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Florida Red Tides: Public Perceptions of Risk

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by

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Abstract

This research integrates the theoretical implications of risk perception, the social amplification of risk, and the role of place-specific contexts, in order to explore the various perceptions surrounding Florida red tides. Florida red tides are a naturally-occurring event, yet most scientists agree that they are increasing in frequency, duration, and severity. This has profound implication for public health, the local economy, and the biological community. While many of the negative impacts are not easily controllable at this time, some of the secondary impacts can be mitigated through individuals' responses. Unfortunately, public perceptions and consequent reactions to red tides have not been investigated. This research uses questionnaire surveys, semi-structured interviews, and newspaper content analysis to explore the various perceptions of risk surrounding red tides. Surveys and interviews were conducted along two Florida west coast beaches, Fort De Soto Park and Siesta Key. Results indicate that the underlying foundations of the social amplification of risk framework are applicable to understanding how individuals form perceptions of risk relative to red tide events. There are key differences between the spatial locations of individuals

and corresponding perceptions, indicating that place-specific contexts are essential to understanding how individuals receive and interpret risk information. The results also suggest that individuals may be lacking efficient and up-to-date information about red tides and their impacts due to inconsistent public outreach. Overall, particular social and spatial factors appear to be more influential as to whether individuals amplify or attenuate the risks associated with red tides.

Chapter One: Introduction

Red tides are highly concentrated blooms of microscopic algae called *Karenia brevis* that occur periodically along the coastlines of Florida and occasionally along other gulf coast states. These red tides are capable of producing toxins that can pose health threats to humans and marine organisms. Most scientists agree that Florida red tides are occurring more frequently, staying onshore longer, and increasing in geographic extent (Kirkpatrick et al., 2004; Tester and Steidinger, 1998; Van Dolah et al., 2001; Shumway, 1990). This leaves many Florida residents, visitors, local business owners, government officials, and researchers with a myriad of questions as to how and why this is happening. Likewise, there is a growing consensus among individuals interested in various control and mitigation techniques that may alleviate health problems, economic losses, and biological impacts. With each red tide "season" or event, there are presumably various alterations of typical daily activities by all affected individuals. By affected, I include any individuals experiencing subsequent health impacts, enduring economic losses to their business, avoiding beaches with dead fish, monitoring and researching the biological community, or even those individuals who are unsure and wary of what a Florida red tide entails.

Though there is a growing literature on red tide issues, there continues to be a lack of research on the socioeconomic and public health impacts of such events. Furthermore, there is virtually no published research on the public's perception of Florida red tide events. Some of the existing economic and health impact studies have included a small section within their questionnaires attempting to address perception, but this is not their overall focus and most are not based in Florida (Jensen, 1975; Evans and Jones, 2001; Adams et al., 2002). Before implementing any type of red tide management strategy, it is important to understand how the public perceives and understands red tides and their mitigation techniques. It is through the perception of risk events that individuals respond and behave accordingly. However, their knowledge and behavior may not be consistent with the actual risk surrounding the event and can, therefore, have far-reaching social and economic impacts.

For this study, I conducted a case study along two of Florida's west coast beaches to explore the public's perceptions of risk surrounding red tides. I begin this study by outlining the physical characteristics of Florida red tides, and by reviewing the existing literature on the impacts of red tide events. Given the lack of research concerning the public's responses to Florida red tides, I also address the research surrounding risk perception and the role of social and spatial contextual factors. Using structured surveys and semi-structured interviews, I investigated the various perceptions of Florida red tides by people visiting the two selected beaches. The ultimate goal is to explore the possibility of individuals acting as amplifiers or attenuators of risk information, relative to various social and spatial contextual factors.

Chapter Two: Literature Review

Red Tide Physical Characteristics

Description

What is commonly referred to as a “red tide” is actually a bloom of microscopic, single-celled organisms called dinoflagellates (FWC, 2005). These dinoflagellates have plant-like nutritional characteristics, and are therefore referred to as phytoplankton. Phytoplankton is the algal component of the plankton found drifting throughout the oceans. Also called the “grass of the sea,” phytoplankton is extremely abundant and provides the base of the marine food chain (FWC, 2005). A bloom refers to the higher-than-normal concentrations of the toxin-producing dinoflagellates. The dense accumulation of dinoflagellates discolors the water, giving it a reddish hue, hence the term “red tide.” The color may also be yellow, orange, or brown and, therefore, scientists use the term “Harmful Algal Bloom” (HAB) (FWC, 2005).

Most red tides within the Gulf of Mexico are caused by the toxic marine dinoflagellate, *Karenia brevis*, formerly known as *Gymnodinium breve* or *Ptychodiscus brevis* (FWC, 2005; NOAA, 2006). The toxins of *K. brevis* are called “brevetoxins” and are associated with Neurotoxic Shellfish Poisoning (NSP). Low background concentrations of *K. brevis* of up to 1,000 cells per liter of water are almost always found in the Gulf of Mexico. It is when favorable environmental and biological conditions occur that a *K. brevis* bloom is instigated, with concentrations of up to millions of cells per liter (Tester and Steidinger, 1998; FWC, 2005). Typically confined to the Gulf of Mexico waters, *K. brevis* can occasionally be transported by winds and currents up the east coast of Florida and along the coasts of the Carolinas (Tester and Steidinger, 1998).

K. brevis is considered phototactic, meaning that it is attracted to light. The organisms, therefore, become more concentrated in surface waters during daylight hours and dissipate at night (Steidinger and Joyce, 1973). Although *K. brevis* generally drifts with the currents, the cells have flagella that navigate and propel them through the water. Only moving at a rate of about three feet per hour, they are believed to travel in upward and downward motions (Tester and Steidinger, 1998; FWC, 2005).

History and Distribution

The first documented red tide event was in the 1840s when the Spanish explorers arriving in Tampa Bay indicated large fish kills in their travel logs (FWC, 2005). It was not until the large-scale red tide event of 1946 through 1947 that scientists identified the source of Florida red tides as the dinoflagellate, *Gymnodinium brevis*, named by Dr. C.C. Davis (Steidinger and Joyce, 1973; FWC, 2005). From 1947 to 1963, red tide events reportedly occurred every three to five years (Mote, 2005). With the exception of 1993, a red tide has been recorded in every year since 1970 (Steidinger et al., 1996). Moderate to high blooms were experienced every year from 2001 to 2005 (Mote, 2005). This recorded history of red tides has raised the question of whether blooms are in fact occurring more frequently and with greater intensity, or if there is simply better coverage of their occurrence. Likewise, it is difficult to determine if the historical record of red tide events is indeed accurate and consistent.

Karenia brevis blooms have been experienced along other Gulf Coast states, but are more common to the coasts of Texas and especially Florida. Although the east coast and panhandle regions of Florida have experienced *K. brevis* blooms, they occur most frequent from Tarpon Springs to Sanibel Island, with a reported 21 events occurring within 22 years (Steidinger et al., 1996; Tester and Steidinger, 1998). Red tides can appear throughout the year, but tend to follow a seasonal pattern of beginning in late summer and lasting through January or February (FWC, 2005; NOAA, 2006).

Red Tide Impacts

There are many aspects to what I refer to as the "impacts" of a red tide event. Impacts may refer to the effects on the public's health, the local economy, the biological community, or even the effects on the public's perceptions and consequent reactions. Since the current research is in its early stages, there may be long term impacts that scientists have not yet considered. The negative impacts of any type of hazard event trigger a response from all those affected. To understand the response of individuals when red tide events occur, it is important to first consider what the known impacts are.

Public Health

When a *K. brevis* bloom concentrates and drifts closer to shore, people can potentially be affected by the two most common health impacts. The first, and most severe, is neurotoxic shellfish poisoning (NSP) caused by the consumption of affected shellfish. NSP made its first documented appearance in the 1880s when two people became sick with similar symptoms after consuming oysters (Steidinger et al., 1996). The second major risk from a red tide is associated with the brevetoxins in the air and sea spray that cause respiratory irritation. Such symptoms were first reported by individuals in 1916 and their cause was originally believed to be an odorless, noxious gas (Steidinger et al., 1996; Kirkpatrick et al., 2004). There have also been reports of dermal irritation after spending time in water during blooms, but these symptoms have not been conclusively linked to *K. brevis* red tides (Kusek et al., 1999). Although some information on the health impacts of red tides has been dispersed to the public through various media, there remain many people who are unclear of the scope and conditions of such health implications.

Contrary to common belief, NSP only occurs with the consumption of affected bivalve shellfish. Bivalve shellfish include clams, mussels, and oysters, which ingest *K.brevis* as they filter plant matter from the water for food (FWC, 2005). As these filter feeders pump large amounts of water across their gills, the accumulated harmful algae become highly concentrated, sometimes over 100 times the levels in water (NOAA, 2005). They may become toxic even with exposure to low levels of toxins over a long enough period of time (FWC, 2005).

Scallops are not considered dangerous to eat during a bloom because most people typically only eat the adductor muscle, which does not accumulate the toxins (FWC, 2005). In NOAA's *Sea Stats* newsletter, scientists stated, "The greatest threat to humans posed by *K.brevis* red tides is through the consumption of bivalve shellfish that have been contaminated with the red tide toxin (NOAA, 2005, p. 3)." Although no humans have yet died from NSP, symptoms may include nausea, diarrhea, motor incoordination, pupil dilation, tingling of fingers and toes, and sometimes the reversal of hot and cold sensations (DOH, 2004; Kirkpatrick et al., 2004).

The brevetoxins are not easily detected as they are tasteless and odorless, hence frequent laboratory samples are necessary (Kirkpatrick et al., 2004). After consumption of toxic shellfish, illness occurs within a few minutes to several hours later, but symptoms typically resolve a few days later (Kirkpatrick et al., 2004; FWC, 2005). The medical implications of NSP are relatively minor compared to the more serious paralytic shellfish poisoning (PSP) and ciguatera fish poisoning caused by other harmful algal blooms, but the threat of NSP remains an important issue for Florida residents and visitors (Kirkpatrick et al., 2004). However, discrepancies between NSP and other types of red tide related poisonings may confuse those individuals unfamiliar with Florida-specific red tides. The distinction between *K. brevis* and other dinoflagellates, as well as the accurate portrayal of the current level of threat from NSP, should be made clear and accessible to avoid an unnecessary avoidance of seafood.

Neurotoxic shellfish poisoning is now a rare occurrence because of the effective state monitoring of shellfish harvesting beds since the 1970s. The more commonly experienced health implication from a red tide is from the aerosolized toxins. The red tide cells are broken apart by wave action against the shoreline, releasing their toxins into the air and sea spray (Kirkpatrick et al., 2004). The airborne toxins can provoke asthmatic-like symptoms such as coughing, eye irritation, sneezing, gagging, and respiratory irritation (Kirkpatrick et al., 2004). Researchers believe asthmatic individuals may be more susceptible to these symptoms, perhaps even instigating asthma attacks for some (Kirkpatrick et al., 2004). Since the toxins are released by wave action, symptoms are not typically experienced once off shore. One study, however, did find that chronic symptoms may persist from days to weeks, with some individuals even requiring medical attention (Quirino et al., 2004). Beachgoers, as well as coastal residents and workers, are all at risk to experience these symptoms from the aerosolized toxins. The extent to which these health effects interrupt their outdoor activities or well-being may influence how these individuals perceive red tides and whether mitigation or control techniques are necessary.

Economic Impacts

Economic assessments following a red tide have previously consisted of rough estimates from business owners, scientists, or government officials. With recent red tides occurring almost annually, there is a growing effort for both small-scale and large-scale economic impact studies. Because HABs appear throughout nearly all coastal states in the United States, it is difficult to find regional impact studies for Florida alone. Most of these studies are completed at the national scale and include all types of HABs and other types of invasive macroalgae (seaweed) (Shumway et al., 1990; Anderson et al., 2000; Hoagland et al., 2002). The economic assessments are typically divided into four major sectors: public health, commercial fishing, recreation and tourism, and monitoring and management efforts.

Public health usually refers to associated medical costs with either NSP or respiratory symptoms, but sometimes includes lost productivity of workers. In a 2000 study by Anderson et al., the annual average economic costs of public health were approximately $22 million, representing 45% of the total economic impacts caused by HABs in the United States. However, these figures are misleading because only $1 million of the costs are associated with neurotoxic, paralytic, or amnesiac poisoning; the remaining $21 million relates to ciguatera fish poisoning (Anderson et al., 2000).

Recreation and tourism industries may experience economic losses as a result of people choosing to avoid areas experiencing a red tide or even areas that are known to experience frequent blooms. The individuals may hear about adverse health effects from the media or their friends, may have asthma, or may have seen pictures of massive fish kills along the shoreline, or may have had a previous negative experience with a red tide event. This direct or indirect experience, coupled with preconceived notions, may play an integral role in how individuals form their perceptions and alter their behavior during or after a red tide event.

One of the first recorded economic loss estimates followed the extensive red tide event of 1953 to 1954, with a reported $3.8 million loss to the tourism industry in Clearwater alone (Mote, 2005). Later blooms near the Tampa Bay region impacted the tourism industry with a loss of $20 million in 1971 (including beach clean-up costs) and $15 million in 1974 (Mote, 2005). For a study period between 2004 and 2006, researchers from the University of Florida found a 13.5% decline in beach attendance per month in Sarasota County during a red tide (Adams et al., 2002). Overall, the tourism industry represented 13% of the estimated annual economic impact from HAB events in the United States in a study of 1987 to 1992, with a yearly average loss of $6.6 million (Anderson et al., 2000; Hoagland et al., 2002). Whether this declined beach tourism is the result of respiratory irritation, beaches covered in dead fish, bad press, or stigmatization, the results indicate that people have a negative perception of red tides. Since the origin of this response has not yet been determined, it becomes apparent that there is a lack of research corresponding to the public's attitudes and risk perceptions surrounding Florida red tide events.

The estimated average annual cost to commercial fisheries from 1987 to 1992 was $18.4 million, or 37% of the total economic impacts (Anderson et al., 2002). With shellfish as the source of NSP, it is expected that the shellfish industry experiences the greatest economic hardship within the commercial fisheries. Despite the massive numbers of fish mortalities during red tide events, the economic effects from the loss of these finfish remain unclear. This effect may be because: (i) the affected finfish are generally not considered the popular marketable species; (ii) the Gulf of Mexico has experienced red tides throughout its history and fish species have adapted and recovered; and (iii), other species may benefit that are also profitable for fisherman, such as crabs (Anderson et al., 2000; Hoagland et al., 2002; FWC, 2005). Furthermore, research has shown that the economic "halo effect," or the damage to areas of the fishing industry not directly related to NSP, may have caused declines in finfish sales with unrelated species and in unaffected areas (Jensen, 1975; Evans and Jones, 2001; Hoagland et al., 2002).

