1.4.3:** Create a formal Florida Reef System Management Council, including federal, state, local, county managers and user groups to advise, recommend, and oversee a coordinated ecosystem-management approach for the entire Florida reef system."  
(CCAPFRS p.10)

Several managers expressed concern and resistance to this action item as it could further complicate the existing jurisdictional complexities in the Florida reef tract as previously

discussed. One manager commented, “Do we really want to add another layer of management in an already complicated system? Who has time for another council when we are all already involved in so many other councils?” Additionally, it has been observed the Florida reef tract is biologically two distinct reef tracts, one being the Florida Keys tract and the other being the northern, mainland coral reef tract (per comm. Chris Bergh, TNC Office Miami 4/20/2015). Regardless, there are obvious spillover effects and an interconnectedness of stressors that would benefit from unified oversight.

## **DISCUSSION**

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As previously mentioned, ghost fishing from derelict fishing gear was identified as a major concern and high priority. There was a high level of agreement on this issue, and visible concern on behalf of reef user groups from online forums. Although there is a vast amount of research happening at Florida Fish and Wildlife Research Institute, this research has not yet translated into effective management control of the situation. It was speculated perhaps the true cost of lobster fishing, which includes the destruction abandoned gear causes to the reef and other associated ecosystems, is not taken into account in the price consumers face on the market for lobster. Ghost fishing is an externality that should be accounted for in economic evaluations of the commercial spiny lobster fishery in Florida, but currently is not. There was a high level of disagreement on how to best handle lobster fishing. This is a politically and economically charged issue that requires time and negotiation.

Next, there are concerns over regulating the diving industry, which has historically been self-regulated (per comm. Dr. Billy Causey, via phone 6/1/2015). The dive industry’s support is critical to effective management and caution should be taken by managers to

avoid conflict with those industries that rely heavily on the reef. An education and outreach program would be beneficial to educate dive captains and divemasters on the science of coral vulnerability and bleaching events. Training to provide strategies that reduce physical impact in times of high vulnerability, such as a bleaching event, could empower the dive industry to continue to self-regulate and take stewardship of their natural resources such as the reef habitat.

### **The Climate Change Lens**

Natural resource managers are stretched beyond capacity; they are expected to manage a wide variety of issues with very little resources. In an era of tangible environmental distress, there are countless projects, initiatives, and actions requiring consideration. This dilemma was certainly revealed by several managers throughout the course of the interview process. Climate mitigation and adaptation strategies may be vulnerable to the attention of other priorities due to the delay in achieved benefits. Costs are undertaken now for benefits foreseen into the future, and that is not always easy to justify when there are so many other issues requiring attention. Unfortunately the missed opportunity is that everything that is managed should have a climate lens. Rather than viewing climate adaptation as another issue to address, integrate the idea of climate change mitigation into everyday decisions. Focus should be given on what are the actions already occurring and reflection given to how robust those actions are in the reality of climate change. Climate informed management could be incorporated into daily work and existing projects to ensure that project's longevity and success in the face of climate change (per comm. Alex Score via email 7/1/2015).

Equally important to consider is the framing of strategies and the lens through which action plans are perceived. Rather than framing an action plan as climate targeted such as the “Climate Change Action Plan for the Florida Reef System”, it is worth considering leaving the vernacular of climate change out of the conversation altogether when soliciting support. Framing is important to contemplate before broadcasting climate change messages to the general public. Various political groups and individuals may have different opinions on the science of climate change, and it is worthwhile to speak on subjects they may be more familiar with.

For example, many climate adaptation strategies work to reduce local, human stressors many already have experience or knowledge about. Individuals may be more comfortable confronting well-known issues such as increased flooding, wildfires, and drought. Although these events are scientifically linked to climate change, they have been forces of nature that engineers, city planners, and natural resource managers have been dedicated to for the past century. It may not always be preferable to encourage action on behalf of climate change, but rather more simply, on behalf of a resilient community facing flooding, wildfires, and drought.

