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Analysis of Hurricane Preparedness Levels and Evacuation Intent for South Carolina Coastal Residents

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by

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DEDICATION

This thesis is dedicated to my wife, Michelle and my children, Trevor, Victoria, and Sophie. This could have never been accomplished without their patience and support.

ABSTRACT

Many communities across the nation, especially those in coastal areas, are experiencing extensive growth and expansion. This growth and the associated need for additional infrastructure, goods and services, and basic human needs often place people and the things they value in harm's way due to the threat of a natural disaster. In order to properly prepare and mitigate disaster impacts, individuals and communities must view disasters as events that will likely occur at least once during their lifetime rather than simply outside possibilities.

Residents of coastal communities must prepare for potential impacts from hurricanes and resulting storm surges and must consider evacuation ahead of the storm to ensure their personal safety. The decision to evacuate from a disaster area as opposed to sheltering in place is contingent upon a variety of place-based heuristics. These world views are heavily influenced by a variety of variables including the type and quantity of information about disasters received, preparedness activities undertaken, previous disaster experience, and risk perception which may each lead to inappropriate evacuation decisions. However, the concepts of disaster preparedness and previous experience and their combined influence on evacuation intent are not yet fully understood. This thesis will analyze the influence of hurricane preparedness and previous evacuation experience at the individual level on intent to stay or evacuate from a hurricane. Utilizing data collected by The Hazards and Vulnerability Research Institute (HVRI) at The University

of South Carolina during a 2011 hurricane evacuation behavioral study, the types and number of preparedness measures taken by respondents and their previous hurricane experience were compared against the number of citizens that indicated their willingness to evacuate for varying categories of hurricane. Understanding the individual and coupled influence of these population characteristics is useful information for emergency planning and response agencies responsible for educating citizens on preparedness and planning activities with the goal of promoting evacuation when one has been ordered. Across coastal areas of SC, preparedness and planning, hazard perception, and previous experience were the most influential factors on evacuation intent. It was noted that citizens who completed a minimum of three actions to prepare for hurricane season were over 200% more likely to evacuate than those that did not prepare. As such, citizens that were very concerned about the threat of a hurricane were much more likely to prepare prior to the event. Conversely, those that had experienced a hurricane within their lifetime were less likely to evacuate. Natural disasters occur on varying temporal and spatial scales, and as such, it is critical to identify the factors that may cause evacuation behavior to differ by locale. Such information will enable emergency planners to focus educational efforts on specific areas of the communities that are more vulnerable. By promoting planning and preparedness and understanding how those factors aide in evacuation, community and state emergency management agencies will not only enhance resistance to hurricanes, but create a path for quick recovery and resiliency to future events.

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CHAPTER 1

INTRODUCTION

Coastal areas across the nation are experiencing an influx in population as more citizens desire to reside closer to the shoreline. As such, extensive growth and expansion have altered the infrastructure of coastal communities through an expansive conversion of the landscape for both residential and industrial uses (Valiela, 2006). These changes have resulted in an increased vulnerable population as more individuals are residing in areas where there is a significant threat of natural disasters. Impacts of large scale disasters may result in loss of life or property and have a ripple effect throughout the community. Individuals and communities must plan for the disasters that can potentially impact their area prior to the event occurring. Disaster planning, which accounts for these changing risks and vulnerabilities, is vital in order to avoid future catastrophes. Equally important, however, is the need to understand the drivers of disaster preparedness and evacuation intent within these zones of increased risk. Knowing how preparedness and past experience influence evacuation intent can lead to better evacuations during future disasters.

Large scale disasters have enormous implications that extend well beyond the initial impact area and often lag behind the passing of the event itself. Affected areas are left to deal with losses to property, lives, and livelihoods as the true impacts of a disaster ripples through an area. Disaster response and initial recovery can be slowed or even

halted when residents either do not take threats seriously or do not heed emergency response and evacuation messages. The Federal Emergency Management Agency (FEMA) and State Emergency Response Commissions (SERCs) have recently changed focus from a mainly top down disaster management approach to one where citizens are empowered to develop their own response, recovery and mitigation techniques through educational and preparedness activities (Lindell and Perry, 2001). Proper individual preparation for such events can not only greatly reduce personal impacts, but can also enable more rapid and effective response and recovery efforts by emergency management personnel in the immediate aftermath of a disaster event. Statistics have shown the risks of disasters are unevenly distributed globally, and there are complex interactions of social, economic and environmental factors operating on varying temporal and spatial scales that determine vulnerability of communities (Thomalla et al., 2006). This is most prevalent in coastal areas where the vulnerability of residents varies greatly throughout the community. Residents must understand how they can be impacted by such an event, be prepared for potential losses from a hurricane and resulting storm surges, and evacuate ahead of the storm to ensure their personal safety. Coastal areas are more prone to impacts from such events and are experiencing an increase in population as more individuals are relocating to coastal zones. Increasing populations with generally less awareness and experience with local hazards tends to increase vulnerability for coastal communities. Coastal residents present an interesting subset of the general population in that personal/family preparedness and evacuation behavior can mean the difference between life and death. Coastal residents place varying emphasis on different types of preparedness activities, and their decision to evacuate will be based on numerous factors,

some of which include factors related to risk perception, personal and family preparedness and planning, and previous disaster and evacuation experience.

Atlantic and Gulf of Mexico coastal communities provide a large and diverse study area where some of the best examples of preparedness or lack-there-of exist. These low lying areas are more prone to impacts from hurricanes and associated storm surges and are experiencing a change, not only in population, but community infrastructure due to constant development. For a variety of reasons, including lack of hazard or situational awareness, lack of resources, or lack of experience, coastal residents often overlook or fail to partake in many types of preparedness activities. The decision to evacuate from a disaster area, as opposed to sheltering in place, is fraught with many of the same challenges as preparing prior to the event - where lack of information, preparedness, disaster experience, or risk perception may lead to inappropriate evacuation decisions. The relationships between risk perception, disaster experience and evacuation intent as drivers of disaster preparedness and the influences that each of these variables has on each other has not been adequately studied. To date, we do not know how perception of an event influences preparedness or how preparedness influences evacuation intent. Identifying, analyzing, and understanding these dynamic relationships will create a new set of knowledge and information for planners, emergency managers, decision makers, and the general public. Results of this research will provide a base of information from which new methods for increasing citizen awareness and personal/family evacuation decision making can be derived.

CHAPTER 2

PREPARING FOR THE EVENT

2.1 Assessing the Threat

Through collaborated efforts with the local, regional, and national government entities, the responsibility of hazard and vulnerabilities assessments and disaster preparedness is a burden that everyone must share. Though many individuals feel that they are responsible for their own welfare in times of disasters, government bodies are charged with protecting their citizens and often make mitigation and preparedness planning a top priority. Considering the adage that "all disasters are local", emergency planning must be specific to the areas that can be potentially impacted. Pre-disaster planning that is specific to the impacted area is a key component of The Disaster Mitigation Act of 2000 (DMA 2000) as a prerequisite for federal mitigation funds to aid in recovery after the event.

DMA 2000, as an amendment to the Stafford Act, mandates that state, local and tribal governments actively engage in mitigation planning before and after a disaster occurs. Localized mitigation planning is required in order to access federal relief funds to aide impacted areas in the aftermath of an event. The act further states these plans be based on a comprehensive process encompassing the risks and vulnerabilities of the community. The act also encourages state and local agencies to cooperate with each

other and seek public involvement throughout the planning process. The risk assessments that are part of this plan are based on historical occurrences and the likelihood of future events and utilized to provide a strategy that minimizes losses and promotes resiliency. Engaging the public in the planning process is essential as it provides individuals with historical and research-based knowledge regarding the types of threats that can affect the community. By educating the public about risks and vulnerabilities to such events, it may result in an increase of individuals that will take appropriate preparation measures to ensure that they minimize their personal impacts ahead of a disaster.

2.2 What is Preparedness and Why Does It Matter?

The goal of disaster preparedness is to achieve and maintain a level of readiness in order to respond to any emergency situation (Sutton and Tierney, 2006). During this phase, government agencies, organizations, and individuals may develop plans that protect life and property, ensure an effective disaster response, communicate the hazards to the communities, and encourage citizens to create individualized plans. Examples of preparedness measures may include preparedness plans, emergency exercises/training, warning systems, emergency alert systems, resource inventories, mutual aid agreements, and public education. The success of preparedness actions depends on the involvement and cooperation of all stakeholders, and the effectiveness of these actions depends on the completion of an adequate risk and vulnerability assessment specific to the area(s) that could be impacted.

The National Incident Management System (DHS, 2013) defines preparedness as a continuous cycle of planning, organizing, training, equipping, exercising, evaluating,

and taking corrective action in an effort to ensure effective coordination during incident response. Following this ideology, preparedness is far more complex than maintaining a "state of readiness"; it represents a separate, complex and self-evaluating cycle that can manipulate and drive other phases of emergency management. The cyclical nature of this phase is a fundamental component as it forces individuals, organizations and agencies to constantly re-evaluate their risks and threats to determine if vulnerabilities have been addressed and if they are properly prepared for an event. This is crucial, given the fact that risks and vulnerabilities can change over time or even during an event.

By utilizing the methods outlined by NIMS, entire communities and even individuals have a consistent method in order to thoroughly prepare, respond, and recover from events. NIMS focuses heavily on preparedness before a disaster occurs as it elevates, or possibly eliminates, some of the resources and time spent during the response and recovery phases. NIMS recognizes that preparedness is a continuous cycle and has defined five activities as its key components:

1. Plan: Through proper planning, the entire event, even preparation of the event itself, can be managed from cradle to grave. Both logistical and operational plans can be used to define priorities, vulnerabilities, resource requirements or limitations of capabilities. Individuals that may be affected or involved in the response have their roles and responsibilities defined more clearly. Organizations in the community can take this as an opportunity to review any standard operating procedures (SOPs) or contingency plans.
2. Organize and Equip: During this phase individuals and organizations will inventory existing supplies and procure any additional resources needed to

ensure that they safely and effectively react after the event occurs. During this phase, individual and organizational capabilities should be addressed, and any training required to overcome their limitations should be outlined during transition into the next preparedness phase.

3. Training: Responding agencies, emergency managers, citizens and organizations should possess the knowledge, skills, and abilities needed to perform key tasks in the moments after an event occurs to protect themselves, others and property. Those affected should make training decisions based on information derived from the previous steps
4. Exercise: Perhaps one of the most important phases of the preparedness cycle, exercising the plans provides a chance to identify strengths and weaknesses and outlines practices to implement in order to ensure that the plans will be successful. Exercises should be objective in nature and in a real-world setting in order to clarify roles and responsibilities and improve communications between public agencies and potentially impacted communities.
5. Evaluate and Improve: During this phase, organizations collect lessons learned, develop improvement plans, and track corrective actions to address gaps and deficiencies identified in exercises or real-world events.