Economic impacts on the shellfish industry are better understood, but there remain questions about how such costs should be measured and whether the effects are temporary or permanent. Perhaps the most common economic cost to the shellfish industry is the subsequent harvest bed closures following the evidence of a red tide bloom. Florida officials periodically sample the water for the presence of *K. brevis* cells and once levels have reached 5,000 cells per liter of water, shellfish harvest beds are closed until counts fall below 5,000 and a mouse bioassay reveals no evidence of toxicity in the shellfish (Shumway, 1990; Division of Aquaculture, 2005). Additional losses include unmarketable fish stocks, lack of consumer confidence, and the "halo effect" to other shellfish species or in unaffected harvest areas.

Public Reaction

The phenomenon associated with the “halo effect” first gained momentum with Albert C. Jensen’s 1975 paper in the *Proceedings of the First International Conference on the Toxic Dinoflagellate Blooms*. The term now appears in many other red tide studies, serving as a plausible explanation for the public’s overreaction to the implications of a red tide (Jensen, 1975; Shumway, 1990; Anderson et al., 2000; Evans and Jones, 2001; Hoagland et al., 2002). Although state regulations have prevented cases of NSP from shellfish since the 1970s, individuals may have uncertainties about the possibility of other fish being affected and therefore choose to avoid all potential sources of health risk. For instance, Adams et al. (2002) found that about 75% of the respondents believed finfish and crustaceans were unsafe to eat during blooms. It is difficult to estimate the full economic implications of such reactions by the public to red tide events, but it is obvious that the public’s perceptions are significant enough to have far-reaching impacts.

Shumway (1990, p. 89) stated, “Probably more devastating than the blooms themselves are the subsequent publicity, dissemination of misinformation and public uneasiness.” Many researchers attribute negative media coverage as a major cause of adverse consumer reaction. Media are criticized for failing to report both affected and unaffected species and for the lack of coverage once bans are lifted (Jensen, 1975; Shumway, 1990; Hoagland et al., 2002). After analyzing over 500 articles from the St. Petersburg Times from 1953 to 1997, Kusek et al. (1999) referred to the articles as relaying “a science-fiction drama” rather than discussing the natural phenomenon. The authors stated, “Inaccuracies ranged from repetitive misspellings, erroneous red tide descriptions, and lack of content, to irresponsible headlines and alarmist, poorly explained photographs that could ultimately cast a negative eye on the state of Florida at large (Kusek et al., 1999, p. 166).”

Monitoring and Management of Red Tide

The first attempt to mitigate the effects of a red tide occurred only four years after the most severe red tide on record, the event of 1946 through 1947. In 1952, a red tide bloom encompassed a 400 square mile area from Boca Grande to Sanibel Island. To keep a 150 square mile area of dead fish from washing up along the beaches, Mayor Herbert Brown of Clearwater suggested using Air Force planes to fire-bomb the area with napalm (Mote, 2005). Again in 1957, officials were anxious to alleviate the negative impacts of *K. brevis*. Motivated by the unusually high number of marine animal mortalities, officials decided to spray copper sulfate from crop duster planes along the waters from Clearwater to Naples. This idea was based on an experiment demonstrated by federal researchers in front of management agencies and the public in which copper pennies were dropped into an aquarium of *K. brevis* and it later died (Kusek et al., 1999). This method turned out to be very expensive and caused unforeseen damage to other marine life and was therefore terminated early (Mote, 2005).

Today, most researchers and officials agree that Florida red tides are natural and, therefore, may have ecological significance that cannot be ignored. Regardless, there is a continuing effort to mitigate the harmful effects on humans, fish, and mammals. Following the lead of Japan and other Asian countries, Florida is now researching the possibility of clay flocculation as a control measure (Mote, 2006). This method involves distributing clay over the affected areas, allowing the *K. brevis* cells to attach to the clay particles and subsequently sink to the ocean floor where their survival and growth is significantly limited (Mote, 2006). This control method is highly controversial and lacks convincing research that proves it causes no further damage to bottom-dwelling organisms or other marine life.

At the 2006 Mote red tide public forum in Sarasota, Florida, more than half of the questions from the public raised issues with clay flocculation. Some compared red tides to infectious diseases – something that must be controlled with every effort. Most forum participants were highly concerned with the possible negative effects to other marine organisms or unknown long-term effects. Others were more interested in focusing efforts on the reduction of coastal pollution, which they believed to be a major contributory factor to increased blooms. The topics of coastal pollution prevention and clay flocculation as a control method were the two most prominent and controversial issues for discussion from the audience.

Other control or mitigation efforts are directed toward shellfish toxicity. Researchers are examining various methods of detoxification of contaminated shellfish, including the use of environmental stressors, chlorination, ozonation, and relocating the shellfish to uncontaminated waters for self-depuration (Shumway, 1990). In addition, some shellfish species may be resistant to the toxins and others may recover quickly (Shumway, 1990). Shumway (1990) points out that the current methods of detoxification are not yet economically viable. Hence, it appears that a combined effort involving effective monitoring and culturing "rapid-release" species may be most effective in preventing economic losses to shellfish industries (Shumway, 1990).

The most efficient method for managing both health and economic impacts from a red tide event is statewide monitoring. Since the 1970s, officials from the Florida Division of Aquaculture and the Florida Marine Research Institute (FMRI) have both tested shellfish harvesting areas for the presence of *K. brevis* and regulated harvesting (FWC, 2005). As to the effectiveness of this monitoring program, there have been no reported cases of NSP from commercially-regulated beds since its inception (MOTE, 2006).

The ultimate goal for management efforts is to develop a bloom forecast system, as well as an Internet-based system for accessing and disseminating data for HAB management (NOAA, 2005). Currently, NOAA uses SeaWiFS imagery (Sea-viewing Wide-Field-of-view Sensor) to indicate possible blooms. The imagery detects chlorophyll which is typically associated with phytoplankton at the surface of the water column. The information is then used to direct crews to appropriate locations for water samples. The water samples are necessary to determine the presence of toxins because the imagery cannot distinguish between the toxic and nontoxic varieties of algae, or the levels of concentration (NOAA, 2006).

An additional source of information for individuals is the Sarasota and Manatee County Beach Conditions Report website. This service provides beach conditions reports posted twice a day by lifeguards at eight public beaches within Sarasota and Manatee Counties (Mote, 2007). The report includes the water color, wind direction, surf, beach flag color, the presence of dead fish, and respiratory irritation. The service began in August of 2006 and is in collaboration with Mote Marine Laboratory, Sarasota County, Manatee County, Solutions to Avoid Red Tide (START), and the Florida Department of Health (DOH). Although it is a useful resource for the public, it is limited to the beaches within those two counties and the reports are somewhat subjective as they are based on the lifeguards' observations.

While research continues to suggest efforts to minimize or eliminate the harmful impacts of red tide, the implementation of such efforts necessitates careful consideration from decision-makers. This is necessary because the health of individuals, the economic stability of businesses, and the viability of biological communities all depend on the decisions and actions regarding Florida's red tides. Decisions should, therefore, be informed by all stakeholders. Scientists are actively researching the biological impacts of all potential control and mitigation efforts. National and state-level agencies are exploring cost-effective methods of loss prevention for impacted businesses. However, the voice of individuals as stakeholders are overlooked by scientists and decision-makers who rely on assumptions of public opinion, claiming to make decisions based on the public's "best interest." An improved understanding of the responses of such individuals can only be informed by allowing their opinions and suggestions to be voiced. In this study, my aim is to provide an initial step for understanding the perceptions and responses of individuals in relation to Florida's nearly annual red tides.

Response to Red Tide

In a society where we can practically communicate with anyone at any given time and watch or read the news by various means, it can be assumed that the local occurrence of a red tide will always be a publicized event. Whether people learn about it from direct experience, friends or family, the media, local business owners, or research publications, they have inevitably heard something about red tides. What they have heard may in fact be very different than what is actually happening, but regardless, for most there is a conceptual understanding of Florida red tides. The general understanding of red tide has shifted over the last decade from a mysterious tide that brings unexplainable fish kills and noxious gas, to a naturally-occurring *K. brevis* bloom that we are learning more about every day.

Unfortunately, the negative effects of red tide blooms continue to impact lives. However, the level or severity of some of the impacts is largely dependent upon individuals' behaviors. The worst of the health impacts have already been mitigated by the effective monitoring of shellfish, but for now individuals will have to endure the respiratory effects. This can also be remedied by successful media coverage of red tide affected areas, by informing individuals of the locations to avoid in order to minimize respiratory irritation.

Conversely, individuals' behaviors have the most prominent influence on the economic impacts during and following a bloom. If individuals are told that a particular area is prone to red tide events, they may decide to avoid it altogether. Likewise, if they hear anything about shellfish poisoning during a red tide, they may avoid all seafood or avoid it for a much longer period of time. These types of behaviors are passed on through social networks and can in turn lead to significant economic losses to tourism industries, restaurants, local businesses, and the seafood industry. The economic impact literature has so far referred to this as the "halo effect," or the repercussions of the public's aversion to seafood not affected by red tides or from areas not impacted by blooms (Jensen, 1975; Shumway, 1990; Anderson et al., 2000; Evans and Jones, 2001; Hoagland et al., 2002).

This general concept of the halo effect has a place within risk perception literature as well. In 1988, Kasperson et al. first introduced a concept referred to as the "social amplification of risk," describing a tentative conceptual framework. Later, in 1992 and 1996, the concept was developed into a theoretical framework that is applicable to many disciplines of research (Renn et al., 1992; Kasperson and Kasperson, 1996). The framework is based on the postulation that "the social and economic impacts of an adverse event are determined not only by the direct physical consequences of the event, but by the interaction of psychological, cultural, social, and institutional processes that amplify or attenuate public experience of risk and result in secondary impacts (Renn et al., 1992, p. 154)." To understand the role of the social amplification of risk framework, we must first understand its place within the larger risk perception literature.

Risk Perception

In the effort to understand the responses and behaviors of individuals when faced with hazardous events, there have been numerous explanations relating perception to response. Collectively, all approaches attempt to understand how individuals arrive at their decisions and eventual response, relative to economic, social, and political factors (Tobin and Montz, 1997).

Traditionally relying on concepts such as economically rational behavior (individuals making decisions based on cost-benefit analyses), researchers soon realized that individuals base decisions on consideration of many other factors not concerned with maximizing benefits (Tobin and Montz, 1997). By integrating social science research techniques with traditional geographical techniques, Gilbert F. White's research first considered the social factors that influence individuals' behaviors. In 1974, White conducted a cross-cultural comparison of hazards from around the world, and although there are many criticisms of the specific methods, his work established the importance of social context as well as perceptual variables (White, 1974; Tobin and Montz, 1997).

Psychological risk perception initially focused on “revealed” and “expressed” preferences to explain behavior. Starr (1969) used the revealed preference approach, claiming that society uses a comparison of risk and benefits to determine the acceptability of the risks associated with technologies or activities. A significant finding of Starr was that individuals tend to accept risks more easily if from voluntary activities or risks, whereas they feel a lack of control for involuntary risks. Following Starr’s work, a new approach using the expressed preferences of individuals, rather than assumptions on their behalf, was also implemented. Although both approaches provided useful concepts for understanding behavior, there remained discrepancies between previous actions or expressed actions as opposed to actual behaviors adopted by individuals when faced with disasters (Cutter, 1993; Tobin and Montz, 1997). In general, the various approaches, which attempted to explain the behaviors of individuals when confronted with hazards, eventually led to the development of theoretical frameworks aimed at distinguishing the factors influencing responses.

As reflected in the literature, the responses and behaviors of individuals reflect the subjective identification and evaluation of risks associated with certain hazards. In the process of identifying and evaluating risks, individuals attach particular characteristics to the risk which ultimately influence their perception and response. These characteristics often differ greatly from expert judgements of risks because while experts attribute risk to the probability of death, lay people subjectively employ social, psychological, and environmental factors in their assessments (Cutter, 1993). To assist policy-makers in understanding public perceptions of risks, Slovic (1987) used the psychometric paradigm as a "cognitive map" explaining the risk attitudes and perceptions of individuals concerning 30 "risky" activities. Slovic (1987) determined that the most prominent factors in evaluating risks are familiarity, controllability and dread, indicating that higher levels of uncertainty lead to higher risk perceptions as do the determined likelihood for catastrophic potential. Despite the criticisms of Slovic's work (as outlined by Cutter, 1993), the introduction of accidents as "signals" (when an extreme event causes a ripple effect of social impacts) led to the "social amplification of risk" framework developed by Kasperson et al. (1988). The social amplification of risk framework incorporates this notion of "signals" and explains the ripple effect of impacts as the result of either the amplification or attenuation of risk information. As discussed in Chapter Three, the framework emphasizes the role of social, cultural, and psychological processes in the formation of risk perceptions.

Chapter Three: Theoretical Framework

Introduction

The following outlined theoretical framework corresponds to the theoretical foundations of the "social amplification and attenuation of risk framework" (SARF) (Kasperson et al., 1988; Renn et al., 1992; Kasperson and Kasperson, 1996). Kasperson et al. (1988) problematize the established technical concept of risk as the probability of events multiplied by the magnitude of consequences, and advance the premise for understanding risk perception. Public perceptions, Kasperson et al. (1988, p. 178) argue, are "the product of intuitive biases and economic interests and reflect cultural values more generally." It is hypothesized that psychological, social, and cultural processes all interact with risk events to potentially amplify or attenuate public perceptions of risk and related risk behavior (Kasperson et al., 1988). Hence, the amplification or attenuation has a ripple effect that can induce secondary or higher order social and economic impacts. By integrating concepts from Slovic's (1987) work with signals as well as concepts within communications theory of intensifying or attenuating signals, Kasperson et al. (1988) developed a conceptual framework for understanding this phenomenon (Figure 3.1).