Of course, education and outreach are the preferred method for garnering support. All members of government, the community, and anyone using the reef tract should be informed of the risks and vulnerabilities the region faces to climate change. In fact, the Action Plan’s second main outcome works to address this, as previously mentioned in “The Action Plan” section. Considering 50% of the community awareness strategies are fully



implemented, there is still a lot of work to be done here. However, this may be a reflection on the political environment in Florida, as discussed in the next section.

### **Florida's Governor Bans "Climate Change"**

One month before I departed to South Florida to interview managers about efforts on climate change, news broke Florida's Governor Rick Scott had placed on a ban on the words "climate change" and "sea level rise" (Korten, 2015). I quickly began consulting committee members and mentors as to how to approach the situation. I compiled alternative phrases and words to use in dialogue for the interviews, such as "nuisance flooding" in place of SLR and "increased temperatures" rather than climate change. I confronted the situation directly and asked state employees on the rules and requirements during our interview. Thankfully, it was not an issue with anyone and the 'ban' had clearly been reprieved and denied by the Governor of ever happening. State employees freely and openly spoke about climate change, and were very willing to speak about it as well. In fact, this could have been a positive impact. This media frenzy brought the nation's attention to Florida's unique vulnerability and impacts the region is already facing today.

### **Benefits of Monitoring and Evaluation**

#### Direct Benefits

- Discovers what has and has not been accomplished, and where resources are most needed in the near future
- Identifies lessons learned to be applied to other geographic areas, saving time and financial resources moving forward
- Scorecard consolidates information about strategies across jurisdictional boundaries into a single platform for information
- Pinpoints goals and priorities which may have changed over time and why
- Serves to communicate, raise awareness, and coordinate efforts across disjointed jurisdictions and agencies in complex management schemas
- Informs subsequent action plans

### Indirect Benefits

- Re-engages decision-makers and managers
- Rejuvenates the plan and possibly inspires action
- Sparks ideas and reminds managers of strategies to be integrated into daily decisions

## **RECOMMENDATIONS**

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The language in this Action Plan is quite broad and vague. There is a direct need and desire for more specific and detailed examples of how the actions can be implemented on the ground. Several managers commented, “How do you translate these big picture items into the day to day actions?” When drafting the next action plan, use day-to-day examples in the language for more clarity and effectiveness. This includes realistic, attainable, and timely actions to be taken at finer temporal scales, rather than long-term goals. Additionally, accompany action plans with implementation plans outlining benchmarks and metrics of success. These indicators are critical to track efficacy and ensure progress. When there is a clearly defined threshold, monitoring and evaluation efforts will be more efficient and therefore productive as well.

There is also a desire to transition from passive to active management. For example, rather than “simply drawing a line on a map or closing an area to protect the reef” as one manager describes, be proactive and initiate efforts to actively assist the reef in recovery when bleached. The only research action item unaddressed aims to do this, which states, “support field research of novel intervention methods designed to reduce stress from climate change and ocean acidification on the reef” (CCAPFRS p.13). Florida, like many other marine environments, has typically utilized marine spatial planning zones as the primary method of management. However, the influences of climate change do not respect

boundaries on a map. These issues and habitats are all interconnected; a complex multi-prong approach is needed.

## CONCLUSION

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### Project Outcomes

- Scorecards
- CAKE.org case study published
- Presentation and poster at National Adaptation Forum 2015
- Future webinar to disseminate results
- Future presentation to NOAA Office of National Marine Sanctuaries
- Future presentation at FRRP 10 year anniversary conference

The scorecards produced from this evaluation serves to communicate to reef managers, key decision makers, political entities, reef user groups, and the general public about the various actions and strategies currently underway protecting Florida's reef tract from the negative impacts of climate change. Areas of success have been identified to bring awareness to other communities needing mitigation and adaptation strategies. Areas of opportunity have been identified to call to action the issues still requiring attention and resources. The region would greatly benefit from a subsequent action plan adapted from the results of this evaluation. Through the implementation of climate change action plans such as this, entire communities and local economies are better protected and resilience is increased. Lots of time and money are invested into creating these documents, and it is a great missed opportunity to disregard monitoring and evaluating the plan's efficacy. In fact, many benefits come from doing so, as revealed through this qualitative evaluation process. In conclusion, *climate change on Florida's reefs is IN ACTION.*