2.3 Preparing for the real threat within South Carolina coastal communities

Coastal counties across the country have been experiencing an increase in population for a variety of reasons. This growth may be a result of citizens relocating to metropolitan coastal cities for employment opportunities or some finding smaller coastal

areas a more desirable location to raise families or retire. Recent data shows that these areas have experienced even more growth, and now almost 39% of the nation's population lives in coastal shoreline counties (NOAA, 2013). Consistent with these findings has been the growth of population within the along the South Carolina zone. In 2008, 19.6% of residents lived inside coastal counties, and between 2010 and 2012, these counties experienced an additional population increase of 2%, making the coastal areas of South Carolina one of the fastest growing in the nation.

In The United States, one of the more devastating natural events that can impact communities is hurricanes. On average, the National Oceanic and Atmospheric Administration (NOAA) predicts that a typical hurricane season for the Atlantic hurricane region may produce twelve named storms, six hurricanes and three major hurricanes. Many coastal residents recognize the ever present threat of a hurricane and understand the need to prepare for such an event in order to protect themselves and their property. Unfortunately, large scale events such as Katrina and Sandy have shown that there may still be a lack of awareness and preparation within coastal communities. This may be due to the fact that these communities can be impacted not only by the hurricane itself, but the associated winds, floods, and storm surges.

One major challenge in preparing for hurricanes is that individuals must understand that each storm is different and that communities may be impacted differently based on the category and trajectory of the storm. The strength and intensity of a hurricane is measured using The Saffir-Simpson Hurricane Wind Scale which places hurricanes into five different categories. Storms that are categorized as three or above are considered major hurricanes.

Category	Winds	Summary
1	74-95 mph	Very dangerous winds will produce some damage
2	96-110 mph	Extremely dangerous winds will cause extensive damage
3	111-129 mph	Devastating damage will occur
4	130-156 mph	Catastrophic damage will occur
5	>157 mph	Catastrophic damage will occur

Figure 2.1 Saffir-Simpson scale of hurricane intensity, adapted from NOAA

It is imperative that coastal residents have an understanding as to what constitutes a major hurricane in order to maximize their preparedness effort and minimize any delay in evacuation. Sattler (2000) utilized a conservation of resources stress model to understand the importance of disaster preparedness. According to this model, disaster preparedness depends on the optimal availability and utilization of personal characteristics and resources. Also, actions that minimize losses will reinterpret the stressors to minimize or remove their associated threats (2000). Those that have experienced disasters will often acquire disaster specific knowledge skills that will promote preparation activities ahead of the event. While previous experience can be valuable, it may hinder hurricane preparedness as residents that have lived through such events may be tempted to treat hurricanes of similar categories the same and not adequately prepare.

The coastal area of South Carolina has proven to be a critical resource to the state in which tourism has remained its largest industry, contributing nearly $16.5 billion to the economy. As seen during Hurricanes Hugo (1989), Bertha (1996), Fran (1996), and Floyd (1999), South Carolina is vulnerable to hurricane strikes, and the associated impacts are highly variable depending on hurricane strength and trajectory. Given the

financial importance of the state's coastal counties, individuals, businesses, and county officials must take proactive measures to prepare for potential hurricane strikes. The measures into which individuals protect themselves and their property may lessen their personal impacts and can ensure that they will recover from the event as quickly as possible. Whether those preparatory actions are aimed at protecting property from storm damage and flooding or evacuating prior to landfall, a more comprehensive understanding of the factors influencing preparatory decisions has been a largely overlooked, yet important facet of emergency management research.

Undertaking hazard assessments and preparing for disasters can be daunting tasks. Hazard and disaster preparedness planning varies depending on the region and may even be hindered by political and geographical boundaries. For these reasons it has become even more important for individual citizens and families to understand the need for personal preparedness and to be aware of the hazards within their communities. Unfortunately, individuals and families may lack the expertise, have reduced financial capability, or simply not know enough about the risks to adequately prepare for disasters within their communities. Such limitations will not only hinder preparedness before the event, but also exacerbate dwindling resources needed during the response and recovery phases as more citizens require assistance. In addition, understanding that coastal citizens may prepare to evacuate in addition to protecting their property is a crucial part of the planning process that cannot be overlooked. A review of the available literature further illustrates the fact that disaster preparedness and evacuation intent is caveat of disaster research that can be further explored.

CHAPTER 3

LITERATURE REVIEW

If a coastal community is threatened by an incoming hurricane, it is critical that county and state emergency agencies are prepared to call for an evacuation in a timely manner ensuring every citizen that wishes to flee can do so and reach a safe area prior to landfall. Unfortunately, some individuals choose not to heed evacuation orders which may slow down response and recovery efforts. Understanding influences on individual preparedness for a hurricane as well as those factors promoting or prohibiting evacuations can be a key component for emergency managers and responders during the planning and assessment phases. A review of the available literature regarding evacuation behavior has shown that there are numerous social, economic, and environmental factors that may predetermine whether or not an individual will evacuate prior to a hurricane making landfall.

A measurable amount of research has been conducted on the various factors that affect evacuation decisions within communities. Preparedness activities identified in such research are often utilized in order to create a holistic, community based response plan. Such data is especially useful in identifying, for example, the potential influx of traffic on major roadways or supplies needed per evacuee at each emergency shelter.

Evacuation behavior is a dynamic concept that is often assessed on a multi-tiered, nonlinear approach based on the citizen's personal risk and vulnerability. Mileti and

O'Brien (1992) stated that some of the factors that influence whether an individual will evacuate or not are often environmental, social, and psychological attributes. These findings were expanded upon by additional research that stated that risk perception, social influences and access to resources were the factors that had the highest influence on the evacuation decision process (Riad, Norris and Ruback 1999).

As stated by Slovic (1987), one challenge when dealing with risk perception at the individual level is that decision are often based on what is deemed as acceptable risk. In order to help citizens understand the threats within their community, planners and policy makers must quantify risks in terms that are intelligible and explicit to the area, such as number of deaths per hurricane and the probability of a hurricane threatening the community. However, attempting to compartmentalize risks associated with hurricanes may have adverse consequences due to the fact that such events occur on varying temporal and spatial scales, and the impacts are a result of the magnitude and trajectory of the storm.

Often citizens remain under-prepared because they may view disasters as an anomaly and remain dependent on governmental agencies to ensure their safety (Chen, 2012). This may be due to the fact that the average citizens or organizations have not been fully educated as to the threats within their community. Individual citizens and organizations must prepare and plan for how they would respond during an event in order to protect their families, employees, and property. However, the local government should be charged with developing over-arching response strategies that include an all hazard multi-agency response approach. These strategies should define the events that would result in a declaration of a disaster while remaining flexible in order to identify emerging

smaller disasters that would evolve as a result of the crisis itself. The ability to predict the magnitude and severity of extreme events will not only create adaptive mitigation strategies, but enhance effective response and preparedness planning (Thomalla, 2006).

Government agencies and their role in emergency management should not be underestimated. However, as noted by Murphy (2005), it is critical that agencies recognize the importance of community-level emergency management. Often times, agencies will adopt a command and control approach to disasters, and communication to the public takes a top down approach (Quarantelli, 1988). Understanding that community leaders and individuals act as "active agents" rather than potential victims can correct the top down management scheme that often plagues emergency management (Dynes, 2002). The exclusion of individuals and community leaders in the planning process will limit exchange of information that can be utilized in the assessment phases and may further encourage citizens to rely on these agencies to prepare the community prior to the event.

Understanding the roles of government agencies, community leaders, and individual citizens is a key component in emergency management and is critical when building toward a disaster-resistant community. Communities will often have horizontal relationships (neighborhoods and social organizations) among themselves and existing vertical relationships (government agencies and institutions) that need to be understood as potential resources in the planning stages (Murphy 2005). These vertical and horizontal relationships can be viewed as social capital and will often become more important in the moments after a disaster strikes as a conduit to which resources can be funneled (Faupel 1992).

Once the threat and available resources have been identified, the degree to which communities and individuals will be impacted is measured in terms of how vulnerable they are to the threat. As seen in large scale natural disasters, the vulnerabilities of the affected area become exposed and can greatly reduce resiliency (Adger, 2006). Much like risk, vulnerability may vary greatly within the community. Those most vulnerable may not be aware as it is based their individual perception of insecurity with poorer households often living in riskier areas (Hewitt, 1997). Those that are highly vulnerable must be accounted for and be an active part in the planning process as they may remain inadequately prepared or may need assistance should an evacuation be mandated.

When the threat is a hurricane, the planning process is further complicated by the fact that the actual threat and impact remains uncertain to citizens as the hurricane's path will continue to evolve as it approaches land (Dash and Gladwin, 2007). Often times the source of the warning will influence the decision to evacuate more than the actual impending hurricane. One must keep in mind that often the decision to evacuate occurs when the risk of remaining in the area has become too great for citizens to ignore. For that reason it is critical that warnings are communicated with a high degree of consistency and that the risk is communicated properly. Dow and Cutter (1998) found that household evacuations are influenced more by the media and household characteristics rather than the actual warning itself. Baker (1991) stated orders from public office will have a strong effect on the evacuation behavior. A study of the evacuation of citizens in response to Hurricane Ike confirmed Baker's findings as citizens took the evacuation more seriously when the orders where issued from the National Hurricane Center or state and local officials (Huang, et al 2012). Other evacuation studies

conducted following Hurricanes Andrew (Gladwin et al 2001; Gladwin and Peacock 1997; Wilmont and Mei 2004), Bonnie (Whitehead 2005), Katrina, and Rita (Lindell and Prater 2008), reported similar findings.

Other research in evacuation behavior shows that the decision of whether to evacuate or remain is greatly impacted by citizens' perception of their individual hazards, risks, and vulnerability. Citizens that live closer to sea level or in close proximity to a body of water are much more likely to evacuate (Baker, 1991; Wilmont and Mei 2004). Thus it stands to reason that individuals that live in areas prone to hurricanes would understand their associated risks and have a plan of how and when to evacuate as a hurricane threatens their area. This is consistent with research that shows coastal residents will assess and identify their risks and be prepared to be impacted more severely (Fitzpatrick and Mileti 1991; Mileti and Peck 2000).