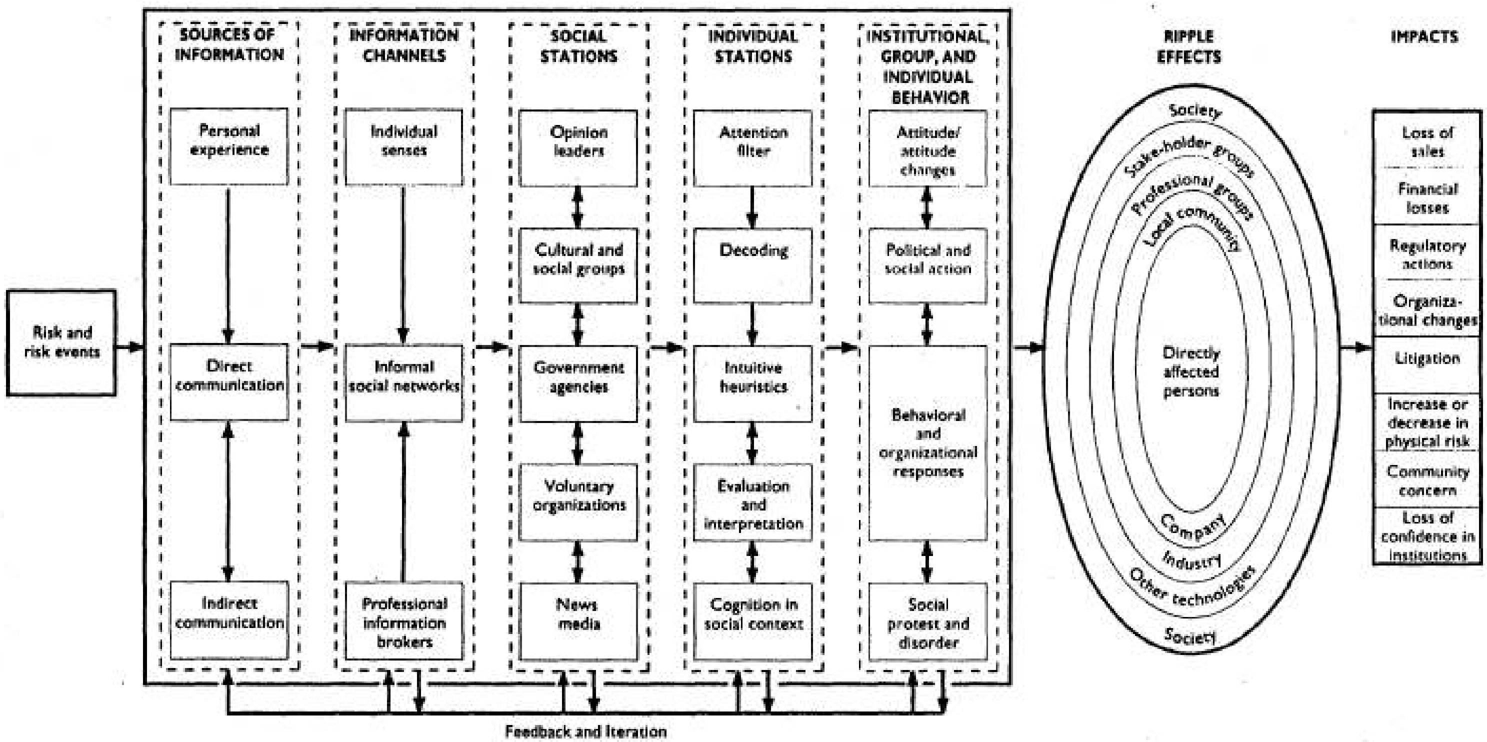

Figure 3.1. The Social Amplification and Attenuation of Risk (Kasperson and Kasperson, 1996)

Once a hazard event, in this case a red tide event, occurs, those individuals or groups who initially discovered the event then have the responsibility of delivering the message to the public. The message is the result of the interpretations of those individuals and the selection of event characteristics that are deemed meaningful. The red tide event then becomes the initial individual's or group's portrayal of the event as the message is communicated to others, including the public.

As individuals or groups receive the message, they can become "amplification stations" through which the risk information is shaped by their own biases and perceptions and passed on either as behavioral response or communication (Renn et al., 1992, p. 140). These amplification stations are influenced by the individual's or group's social roles within society, as well as by family, friends, and employers.

At the individual level, Renn et al. (1992) have outlined eight steps that correspond to the perception and amplification process and the formation of the message. Initially, an individual receives signals from the environment, media, friends, and so on, some of which are selected and others disregarded. The selected signals are then decoded according to existing knowledge, and inferences are drawn based on reasoning and beliefs, as well as by the comparison with other messages. At this point, the messages are then evaluated according to personal beliefs, values, perception of risk, and level of importance. This step is followed by the formation or changing of personal beliefs, or conversely, the reassertion of previously held beliefs as they relate to the message content. After rationalizing this shift in beliefs, or lack thereof, the messages are translated into potential action, or behavior. This process of decoding, interpreting, and evaluating a message is essentially where the amplification or attenuation of messages begins.

Renn et al. (1992) further argue that not only do individuals play a role in this amplification process, but so do the larger social groups of which they are a part. As “social stations of amplification,” these larger social units impose their own influences upon the individual’s perception and interpretation of risk messages. The values, biases, and expectations of the larger social groups are translated at some length to the individuals directly influenced by them. Therefore, this amplification or attenuation of risk becomes an intricate social process through which communication and behavior extend outward, causing secondary impacts. Resembling a ripple effect, the secondary impacts may also create signals and messages that in turn can lead to third or higher order impacts.

Situational Factors

Extending this concept of social amplification of risk, Masuda and Garvin (2006) further emphasize the role of place and culture in the perception of risk. They argue that place is central to the cultural basis from which individuals perceive risks (Masuda and Garvin, 2006). They go on to state, “Place attachment becomes important in both reinforcing and reflecting the social construction of risk in the local environment (Masuda and Garvin, 2006).” In their case study of Edmonton, Alberta, Canada, the authors conducted in-depth interviews with both residents and non-residents in order to determine the range of situated perceptions of risk. After identifying the most prominent social constructs, they found that most of the risk amplifiers were residents with place attachments to their farms and land. Conversely, the risk attenuators were largely the non-resident stakeholders who showed no particular attachment to the local area or land, and who were directly involved in government related jobs.

There are additional factors that contribute to the perception of risk, and potentially to the amplification or attenuation of risk as well. These include gender, age, education, and occupation, among others not addressed in this research. Gustafson (1998) identifies from the existing literature three perspectives that correspond to the role of gender in risk perception. First, the same risks invoke different levels of concern from women and men. Second, women and men perceive different types of risk, and third, gender differences also exist in terms of the attributed meanings to the same risks. The role of gender in the process of amplification or attenuation of risk has not been fully explored by researchers, but is addressed in the context of this study.

Age may also play a role in risk perception because of the differential vulnerability of age groups to health risks. For instance, elderly individuals may be at greater risk to the health effects of certain hazards (in this case red tides), and therefore have heightened perceptions of risk (Tobin, 2005). The role of education and occupation within risk perception research remains unclear, but perhaps these factors are more applicable to this particular research. Since red tides have both direct and indirect impacts on businesses, the individuals who own or are employed by particular businesses may have varying perceptions of risks associated with red tides. Those employed in tourism-related or service oriented industries, as well as those within the seafood industry, may have intensified perceptions of risk. Likewise, individuals employed in environmental or biological related businesses may be less likely to perceive red tides as a greater threat that requires more effective control measures. Employees in health-related industries may attribute greater risk to the effects from red tides because of their constant involvement with the health and well-being of people.

Education may be linked to occupations both because of the level of skill associated with education, and the types of education received on behalf of the company for which they work. As viewed separately from occupation, higher levels of education may equate to more accurate perceptions of red tides and the associated impacts.

Hence, the role of these various situational factors can be explored in relation to the existing framework for the social amplification of risk. Essentially, a modified framework of social amplification of risk and the role of place will be the underlying theoretical framework for this research.

Chapter Four describes the research questions and hypotheses for this research, each of which explores the role of the aforementioned social and spatial factors as potentially influential in the formation of risk perceptions surrounding red tides.

Chapter Four: Research Questions and Hypotheses

Research Questions

Relative to the literature discussed in Chapters Two and Three, public perceptions of Florida red tides and their associated causes and impacts are explored as they relate to social and spatial factors. This research addresses the following research questions surrounding Florida red tide events in the context of two case study areas:

1. What is the public's perception of risk concerning Florida red tide blooms, and how does this vary between different social groups?
2. What causes and impacts do people associate with Florida red tides?
3. How do perceptions of risk vary spatially, relative to the two study sites and where individuals live relative to the beach?
4. How do local newspapers contribute to the information available to the public concerning red tides and their causes and impacts?

The ultimate goal of each of the research questions is to distinguish some of the underlying characteristics that may lead individuals to act as amplifiers or attenuators of risk information.

Hypotheses

- *Individuals less cognizant of red tides are hypothesized to perceive risks differently from individuals who are more aware of red tides or have been affected by red tides.* If individuals more accurately describe what a red tide is, then it is expected that they will also have a better understanding of the effects, such as the dangers of eating seafood during a bloom. Individuals who report being affected in some way by red tides are also expected to be more concerned about red tides since they have direct experience with the impacts of red tides.
- *Women and older age groups will have perceptions of greater risk, especially related to the health risk of red tides.* As discussed in Chapter Three, women are expected to give more weight to the health effects and level of concern of red tides than men. I anticipate that older individuals will also rate the health effects and overall level of concern higher because they may be more vulnerable to the respiratory effects of red tides.
- *Individuals with higher levels of education will attribute lower risk to the effects of red tides because they are more likely to have a more complete understanding of red tides.* As discussed in Chapter Three, individuals with higher levels of education may have more accurate perceptions of risk associated with red tides, which may lead to perceptions of lower risk of the effects from red tides.
- *Individuals working in health-related industries are expected to attribute greater risk and overall concern with red tides because their work*

generally necessitates being more concerned about the health and well-being of others. As discussed in Chapter Three, the relationship between occupation and risk perception is unclear, but should be explored to determine any noticeable trends.

- *There will be a difference between individuals at Siesta Key and Fort De Soto in how accurately they describe Florida red tides and how much experience they have had with the effects of red tides.* Siesta Key is near the Mote Marine Laboratory which means that there may be better public outreach regarding red tide information. In addition, Siesta Key is a beach surrounded by commercial and residential areas, while Fort De Soto is a county park without residential or commercial areas. Individuals at Siesta Key are more likely to be near the beach during a red tide even if they choose to avoid the beach and would, therefore, be more likely to experience the impacts.
- *Florida residents living near the west coast will have a more accurate understanding of the causes and effects of red tides than will Florida residents living further inland or Florida visitors.* Florida residents living near the west coast of Florida may have better access to red tide information and may be more likely to experience the effects of red tides since the west coast is the most commonly impacted area for Florida red tides.
- *Individuals at Siesta Key will perceive risk associated with the effects of red tide differently than those at Fort De Soto.* Red tides can affect

different areas at varying intensities, which translates to varying degrees of impact to individuals near the beaches. More experience with impacts will affect perceptions of the associated risk, as will little or no experience. For instance, individuals at Siesta Key may have perceptions of greater risk due to the increased likelihood of experiencing the effects of red tides.

- *Florida residents are expected to rate the impacts and the overall level of concern higher than non-residents due to the increased likelihood of being near the beach during a bloom.* Since Florida residents are more likely to live near the beach, or visit the beach more often, they may have experienced more health impacts from active blooms that could cause them to become more concerned about red tides.
- *Individuals living closer to the beach will attribute higher risk to the effects of red tides.* As mentioned above, living in close proximity to the beach increases the likelihood of being around the beach during red tides. This increased experience, in turn, may lead to amplified levels of concern about red tides and their effects.
- *Florida visitors are hypothesized to attribute greater risk to eating seafood because of their uncertainties or lack of information.* It is unlikely that the Florida-specific red tide blooms are well publicized in other states or countries, and so visitors may base their knowledge of risks on hearsay or media which may not be accurate.
- *Newspapers from the Siesta Key area will portray red tides more accurately than those from the Fort De Soto area.* Since Siesta Key is

located near Mote Marine Laboratory which plays a major role in red tide research, it is expected that there is better public outreach through media sources. In addition, I expect there to be some inaccuracies in how Florida red tides are discussed, and an overall lack of coverage when there are no severe blooms.

Research Goal

The previously discussed hypotheses provide the foundation from which to determine the potential for individuals to become either amplifiers or attenuators of risk information. After testing the hypotheses, the results are discussed in terms of identifying key characteristics that may lead individuals to become either amplifiers or attenuators of risk. This serves as an initial step in understanding some of the complex processes that make up the social amplification of risk framework discussed in Chapter Three.

Chapter Five: Study Area

Introduction

For investigating the phenomenon of the social amplification of risk as it pertains to Florida red tides, I have chosen a case study approach. Although there are two study sites, they can be collectively referred to as an “instrumental” case study (Stake, 2003). This refers to the investigation and examination of one case in order to provide potential insight and understanding of other cases (Stake, 2003). This concept does not equate to generalizability, but rather seeks to obtain results and insights that may transferable to other similar sites and situations (Baxter and Eyles, 1999).

Site Selection

There are many considerations that influence the location of the case study area. The selection criteria that are most important for this study include: a location along Florida’s west coast, easy access for the public, a population of both visitors and locals, and a history of red tide events affecting the area.

Although *K. brevis* blooms have occurred along all of Florida’s coasts, they are most prevalent along the west coast, especially in the region from Tarpon Springs to Naples (Steidinger et al., 1996; Tester and Steidinger, 1998). There are many major cities to choose from along the west coast, most of which meet the other criteria. However, locations within a shorter driving distance from Tampa are beneficial because of less travel expense, making it easier for more frequent visits.

Because this study is focused on public perceptions, it is necessary to find a location that is both easily accessible to and widely used by the public. A beach is the ideal candidate for the second and third criteria because it attracts a diverse crowd who presumably enjoy some aspect of being outdoors near the ocean. Florida has many popular public beaches, many of which are highly regarded and easily accessible. The more renowned beaches have the benefit of ensuring a larger population from which to sample. This leads more specifically to the third criterion, which is finding a diverse population of both locals and visitors.

Since I am looking at public perceptions as they relate to response and economic impact, it is crucial to include both visitors and local residents in the sample. It is difficult to find a single beach that has a proportionate number of both visitors and locals because visitors may stay closer to hotels and resorts, while locals may prefer more remote beaches. Thus, two locations are necessary to better capture the diversity of the population and subsequent samples.

The final criterion is experience with red tide events. This cannot be guaranteed with every individual within the sample; however, the locations' experience with blooms is perhaps the most important criterion. It is when a red tide occurs at a nearby or favorite destination beach that truly captures the public's attention. It may interfere with vacation plans or make the beach unpleasant due to dead fish or respiratory irritation. Therefore, the occurrence of red tide events precedes the notion of what a red tide is and how it affects individuals.

The two locations for the case study are Siesta Key Beach in Sarasota County (Figure 5.1), and Fort De Soto Park in Pinellas County (Figure 5.2). Both locations fulfill all of the above criteria, including being within an hour's driving distance from Tampa, where I am located. Siesta Key has been voted "the world's finest and whitest" sand beach and remains a top tourist destination in Florida (Siesta Key Chamber of Commerce, 2006). Conversely, Fort De Soto Park is a more remote beach and is known as a haven for locals, yet was named America's number one beach for 2005 (Pinellas County, 2006). Both sites have experienced nearly annual red tide blooms since the 1970s (Steidinger et al., 1996), further qualifying them as optimal study areas.