## Afterword

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*I chose this capstone based upon what I strive to do professionally upon graduation from the MAS program. It is my core belief and professional motivation that policy is the most direct and effective mechanism for generating concrete change in environmental conservation. As a Florida native, I know firsthand the negative impacts climate change is already having in my community and I am driven to continue to learn effective adaptation and mitigation strategies. This capstone project was a valuable opportunity to learn this process at all levels of government and apply the insight gained from my work in future endeavors. This experience enhanced my path towards marine planning and coastal natural resource management in compliance with federal, state, and local law. Thanks to this capstone project, I am graduating from this program better trained in translating science into effective policy as a result of working with various, highly respected agencies to achieve sustainable, responsible stewardship of natural resources.*

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## Appendix 1

# Degree of Implementation

Action Item	Confidence
1.1.1 Continue/expand FRRP DRM/BleachWatch	***
1.1.2 Integrate entire reef system into bleaching response management plans	**
1.2.4 Protect vulnerable species/habitats from non-climate pressures	**
1.2.5 Include vulnerability into assessments of threatened & endangered species	**
1.3.1 Require mitigation & adaptation in county & municipality plans	*
1.4.1 Revise existing programs/strategies to optimize effectiveness	**
1.5.1 Provide climate change tools and <i>training</i> for Florida's reef managers	**
2.2.1 Develop scientifically based climate change fact sheets	**
2.2.2 Involve community members in coral reef research and monitoring efforts	***
2.2.4 Develop a Greater Everglades Ecosystem education program	***
2.3.2 Communicate findings of climate change reports & risk assessments	**
2.3.3 Implement regional marine/coastal accreditation programs	*
3.1.2 Examine relationships between reef fish-stony coral populations-condition	***
3.1.4 Translate climate forecasts into a relevant, useful product for managers	*
3.2.1 Determine and map areas of high and low resilience to climate change	***
1.2.2 Develop a marine zoning plan to protect against non-climate stresses	***
1.2.3 Identify and protect transition/alternative refugia habitats for range shifts	***
1.3.2 Include sea level rise adaptation into county & city comprehensive plans	***
1.3.3 Limit certain kind of development that are at risk from sea level rise	*
1.4.4 Work through formal council to minimize water quality impacts	**
1.4.5 Evaluate resource protection legislation for climate change impacts	**
1.4.6 Place mainland corals under authority of principal management authority	***
1.6.3 Promote minimum impact reef use activities & avoidance of stressed corals	***
1.6.4 Create a boating license similar to driver's license	***
2.1.1 Identify & forecast socio-economic effects of vulnerable human communities	**
2.2.3 Incorporate reef impact information into school science curricula	*
2.3.1 Create business adaptation plans	*
2.3.4 Identify & support "climate smart" coastal/marine organizations	**
3.1.1 Revise regulations on coastal development & beach nourishment projects	**
3.1.3 Examine calcium carbonate saturation state & calcification rates	***
3.2.2 Identify thresholds by which climate change causes irreversible damage	**
3.2.3 Define and model the transition of one habitat to another	**
1.2.1 Integrate climate change induced crisis response strategies in plans	**
1.2.6 Prohibit new dredging	***
1.4.2 Evaluate risks of climate change into fisheries management	***
1.4.3 Create a formal Florida Reef System Management Council	***
1.6.1 Increase law enforcement presence & regulatory compliance	***
1.6.2 Fully implement the states lobster trap reduction plan, reduce ghost fishing	***
2.2.5 Create community feedback mechanisms for adaptive management	***
3.3.1 Support field research of novel <i>intervention</i> measures	**

### Implementation Scoring:

Action has been fully addressed  
 Action addressed to some degree  
 Action not yet been addressed