Hazard and risk perception have been heavily researched in order to understand evacuation decisions or the factors that may convince residents to remain even when facing a serious threat. Often citizens are concerned with both the intensity and track of the storm as well as their personal impacts (Haung 2012). During Hurricane Bonnie, the size and magnitude of the storm was a very significant driving factor for residents that chose to evacuate (Whitehead et al 2000). This was also was also noted during Hurricanes Katrina and Rita in which the resident's proximity to the where the hurricanes struck correlated positively with the decision to evacuate (Lindell and Prater 2008).

In conjunction with early warning, social cues, and hazard perception, previous experience is a major factor in whether or not citizens will evacuate. Examining behavior

for Hurricanes Bertha and Fran, which respectively impacted the South Carolina coast in 1998, Dow and Cutter (1998) found that there was a high degree of consistency for those that evacuated and remained during both events. Previous hurricane and evacuation experience could prove positive, as it would create "hurricane-savvy" populations that would utilize their personal knowledge to make an informed decision of how to respond to the approaching storm instead of waiting for information from officials (Dow and Cutter 2000). However, negative experience has been heavily studied as to how it could impact future evacuations.

The "crying wolf" syndrome has been a focal point of many evacuation studies because it can place many residents who are aware of the hazards in danger because they assume that the media has significantly exaggerated the potential impact to their area. Studies that focused on evacuation during Katrina showed that the percentage of residents that left the area was equal to or higher than those that evacuated for Ivan the year before, even though the storm trajectory changed, and many evacuees were stranded in traffic congestion on major roadways (Morrow and Gladwin 2005)

When evaluating evacuation decisions, it is critical to examine behaviors in regions where evacuations were mandated and those in areas where evacuations where recommended. There are obviously areas that are highly vulnerable to the effects of the storm, but there are also adjacent areas that are less vulnerable but still will be impacted by the event. Depending on the path and intensity of the storm, there may be additional evacuees that will tax the capacity of the roadways utilized as evacuation routes as well as the refugee shelters. This was found to be true during Hurricanes Floyd and Rita in

which massive shadow evacuations caused prolonged evacuation times (Dash and Gladwin 2007).

It is worth mentioning that there is a notable amount of research that shows many socio-economic demographics have positive and negative influences on evacuation behavior. Studying the decision-making processes of households impacted by Hurricane Bonnie, it was found that females are more effective at analyzing their risks through an objective method and have more realistic perceptions of risk (Bateman and Edwards 2002). This seems to be consistent with other research in which females are more likely to evacuate ahead of the approaching hurricane (Morrow and Gladwin 2005; Lindell et al. 2005; Whitehead 2005). Gladwin and Peacock (1997) suggested that low income based, African-American homes were less likely to evacuate and that cost of travel and modes of transportation could heavily influence that decision. Conversely, Lazo et al. (2010) found that residents with a full-time job and higher education levels were more likely to evacuate.

Even before the decision to evacuate is made, residents will engage in a series of preparedness activities as the storm approaches. These activities can range from creating an evacuation plan, stockpiling essential supplies, or securing their property. Often the goals of these activities are to minimize their individual risk and ensure that their family and property will remain safe during the storm so that they can return quickly to a sense of normalcy. To date, evacuation studies have focused very little on finding a correlation between preparedness activities the willingness of residents to flee. Understanding what drives the decision to evacuate or shelter in place and how it relates to individual

preparedness may prove to be a key element in understanding evacuation behavior and may be utilized for future planning.

CHAPTER 4

RESEARCH QUESTIONS, STUDY AREA AND METHODOLOGY

4.1 Research Questions

In 2011, the Hazards and Vulnerability Research Institute (HVRI) at The University of South Carolina was contracted by The South Carolina Emergency Management Division (SCEMD) and The United States Army Corps of Engineers (USACE) to administer an evacuation behavioral study for citizens residing in the coastal regions of the state. The purpose of this study was to provide an update to a 2000 evacuation study and to account for any changes in the demographics within the coastal counties. The findings of the current study served to provide a baseline measurement for the evacuation behavior of the coastal residents

The purpose of this thesis is to examine relationships between preparedness, past experience, and hurricane evacuation of South Carolina residents. Data collected from the 2011 hurricane evacuation study conducted by the HVRI will be utilized to identify correlations between preparedness and evacuation decisions. In examining those survey questions pertaining to preparedness activities and the intent of residents to evacuate or shelter in place, an attempt will be made to answer the following research questions:

1. How is hurricane preparedness influenced by perception, previous experience and evacuation intent?

a. How does risk perception influence preparedness?
b. How does previous experience influence preparedness?
c. How does evacuation intent influence preparedness?
d. Does resident location in relation to hurricane evacuation zones influence preparedness differentially?

2. How is evacuation intent influenced by perception, previous experience, and preparedness?
    a. Does risk perception predict evacuation intent?
    b. Does preparedness predict evacuation intent?
    c. Does previous experience predict evacuation intent?
    d. Does resident location in relation to hurricane evacuation zones influence intent differentially?

For the purpose of this thesis, these questions will be used as baseline measurements of the SC coastal residents and how they perceive the threat of a hurricane within their community and if they are aware if the location of their residence places them at a higher risk. In addition, it is important to measure SC residents as to how concerned they are about a hurricane strike, given the length in time since the last evacuation in 2000. Finally, in order to compare the evacuation behavior of SC coastal residents with that of similar research, it imperative to measure those factors that may encourage or discourage evacuation as well as previous experiences.

4.2 Study Area

Similar to other research that focused on evacuation studies, residents of the coastal regions were surveyed on previous and potential evacuation behaviors in regards

to a hurricane strike. Residents that lived in counties that were located within the three hurricane aggregates were the targeted recipients for the survey. The three hurricane aggregates are recognized zones that are utilized for planning and response by SCEMD. These conglomerates are: Northern (Horry and Georgetown); Central (Charleston, Berkeley, and Dorchester) and Southern (Beaufort, Colleton, and Jasper). For the HVRI survey, the coastal counties were further divided into evacuation zones based on hurricane category. Respondents that reside in zones 1 and 2 would be evacuated for minor and major hurricanes whereas respondents that reside in zones 3-5, would only be evacuated for major hurricanes. Depending on the location to the shoreline, counties will have citizens that reside in different evacuation zones. For example, portions of Jasper County contain evacuation zones 1 through 3. Residents that live in the southern tip of this county would be evacuated for any categorized hurricane, however residents further away from the shore would only be evacuated for major storms (categories 3-5). An additional zone was analyzed for this survey in order to capture respondents that live in areas where the impacts of a hurricane would be minimal and an evacuation not mandated. This shadow zone refers to portions of the coast that are far enough from the threat where residents may be able to shelter in place safely. For the purpose of the survey, residents that resided within a 5-mile buffer around a recognized evacuation zone were polled as potential shadow evacuees. By measuring responses within these zones, it was possible to analyze behavior geographically as influenced by: minor hurricanes (Category 1 and 2 together, Category 2 separate), major hurricanes (Category 3, 4, and 5 together), and a shadow evacuation zone (figure 4.1).

4.3 Methodology

Residents in these zones were mailed a survey that used descriptive and exploratory questions to evaluate evacuation behaviors. In addition, personal and socio-economic factors were measured as components that would heavily influence or hinder the decision process. Portions of the survey elicited multiple choice, Likert-scale rating (degree of agreement/disagreement style questions), and open response questions. The open response questions were a crucial part of the survey as they provided an effective manner to gather information regarding levels of preparedness, information sources, and

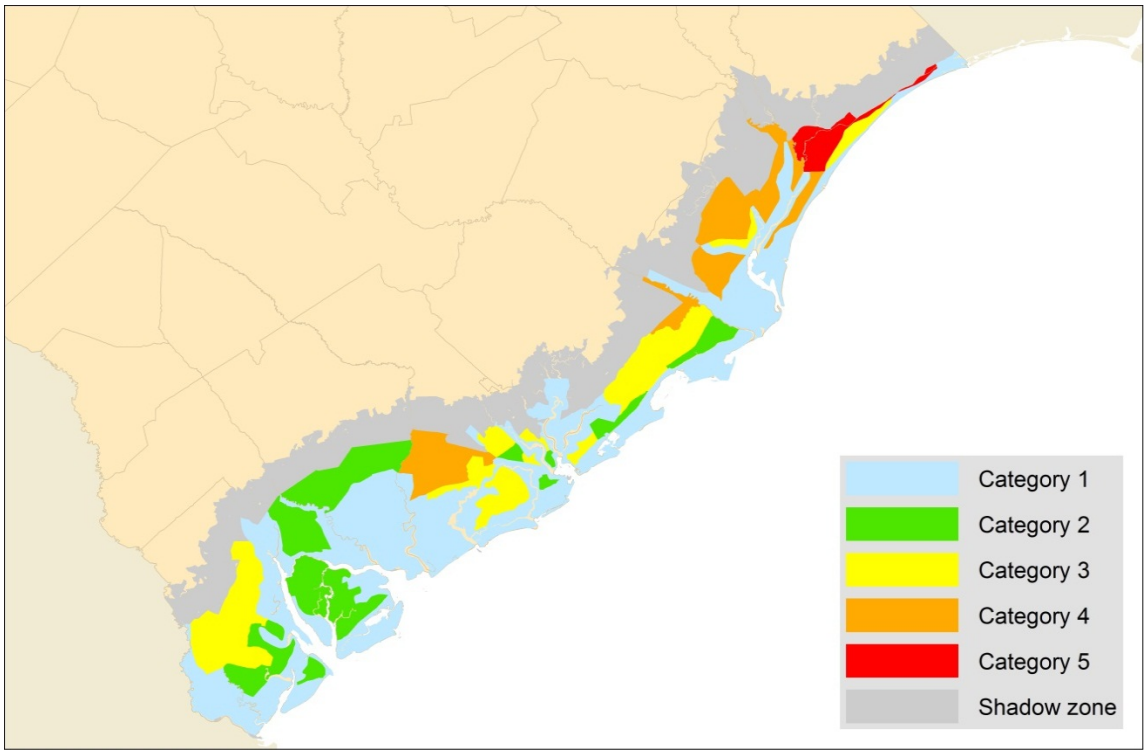

Figure 4.1 Study Area and Evacuation Zones

factors that would influence evacuations. In all, the survey contains questions that fall into eight broad categories: demographics, hurricane preparedness, evacuation behavior, evacuation history, evacuation intentions, home and personal safety, information sources, and personal risk assessment.