Physical Context

Siesta Key is an eight mile-long barrier island located just offshore of Sarasota and approximately 55 miles south of Tampa (Figure 5.3). Sarasota County is located along Florida's southwest coast, between Manatee County to the north, and Charlotte County to the south. White quartz sand beaches span across the 35 miles of beachfront land within Sarasota County. Total land area of the county is approximately 572 square miles (Sarasota County, 2006). The famous beaches and islands found within Sarasota County attract millions of tourists every year, with the peak season from February through April, and the value (or discounted) season is from June to September. Characterized by classic warm Florida temperatures, Sarasota County has an average annual temperature of 72.6 degrees Fahrenheit, with typical low temperatures near 62 degrees and average highs near 83 degrees (Sarasota County, 2006).

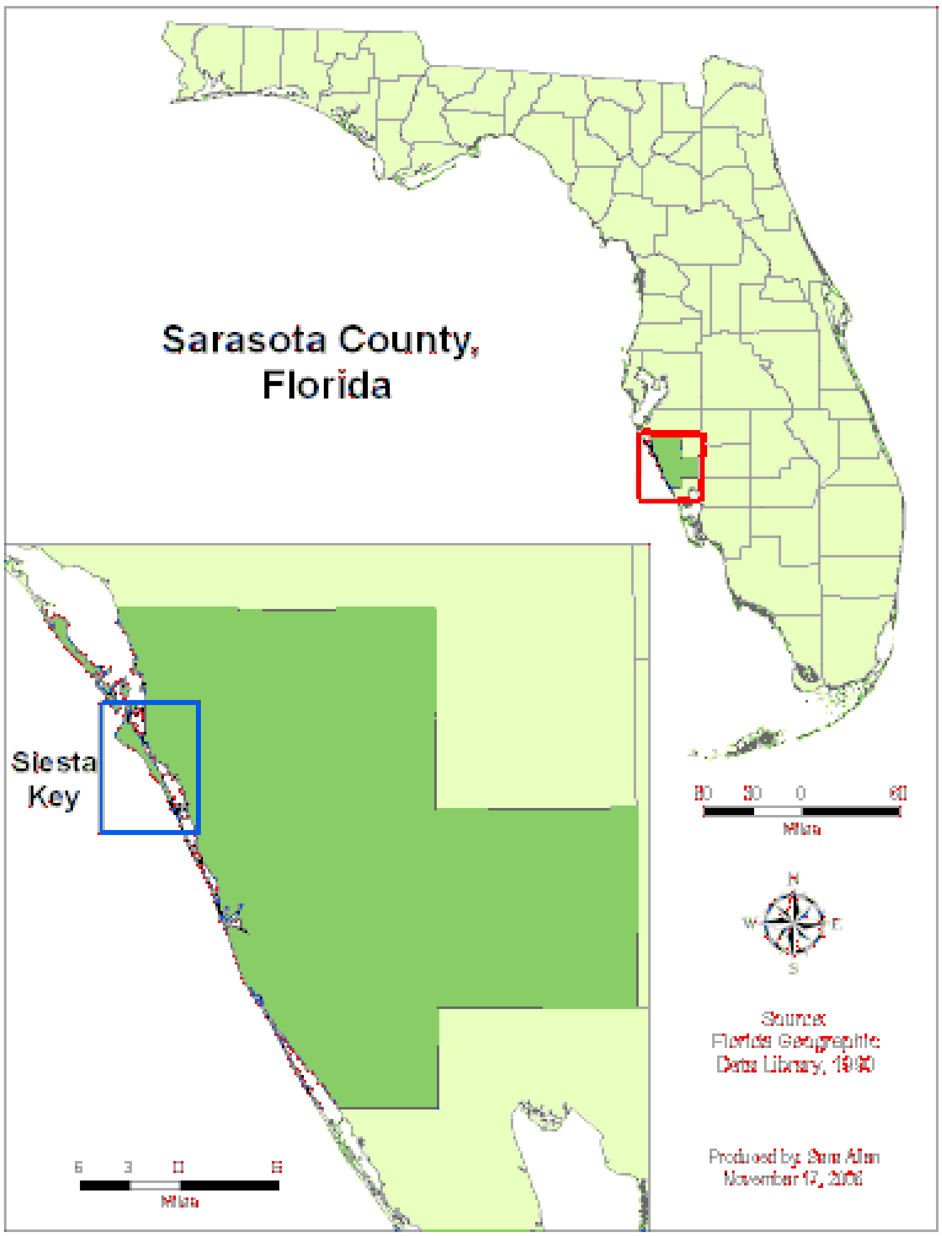

Figure 5.1. Sarasota County, Florida

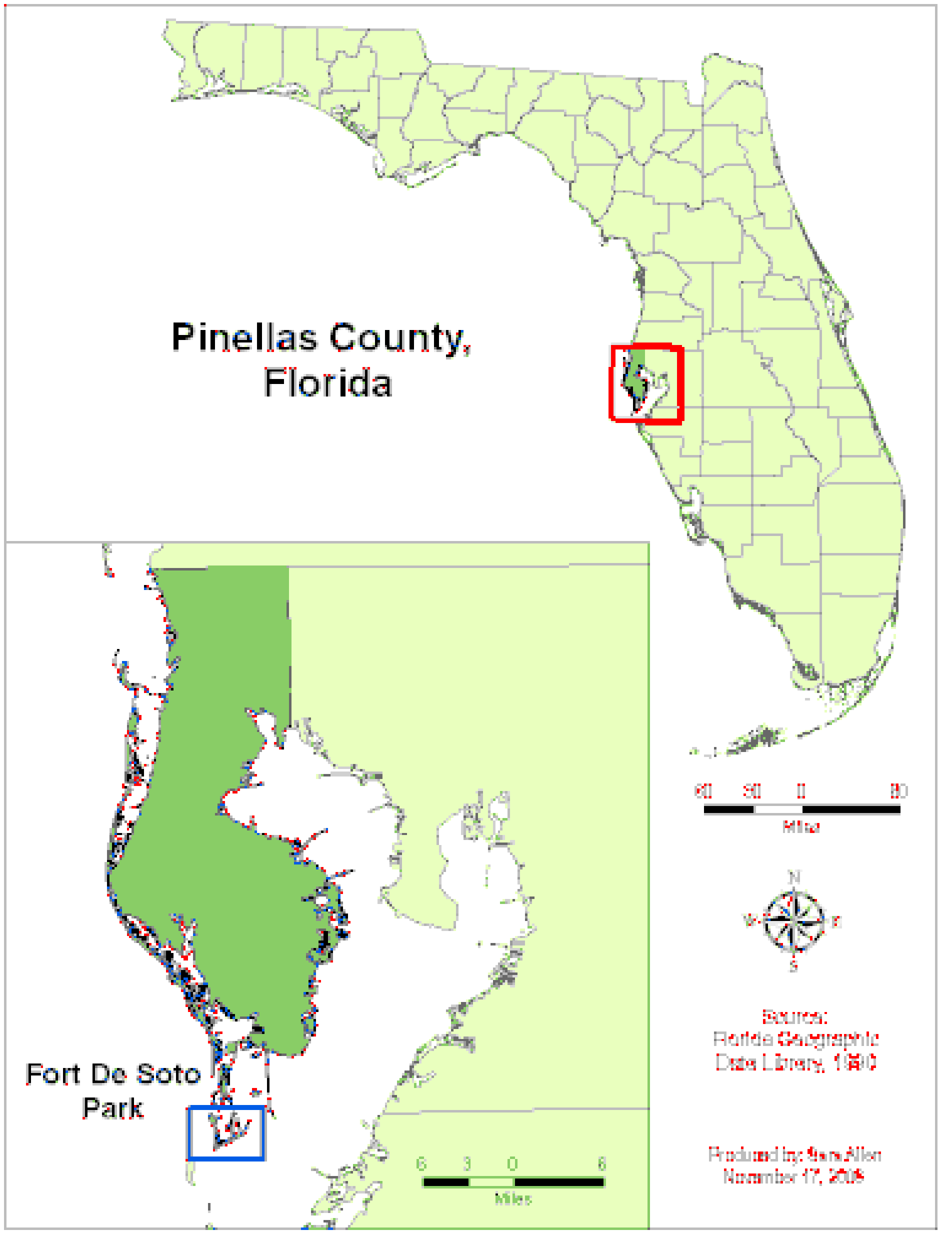

Figure 5.2. Pinellas County, Florida

Fort De Soto Park consists of five interconnected islands, totaling 1,136 acres of land area (Pinellas County, 2006) (Figure 5.4). The park is located approximately five miles south of the southernmost tip of Pinellas County on Mullet Key. Dedicated as a public park in 1963, Fort De Soto is an historical landmark named after the Spanish explorer Hernando De Soto (Pinellas County, 2006). The park is a part of Pinellas County which is located along Florida's west coast just west of Hillsborough County. It is the second smallest county in Florida, and most densely populated, with only 280 square miles of land area (Pinellas County, 2006). Average annual temperatures range from 62 degrees Fahrenheit in January to near 83 degrees in August (Pinellas County, 2006).

Figure 5.3. Siesta Key in Sarasota County, Florida

Figure 5.4. Fort De Soto Park in Pinellas County, Florida

Social Context

The Siesta Key community was originally founded in 1846 and has since undergone the construction of two bridges connecting the barrier island to Sarasota, making it accessible to the public (Siesta Key Chamber of Commerce, 2006). There are now an estimated 24,000 residents living on Siesta Key, including both full- and part-time residents (Siesta Key Chamber of Commerce, 2006). The total population of Sarasota County from the 2000 Census, is 325,957; however, the estimated population for 2005 is 366,256 (Table 5.1) (U.S. Census Bureau, 2006). Of this county population, there are approximately 93.6% white persons, 4.5% black persons, 5.9% persons of Hispanic origin, and 1.2% persons of other minority groups including Asian, American Indian, Alaskan native, Native Hawaiian, and other Pacific Islander persons (U.S. Census Bureau, 2006). The county has nearly an equal proportion of males and females, with a higher percentage of females (52.2%) than males (47.8%).

Table 5.1. Total Population with Gender and Race/Ethnicity

	Pinellas County	**Sarasota County**	**Florida**
Population, 2005 Estimate	928,032	366,256	17,789,864
Female persons, 2004	52.1%	52.2%	51.0%
Male persons, 2004	47.9%	47.8%	49.0%
White persons, 2004	85.9%	93.6%	80.6%
Black persons, 2004	10.0%	4.5%	15.7%
Persons of Hispanic or Latino Origin*, 2004	6.0%	5.9%	19.0%
Asian Persons, 2004	2.6%	1.0%	2.0%
Other Minority Persons**, 2004	0.4%	0.2%	0.5%

Note: With the exception of Persons of Hispanic or Latino Origin, all above racial categories include persons reporting only one race.
* Hispanics may be of any race, so are also included in applicable race categories.
**Other minority groups include American Indian, Alaskan Native, Native Hawaiian, and other Pacific Islander persons.
Source: U.S. Census Bureau: State and County QuickFacts, Data derived from Population Estimates, Last revised June 8, 2006.

Many of the economic indicators for Sarasota County reveal more favorable economic conditions as compared to the averages of Florida. For instance, the median household income for Sarasota County is $42,306, yet the state of Florida has a median of $38,985 (U.S. Census Bureau, 2006). The percentage of persons below poverty is only 8.4%, whereas the Florida average is about 13.0% (U.S. Census Bureau, 2006). A further indicator is the home ownership rate as of the 2000 Census, which is 79.1% for Sarasota County and 70.1% for the state of Florida. As shown in Table 5.2, Sarasota County has a higher percentage of persons aged 25 or older with a bachelor's degree or higher (27.4%) than both Pinellas County (23.0%) and the state of Florida as a whole (22.4%) (U.S. Census Bureau, 2000).

Table 5.2. Educational Attainment

	Pinellas County	**Sarasota County**	**Florida**
Less than 9th Grade	3.9%	3.4%	6.7%
9th to 12th Grade, No Diploma	12.1%	9.5%	13.4%
High School Graduate (or equivalent)	29.6%	30.1%	28.7%
Some College, No Degree	23.9%	23.3%	21.8%
Associate Degree	7.5%	6.3%	7.0%
Bachelor's Degree	15.1%	17.1%	14.3%
Graduate or Professional Degree	7.9%	10.3%	8.1%
Total	100.0%	100.0%	100.0%

Note: Includes only population aged 25 years and older.
Source: U.S. Census Bureau: Census 2000 Summary File 3, Matrices P37 and PCT25

Most of Sarasota County residents are either employed in management, professional, and related fields (31.7%), or sales and office (29.7%), according to the occupation classifications of the U.S. Census Bureau (2000) (Table 5.3). The service industry employs the third highest percentage (19.1%) of the county's population, and the farming, fishing, and forestry industries employ the lowest portion (0.3%) (U.S. Census Bureau, 2000). The Sarasota County Tourist

Development Council estimates that the total percentage of Sarasota County residents who are employed in tourism related businesses is about 8.3%. In addition, they estimate that in 2005, there were approximately five million visitors to Sarasota County, generating a total of $1.47 billion in direct dollars and close to $3.9 billion in total direct and indirect dollars (Sarasota County Tourist Development Council, 2005).

Table 5.3. Occupational Categories

	Occupation Category	Pinellas County	Sarasota County	Florida
Distribution by Occupation	Management, Professional, & Related	34.2%	31.7%	31.5%
	Service	15.5%	19.1%	16.9%
	Sales & Office	31.0%	29.7%	29.5%
	Farming, Fishing and Forestry	0.2%	0.3%	0.9%
	Construction, Extraction, and Maintenance	8.1%	10.2%	10.3%
	Production, Transportation, and Material Moving	11.0%	8.9%	10.8%
Selected Industries	Agriculture, Forestry, Fishing and Hunting	0.2%	0.4%	1.2%
	Manufacturing	10.1%	6.4%	7.3%
Government Workers (local, state, or federal)		10.8%	10.0%	13.7%

Note: Includes occupation, industry, and class of worker of employed civilians aged 16 years and over.
Source: U.S. Census Bureau: Census 2000 Summary File 3, Matrices P49, P50, and P51

Fort De Soto Park is maintained by the Pinellas County Park Department and is operated as a public service by the Board of County Commissioners. With nearly 2.6 million visitors annually, Fort De Soto Park is known for its camping facilities, historic museum, white sand beaches, and its interpretive nature trail that accommodates individuals with physical disabilities (Pinellas County, 2006).