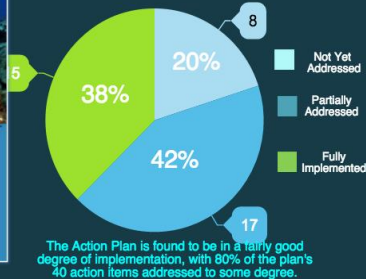
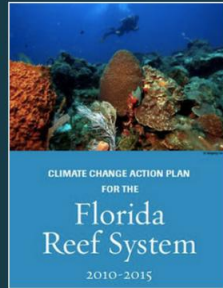
### Confidence Ranking

\*Low Confidence, \*\*Intermediate Confidence, \*\*\* High Confidence

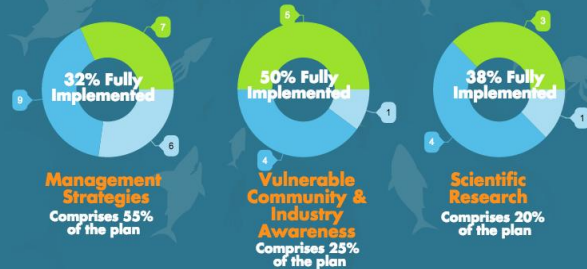
Reflects amount of information + Level of agreement  
 amongst participants for each action item

## Appendix 2

### REPORT CARD Climate Change Action Plan for the Florida Reef System 2010-2015



#### STATUS OF INDIVIDUAL OUTCOMES



#### What is the Climate Change Action Plan for the Florida Reef System?

A document to guide decision makers to address the negative impacts of climate change on Florida's coral reef ecosystem. The action plan addresses a wide variety of issues to ensure the social, economic, and ecological resilience of Florida's reef community. Impacts addressed include:



View the complete action plan at [ecosadapt.org](http://ecosadapt.org)

#### SUCCESSES

Through several programs, community members are empowered to be actively engaged in reef monitoring and influence management decisions.

The region heavily monitors and responds to coral bleaching events through the success of the Disturbance Response Monitoring Program and Bleach Watch.

Broward, Miami-Dade, Palm Beach, and Monroe Counties have updated their comprehensive plans to mitigate and adapt to the impacts of climate change.



#### OPPORTUNITIES

Ghost fishing of derelict lobster traps continues to negatively impact the reef.

Integrating climate change research into fisheries management is still needed at the state level.

Increased law enforcement presence on the water is needed to ensure regulatory compliance.



## Appendix 3

### Interviewee and Respondent Affiliations

The interdisciplinary framework of the Center for Marine Biodiversity and Conservation is what drew me to the Master of Advanced Studies program at Scripps Institution of Oceanography. I wanted to build on this framework and thus chose a capstone project that would further extend my professional network and allow me to gain insight into a variety of issues. This goal was undoubtedly met. In the words of Dr. Dick Norris, I went “an inch deep and a mile wide”. This project provided an opportunity to interview key players I otherwise would not have had direct access to. The participants in my project are leaders in marine resource management and highly respected, experienced individuals. We had enlightening conversations, and they provided insights I would not have otherwise gained in a textbook. Many thanks to all those participated.

#### (13) In-Person Interviews

*April 10-20, 2015*

- MOTE Tropical Marine Laboratory
- Florida Keys National Marine Sanctuary Council (partial, 6 members in 1 interview)
- Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute (2 individual interviews)
- The Nature Conservancy (3 individual interviews)
- NOAA Coral Reef Conservation Program
- Monroe County
- City of Marathon
- Coral Restoration Foundation
- Keys Diver Dive Shop
- Marine Science Teacher

- National Park Service
- Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute

#### (13) Online Surveys

*April 12-June 2, 2015*

- A- 3 federal, 2 county, 1 city
- B- 6 researchers
- C- 1 FWC

#### (6) Phone Interviews

*April 13-June 1, 2015*

- Florida Keys National Marine Sanctuary (2 separate calls)
- Florida Department of Environmental Protection/SEFCRI Southeast Florida Coral Reef Initiative
- Florida SeaGrant

#### Individual Totals:

Federal-13

State-4

County-3

Municipal-2

Researcher-7

NGO-6

School-1

Diver-1

**=37**