Initial surveys were mailed during the week of March 7, 2011 to 15,608 randomly selected addresses within the eight coastal counties of South Carolina. It was requested that surveys be returned no later than May 31, 2011. In all, 3,272 surveys were returned prior to the deadline resulting in a sample return rate of 21% which, statistically, was adequate enough to draw generalizations regarding the evacuation behavior of the three conglomerates and shadow zones. Figure 4.1 illustrates the evacuation and shadow zones that can be used for this analysis. Table 4.1 shows the confidence intervals for each of the evacuation zones, the shadow zones, and the entire study. A copy of the behavioral study from The HVRI can be found in an appendix at the end of this paper.

Table 4.1 Confidence Level and Return Rates by Study Area and Strom Surge Zones

Classification	Number of Mailed Surveys	Number of Returned Surveys	Return Rate	Confidence Interval (based on 95% level)
South Carolina Study Region	15608	3272	21.0%	+/- 1.71%
By Storm Surge Evacuation Zone				
Category 1-2	2760	669	24.2%	+/- 3.78%
Category 2	1917	462	24.1%	+/- 4.52%
Category 3-5	5610	1208	21.5%	+/- 2.71%
Shadow Zone	5321	933	17.5%	+/- 3.19%

The aforementioned research questions will be tested by cross comparative analysis of answers provided by residents to the South Carolina hurricane evacuation behavioral survey. Table 4.2 is a crosswalk between the research questions and most

appropriate survey questions. Specific statistical procedures utilized to answer each research question (RQ) are discussed in detail below.

Table 4.2 Research Questions

Research Questions (RQ)	Survey Questions (SQ) used to analyze RQs
1. RQ1: How is hurricane preparedness influenced by perception, previous experience and evacuation intent?	
RQ1a. How does risk perception influence preparedness?	Survey Question 1: *How Concerned are you about the threat of a hurricane?* Survey Question 2: *How likely is it that your home would ever be seriously damaged or destroyed by hurricane winds or tree damage from winds?* Survey Question 3: *How likely is it that your home would ever be seriously damaged or destroyed by hurricane-related floods or storm surge?* Survey Question 4: *How likely is it that your home would NOT be damaged in a hurricane?* Survey Question 10: *What do you do to prepare for hurricane season?* *Survey Question 11: How many days will the supplies in your disaster kit sustain your household?*

	Survey Question 12: *Is your address in a hurricane evacuation zone?* Survey Question 13: *Is your address in a FEMA flood zone?*
RQ1b How does previous experience influence preparedness?	SQ 10 and 11 Survey Question 35: *Have you experienced a hurricane before?* Survey Question 36: *Have you evacuated for a hurricane before?*
RQ1c. How does evacuation intent influence preparedness?	SQ 10 and 11 Survey Question 7: *If a category 3 or stronger hurricane, a major hurricane, was threatening your community, how likely is that you would leave your home?* Survey Question 8: *If a category 1 or a category 2 hurricane, a weaker hurricane, was threatening your community, how likely is that you would leave your home?* Survey Question 9: *Has your household or family talked about what you might do if you had to evacuate your home for a hurricane?*
RQ1d. Does resident location in relation to hurricane evacuation zones influence preparedness differentially?	

2. RQ2. How is evacuation intent influenced by perception, previous experience, and preparedness?	
RQ2a. Does risk perception predict evacuate intent?	SQ 1,2,3,4,7 &8
RQ2b. Does preparedness predict evacuate intent?	SQ 7,8,9,10 & 11
RQ2c. Does previous experience predict intent to evacuate or intent to stay?	SQ 7,8 35, 36
RQ2d. Does resident location in relation to hurricane evacuation zones influence intent differentially?	

4.4 Research Question Analysis Methods

RQ 1 aims to understand the relationships between risk perception and hurricane preparedness across the entire coastal zone and between areas of differential hurricane threat – namely zones of evacuation for category 1 or 2 (minor) hurricanes; zones of evacuation for category 3-5 (major) hurricanes, and an area outside of these zones (known as the "evacuation shadow"). Bivariate correlation analysis will be employed to analyze the relationship between risk perception and preparedness across the entire coastal zone. Results of correlations will indicate linkages between risk perception and preparedness activities. Additionally, multiple measures of preparedness (survey questions z, y, and z) will be regressed against multiple measures of risk perception (survey questions z, y, and z) to identify the existence of particular drivers of preparedness.

RQ2 aims to understand how evacuation intent is influenced by risk perception, past hurricane experience, and preparedness. Multivariate polynomial regression will form the basis of analysis for this question where evacuation intent will be the dependent variable and risk perception, past experience, and preparedness act as the independent variables. Four individual regressions will be implemented: 1.) the entire costal area, 2.) minor hurricane zone, 3.) major hurricane zones, and 4.) shadow zones to understand the individual drivers of evacuation for each area.

Since preparation and evacuation behavior will vary greatly due to the size of the threat and how that is communicated to the residents, it is important to understand if citizens will evacuate during a watch versus a warning and whether it has been recommended or ordered by officials. Preparation may be less important to citizens when there is no active threat or when they have not been impacted by such an event for a long time. Understanding how SC coastal residents gather information and prepare for potential impact will be a critical component in understanding their evacuation behavior and can be utilized by emergency planners in order to promote preparedness for future events.

By extrapolating key data from this survey regarding background (risk perception and experience) as well as preparedness activities (information gathering and planning), it will be possible to measure the intent to evacuate for SC coastal residents. This will provide an opportunity to evaluate the evacuation behavior along the SC coast against that of similar research studies. However, the key purpose of this thesis is to evaluate if there is a correlation between individual preparedness and evacuation. Evaluating how residents prepare for a hurricane within each conglomerate and shadow zone, and in turn,

comparing that data against the number of individuals that indicate they will flee, may make it possible to draw a correlation between preparation and the willingness to evacuate. By analyzing individuals' risk assessment and preparedness activities against their willingness to evacuate on a recognized spatial scale, it will be possible to measure the overall preparedness along South Carolina's populous coast line.

CHAPTER 5

DATA ANALYSIS, RESULTS AND DISCUSSION

The responses to the survey questions examined for this thesis were collected and coded for the analyses indicated in the previous chapter by utilizing the Statistical Package for the Social Scientist (SPSS). For survey questions that measured answers using the Likert-scale rating for degree of agreement or disagreement, the responses were coded on a scale of one to five where five indicated a very strong agreement and one a very strong disagreement to the question. Those that were coded in this manner were survey questions 1, 2, 3, 4, 7 and 8. Other survey questions, such as 9, 12, 13, 35, and 36, required the respondents to answer either "yes", "no", or "I don't know"; for these questions the answers were re-coded as 3 for "yes", 2 for "no" and 1 for "I don't know". Finally, survey questions 10 and 11, elicited the respondent to indicate a certain number of either preparation activities or days that an emergency kit will last, for these questions, the data was coded according to the number answered.

Correlations were performed to examine if there were strong connections between risk and hazards perceptions, preparation activities, and previous experience in terms of willingness to evacuate for a major versus minor hurricane. Binary logistic regressions were also performed to understand the relationships between all factors and how multiple variables will impact the willingness to evacuate for hurricanes. In order to measure the results on a spatial scale, the analyses were performed for the entire coastal area of South

Carolina as well as for respondents that reside within the evacuation zones for minor hurricanes (category 1-2) , major hurricanes (category 3-5), and those residing within the shadow zone. The findings and an explanation of the results are found in the subsections below.

5.1 Correlation Analysis

Simple correlations were performed to understand if there are positive or negative linear relations between hazard awareness and risk perception (concern), risk perception and the willingness to evacuate, and preparation activities and the willingness to evacuate. Correlations were conducted for willingness to evacuate in both major and minor hurricanes, shadow zones, and across all evacuation zones – irrespective of specific evacuation zone. While this analysis showed results that were statistically significant, most of the correlations were, at most, moderate to weak with Kendall's Tau correlation or r values less than 0.70.

5.1.1 Relationship between Risk Perceptions and Evacuation Intent

For these correlations, respondents that indicated they were moderately to very concerned about hurricanes, flood and wind damage were used to determine if there is a relationship between risk perception and evacuation intent for both major and minor hurricanes. For evacuation intent, any response ranging from *not likely at all* to *very likely* were included in this analysis. Across all zones, these variables show a positive correlation, meaning that when x increases so does y. However, the correlations between these concerns and evacuation intent were much weaker. This indicates that while there

is a relationship between perception and evacuation intent, the extent of the relationships between these variables cannot be fully understood by correlation analysis .This method only shows the type of relationship (positive or negative) between the variables and the strength of the relationship. As this analysis was performed for each evacuation zone, the relationship became significantly weaker.

Correlations for perceptions and evacuation intent along the entire coast show that residents that were moderately concerned about the threat of a hurricane were moderately likely to evacuate prior to the storm making landfall with an r-value of 0.14 for major hurricane and 0.17 for minor storms. Some of the stronger correlations were seen when the relationships between concern of the threat and the types of damage one may incur and the relationship of those that will evacuate for major hurricane and minor hurricanes. For residents that were moderately concerned about the threat of a hurricane, were moderately concerned about both wind and flood damage with a slightly higher correlation for damage by flood and storm surge. Concerned respondents that were likely to evacuate for a major hurricanes were also likely to evacuate for minor hurricane with an r-value of 0.44. These findings for the entire coastal area of SC can be found in table 5.1.

5.1.2 Correlation between Perception, Preparation and Evacuation Intent

Across the coastal area of SC, positive correlations were observed for respondents that indicated they were at least moderately concerned about a hurricane and those that would actively prepare for such an event. Those that prepare for hurricane season by completing at least one action and those that prepared a disaster supply kit were included

in this analysis. Similar to the correlations between risk and evacuation intent, the r-values show only a weak correlation between these variables as illustrated in table 5.2 Respondents that were moderately concerned would likely prepare for the hurricane with at least one activity as well as stock a disaster kit to last at least one day. With an r-value of 0.14, there is slightly stronger correlation for those that prepared with a minimum of one activity and would also stock a disaster kit. Table 5.3 illustrates that respondents that were likely to evacuate for a major hurricane were also likely to perform at least one action to prepare and were more likely to stock a disaster kit. By using a minimum of one activity and one day of emergency supplies, a baseline relationship between perception, preparation, and planning could be established.

These weak relationships were constant across all evacuation zones along the state. It was also noted that as the correlation was changed to only include citizens that performed at least three actions, the relationship changed from a weak positive to a weak negative. One may infer that an increase in preparation would result in more citizens assuming that they are ready for such an event and be tempted to "ride out the storm". However, this relationship cannot be properly assessed through this simple bivariate correlation. The relationships between different variables and their impacts on intent to prepare or evacuate are not evident through such analysis. In addition, a comparison of evacuation intent for those that have higher level of concern or take on more preparation actions to those that are less concerned or prepared is not included here but is a very important aspect to study in terms of how that impacts the decisions of residents living within the hazard zones. In order to capture this portion of the data, logistic regressions with various dependent variables and co-variations were performed.