Pinellas County, to which the park belongs, has an estimated 2005 population of 928,032 compared to the 2000 Census population of 921,482 (U.S. Census Bureau, 2006). The population, as estimated by the U.S. Census Bureau for 2004, consists of 85.9% white persons, 10% black persons, 3% Asian or other minority groups (see Table 5.1), and 6% persons of Hispanic or Latino origin. Similar to Sarasota County, Pinellas County has approximately 52.1% females and 47.9% males within its total population (U.S. Census Bureau, 2006).

Unlike Sarasota County, the economic indicators for Pinellas County are closer to the averages for the state of Florida. Florida's median household income is $38,985, while Pinellas County's median is slightly less at $36,209 (U.S. Census Bureau, 2006). On the other hand, the percentage of persons below poverty is somewhat better at 12.1% than that of Florida (13%) (U.S. Census Bureau, 2006). The home ownership rates, as of 2000 Census, are nearly identical at 70.8% for Pinellas County and 70.1% for Florida.

The educational attainment distribution is also closer to that of the state of Florida compared to Sarasota County (Table 5.2). For instance, the percentage of persons over the age of 25 with a bachelor's degree or higher is 23% for Pinellas County and 22.4% for Florida. However, Pinellas County does have a higher percentage of persons over the age of 25 with a high school diploma, some college, or an Associate's degree (61%) than does Florida as a whole (57.5%), and Sarasota County (59.7%) (U.S. Census Bureau, 2000).

Again, Pinellas County is similar in its distribution of occupational categories to the averages for Florida, and for that matter, also Sarasota County

(Table 5.3). Approximately 15.5% of county residents are employed in service related industries, and the majority is employed within management, professional and related industries (34.2%), and sales and office (31%). Only 0.2% of the population is employed in farming, fishing and forestry compared to the 0.9% average for Florida (U.S. Census Bureau, 2000).

Summary

The two selected study sites have fairly similar distributions of the demographic characteristics previously discussed. This is beneficial because any demographic differences between the two study sites are less likely to be a confounding factor in the selection of the sampled population. Differences between the two samples, therefore, are more likely to be due to the types of people who visit each of the beaches. For instance, there may be more Florida residents at one beach than the other, or residents may live at varying distances from the beach. Furthermore, the physical attributes of the two beaches make ideal study site candidates for the present study.

Chapter Six: Methodology

Introduction

As previously discussed, I am using a modification of the Kasperson et al. (1988) "social amplification of risk framework", with emphasis on place-specific context as an influential factor in risk perceptions (Masuda and Garvin, 2006). The methods I use are partially derived from the work of Renn et al. (1992), Kusek et al. (1999), Wakefield and Elliot (2003), and Masuda and Garvin (2006), and consist of a case study using public surveys, semi-structured interviews, and content analysis of two local newspapers. Although the social amplification framework is widely accepted and used to help explain the public's adverse (or attenuated) reaction to major hazardous events (Renn et al., 1992; Kasperson and Kasperson, 1996; Leschine, 2002; Barnett and Breakwell, 2003; Masuda and Garvin, 2006), there are few studies providing comprehensive and replicable methodologies. Therefore, I triangulate the useful themes and methods from an array of studies (Renn et al., 1992; Kusek et al., 1999; Wakefield and Elliot, 2003; Masuda and Garvin, 2006), while modifying the variable classes to better represent risk perceptions related to Florida red tides (a high probability, low consequence hazard).

Sample Design

For the public surveys, I used a stratified sampling design to ensure a fairly even number of individuals were selected from each beach relative to the study site. Within each beach, a systematic sampling design was used to select survey participants. Thirty individuals were sampled from Fort De Soto, and 29 were sampled from Siesta Key, to give a total sample size of 59 surveys. It took five days on each beach to complete surveys, for a total of 10 days of surveying. The number of surveys collected on each day was directly proportionate to the number of people present on the beach. For instance, if there were an estimated 27 groups of people on the beach, the number of surveys collected was 9; likewise, fewer people on the beach resulted in smaller samples. The total estimated population (N) from which I sampled was 183.

Upon entering the beach, I walked up to the third closest person(s) for the first survey, and then proceeded to survey every third person(s) in a zigzag pattern relative to the shoreline. I only walked up to individuals sitting on the beach, and did not approach those who appeared to be sleeping, or otherwise occupied. Upon approaching a person or group of persons, I introduced myself and the overall purpose and intentions of the survey. If more than one individual agreed to participate, I asked to speak with the person with the most recent birthday. I did not survey individuals if they were under the age of 18 or could not speak fluent English. Only two people refused to participate in the surveys, and two others could not speak fluent English.

I began surveys in mid-April and finished in the beginning of September. Most surveys were completed in April and May. There was no red tide present during the sampling time frame and the most recent recorded bloom ended in February of 2007. The surveys took approximately 15 to 20 minutes with most respondents. There were many individuals, however, who wanted to talk longer about the topics or had questions that took up to 15 minutes longer than the actual survey.

Survey Questionnaires

Using the previously mentioned sampling design, I conducted face-to-face survey questionnaires to individuals along the beach in order to gather information about Florida red tides and their impacts. The survey included fixed-response questions and fixed Likert scale, as well as open-ended questions. Fixed-response questions are ideal for less complex questions, such as those seeking demographic information, and they limit the range of answers, making it easier to analyze responses. However, limiting the scope of response for other more complex questions can be problematic because individuals do not have the opportunity to answer according to their own understandings and viewpoints (McLafferty, 2003). Hence, open-ended questions were also used, which allowed for the exploration of new topics related to red tides and their associated impacts. The additional fixed Likert scale questions consisted of a five-point scale to measure individuals' perceptions of risks. A scale of five was chosen because three may limit the range of responses too much, whereas seven or more may offer too many choices, leading to a lack of differentiation between the categories (McLafferty, 2003). The survey questionnaire contained four themes that were concerned with: (i) place-specific contexts; (ii) the perceived causes and impacts of Florida's red tides; (iii) the perception of risk surrounding red tides; and (iv), information sources and demographics.

For the pilot study, I spent one day surveying five people along a beach in Honeymoon Island State Park. I used the same sampling design as in the actual study, and obtained five surveys. In addition, I administered it to several graduate students in the department to ensure clarity and flow of the questions. Any problems or ambiguities that I identified in the pilot study were corrected before conducting the actual surveys.

Survey Design

Masuda and Garvin (2006) first formally introduced a place-sensitive application of the social amplification of risk framework. They used such comparisons as residents versus non-residents to explore place attachments, but also included more obscure notions of place in which the perceived qualities of their surroundings were considered. Similarly, I compared the responses of Florida residents and non-residents, and introduced questions that probed the aesthetic attributes associated with each of the beaches.

Adams et al. (2002) conducted telephone surveys that explored the public's knowledge of the biology and effects of Florida's red tides, but only measured the correctness of the responses. The social amplification of risk framework, however, is more concerned with understanding the responses and the rationale behind them as well as how social, cultural, and psychological factors may influence perceptions.

Renn et al. (1992) attempted to measure socioeconomic and political impacts by analyzing the information in news media as well as by using a group Delphi procedure with experts from various related fields. This attempt for an objective measurement of impacts is not necessary for this study because I am more interested in the public's perceived impacts of red tides. Presumably, the responses given to these questions represent their actual understandings and perceptions associated with the impacts of red tides, which are therefore potentially disseminated through each of their social networks. This translation of understandings through social networks may create the ripple effects associated with the social amplification of risk framework.

In Renn et al. (1992), the individual layperson's perceptions were assessed with surveys and included many new measures, such as manageability, blame, and future risk. I did not explore the perceived managerial (in)competence or the assignment of blame as these researchers did, but I did obtain information pertaining to the public's perceptions of the current status of research and effort for Florida's red tides. Renn et al. (1992) also examined the potential for personal political involvement and personal action, but found that their measures lacked validity. Instead, I investigated the extent to which individuals would prefer mitigation or control efforts for red tide and determined who they believed should be responsible for these efforts.

The final section of each survey consisted of basic demographic questions that helped determine the representativeness of the samples and additionally provided some independent variables. These include gender, age, occupation, and education. The previous sections containing the literature review and theoretical context provide a more detailed rationale behind the expected relationships of these variables with those of risk perception.

Semi-structured Interviews

Using the key themes from the survey questionnaires, I conducted semi-structured interviews that have a similar framework. This enabled a more detailed analysis of the underlying factors of risk perception. On every other day of surveys, I asked the fourth person I was surveying if he or she would be interested in answering a few more in-depth questions. The questions acted as probes to solicit more information from previously asked questions from the survey as well as more specific questions about sources of information. As the interviewees talked about the presented topics, I noted their responses. I chose not to tape the conversations because I found that people were more likely to speak with me for an extended period of time if the questions were more conversational. Using the completed surveys, interview notes, and my own observations, I compiled a narrative of each interview to be further analyzed.

Qualitative research methods with in-depth interviews are employed in all three of the studies upon which I have based my own methods (Renn et al., 1992; Wakefield and Elliot, 2003; Masuda and Garvin, 2006). McGuirk and

O'Neill (2005, p. 147) provide a description of qualitative research, claiming that it "seeks to understand the ways people experience the same events, places, and processes differently as part of a fluid reality; a reality constructed through multiple interpretations and filtered through multiple frames of reference and systems of meaning-making." In other words, qualitative research can provide insight into multifarious responses and behaviors, thereby revealing both departure and consensus on particular issues. The interviews are, therefore, used to help fill any gaps from the surveys and to provide pertinent information about this relatively nascent topic concerning the public's perceptions of risk associated with Florida red tides.

Although the original work using the social amplification of risk framework does not include in-depth interviews (Renn et al., 1992), many of the subsequent studies employing the framework are based upon qualitative methodologies, including in-depth interviews (Barnett and Breakwell, 2003; Masuda and Garvin, 2006). While investigating the social impacts from a "pill scare," Barnett and Breakwell (2003) combined six in-depth interviews with the contextual analyses of news information and medical journals. The integration of their chosen qualitative methods allowed them to reconstruct the flow of information surrounding the event and elucidate the social processes that amplified the risks associated with that event. While their methods complemented their objectives, my own research is less concerned with a particular event and instead seeks to understand the social phenomenon surrounding the regular occurrence of the risk event(s), or red tides.

Perhaps more similar to my own methodology, Masuda and Garvin (2006) completed several in-depth interviews with both residents and non-residents within their study area and were able to identify the most prominent social constructs related to the perceptions of risk. The constructs or themes were identified as either high risk or low risk, and the individuals as either potential amplifiers or attenuators of risk. The authors concluded that "whether individuals will amplify or attenuate risks, then, depends on cultural worldviews that are influenced by the social network in which they are situated (Masuda and Garvin, 2006, p. 449)." Although the subject matter of their study is quite different from that of the present study, their overall approach to understanding the processes of the social amplification of risk provides a practical example to use in my own methods. In essence, the combined approaches of survey questionnaires and in-depth interviews complement each other by offering both the individual and general perspectives regarding the perceptions of Florida red tides (Hay, 2005).

Content Analysis of Newspapers

Because the social amplification of risk is in many ways influenced by mass media (Kasperson et al., 1988; Renn et al., 1992; Masuda and Garvin, 2006), I also investigated the two most commonly read newspapers by survey respondents to determine the extent and nature of news coverage before, during, and after a red tide bloom. Within the survey, there was a question asking about the most commonly used source for news concerning the beach. Using the responses to this question, I narrowed the choices down to the *Sarasota Herald-*

Tribune and the *St. Petersburg Times* in order to ensure a more in-depth investigation.

For the content analysis, I used similar methods as Wakefield and Elliot (2003) in their research examining the role of local newspapers in the communication of environmental risk information. I created a database in which I included the newspaper name, date of the article, page number, total word count, headline title and any subtitles, author's name, type of article, the themes of the article (Wakefield and Elliot, 2003). From this information, I explored the emergent key themes and prominence of red tide related news as it relates to each of the news sources. The content analysis of the two newspapers provides a contextual understanding of how scientific information is exchanged and how media can influence public perceptions.

Using the University of South Florida library's online newspaper database search, articles were selected from each of the newspapers for the time period from January 1, 2004 to July 23, 2007. Articles were returned if they had "red tide" as a keyword in any of the text or headlines. There were a total of 480 articles returned for the *Sarasota Herald* and 506 articles returned for the *St. Petersburg Times*. To obtain a sample, I selected every 10th article from each newspaper to include in the analysis. This gave me a sample of 48 articles for the Sarasota Herald-Tribune and 50 articles for the St. Petersburg Times. The sampled articles were then entered into the above mentioned database. Descriptions of red tides and discussions about related topics were the focus of the analysis in order to make comparisons with the results from the surveys.

Similar to Kusek et al. (1999), I created appendices showing the headlines, word counts, page number, authors, and red tide descriptors.

Ethical Considerations

In the process of collecting data from participants, I was face-to-face, asking questions that may have for some individuals seemed invasive, particularly the socioeconomic questions. Within the semi-structured interviews, I was involved in a conversation that required the establishment of some level of rapport between me, the researcher, and the individuals, or respondents. Because we know that the researcher can never be considered separately from the research or society, we must therefore examine the interrelatedness between all those involved in the research (Hay, 2005). Furthermore, as a researcher, I must ensure my awareness of and responsibility to consider ethical issues throughout all phases of the research, from initial design to presentation of results. Within the realm of ethical issues, I must attend to such assurances as privacy and confidentiality, informed consent, and nonmaleficence (the principle of doing no harm) (Burton and Steane, 2004). This was accomplished through the initial survey introduction that was read to all participants, in which the intended research as well as the scope of expectations was provided. In addition, before completing any of the pilot surveys or actual surveys, I completed the requirements for the Institutional Review Board.

Quantitative Analysis

For the fixed-response questions of the survey, I used SPSS statistical package for Windows. Basic descriptive statistics along with frequency counts were initially derived for all responses before further analysis. Since I used binary response questions (i.e., yes or no questions) and Likert scale questions, I was limited to using nonparametric statistical techniques. The data from the binary questions were nominal (or categorical), and the Likert scale data were ordinal (or ranked). The assumptions for a normal distribution, therefore, were not fulfilled because the data were not interval. The data must then be considered as a comparison of rank orders rather than as actual numbers with interval characteristics (Hinton, 1995). The nonparametric statistical tests that I used were contingency table analysis with chi-square (χ^2), Spearman's rho (r_s), and the Wilcoxon (W) rank sum test (Elliot and Woodward, 2007).

Contingency table analysis was used for the binary responses from either pre-existing fixed-response questions or for open-ended responses coded as binary 0 or 1. The chi-square (χ^2) test for homogeneity was used to determine if the distribution of the chosen binary variable was consistent across the two sampled populations (Elliot and Woodward, 2007). This test was primarily used to test for differences in coded responses from open-ended questions between the two beaches and the coded proximity of residences to the beach.

The Spearman's rho (r_s) test was used instead of Pearson's correlation coefficient. Spearman's rho measures the strength of either an increasing or decreasing relationship between ranked variables (Elliot and Woodward, 2007). Similar to Pearson's correlation, the Spearman's rho value uses a value between -1 and 1 to measure the strength of the relationship. This test was used to examine the relationship between risk perceptions and ranked variables, such as age, education, and distance to the beach.

Serving as the nonparametric alternative for the independent *t* test, the Wilcoxon (*W*) rank sum test was used to determine if two independent samples were drawn from populations of the same distribution (Hinton, 1995). It compares the rank positions of the two sample sets and tests a null hypothesis of no difference between the populations from which the two samples were drawn (Hinton, 1995). This test was primarily used to compare differences between the Likert scale responses from each of the study sites, and between Florida residents and visitors, gender, and occupation.

All of the above statistical techniques were used in addition to my qualitative analysis of the data. The results helped determine the applicability of the hypotheses I provided in Chapter Four as they relate to the samples from the two study sites.

Qualitative Analysis

The primary goal of the qualitative analysis was to gain better insight into the various responses and behaviors, as well as to fill any gaps from the surveys. Since red tides are a relatively nascent topic for many people, open-ended questions and additional interview questions were necessary to explore the topic in more detail. The open-ended responses from the surveys, the interview notes, and the newspaper content were all analyzed for recurring themes related to red tides and their associated causes and effects.

The open-ended questions were categorized according to emerging themes instead of using pre-set themes. Many of the responses to questions were similar, and so the underlying concepts were grouped together to form general themes. The resulting themes were then coded for further statistical analysis, but the actual responses were also used to supplement interpretations.

The semi-structured interviews provided additional information about key concepts from the survey and allowed opinions to be further explored. Notes and quotations were used to supplement the interpretation of the survey results, providing key links between the opinions and their potential sources. Additionally, they provided insight into sources of information and how individuals interpreted information from these sources, forming their own opinions.

Excerpts from the newspapers were used similarly as the interview notes, in that they provided additional context for the discussed topics. Since the articles represented a subset of the total coverage, the quantitative analysis of the timing and length of articles in comparison to the occurrence of red tide blooms could not be accomplished. Instead, a qualitative approach to content analysis was used to determine the key themes presented in the articles that were related to red tides, their causes and impacts, and other relevant themes. Many of the prominent themes discussed in the articles coincided with those from the surveys and interviews.

Chapter Seven: Descriptive Statistics

Introduction

There were four main themes presented in the survey and the descriptive analyses of the results are displayed accordingly. The first theme was place-specific contexts and included questions about the respondents' residences in comparison to the beach and an open-ended question exploring the reasons that attracted the respondents to each particular beach. In addition, respondents were asked about the likelihood that various scenarios would prevent them from going to the beach. The next section, the perceived causes and impacts of Florida red tides, began with a question to determine if the respondent was aware of Florida red tides. If the respondent answered no, I skipped to the final section of the survey for the demographic questions. If yes, they were asked open-ended questions to identify potential causes for red tides, as well as any effects they may have experienced.

There were additional questions concerning seafood consumption patterns, desire for management or control efforts, and a series of statements related to commonly-held notions of red tides that the respondents were asked to evaluate. The final section included demographic questions about education, occupation, age, and gender, as well as a question about sources of information.

Section 1: Place-specific Contexts

The purpose of this section was to determine where the respondents lived in reference to the beach, how often they visited the beach, what they enjoyed most about the beach, and how likely certain scenarios would prevent them from going to the beach. The majority of people I surveyed were Florida residents (73%), but there was a much more apparent contrast between residents and non-residents at Fort De Soto than at Siesta Key (Table 7.1). Of the 30 people I spoke with at Fort De Soto, 24 (80%) were Florida residents and only 6 (20%) were not. Visitors to Fort De Soto were from Canada, New York, Rhode Island, North Carolina, and Tennessee. At Siesta Key, I spoke with a total of 29 people, 19 (65.5%) of whom were Florida residents and 10 (34.5%) of whom were non-residents. Visitors to Siesta Key were from Pennsylvania, New York, Rhode Island, Georgia, Colorado, and many of the Midwestern states.

Table 7.1. Residency Status

	Fort De Soto		Siesta Key		Total	
Residency	**N**	**%**	**N**	**%**	**N**	**%**
Florida Resident	24	80.0	19	65.5	43	72.9
Non-resident	6	20.0	10	34.5	16	27.1
Total	30	100.0	29	100.0	59	100.0

Appendix A: Question 1

Florida Residents

If respondents said that they were Florida residents, the next three questions were different from those for Florida non-residents. Tables 7.2, 7.3, and 7.4 describe the responses of those individuals who stated they were Florida residents. Respondents were asked how long they have lived in Florida as an open-ended question, and the answers were grouped in categories for the following table (Table 7.2).

Table 7.2. Length of Florida Residency

Length of Residency	Fort De Soto		Siesta Key		Total	
(in years)	N	%	N	%	N	%
< 5 years	8	33.3	5	26.3	13	30.2
6 – 10	5	20.8	3	15.8	8	18.6
11 – 20	5	20.8	5	26.3	10	23.3
21 – 30	4	16.7	4	21.1	8	18.6
31 – 40	1	4.2	0	0.0	1	2.3
41 – 50	1	4.2	2	6.9	3	7.0
Total	24	100.0	19	65.5	43	100.0

Appendix A: Question 2

Most respondents from both beaches have lived in Florida for less than five years (30.2%), with slightly more from Fort De Soto (33.3%) than Siesta Key (26.3%). The distributions for the remaining categories are very similar for the two study sites, and of the total sample of Florida residents, over half have lived in Florida for more than 10 years.

Florida residents were also asked approximately how many miles away they lived from that particular beach (either Fort De Soto or Siesta Key), and their answers were placed in the appropriate category, as shown in Table 7.3. Interestingly, the vast majority of the Florida residents at Siesta Key lived within 10 miles of the beach (63.2%), and there were no respondents living within 31 to 60 miles of the beach. Fort De Soto, on the other hand, seemed to have residents living at varying distances from the beach, with about 42% within 10 to

20 miles. Overall, most Florida residents sampled (62.8%) between the two study sites live within 20 miles of the beach they were visiting the day I spoke with them.

The last question for Florida residents was an open-ended question asking how frequently they visit that particular beach (either Fort De Soto or Siesta Key). Since people could respond using any scale of frequency, I grouped their responses into the categories shown in Table 7.4. Most people surveyed visit the beach at least once a year (90.7%), but the frequency of their visits varied between the beaches. Overall, the respondents at Siesta Key seemed to visit the beach more frequently than those at Fort De Soto, with 63.1% visiting at least once per month compared to only 33.3% for Siesta Key.

Table 7.3. Distance between Beach and Residence

Distance from home	**Fort De Soto**		**Siesta Key**		**Total**	
(in miles)	**N**	**%**	**N**	**%**	**N**	**%**
< 10 miles	3	12.5	12	63.2	15	34.9
10 – 20	10	41.7	2	10.5	12	27.9
21 – 30	3	12.5	1	5.3	4	9.3
31 – 40	3	12.5	0	0.0	3	7.0
41 – 50	3	12.5	0	0.0	3	7.0
51 – 60	1	4.2	0	0.0	1	2.3
> 60 miles	1	4.2	4	21.1	5	11.6
Total	24	100.0	19	100.0	43	100.0

Appendix A: Question 3

Florida Visitors

Table 7.5 corresponds to a question asked only of Florida non-residents. The question asked what best described their reason for visiting Florida with provided responses. Of the 16 respondents, 8 (50%) stated they were visiting Florida on vacation, followed by 5 (31.3%) who said they were visiting family or friends. The distributions between the two beaches were relatively similar.

Table 7.4. Frequency of Beach Visits for Residents

Frequency of visiting beach	**Fort De Soto**		**Siesta Key**		**Total**	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
Rare – Less than once per year	2	8.3	2	10.5	4	9.3
1 to 3 visits per year	8	33.3	3	15.8	11	25.6
4 to 8 visits per year	6	25.0	2	10.5	8	18.6
1 to 3 times per month	5	20.8	7	36.8	12	27.9
Frequent – At least one visit per week	3	12.5	5	26.3	8	18.6
Total	24	100.0	19	100.0	43	100.0

Appendix A: Question 4

Both Florida residents and visitors were asked an open-ended question that solicited the top three reasons that attracted them to the beach (either Fort De Soto or Siesta Key), or what they enjoyed most about it. Responses were then categorized according to prominent themes that were grouped by three major topics. The three topics are aesthetic qualities, locational qualities, and activities. Aesthetic qualities include any mention of the natural qualities of the beach, such as the sand, sun, water, the beautiful views, and so on. Locational qualities refer to mentions of the proximity of the beach, the facilities, the crowd of people at the beach, and other characteristics unrelated to the aesthetic qualities of the beach. Finally, activities include walking on the beach, bringing a dog to the beach, volleyball, people watching, and so on.

Table 7.5. Reasons for Visiting Florida

	Fort De Soto		Siesta Key		Total	
Reason for Visiting	**N**	**%**	**N**	**%**	**N**	**%**
Vacation	3	50.0	5	50.0	8	50.0
Seasonal Residence (e.g., time-share, condo, vacation home)	1	16.7	1	10.0	2	12.5
Work-related	0	0.0	1	10.0	1	6.3
Visiting family or friends	2	33.3	3	30.0	5	31.3
Considering moving to Florida	0	0.0	0	0.0	0	0.0
Total	6	100.00	10	100.0	16	100.0

Appendix A: Question 6

Table 7.6 displays the number of times a theme was mentioned, as well as the percentage of the respondents who used that descriptor. Since respondents could provide multiple attributes about the beach, the totaled percentages do not equal 100. Aesthetic qualities were the most frequently mentioned with 91 mentions out of the total sample of 59 individuals, followed by locational qualities with 66 mentions. The majority of the individuals at Fort De Soto talked about the beautiful view or natural surroundings (40%), as well as the facilities (56.7%). Over 75% of the respondents at Siesta Key said they enjoyed the white, soft sand. Other popular features were the water and waves (26.7%) and weather-related aspects (26.7%), such as the sun or the ocean breeze.

Beach Visits

The next set of tables (Tables 7.7a – 7.7f) correspond to a question that used a scale of 1 to 5 to determine the likelihood that each of the given scenarios would prevent the respondent from visiting the beach, with 1 being the least likely and 5 being the most likely. The purpose of the each of the scenarios was to solicit a variety of responses that can be used in comparison of each other, but this will discussed in greater detail in the analysis section.

Table 7.6. Attractive Qualities of the Beach

		Fort De Soto		**Siesta Key**		**Total**	
Topics	**Themes**	**N**	**%**	**N**	**%**	**N**	**%**
Aesthetic	Beautiful view	12	40.0	5	16.7	17	28.8
	Clean beach	7	23.3	6	20.0	13	22.0
	Sand	4	13.3	23	76.7	27	45.8
	Weather	2	6.7	8	26.7	10	16.9
	Water/Waves	6	20.0	8	26.7	14	23.7
	Nice/Best beach	5	16.7	5	16.7	10	16.9
Locational	Family beach	6	20.0	4	13.3	10	16.9
	Close to home/hotel	4	13.3	6	20.0	10	16.9
	Quiet/Serene	7	23.3	5	16.7	12	20.3
	Not too crowded	8	26.7	6	20.0	14	23.7
	Facilities/Parking	17	56.7	3	10.0	20	33.9
Activities	Dog beach	5	16.7	0	0.0	5	8.5
	Sports/Exercise	1	3.3	3	10.0	4	6.8
	Shark teeth/Shells	2	6.7	0	0.0	2	3.4

Appendix A: Question 7
Note: Respondents could choose more than one category.

The first scenario was an expected tropical storm or hurricane, and the purpose of this question was to provide one extreme scenario from which to gauge other responses (Table 7.7a). There were, surprisingly, some individuals who said they would still come to the beach if there was a looming storm, most of whom said it was because they enjoyed seeing the waves. The overwhelming majority, however, said they would definitely not come to the beach (81.4%), especially those at Fort De Soto (93.3%).

Table 7.7a. Expected Tropical Storm or Hurricane Scenario

Expected tropical storm or hurricane	**Fort De Soto**		**Siesta Key**		**Total**	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
1 – Least likely	1	3.3	2	6.9	3	5.1
2	0	0.0	2	6.9	2	3.4
3	0	0.0	4	13.8	4	6.8
4	1	0.0	1	3.4	2	3.4
5 – Most likely	28	93.3	20	69.0	48	81.4
Total	30	100.0	29	100.0	59	100.0

Appendix A: Question 8a

The second scenario was rain, and most respondents (66.1%) said that it was more likely to prevent them from coming to the beach (Table 7.7b). Some respondents said they may still go to the beach if they thought it would not rain for long. Again, individuals responded similarly at the two beaches.

Table 7.7c shows the responses to the third scenario, too crowded. Responses were more diverse for this scenario, but it seems as though people either indicated that it did not stop them from coming to the beach (27.1%) or it was somewhat more likely to prevent them from coming (27.1%). There are apparent differences between the two beaches; for instance, 36.7% of respondents at Fort De Soto rated this scenario a "4" or somewhat more likely, while Siesta Key only had 17.2% respondents give the same rating. In addition, no respondents at Fort De Soto said it was the most likely ("5") to prevent them from going to the beach and yet 5 people did at Siesta Key.

Table 7.7b. Rain Scenario

Rain	Fort De Soto		Siesta Key		Total	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
1 – Least likely	1	3.3	1	3.4	2	3.4
2	3	10.0	3	10.3	6	10.2
3	9	30.0	3	10.3	12	20.3
4	7	23.3	10	34.5	17	28.8
5 – Most likely	10	33.3	12	41.4	22	37.3
Total	30	100.0	29	100.0	59	100.0

Appendix A: Question 8b

Table 7.7c. Too Crowded Scenario

Too Crowded	Fort De Soto		Siesta Key		Total	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
1 – Least likely	7	23.3	9	31.0	16	27.1
2	6	20.0	3	10.3	9	15.3
3	6	20.0	7	24.1	13	22.0
4	11	36.7	5	17.2	16	27.1
5 – Most likely	0	0.0	5	17.2	5	8.5
Total	30	100.0	29	100.0	59	100.0

Appendix A: Question 8c

The responses for the fourth scenario, cold weather, are shown in Table 7.7d. Again, responses were more divided among the 5 ratings, but most individuals said cold weather would most likely prevent them from going to the beach (28.8%).