Table 5.1 Correlation between Risk Perception and Evacuation Intent for the SC Coastal Area

		SQ1	SQ2	SQ3	SQ7	SQ8
SQ1: Concern of the threat of a hurricane	R-Value	1	.359**	.257**	.139**	.165**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	1598	1598	1598	1598	1598
SQ2: Concern that home will be damaged hurricane winds or trees	R-Value	.359**	1	.580**	.157**	.195**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	1598	1598	1598	1598	1598
SQ3: Concern that home will be damaged by flood or storm surge	R-Value	.257**	.580**	1	.121**	.183**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	1598	1598	1598	1598	1598
SQ7: Evacuation intent for major hurricane	R-Value	.139**	.157**	.121**	1	.439**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	1598	1598	1598	1598	1598
SQ8: Evacuation intent for minor hurricane	R-Value	.165**	.195**	.183**	.439**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	1598	1598	1598	1598	1598

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5.2 Correlation between Risk Perception and Preparation for the SC Coast

		SQ1	SQ10	SQ11
SQ1: Concern of the threat of a hurricane	r-value	1	.087**	.103**
	Sig. (2-tailed)		.002	.000
	N	1203	1203	1203
SQ10: Preparation prior to hurricane season (min. 1 activity)	r-value	.087**	1	.142**
	Sig. (2-tailed)	.002		.000
	N	1203	1203	1203
SQ11: Number of days disaster kit will sustain household (min. 1 day)	r-value	.103**	.142**	1
	Sig. (2-tailed)	.000	.000	
	N	1203	1203	1203

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5.3 Correlation between Preparation and Evacuation Intent for the SC Coast

		SQ10	SQ11	SQ7
SQ10: Preparation prior hurricane season (min. 1 activity)	r-value	1	.161**	.062
	Sig. (2-tailed)		.001	.201
	N	432	432	432
SQ11: Number of days disaster kit will sustain household (min. 1 day)	r-value	.161**	1	.079
	Sig. (2-tailed)	.001		.100
	N	432	432	432
SQ7: Evacuation intent for major hurricane	r-value	.062	.079	1
	Sig. (2-tailed)	.201	.100	
	N	432	432	432

**. Correlation is significant at the 0.01 level (2-tailed).

5.2 Regression Modeling of Evacuation intent for Major and Minor Hurricanes

Actions such as intent to evacuate or prepare are often influenced by other factors like experience and risk perception. Through logistic regression modeling, it is possible to examine these influences in more detail and compare the results to the data for those respondents that are less concerned, less experienced, or less prepared. For this analysis

the willingness to evacuate for major and minor hurricanes (SQ7 and 8) were set as dependent variables and measured against factors such as risk perception (SQ 1-4), preparation (SQ 9-11) and previous experience (SQ 35 and 36) to better understand how the decision to evacuate can be influenced prior to a hurricane making landfall along the SC coastline. This process was repeated for each evacuation zone as well as the shadow zones. Table 5.4 shows which factors have the most influence on the decision to evacuate for a major hurricane.

Across the entire coastal zone, when all other variables were controlled, risk perception (concern) and preparing prior to the event were two of the most influential variables that impact evacuation intent. Respondents that indicated that they were moderately to highly-concerned about a hurricane were 260-390% more likely to evacuate than those that indicated that they were not concerned. Those that undertook at least two actions to prepare for the hurricane season were 185% more likely to evacuate, and the likelihood of evacuation increased to 529% for those that prepared with five activities when compared to those that did not prepare for hurricane season.

Family planning is also highly influential as those that have drafted a family plan are 206% more likely to evacuate than those that have not. Part of this plan may be to have a disaster kit ready in order to sustain the household during the event. It is worth noting that this has an inverse relationship to evacuation intent in that those with supplies are less likely to evacuate than those residents with less supplies. For example, if the home has supplies for one day, it is 87% less likely the respondent would evacuate compared to those with no supplies; this decreases for each day falling to 32% when a home has five days of supplies. This may indicate that the negative relationship is

limited by the number of days a citizen feels that they would be without utilities. After three days, the negative relationship becomes weaker and respondents are in fact more likely to evacuate than those with less. To illustrate this point, those with four days of supplies are 40% less likely to evacuate than those with three days of supplies who are 55% less likely to evacuate than those with two days of supplies.

Previous hurricane and evacuation experience have two different impacts on evacuation intent. Those with previous hurricane experience are 48% less likely to evacuate than respondents that have not experienced such an event. Conversely, those that have evacuated previously are 214% more likely to evacuate again compared to those that have not. This indicates that those that many of those with previous hurricane experience may not have been heavily impacted while those that have previously evacuated may have had a positive experience leading them to evacuate again.

Similar results were observed as the analysis was performed for different evacuation and shadow zones, however some of the factors that influence evacuation intent differ between zones. For example, as stated previously, concern is highly influential, but within the shadow zone, those that are concerned that their home will be damaged by wind or trees are 285% more likely to evacuate increasing to 325% for those very concerned than those with no concern about damage. For respondents residing within major hurricane evacuation zones, the concern that their home would be damaged by floods or storm surge heavily influences evacuation intent. As concern about flood and storm surge increases, the likelihood that residents will evacuate also increases from 174-235% compared to those respondents within the same area that expressed no concerned about flood or storm surge damage. Interestingly, when this analysis is

Table 5.4 Regression of Evacuation Intent for Major Hurricanes along the SC Coast

Entire SC Coast	B	Sig.	Exp(B)
SQ1: Concern of the threat of a hurricane		.000	
SQ(1)	.071	.822	1.073
SQ(2)	.594	.044	1.811
SQ1(3)	.971	.002	2.640
SQ1(4)	1.127	.000	3.087
SQ3: Concern home would be damaged by flood/storm surge		.002	
SQ3(1)	.303	.031	1.354
SQ3(2)	.475	.002	1.608
SQ3(3)	.697	.000	2.008
SQ3(4)	.505	.023	1.656
SQ9 Family Emergency Plan	.722	.000	2.058
SQ10 Preparation prior to hurricane season		.001	
SQ10 1 Action	.516	.025	1.676
SQ10 2 Actions	.613	.008	1.846
SQ10 3 Actions	.870	.000	2.386
SQ10 4 Actions	.840	.001	2.317
SQ10 5 Actions	1.666	.000	5.288
SQ10 6 Actions	.948	.019	2.581
SQ11 Days supplies will last in disaster kit		.000	
SQ11 1 day	-.144	.724	.866
SQ11 2 days	-.417	.114	.659
SQ11 3 days	-.606	.015	.546
SQ11 4 days	-.915	.001	.401
SQ11 5 days	-1.139	.000	.320
Q35 Previous hurricane experience	-.743	.000	.476
SQ 36 Previous evacuation experience	.761	.000	2.141

expanded to include those residing within minor hurricane evacuation zones, one variable that is statically significant that has not been evident in the other zones is the perception that one's residence would not be damaged in a hurricane. Evacuation intent is strongly

influenced negatively by this factor resulting in residents being approximately 50% less likely to evacuate than those that indicate that their home would not be impacted by a hurricane. In addition, evacuation intent for residents within these areas was not significantly influenced by family planning as seen along the entire coastal area and shadow zone. Significant influences of independent variable co-variation (combination) for major hurricanes across all evacuation zones is illustrated in table 5.5

Generally, evacuation intent for coastal residents is influenced equally by the same variables when faced with the threat of a minor hurricane. Concern, preparation and family planning have the highest impact on whether or not one will evacuate prior to the hurricane making landfall. Previous hurricane experience and having adequate supplies also decrease evacuation intent in the same manner seen for major hurricanes.

One noticeable difference when comparing the impact of major and minor hurricanes on evacuation intent is that more preparation is required in order to elicit a positive response when the threat is a minor hurricane. Respondents indicating completion of six actions prior to the hurricane season are 241% more likely to evacuate for a minor hurricane compared to those that take no preparatory action. This was the only number of preparation actions that resulted in a significant impact leading to the likelihood they would evacuate. When comparing intent for a major hurricane, any amount of preparedness actions will produce a positive response and an increase in intended likelihood to evacuate. This may indicate that the threat of a minor hurricane is not serious enough to cause residents to actively prepare and evacuate. Previous hurricane experience negatively influences intent the same for major and minor hurricanes. Those that have lived through such an event may not have a sense of security

preventing them from evacuating in the future. The influential factors and their effect on evacuation prior to a minor hurricane can be found in table 5.6 for the entire coast and table.5.7 for the varying evacuation zones.

5.3 Identifying What Influences Preparedness and Planning

When examining what drives evacuation intent, preparedness and planning is the most prominent variable that will induce a positive response. Across the coast preparing for the hurricane season and creating a family emergency plan often increases the likelihood that residents will evacuate for both major and minor hurricanes. Since these actions have such a significant impact, it is crucial to understand the driving factors that will encourage residents to prepare beforehand. In order to accomplish this, binary logistic regressions were performed with questions focusing on preparedness (SQ10 and SQ11) and family planning (SQ9) set as dependent variables, and measured against varying levels of risk/concern (SQ1-4) and hazard awareness. To assess the influence of hazard awareness, the questions asking whether respondents knew if they resided in an evacuation zone (SQ12) or inside a FEMA flood zone (SQ13) were utilized. Results that captured the entire coast of SC show that when all other variables are controlled, in general, high levels of concern of flood and wind damage as well as knowing that one resides inside a hurricane evacuation zone are the most influential variables in terms of planning and preparing.

As seen in the regression regarding evacuation intent (Tables 5.4 and 5.5), the more actions one takes to prepare for hurricane season, the more likely it is that an evacuation would occur prior to the storm making landfall. In order to better

understand the variables that lead to preparing, the regression only included those that completed more than three actions. Along the coastal area, those that perceived the threat of a hurricane as very serious were 255% more likely to complete at least three actions to prepare for the season compared to those that were not concerned.