Table 7.7d. Cold Weather Scenario

Cold Weather	Fort De Soto		Siesta Key		Total	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
1 – Least likely	7	23.3	4	13.8	11	18.6
2	4	13.3	3	10.3	7	11.9
3	6	20.0	8	27.6	14	23.7
4	3	10.0	7	24.1	10	16.9
5 – Most likely	10	33.3	7	24.1	17	28.8
Total	30	100.0	29	100.0	59	100.0

Appendix A: Question 8d

The fifth scenario was an active red tide bloom and the results are displayed in Table 7.7e. People responded more strongly to this scenario, with an overwhelming majority (80%) indicating they would definitely not come to the beach during a red tide. All surveyed individuals at Fort De Soto rated it at least a “3”, emphasizing that it depends on how severe it is, and 80% gave it the highest rating (“5”). Conversely, Siesta Key did have some people who said they would still come to the beach during a red tide if it is not too severe. Only 63% of those surveyed on Siesta Key gave a red tide the highest rating, stating that they would most likely avoid the beach.

The final scenario was dead fish on the beach, and the results are similar to those of the red tide scenario (Table 7.7f). More than half of the total surveyed respondents (54.2%) said that dead fish would most likely prevent them from going to the beach. There were more individuals at Siesta Key who seemed to be okay with going to the beach despite dead fish (20.6%), than at Fort De Soto (10%). Likewise, 70% of respondents at Fort De Soto said dead fish would most likely prevent them from visiting the beach, while only 37.9% at Siesta Key felt the same way.

Table 7.7e. Active Red Tide Bloom Scenario

Active Red Tide Bloom	**Fort De Soto**		**Siesta Key**		**Total**	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
1 – Least likely	0	0.0	1	3.7	1	1.8
2	0	0.0	3	11.1	3	5.3
3	3	10.0	2	7.4	5	8.8
4	3	10.0	4	14.8	7	12.3
5 – Most likely	24	80.0	17	63.0	41	71.9
Total	30	100.0	27	100.0	57	100.0

Appendix A: Question 8e
Note: Two individuals from the Siesta Key sample were unsure of what a red tide was and declined to answer the question and ,therefore, they were excluded from this table.

Table 7.7f. Dead Fish on Beach Scenario

Dead Fish on Beach	**Fort De Soto**		**Siesta Key**		**Total**	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
1 – Least likely	2	6.7	1	3.4	3	5.1
2	1	3.3	5	17.2	6	10.2
3	1	3.3	7	24.1	8	13.6
4	5	16.7	5	17.2	10	16.9
5 – Most likely	21	70.0	11	37.9	32	54.2
Total	30	100.0	29	100.0	59	100.0

Appendix A: Question 8f

Section 2: Perceived Causes and Impacts of Red Tides

Awareness of Red Tides

This section was designed to determine whether or not respondents are aware of Florida red tides, but also to solicit information through open-ended questions about what they believe to be the causes of red tides and how they may have been affected by them. The first question (Table 7.8) asked respondents if they had heard of Florida red tides. If they answered yes, I continued with the remaining questions of the survey, but if they answered no, I skipped to the final demographic questions of the survey.

As shown in Table 7.8, most individuals (93%) on both beaches were aware of Florida red tides to some extent. When I asked the question, some people were concerned that although they have heard of it, they were not sure if they knew enough about it to continue with the survey. I assured them that I was not looking for correct answers, but was only interested in their responses based on their opinions or what they may have heard.

Table 7.8. Respondents' Awareness of Red Tides

	Fort De Soto		Siesta Key		Total	
Heard of red tide	**N**	**%**	**N**	**%**	**N**	**%**
Yes	28	93.3	27	93.1	55	93.2
No	2	6.7	2	6.9	4	6.8
Total	30	100.0	29	100.0	59	93.2

Appendix A: Question 9

Respondents were then asked to identify any potential causes for Florida red tides, or to describe what it is, to the best of their understanding. Some respondents talked about the effects of red tides instead of causes. Those responses were grouped with the responses from the question specifically asking about effects. Table 7.9 displays the most common terms used to describe red tides and their potential causes. “Weather aspects” includes mentions of wind patterns, currents, tides, storms, and even global warming. Terms were grouped as “naturally occurring” if they mentioned that red tides were natural, cyclical, seasonal, or always in the Gulf. If respondents mentioned algae, algal blooms, microscopic plant organisms, dinoflagellates, or phytoplankton, it was categorized as “algal blooms.” The “pollution or runoff” category also includes talk about dumping, spills, fertilizer use, chemicals, and phosphate mining. “Bacteria” is its own category, but “water quality levels” includes mentions of salinity levels, warm water temperatures, and oxygen levels in water.

Table 7.9. Potential Causes for Red Tides

	Fort De Soto		Siesta Key		Total	
Descriptors	**N**	**%**	**N**	**%**	**N**	**%**
Weather aspects	1	3.3	4	13.8	5	8.5
Naturally occurring	9	30.0	2	6.9	11	18.6
Algal blooms	11	36.7	13	44.8	24	40.7
Pollution or runoff	14	46.7	9	31.0	23	39.0
Water quality levels	8	26.7	2	6.9	10	16.9
Bacteria	7	23.3	6	20.7	13	22.0
Not sure	3	10.0	6	20.7	9	15.3

Appendix A: Question 10
Note: Respondents could choose mention more than one.

Over 40% of the respondents felt that red tides are caused by algae or algal blooms, with about the same number of individuals from both beaches.

Pollution or runoff was the second most mentioned cause for the entire sample (39%), with slightly more at Fort De Soto (46.7%) than at Siesta Key (31%). There are substantially more individuals from Fort De Soto who mentioned that red tides are a natural or cyclical occurrence (30%) than at Siesta Key (6.9%). Approximately 15% of the entire sampled population stated that they are unsure about what a red tide is or what causes them, which does not include those individuals who said they have not heard of red tides from the previous question. Although not included in Table 7.9, six respondents from each beach mentioned fish kills or large amounts of dead fish on the beach instead of potential causes.

Impacts of Red Tides

The second question asked respondents if they have been affected in any way by Florida red tides or if it has prevented them from any activities or plans. Table 7.10 indicates that most individuals (67.3%) have been affected by Florida red tides in some way. There is, however, a distinct difference between the two beaches. Siesta Key has a much higher percentage of individuals reporting personal impacts with 77.8%, than does Fort De Soto with 57.1%.

Table 7.10. Respondents Affected by Red Tides

	Fort De Soto		**Siesta Key**		**Total**	
Affected by red tide	**N**	**%**	**N**	**%**	**N**	**%**
Yes	16	57.1	21	77.8	37	67.3
No	12	42.9	6	22.2	18	32.7
Total	28	100.0	27	100.0	55	100.0

Appendix A: Question 11

Upon answering yes to the question discussed above, respondents were asked to describe how they have been affected by red tides, in their own words. Most of the respondents mentioned that it prevents them from visiting the beach (45.8%), while many brought up health effects (Table 7.11). Of the mentioned health effects, the most common symptom is coughing or choking (27%), but there are substantially more mentions of coughing at Siesta Key (41%) than at Fort De Soto (13%). In fact, considerably more individuals at Siesta Key reported health symptoms from red tides than at Fort De Soto. Other mentions of health symptoms include trouble breathing, irritated eyes, irritated throat, or sneezing. Many individuals simply stated that they experience respiratory irritation in general (15.3%). There is only one mention each of headaches, intensified asthma symptoms, and discomfort, and so these are not included in Table 7.11.

There was one respondent who, when asked how she has been affected, began telling me that she had Neurotoxic Shellfish Poisoning (NSP) from eating clam linguine with her family on New Year's Eve of 2006. Her brother-in-law illegally harvested clams to serve for dinner, and she and her brother-in-law became very sick not long after eating them. She was taken to the hospital after experiencing a pins-and-needles sensation and a loss of basic motor skills. Upon hearing this information, I was asked to send my notes from the conversation to Andy Reich at the Florida Department of Health where they could investigate this unreported claim. My survey notes did not include any personal information about the respondent and therefore, I only included the gender, age group, and approximate location that the respondent mentioned. He later indicated that the person was located by searching the emergency responders' reports for that area on New Year's Eve. After further investigation, there were approximately 20 individuals from the same family who became sick with NSP after eating the clam linguine (Andy Reich, personal communication, 2007).

Table 7.11. Personal Impacts from Red Tides

		Fort De Soto		Siesta Key		Total	
Topics	**Themes**	**N**	**%**	**N**	**%**	**N**	**%**
Health Effects	Coughing or Choking	4	13.3	12	41.1	16	27.1
	Trouble breathing	1	3.3	3	10.3	4	6.8
	Irritated eyes	2	6.7	3	10.3	5	8.5
	Irritated throat	0	0.0	4	13.8	4	6.8
	Sneezing	0	0.0	3	10.3	3	5.1
	General respiratory	1	3.3	8	27.6	9	15.3
Limitations	Affected at home	1	3.3	5	17.2	6	10.2
	Avoid the beach	13	43.3	14	48.3	27	45.8
	Smell or Odor	3	10.0	3	10.3	6	10.2
	Avoid water	2	6.7	2	6.9	4	6.8
	Forced to leave beach	0	0.0	4	13.8	4	6.8
	Dead fish	2	6.7	1	3.4	3	5.1

Appendix A: Question 12
Note: Respondents could choose more than one category.

Table 7.12 describes the responses of the question asking respondents about the severity of the health impacts they typically experience during red tide blooms. The scale is from 1 to 5, with 1 being no symptoms at all and 5 being severe symptoms. Since this question was based subjectively on the opinion of the respondent and not on actual health symptoms experienced, it is considered a measure of the perception of risk associated with health impacts.

Table 7.12. Severity of Health Impacts

Health Symptoms	**Fort De Soto**		**Siesta Key**		**Total**	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
No health impacts	23	82.1	9	33.3	32	58.2
Very little health impacts	0	0.0	2	6.9	2	3.6
Moderate health impacts	1	3.6	7	25.9	8	14.5
Somewhat severe health impacts	3	10.7	5	18.5	8	14.5
Severe health impacts	1	3.6	4	14.8	5	9.1
Total	28	100.0	27	100.0	55	100.0

Appendix A: Question 13

More than half of the respondents (58.2%) reported no health symptoms from red tides, many of whom because they have never been near the beach during an active bloom. Considerably more individuals from Fort De Soto reported no health impacts (82.1%), than at Siesta Key (33.3%). In general, respondents at Siesta Key indicated a wider range of health impacts and, in fact, 59.2% of Siesta Key respondents reported experiencing moderate to severe health impacts during active blooms.

Section 3: Perceptions of Risk Surrounding Red Tides

This was the most substantial section and consisted of a wide variety of questions to determine whether people avoid certain types of seafood during red tides, the level of risk they associate with eating seafood during blooms, how concerned they are about red tides, whether they are aware of management or control efforts, and their level of agreement with a range of statements about red tides. Before determining whether the respondents avoid certain types of seafood during red tide blooms, I needed to find out if they eat seafood in general. Table 7.13, therefore, shows whether or not respondents indicated that they eat seafood.

Seafood Consumption

Only 3 (5.5%) individuals from the entire sample indicated that they do not eat any type of seafood (Table 7.13). Therefore, I did not ask those respondents any of the ensuing questions that were specific to eating seafood (Appendix A, Questions 15 – 18).

The respondents who did affirm that they eat seafood were then provided with a list of specific types of seafood and were asked to indicate whether or not they typically eat each type. The types of seafood were later grouped into finfish, crustaceans and scallops, and other bivalves. Finfish includes mahi-mahi, grouper, snapper, and tuna. The crustaceans group includes shrimp, lobsters, and crabs, but for the purposes of this study, I also included scallops in this group because the portion of scallops that most people eat is not dangerous. Finally, bivalve shellfish only includes those that are affected by red tide, such as oysters, clams, and mussels. Respondents were counted in a category if they indicated consuming at least one type of seafood within each of the previously mentioned categories.

Table 7.13. Seafood Consumption

	Fort De Soto		Siesta Key		Total	
	N	%	N	%	N	%
Yes	26	92.9	26	96.3	52	94.5
No	2	7.1	1	3.7	3	5.5
Total	28	100.0	27	100.0	55	100.0

Appendix A: Question 14

As shown in the left column heading of Table 7.14, the most commonly consumed types of seafood are finfish and crustaceans and/or scallops. About 94% of respondents at Fort De Soto consume these two types of seafood, while slightly fewer do at Siesta Key with 87.5% consuming finfish and 93.8% consuming crustaceans and/or scallops.

Table 7.14. Seafood Consumption Patterns

		Typically Consume		Avoid During Red Tide	
Beach	**Type of Seafood**	**N**	**%**	**N**	**%**
Fort De Soto	Finfish	17	94.4	1	5.6
(N = 18)	Crustaceans (& Scallops)	17	94.4	1	5.6
	Bivalves	14	77.8	2	11.1
Siesta Key	Finfish	14	87.5	0	0.0
(N = 16)	Crustaceans (& Scallops)	15	93.8	2	12.5
	Bivalves	11	68.8	3	18.8

Appendix A: Questions 15 and 16.

The right column of Table 7.14 displays the number of respondents stating that they avoid eating a particular (or all) types of seafood during an active red tide bloom. Similar to the counts for the consumption of seafood, if the respondent indicated avoiding at least one type of seafood within the category, the category was counted as a whole. Overall, we can see that not many people acknowledged avoiding seafood during a red tide bloom. There are only slight differences between the two study sites. For instance, one person at Fort De Soto said they will not eat finfish during a red tide, but no respondents at Siesta Key indicated that they avoid finfish during active blooms.

There was also a question in the survey asking if the respondent avoids eating seafood during any particular months of the year. This is important to account for other potential reasons that people may avoid eating seafood. Table 7.15 depicts the responses, and it is shown that the majority of respondents (88.5%) from both beaches do not avoid certain months. Three respondents at Fort De Soto and two at Siesta Key, however, did say that they avoid consuming some type of seafood during particular months. At Siesta Key, one person said he avoids eating all types during months without an “r”, and the other person said he only avoids raw oysters during months without an “r”. Interestingly, at Fort De Soto, one person said she avoids all types of seafood during months with an “r”, the second person said he avoids all types during summer months, and the third person avoids local oysters in summer months.

Table 7.15. Avoiding Seafood during Certain Months

	Fort De Soto		**Siesta Key**		**Total**	
Avoid Seafood	**N**	**%**	**N**	**%**	**N**	**%**
Yes	3	11.5	2	7.7	6	88.5
No	23	88.5	24	92.3	46	11.5
Total	26	100.0	26	100.0	52	100.0

Appendix A: Question 17

Regardless of whether respondents indicated that they eat seafood, they were all asked about how risky they feel eating seafood is during a red tide bloom on a scale of 1 to 5, with 1 being not at all risky and 5 being very risky. Although the majority from the entire sample (38.2%) rated it not at all risky, there are comparable differences between the two study sites' samples (Table 7.16). The largest percentage (39.3%) of respondents at Fort De Soto considered consuming seafood during a bloom very risky, while only 14.8% at Siesta Key felt the same. Conversely, 48.1% of those surveyed at Siesta Key felt there was no risk at all when eating seafood during a red tide, whereas only 28.6% of those at Fort De Soto rated it the same.