Understandably, those that felt it was very unlikely that their home would not be damaged were 128% more likely to prepare than those that felt that their home would survive a storm unscathed. Being aware of one's personal vulnerability is major driver for preparing as those that knew they resided in an area that would be evacuated for all hurricanes (zones 1-5) were 263% more likely to prepare than those that were not aware of that they resided in an evacuation zones. It is also worth noting that concern about damage due to flood and storm surge would result in respondents living in the shadow zone being 209% more likely to prepare, and those in zones 3-5, 178% more likely than those that were not concerned about such damage. In terms of creating a family emergency plan, concern about residential damage due to both wind and flood were significantly influential across the entire coastal area. When compared to those that were not concerned about their home being damaged, respondents were 223% more likely to create a plan if they were concerned about wind damage, and 183% more likely to create a plan when concerned about flood damage. Also, awareness of the evacuation zones would increase the likelihood of creating a plan by 180% compared to those that were not aware they resided in an evacuation zone.

Table 5.5 Regression of Evacuation Intent for Major Hurricanes along All Evacuation Zones

Shadow Zone	B	Sig.	Exp(B)
SQ2 Concern that home would be damaged by winds or trees		.118	
SQ2(2)	1.052	.071	2.864
SQ2(3)	1.025	.086	2.787
SQ2(4)	1.180	.047	3.255
SQ3: Concern home would be damaged by flood/storm surge		.158	
SQ3(2)	.440	.082	1.553
SQ3(3)	.768	.047	2.155
SQ9 Family Emergency Plan	.813	.000	2.255
SQ11 Days supplies will last in disaster kit		.087	
Q11 5 days	-.944	.034	.389
SQ35 Previous hurricane experience	-.667	.006	.513
Q36 Previous evacuation experience	.903	.000	2.466
Evacuation Zones 1-5	**B**	**Sig.**	**Exp(B)**
SQ1: Concern of the threat of a hurricane	.151	.792	1.163
SQ1(3)	.958	.081	2.606
SQ1(4)	1.115	.050	3.050
SQ4 Likelihood that home would not be damaged		.133	
SQ4 (2)	-.615	.043	.541
SQ4 (3)	-.918	.021	.399
SQ10 Preparation prior to hurricane season		.002	
SQ10 1 Action	1.525	.001	4.597
SQ10 2 Actions	1.228	.003	3.414
SQ10 3 Actions	1.633	.000	5.120
SQ10 4 Actions	1.596	.000	4.935
SQ10 5 Actions	2.339	.001	10.374
SQ10 6 Actions	2.716	.002	15.115
SQ11 Days supplies will last in disaster kit		.000	
SQ11 4 days	-1.308	.006	.270
SQ11 5 days	-1.559	.000	.210

SQ35 Previous hurricane experience	-.602	.023	.548
Q36 Previous evacuation experience	.860	.000	2.363
Evacuation Zones 3-5	B	Sig.	Exp(B)
SQ1: Concern of the threat of a hurricane		.000	
SQ1(2)	1.265	.008	3.542
SQ1(3)	1.728	.001	5.627
SQ1(4)	1.624	.001	5.074
SQ3: Concern home would be damaged by flood/storm surge		.055	
SQ3(1)	.553	.021	1.739
SQ3(2)	.536	.028	1.709
SQ3(3)	.852	.010	2.345
SQ9 Family Emergency Plan	.802	.000	2.229
SQ10 Preparation prior to hurricane season		.060	
SQ10 5 Actions	1.544	.073	4.682
SQ11 Days supplies will last in disaster kit		.111	
SQ11 4 days	-.863	.070	.422
SQ11 5 days	-.760	.094	.468
SQ35 Previous hurricane experience	-1.051	.000	.349
Q36 Previous evacuation experience	.585	.001	1.796

Table 5.6 Logistic Regression of Evacuation Intent for Minor Hurricanes along SC Coastal Area

	B	Sig.	Exp(B)
SQ1: Concern of the threat of a hurricane		.001	
SQ1(3)	.868	.082	2.382
SQ1(4)	1.273	.010	3.572
SQ3: Concern home would be damaged by flood/storm surge		.000	
SQ3(2)	.626	.001	1.871
SQ3(3)	.645	.002	1.905
SQ3(4)	.886	.000	2.426
SQ4 Likelihood that home would not be damaged		.008	
SQ4 (2)	-.458	.004	.633
SQ9 Family Emergency Plan	.440	.005	1.553
SQ10 Preparation prior to hurricane season		.223	
SQ10 6 Actions	.716	.053	2.046
SQ11 Days supplies will last in disaster kit		.000	
Q11 4 days	-.736	.007	.479
Q11 5 days	-.537	.026	.584
Q35 Previous hurricane experience	-.724	.000	.485
SQ 36 Previous evacuation experience	.602	.000	1.826

Table 5.7 Regression of Evacuation Intent for Minor Hurricanes along All Evacuation Zones

Shadow Zone	B	Sig.	Exp(B)
SQ3: Concern home would be damaged by flood/storm surge		.018	
SQ3 (4)	.979	.033	2.661
SQ4 Likelihood that home would not be damaged		.144	
SQ4 (2)	-.701	.039	.496
Q35 Previous hurricane experience	-.531	.098	.588
SQ 36 Previous evacuation experience	.955	.000	2.598
Evacuation Zones 1-5	**B**	**Sig.**	**Exp(B)**
SQ1: Concern of the threat of a hurricane		.034	
SQ1 (4)	1.195	.077	3.305
SQ3: Concern home would be damaged by flood/storm surge		.003	
SQ3 (2)	.985	.025	2.678
SQ3 (3)	.986	.029	2.680
SQ3 (4)	1.158	.011	3.183
SQ4 Likelihood that home would not be damaged		.069	
SQ4 (2)	-.591	.022	.554
SQ9 Family Emergency Plan	.513	.057	1.671
SQ11 Days supplies will last in disaster kit		.007	
SQ11 4 days	-.795	.039	.452
SQ11 5 days	-.388	.233	.678
Q35 Previous hurricane experience	-.556	.005	.574
SQ 36 Previous evacuation experience	.396	.028	1.486
Evacuation Zone 3-5	**B**	**Sig.**	**Exp(B)**
SQ10 Preparation prior to hurricane season		.138	
SQ10 6 Actions	1.176	.079	3.242
Q35 Previous hurricane experience	-1.070	.000	.343
SQ 36 Previous evacuation experience	.559	.007	1.748

Interestingly, there is a strong negative influence for those that perceive their risk as low and that their home would not suffer damage resulting in them being 34-50% less likely to draft a plan compared to those that were less certain their home would not be damaged in a hurricane. Though this was seen when looking at the entire coast, this influence was strongest in the shadow zone.

Another variable that consistently influences evacuation intent is preparing a disaster supply kit that will sustain a household during the storm. As seen in the regression for both major and minor hurricanes, this variable tends to have a negative influence meaning that coastal residents that have a kit containing emergency supplies are less likely to evacuate and shelter in place. Similar to both preparing and planning, the decision to stock an emergency kit is dependent on risk perception; in this case concern about flood damage would result in respondents being about 380% more likely to stock supplies than those with no concern. Unlike preparedness activities and family planning, being aware that one's residence is inside an evacuation zone had an inverse effect on this action and resulted in respondents being 74% less likely to stock supplies than those who are not aware. This may indicate that those that are aware of the evacuation zones would prefer to leave or perhaps they feel that they will not be detrimentally affected and will not need supplies that last over several days. Table 5.8, shows the variables that will impact planning along the entire SC coastal area.

Table 5.8 Influences on Planning and Preparedness

Influences on Family Planning	B	Sig.	Exp(B)
SQ2 Concern that home would be damaged by winds or trees		.408	
SQ2 (1)	.800	.084	2.225
SQ3: Concern home would be damaged by flood/storm surge		.185	
SQ3 (3)	.606	.026	1.833
SQ4 Likelihood that home would not be damaged		.003	
SQ4 (3)	-.694	.007	.500
SQ4 (4)	-1.079	.002	.340
SQ12 Aware that home is inside evacuation zone	.586	.000	1.796
Influences on Preparedness	**B**	**Sig.**	**Exp(B)**
SQ1: Concern of the threat of a hurricane		.000	
SQ1 (4)	.938	.007	2.554
SQ4 Likelihood that home would not be damaged		.268	
SQ4 (1)	.239	.090	1.270
Influences on creating a disaster kit	**B**	**Sig.**	**Exp(B)**
SQ1: Concern of the threat of a hurricane		.158	
SQ1 (1)	-.979	.066	.376
SQ3: Concern home would be damaged by flood/storm surge	-.332	.144	.717
SQ3 (3)	-.800	.000	.449
SQ4 (4)	-.965	.000	.381
SQ12 Aware that home is inside evacuation zone	-.303	.083	.738

5.4 The Influence of Covariates on Evacuation Intent for Major and Minor Hurricanes

Regression modeling has shown that the intent to evacuate can be influenced either positively or negatively by particular variables. However, intent can be influenced even more so if these variables work in conjunction with one another. In order to understand this potential impact on evacuation, logistic regressions were again performed with covariate influences.

For example, when examining evacuation intent for major hurricanes in the entire coastal area, those that *have an emergency plan, completed three actions of preparedness* **and** *have a disaster supply kit that will sustain the household for at least three days* are 641% more likely to evacuate ahead of a major hurricane than those that are less prepared. The likelihood increases to 928% for *those that complete four actions in conjunction with planning.* In addition those that indicated that they have previously evacuated are 153% more likely to evacuate than those that do not have such experience. There are people that are not concerned about a hurricane, wind and flood damage and think that it is only somewhat likely that their home would not be damaged by a hurricane. As such they are 26% less likely to evacuate than those that are more concerned. For the most part, similar results for the same sets of variables were seen across all evacuation zones. One noticeable difference was seen in the shadow zone where *moderate levels of concern* along **with** *moderate certainty that their home would be damaged* were 376% more likely to evacuate than those that were not concerned. For evacuation intent for minor hurricanes, it was noted that the same types of variables such as: *preparedness* **with** *planning, previous hurricane* **and** *evacuation experience*, and higher levels of concern still impact evacuation intent. However, with a lower level

threat, the likelihood that residents would evacuate is significantly lower when compared to intent for a major hurricane. By comparison, *those with an emergency plan, have completed four actions of preparedness,* **and** *have a disaster supply kit that will sustain the household for at least three days* are 268 % more likely to evacuate for a minor hurricane than those that have not completed those actions. This is significantly lower than the 928% that was noticed for major hurricanes with the same variables. However, for those that *complete six actions, have an emergency plan* **and** *supplies to last two days*, the likelihood that they evacuate is 718% compared to those that have not prepared and planned. Previous hurricane and evacuation experience was very influential in the shadow zone in which those that have experienced both are 259% more likely to evacuate than those lacking such experience. In all, intent to evacuate for minor hurricanes is influenced by many of the same variables as it is for major storms, but the increase in likelihood is much lower likely due to the fact that the threat is not perceived as serious when compared to a major hurricane.

CHAPTER 6

CONCLUSIONS

The coastal area of SC is continuously experiencing growth as more individuals and businesses move into the area, making it one of the fastest growing regions in the nation. Like many other coastal regions, this area is highly susceptible to many natural disasters, prominently hurricanes. It is imperative that residents, and the community as a whole, be aware of their individual vulnerabilities and how they are impacted by extreme events.

The degree to which residents and the community prepare prior to a hurricane making landfall is critical to decreasing the impact and damages incurred from the storm. Evacuating ahead of the storm will minimize the potential loss of life as well as allow emergency management teams to provide quick and effective assistance to those in need. Evacuation will also allow the beginning stages of recovery to evolve almost immediately after the storm passes. Instead of spending an enormous amount time during and after the storm providing triage to victims, crews can begin focusing on clearing debris and restoring lost utilities with a goal of a quick return to normalcy.

Understanding individual and family risk is crucial as it promotes citizens to take responsibility to ensure their safety. However, this requires citizens to be aware of hazards threatening their community and to assess their personal risks. When the threat is a hurricane, coastal communities and their citizens can be impacted differently based on

the intensity and trajectory of the storm in conjunction with community hazards, as well as whether there is a large population that is more vulnerable, such as those with special needs and the elderly. Understanding evacuation intent and the driving factors that can influence or hinder coastal residents to flee before the storm can be very valuable to state and local agencies that are responsible for emergency management. Often these agencies promote preparedness prior to hurricane season and will be the official source of information regarding the storm and, when needed, instructions regarding evacuation.

The purpose of this thesis was to examine relationships between preparedness and hurricane evacuation intent for South Carolina coastal residents. By utilizing the data collected from the 2011 SC hurricane evacuation behavioral study, it was possible to identify connections between individual/family preparedness and evacuation decisions. Through regression modeling, the most influential factors driving evacuation or sheltering in place were identified and examined spatially along state determined hurricane evacuation zones to identify changes in intent for those that would be impacted by minor hurricanes (Categories 1 and 2), major hurricanes (Categories 3-5) , and those residing within a five-mile shadow evacuation zone.

In general, the variables that influenced evacuation intent across these three zones were consistent. Residents that perceived a hurricane as a serious threat or that wind, flooding or storm surge would likely damage their home were much more likely to prepare prior to the hurricane season. Whether the preparation included securing their residence, creating and discussing an emergency plan with their family, or storing a disaster kit with supplies to sustain their household, preparation and planning has a significant influence on evacuation intent. Coastal residents that completed at least three

actions to prepare for hurricane season were over 200% more likely to evacuate for a major storm than those that did not prepare. Understanding the influences and the subtle differences each makes on evacuation intent will allow emergency planners to assess community based knowledge of the threat and to focus on pre-disaster planning that promotes preparedness at the individual level. Recognizing that citizens along the SC coast demonstrate similar evacuation intent provides emergency planners an opportunity to educate citizens on appropriate precautionary measures they can complete prior to the event.

While the variables that influence evacuation were similar across many of the evacuation zones, there were subtle differences in how some of the variables impacted intent within these zones. For example, with the threat of a major hurricane, residents of the shadow zone were more likely to evacuate based on concerned levels regarding storm damage to their homes rather than the hurricane itself. On average, respondents within this area were 200% more likely to evacuate when concerned about their residence being damaged by wind, trees, and flooding. In addition, the shadow zone was the only evacuation zone where preparation and a disaster kit did not have as strong influence on evacuation. This may indicate that respondents of this area understand that their risks are minimal and will not prepare ahead of the event, yet they still consider evacuation as the best option to ensure their safety. This could prove problematic for those residents that are part of a mandated evacuation as shadow evacuees could create excessive traffic congestion resulting in more citizens remaining in the path of the storm along the evacuation routes.

The findings in this paper also indicated that there are variables that have an inverse effect on evacuation intent. Readying a disaster supply kit that could sustain a household for a minimum of four days resulted in respondents being 40 to 45% *less likely* to evacuate for both major and minor hurricanes respectively. This could be a result of the intent of the survey question, as it was asking how many days could the supplies sustain one's household and not if residents had an emergency "go" kit that would allow a citizen to evacuate quickly with essential items. Previous hurricane experience can also influence evacuation intent negatively as those residents are 48% less likely to evacuate for major and minor storms than those that have not experienced a hurricane. Other than Hugo, the SC coast has not been heavily damaged by hurricanes, and those that took part in the survey may not have experienced a similar large scale event. Also, in the 25 years that have passed since Hurricane Hugo, the SC coastal area has experienced rampant growth, and many respondents that took part in the survey did not experience that particular event. What hurricane experience does show is that those that have been impacted by a storm may not have been impacted heavily and feel that an evacuation would not likely be warranted. Identifying that previous hurricane experience has negative impact on evacuation intent can serve as a fundamental portion of community planning. Leaders will need to educate individuals that the threat and impact of a hurricane cannot be compared to previous storms and that the actions and decisions of citizens must be based upon how they can be impacted by the current threat.

Contrarily, those that have previously evacuated for a hurricane are likely to do so again. This indicates that residents are confident that their area's evacuation method or official mandates to vacate the area. Such behavior was consistent among all evacuation

and shadow zones showing those that have previously evacuated are 182 -214% *more likely* to do so again as future storms threaten their area. Such findings are consistent with those from Dow and Cutter (1998) indicating that SC may have a "hurricane-savvy" population that would apply personal real-world knowledge to make an informed decision of how to respond. This variable seems to impact evacuation intent similar to risk awareness, planning, and preparation and may imply that residents, in particular those in the shadow zone, may choose to evacuate rather than shelter in place. This could be due to confusion as to their individual vulnerabilities and what portions of their community are affected by mandated evacuations. Such information is critical for officials and planners to allocate for such more evacuees and limit traffic congestion and identify additional resources needed at available shelter.

Since preparedness heavily influenced evacuation intent, it was also important to understand the factors that influence citizens to prepare prior to the storm making landfall. Throughout the entire coastal area, both preparing and planning were positively influenced by the perception that one would be impacted by the storm and knowledge that they resided inside an evacuation zone. However, both were also negatively influenced by those that perceived that they would not be impacted.

The perception that one would not be impacted by the storm negatively influenced intent and preparedness and may be strongly correlated to previous experience. It is critical for coastal residents to understand that while personal experience is very valuable, it can prove detrimental if individuals assume there is little need to prepare because future storms will behave similarly to the ones that they have experienced. Preparedness and planning must be done in context of what hazards present the risks and measured against

the individual's vulnerability. Understanding hazard and risk assessments and vulnerability and using that information to prepare for disasters can be daunting tasks. Unfortunately, individuals and families may lack the expertise, have reduced financial capability, or simply not know enough about the risks to adequately prepare for disasters within their communities.

The intent of this thesis was to utilize and expand upon previous research regarding evacuation behavior by correlating preparedness and the willingness to evacuate. In general, the factors that influence evacuation intent for SC coastal residents are similar to those identified throughout recent literature. Respondents across all evacuation and shadow zones were much more likely to evacuate based on risk perception, previous evacuation experience, and perception of vulnerability. The analysis outlined here identifies that individual planning and preparation also heavily influences evacuation intent, and understanding these additional influences should be utilized by emergency planning and response agencies as they educate citizens on identifying and preparing for the threat of a hurricane. Additional factors such as socio-economic status, education level, gender, household size and property ownership were part of the HRVI study, but not analyzed within the context of this thesis. Future research as to how these factors impact preparedness, planning and evacuation could prove useful in order to identify subsets of population that may be more vulnerable due to lack of preparation. This may provide emergency planners with additional knowledge as to which counties and evacuation zones could benefit from hurricane educational programs that focus on understanding the threat, preparing before the disaster and effective evacuation tactics.

Across the study area, it is apparent that SC coastal residents recognize that their communities are vulnerable to the threat of hurricane, and as such they place an emphasis on planning and preparing ahead of the event. The findings presented in this paper provide government officials and planning agencies with spatial information regarding evacuation behavior and how it can be positively influenced prior to a hurricane threatening a community. Understanding that behavior and perception does differ spatially and can be enhanced or hindered by such variables allows planners to focus educational effort on areas of the communities that are more vulnerable. Conversely, understanding the behavior of shadow evacuees is crucial as it will allow planners to educate those citizens on preparedness that would allow them to shelter in place so that those that must evacuate can do so effectively.

Overall, residents along the SC coast appear to display similar evacuation behavior despite which storm surge zone they reside within, however, identifying these spatial similarities will allow pre-disaster mitigation planning promote activities that are specific to each evacuation zone. The planning stage will further provide an opportunity to involve citizens and give them community-based knowledge based on sound risk assessments and historical evidence. This will provide citizens that may be subject to a mandated evacuation with the necessary information in order make personal planning and preparing a top priority, which will in turn lead to an effective evacuation. By promoting planning and preparedness as factors that aide in evacuation, community and state emergency management agencies will not only enhance resistance to hurricanes, but create a path for quick recovery and future resiliency.

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APPENDIX A- 2011 Hurriance Evacuation Study

South Carolina
Hurricane Evacuation Survey
2011

This is an official study conducted by the Hazards and Vulnerability Research Institute at the University of South Carolina on behalf of the US Army Corps of Engineers and the South Carolina Emergency Management Division. It is quick and easy to fill out, and your answers are confidential and protected.

For the questions below, please check the box that best describes where you fall on the range of possible attitudes between the two endpoints.

1. How concerned are you about the threat of a hurricane?
   Very concerned ☐ ☐ ☐ ☐ ☐ *Not concerned at all*
2. How likely is it that your home would ever be seriously damaged or destroyed by hurricane winds or tree damage from winds?
   Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*
3. How likely is it that your home would ever be seriously damaged or destroyed by hurricane-related floods or storm surge?
   Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*
4. How likely is it that your home would NOT be damaged in a hurricane?
   Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*
5. How likely is it that your neighbors' homes would NOT be damaged in a hurricane?
   Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*
6. Would you agree or disagree with the following statements?
   a. I am afraid of hurricanes.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
   b. I worry more about my family's safety than my own.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
   c. I would be more likely to evacuate if I saw my neighbors leaving.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
   d. I would consult with family and friends outside my household before making a decision.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
   e. In times of trouble I would need to rely on others.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
   f. In uncertain times, I usually expect the best.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
   g. It's easy for me to relax.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
   h. If something can go wrong for me, it will.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
   i. I'm always optimistic about my future.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
   j. I enjoy my friendships a great deal.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
   k. It's important for me to keep busy.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
   l. I hardly expect things to go my way.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
   m. I don't get upset too easily.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
   n. I rarely count on good things happening to me.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
   o. I believe disaster relief is the responsibility of government.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
   p. I believe disaster relief is my personal responsibility.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
   q. Overall, I expect more good things to happen to me than bad.
      Strongly agree ☐ ☐ ☐ ☐ ☐ *Strongly disagree*
7. If a category 3 or stronger hurricane, a major hurricane, was threatening your community, how likely is it that you would leave your home?
   Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*
   a. For the same storm, would you leave during a hurricane watch *(hurricane conditions possible in 48 hours)*?
      Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*
   b. Would you leave for a hurricane warning *(hurricane conditions expected in 36 hours or less)*?
      Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*
   c. Would you leave if officials recommended it?
      Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*
   d. Would you leave if officials ordered it?
      Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*
8. If a category 1 or a category 2 hurricane, a weaker hurricane, was threatening your community, how likely is it that you would leave your home?
   Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*
   a. For the same storm, would you leave during a hurricane watch?
      Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*
   b. Would you leave for a hurricane warning?
      Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*
   c. Would you leave if officials recommended it?
      Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*
   d. Would you leave if officials ordered it?
      Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*

South Carolina
Hurricane Evacuation Survey
2011

This is an official study conducted by the Hazards and Vulnerability Research Institute at the University of South Carolina on behalf of the US Army Corps of Engineers and the South Carolina Emergency Management Division. It is quick and easy to fill out, and your answers are confidential and protected.

9. Has your household or family talked about what you might do if you had to evacuate your home for a hurricane?
☐ Yes ☐ No ☐ Don't know

10. What do you do to prepare for hurricane season? *(Check all that apply)*
☐ Make a disaster supply kit *(containing food, water, first aid supplies, and a flashlight)*
☐ Call local government agencies for hurricane information
☐ Prepare or review a family evacuation plan *(including plans for pets, if any)*
☐ Have appropriate materials to secure home for hurricane conditions *(for example, boards for windows)*
☐ Have made permanent home improvements to limit hurricane damage *(for example, truss strengthening)*
☐ Have purchased a NOAA weather radio
☐ I do not prepare for hurricane season
☐ Other *(please specify)*: _____

11. How many days will the supplies in your disaster supply kit sustain your household?

0	1	2	3	4	5 or more
☐	☐	☐	☐	☐	☐

12. Is your address in a hurricane evacuation zone?
☐ Yes ☐ No ☐ Don't know

13. Is your address in a FEMA flood zone?
☐ Yes ☐ No ☐ Don't know

14. When preparing for hurricane season, which state or local government agencies would you rely on for preparedness information?

_____

_____

_____

15. Which of the following sources would you rely on for evacuation notices and storm updates prior to a hurricane's landfall, and to what extent?

	Not at all	A little	Fair amount	Great deal
Local radio stations	☐	☐	☐	☐
Local TV stations	☐	☐	☐	☐
National news (e.g., Fox News, CNN)	☐	☐	☐	☐
Weather Channel	☐	☐	☐	☐
Other cable stations	☐	☐	☐	☐
Internet sources	☐	☐	☐	☐
Word of mouth	☐	☐	☐	☐
NOAA weather radio	☐	☐	☐	☐
Newspapers	☐	☐	☐	☐

16. To what extent would you rely on the following sources for updates during and after a hurricane?

	Not at all	A little	Fair amount	Great deal
Local radio stations	☐	☐	☐	☐
Local TV stations	☐	☐	☐	☐
National news	☐	☐	☐	☐
Weather Channel	☐	☐	☐	☐
Other cable stations	☐	☐	☐	☐
Internet sources	☐	☐	☐	☐
Word of mouth	☐	☐	☐	☐

17. What are the top three factors that would encourage you to evacuate ahead of a hurricane?
1. _____
2. _____
3. _____

18. What are the top three factors that would discourage you from evacuating?
1. _____
2. _____
3. _____

19. Would you still evacuate for a hurricane knowing that you would be unable to return until...

	Yes	No	Don't know
3 days later?	☐	☐	☐
1 week later?	☐	☐	☐
2 weeks later?	☐	☐	☐

20. How many people in your household would need to evacuate, including yourself?

_____

21. Are there people in your household who would probably stay and shelter in place even if other people in the household are leaving?
☐ Yes ☐ No ☐ Don't know

22. How many automobiles would your household take in an evacuation?
☐ 0 ☐ 1 ☐ 2 ☐ 3 or more

23. Would you take any of the following types of vehicles in an evacuation? *(Check all that apply)*
☐ Motor home
☐ Trailer
☐ Boat
☐ Camper
☐ Other *(please specify)*: _____

24. What major highways would you use to evacuate from the area? ***(For example, Interstate 26: US-17; US-501; SC-174)***

_____

_____

_____

25. Would anyone in your household need assistance from outside your family in order to evacuate or require any sort of special care in a shelter?
☐ Yes ☐ No *(skip to question 27)* ☐ Don't know

26. What kind of assistance would this person require? *(Check all that apply)*
☐ Transportation
☐ Special care
☐ Other *(please specify:* _____*)*
☐ Don't know

27. Please specify the number of pets that you have.

Dogs	*Cats*	*Other pets*
☐	☐	☐

☐ I don't have any pets *(skip to question 31)*

28. If you plan on evacuating with your pet, what would you take? *(Check all that apply)*
☐ Proper identification and immunization records
☐ Food and water supply
☐ Carrier or cage
☐ Medications
☐ Muzzle, collar, and leash
☐ Toys and treats
☐ Don't plan on evacuating pets

29. Do your pets have immunization records that are current?
☐ Yes ☐ No ☐ Don't know

30. Are your pets crate trained?
☐ Yes ☐ No ☐ Don't know

31. In an evacuation, which of the following potential shelters would be your 1st, 2nd, or 3rd choice?

	1st	2nd	3rd
Public shelter (or Red Cross shelter)	☐	☐	☐
Pet-friendly public shelter	☐	☐	☐
Church or place of worship	☐	☐	☐
Home of friend or relative	☐	☐	☐
Hotel or motel	☐	☐	☐
Workplace	☐	☐	☐
Other (specify below)	☐	☐	☐
_____ *Don't know*	☐	☐	☐

32. How far away is your first-choice shelter from where you are now?
☐ In the same town or community
☐ In the same county
☐ Another county in South Carolina *(please specify which one)*
_____
☐ Another city in South Carolina *(please specify which one)*
_____
☐ Another state *(please specify which one)*
_____
☐ Don't know

33. How long would you be willing to travel to evacuate, in hours?
_____

34. How much are you willing or able to spend per day on evacuation related costs, in dollars?
_____

35. Have you experienced a hurricane before?
☐ Yes ☐ No ☐ Don't know

36. Have you evacuated for a hurricane before?
☐ Yes ☐ No *(skip to question 39)* ☐ Don't know

37. Where did you go?
☐ Public shelter
☐ Home of family or friends in the county
☐ Home of family or friends outside the county
☐ Hotel or motel
☐ Workplace
☐ Other, please specify: _____
☐ Don't know *(skip to question 39)*

38. In what city or county was that located?
_____

39. Including yourself, how many people live in your household?
_____

40. Of these people, how many are under 18?
_____

41. How many in your household are over the age of 65?
_____

42. How many automobiles do you have at your disposal?
☐ 0 ☐ 1 ☐ 2 ☐ 3 or more

43. During which months of the year do you most often stay at this address? *(Check all that apply)*
    - ☐ *I live at this address all year*

Jan	Feb	Mar	Apr	May	June
☐	☐	☐	☐	☐	☐
July	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
☐	☐	☐	☐	☐	☐

44. How long have you lived at this address, in years? _____
45. Do you own or rent this address?
    - ☐ Own ☐ Rent ☐ Don't know
46. Which of the following best describes your current address?
    - ☐ Detached single family home
    - ☐ Duplex or other multifamily structure
    - ☐ Apartment building or condominium, less than 4 stories
    - ☐ Apartment building or condominium, more than 4 stories
    - ☐ Mobile home/manufactured housing
    - ☐ Some other type of structure
    - ☐ Don't know
47. How old is this structure, in years? _____
48. Which of the following best describes your total household income in 2010?
    - ☐ Less than $22,000
    - ☐ $22,000 - $43,999
    - ☐ $44,000 - $65,999
    - ☐ $66,000 - $87,999
    - ☐ $88,000 or more
49. How old are you? _____
50. Are you currently married?
    - ☐ Yes ☐ No
51. Do you have an internet connection in your home?
    - ☐ Yes ☐ No
52. Which of the following phone services do you have available at this address?
    - ☐ Landline ☐ Cellular ☐ Don't know
    - ☐ I don't have phone service
53. If you have a cell phone, are you registered with the South Carolina Reverse 911 system (ReachSC)?
    - ☐ Yes ☐ No ☐ Don't know
    - ☐ Don't have a cell phone
54. Are you male or female?
    - ☐ Male ☐ Female
55. How many church, social, service, or neighborhood organizations do you belong to?

    _____ *(If zero, skip to question 58)*
56. In which one of the above are you most active?

    _____
57. How likely are you to rely on this organization for help after a disaster?

    Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*
58. Which of the following best describes your area of employment?
    - ☐ Construction
    - ☐ Manufacturing
    - ☐ Wholesale trade
    - ☐ Retail and consumer services
    - ☐ Transportation, shipping, and warehousing
    - ☐ Utilities
    - ☐ Professional, financial or IT services
    - ☐ Education and health services
    - ☐ Government
    - ☐ Military
    - ☐ Other, please specify: _____
    - ☐ Retired
    - ☐ Unemployed
    - ☐ Don't know
59. What is the highest grade of school you've completed?
    - ☐ Grade school
    - ☐ Some high school
    - ☐ High school graduate or equivalent (GED)
    - ☐ Technical or vocational school
    - ☐ College (undergraduate)
    - ☐ College (graduate)
    - ☐ Other advanced education
60. How likely are you to rely on friends and family after a disaster?

    Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*
61. How likely are you to rely on the government after a disaster?

    Very likely ☐ ☐ ☐ ☐ ☐ *Not likely at all*
62. Do you consider yourself to be Hispanic or Latino?
    - ☐ Yes ☐ No ☐ Don't know
63. What do you consider as your racial background?
    - ☐ Black or African-American
    - ☐ White
    - ☐ Native Hawaiian or Other Pacific Islander
    - ☐ Hispanic or Latino
    - ☐ Asian
    - ☐ American Indian or Alaska Native
    - ☐ Other *(please specify)*: _____

Thank you for filling out our survey! Your answers will help to improve emergency management in South Carolina.