Table 7.16. Riskiness of Eating Seafood during a Red Tide

	Fort De Soto		Siesta Key		Total	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
1 – Not at all risky	8	28.6	13	48.1	21	38.2
2	4	14.3	1	3.7	5	9.1
3	2	7.1	4	14.8	6	10.9
4	3	10.7	5	18.5	8	14.5
5 – Very risky	11	39.3	4	14.8	15	27.3
Total	28	100.0	27	100.0	55	100.0

Appendix A: Question 19

Management or Control Efforts

The next question was to solicit the level of concern about Florida red tides, in general. The question was also on a scale of 1 to 5, with 1 being not at all concerned and 5 being very concerned. The purpose of this question was to set the stage for the subsequent questions concerning management or control efforts of Florida red tides. As displayed in Table 7.17, most respondents rated it at least a “3” (83.7%), indicating that most individuals felt somewhat to very concerned about red tides. Responses were distributed similarly between the two beaches.

Table 7.17. Level of Concern about Red Tides

	Fort De Soto		**Siesta Key**		**Total**	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
1 – Not at all concerned	3	10.7	1	3.7	4	7.3
2	2	7.1	3	11.1	5	9.1
3	7	25.0	9	33.3	16	29.1
4	9	32.1	5	18.5	14	25.5
5 – Very concerned	7	25.0	9	33.3	16	29.1
Total	28	100.0	27	100.0	55	100.0

Appendix A: Question 20

Respondents were asked whether or not they feel that something should be done to manage or control Florida red tides, and results are shown in the first row in Table 7.18. All respondents at Fort De Soto believe that something should be done to manage or control red tides, whereas about 88.9% of respondents at Siesta Key said the same.

When asked about whether or not respondents are aware of any existing management or control efforts, very few acknowledged anything other than current research. The bottom row of Table 7.18 illustrates that only 23.6% from the entire sample indicated that they are aware of any methods. Siesta Key has notably more respondents (37%) who mentioned some form of red tide management or control method taking place, most of which was related to Mote Marine Lab research.

Table 7.18. Management and/or Control Efforts

	Fort De Soto (N = 28)		Siesta Key (N = 27)		Total (N = 55)	
Management Questions	**N**	**%**	**N**	**%**	**N**	**%**
Believe something should be done to manage or control red tides	28	100.0	24	88.9	52	94.5
Aware of existing efforts	3	10.7	10	37.0	13	23.6

Appendix A: Questions 21 and 23.

Respondents who said that they do believe something should be done to manage or control red tides were then asked who they thought should be responsible for those efforts. I read the available options and respondents could indicate all of the categories that they felt applied. The results are shown in Table 7.19, and clearly, most people (75.9%) feel that the state should play a major role in management and/or control efforts. This pattern is evident in both samples, as is the role of the county. There are, however, slightly more people at Fort De Soto indicating that individuals (25%) and the local community or city (32%) should also be involved in efforts.

Perceptions of Red Tides

The following tables (Tables 7.20a – 7.20h) display the results of multiple statements that I read to respondents as a part of one question in the survey (see Appendix A, Question 25). I began by telling them, “the following statements may or may not be true, but I want you to tell me the level to which you agree on a scale of 1 to 5, with 1 being strong disagree and 5 strongly agree."

Table 7.19. Responsibility for Management or Control Efforts

	Fort De Soto (N = 28)		Siesta Key (N = 26)		Total (N = 54)	
Level	**N**	**%**	**N**	**%**	**N**	**%**
Individuals	7	25.0	4	15.4	11	20.4
Local community or city	9	32.1	5	19.2	14	25.9
County	11	39.3	9	34.6	20	37.0
State	22	78.6	19	73.1	41	75.9
Federal Government	10	35.7	14	53.8	24	44.4

Appendix A: Question 22

The first statement corresponded to whether or not Florida red tides are naturally occurring. As shown in Table 7.20a, the highest percentage of people (43.6%) strongly agrees that they are naturally occurring. There is not much difference between the two sample study sites. The second most common answer is a neutral or unsure position, and there is slightly more of this response at Fort De Soto (32.1%) than at Siesta Key (22.2%).

Table 7.20a. Red Tides are Naturally Occurring

	Fort De Soto		Siesta Key		Total	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
1 – Strongly Disagree	2	7.1	5	18.5	7	12.7
2 – Somewhat Disagree	0	0.0	0	0.0	0	0.0
3 – Neutral/Not Sure	9	32.1	6	22.2	15	27.3
4 – Somewhat Agree	5	17.9	4	14.8	9	16.4
5 – Strongly Agree	12	42.9	12	44.4	24	43.6
Total	28	100.0	27	100.0	55	100.0

Appendix A: Question 25a

The second statement referred to whether or not red tides are occurring more frequently, and the responses are displayed in Table 7.20b. Again, the two most common responses are neutral or not sure (38.2%) and strongly agree (36.4%). There are a few more respondents unsure of this statement at Siesta Key (41.4%) than at Fort De Soto (32.1%), but the responses between the two beaches are mostly similar.

Table 7.20b. Red Tides Occurring More Frequently

	Fort De Soto		Siesta Key		Total	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
1 – Strongly Disagree	3	10.7	1	3.4	4	7.3
2 – Somewhat Disagree	0	0.0	0	0.0	0	0.0
3 – Neutral/Not Sure	9	32.1	12	41.4	21	38.2
4 – Somewhat Agree	6	21.4	4	13.8	10	18.2
5 – Strongly Agree	10	35.7	10	34.5	20	36.4
Total	28	100.0	27	100.0	55	100.0

Appendix A: Question 25b

Table 7.20c refers to the statement that red tide blooms are lasting longer and are more severe. Responses are remarkably similar to the previous two statements. As in the previous two tables, the majority of responses is either in agreement with the statement or unsure (or neutral).

The fourth line stated that Florida red tides are directly affected by urban growth. This statement invoked a much higher number of unsure responses from both Fort De Soto (50%) and Siesta Key (40.7%) (Table 7.20d). More individuals from Siesta Key (22.2%) indicated that they strongly agree with this statement than at Fort De Soto (7.1%).

Table 7.20c. Blooms Lasting Longer and More Severe

	Fort De Soto		Siesta Key		Total	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
1 – Strongly Disagree	3	10.7	1	3.7	4	7.3
2 – Somewhat Disagree	1	3.6	0	0.0	1	1.8
3 – Neutral/Not Sure	7	25.0	13	48.1	20	36.4
4 – Somewhat Agree	7	25.0	4	14.8	11	20.0
5 – Strongly Agree	10	35.7	9	33.3	19	34.5
Total	28	100.0	27	100.0	55	100.0

Appendix A: Question 25c

Table 7.20d. Red Tides Directly Affected by Urban Growth

	Fort De Soto		Siesta Key		Total	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
1 – Strongly Disagree	4	14.3	3	11.1	7	12.7
2 – Somewhat Disagree	2	7.1	2	7.4	4	7.3
3 – Neutral/Not Sure	14	50.0	11	40.7	25	45.5
4 – Somewhat Agree	6	21.4	5	18.5	11	20.0
5 – Strongly Agree	2	7.1	6	22.2	8	14.5
Total	28	100.0	27	100.0	55	100.0

Appendix A: Question 25d

The next statement claimed that any potential control methods should be used to prevent red tides. Results of the responses are depicted in Table 7.20e. Approximately 61% of the respondents from Fort De Soto and 52% from Siesta Key indicated that they either somewhat or strongly agree with this statement, most of which strongly agree (40%). There were, however, many people who felt unsure about the wording of this statement or disagreed with it altogether.

The next statement took the previous statement a step further and said that control methods should be used even if the impacts of doing so are unknown. As can be expected with the stronger wording, most respondents (45.5%) strongly disagree with this statement (Table 7.20f). The responses are similarly distributed between the two beaches, except that there are five respondents who strongly agree with the statement from Fort De Soto and none from Siesta Key.

Table 7.20e. Any Potential Control Methods Should Be Used

	Fort De Soto		Siesta Key		Total	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
1 – Strongly Disagree	3	10.7	1	3.7	4	7.3
2 – Somewhat Disagree	3	10.7	5	18.5	8	14.5
3 – Neutral/Not Sure	5	17.9	7	25.9	12	21.8
4 – Somewhat Agree	6	21.4	3	11.1	9	16.4
5 – Strongly Agree	11	39.3	11	40.7	22	40.0
Total	28	100.0	27	100.0	55	100.0

Appendix A: Question 25e

Table 7.20f. Control Methods with Unknown Impacts

	Fort De Soto		Siesta Key		Total	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
1 – Strongly Disagree	12	42.9	13	48.1	25	45.5
2 – Somewhat Disagree	5	17.9	4	14.8	9	16.4
3 – Neutral/Not Sure	5	17.9	7	25.9	12	21.8
4 – Somewhat Agree	1	3.6	3	11.1	4	7.3
5 – Strongly Agree	5	17.9	0	0.0	5	9.1
Total	28	100.0	27	100.0	55	100.0

Appendix A: Question 25f

The next statement referred to whether there should be stricter regulations to prevent coastal runoff and pollution. The vast majority of the total respondents (81.8%) strongly agrees with this statement, and only one person from Fort De Soto disagrees at all (Table 7.20g).

Table 7.20g. Coastal Runoff and Pollution Regulations

	Fort De Soto		Siesta Key		Total	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
1 – Strongly Disagree	1	3.6	0	0.0	1	1.8
2 – Somewhat Disagree	0	0.0	0	0.0	0	0.0
3 – Neutral/Not Sure	0	0.0	2	7.4	2	3.6
4 – Somewhat Agree	2	7.1	5	18.5	7	12.7
5 – Strongly Agree	25	89.3	20	74.1	45	81.8
Total	28	100.0	27	100.0	55	100.0

Appendix A: Question 25g

The final statement claimed that more research should be done before doing anything. As shown in Table 7.20h, 85.5% of respondents from the entire sample indicated that they either somewhat or strongly agree with this statement. No respondents from Siesta Key disagreed in any way with this statement, but there were three individuals from Fort De Soto that either somewhat or strongly disagreed. Those individuals emphasized that they do not feel that there is time to wait for more research before doing anything more about red tides.

Table 7.20h. More Research before Doing Anything

	Fort De Soto		Siesta Key		Total	
Scale	**N**	**%**	**N**	**%**	**N**	**%**
1 – Strongly Disagree	2	7.1	0	0.0	2	3.6
2 – Somewhat Disagree	1	3.6	0	0.0	1	1.8
3 – Neutral/Not Sure	2	7.1	3	11.1	5	9.1
4 – Somewhat Agree	6	21.4	3	11.1	9	16.4
5 – Strongly Agree	17	60.7	21	77.8	38	69.1
Total	28	100.0	27	100.0	55	100.0

Appendix A: Question 25h

Section 4: Information Sources and Demographics

Sources of Information

This question was asked to all respondents immediately before the demographic questions, whether or not they were aware of red tides. I asked survey participants what their primary source is for beach-related news or conditions and then read the categories, allowing them to choose more than one if they so desired. Table 7.21 shows the results, which indicates that TV or radio is the most common source of information for most respondents (66.1%). The second most common source is newspapers (42.4%), and the third most common is the internet (32.2%).

When people indicated newspapers as a source of information, I asked them which newspaper they typically read. The most commonly read newspapers are the *Sarasota Herald-Tribune* for Siesta Key respondents and the

St. Petersburg Times for Fort De Soto respondents. I used these two newspapers for the newspaper content analysis, as discussed in Chapter Nine.

Table 7.21. Sources of Information

	Fort De Soto (N = 30)		Siesta Key (N = 29)		Total (N = 59)	
Source of Information	**N**	**%**	**N**	**%**	**N**	**%**
TV or Radio	19	63.3	20	69.0	39	66.1
Newspapers	12	40.0	13	44.8	25	42.4
Internet	12	40.0	7	24.1	19	32.2
Friends or Family	8	26.7	8	27.6	16	27.1
Local Sources	3	10.0	1	3.4	4	6.8
State or Federal Agencies	1	3.3	1	3.4	2	3.4
Other (e.g., lifeguards)	5	16.7	1	3.4	6	10.2

Appendix A: Question 26
Note: Respondents could choose more than one category.

Demographics

This section consisted of the final four questions of the survey and included questions concerning the education level, occupation, age, and gender of the respondents. There are significantly more female respondents than males, with 36 (61%) females and 23 (39%) males within the entire sample of 59 (Table 7.22). Fort De Soto has a higher female to male respondent ratio than Siesta Key, with 63.3% of female respondents at Fort De Soto and 58.6% at Siesta Key. The Census Bureau reports a slightly higher percentage of females for both Pinellas and Sarasota Counties, but of a lesser degree at about 52% of females for both counties.

Table 7.22. Gender of Respondents

	Fort De Soto		Siesta Key		Total	
Gender	**N**	**%**	**N**	**%**	**N**	**%**
Male	11	36.7	12	41.4	23	39.0
Female	19	63.3	17	58.6	36	61.0
Total	30	100.0	29	100.0	59	100.0

Appendix A: Question 30

Table 7.23 includes the ages of respondents according to the same categories that were used in the survey. The two most common age groups for the entire sample are 26 to 35 years (22%) and 46 to 55 years (32.2%). Interestingly, there are very few respondents in the 18 to 25 years age category and there is only one individual above the age of 76. Fort De Soto has a much higher percentage of respondents in the age group of 26 to 35 years with a total of 10 (33.3%) respondents out of 30. Conversely, Siesta Key has slightly more respondents within the 66 to 75 years age group with a total of 3 (10.3%) while Fort De Soto does not have any respondents in that age category.

Table 7.23. Age of Respondents

	Fort De Soto		Siesta Key		Total	
Age	**N**	**%**	**N**	**%**	**N**	**%**
18 – 25	2	6.7	0	0.0	2	3.4
26 – 35	10	33.3	3	10.3	13	22.0
36 – 45	4	13.3	5	17.2	9	15.3
46 – 55	7	23.3	12	41.4	19	32.2
56 – 65	6	20.0	6	20.7	12	20.3
66 – 75	0	0.0	3	10.3	3	5.1
76 +	1	3.3	0	0.0	1	1.7
Total	30	100.0	29	100.0	59	100.0

Appendix A: Question 29

The level of education and occupational categories are shown in Tables 7.24 and 7.25, respectively. Respondents were asked to identify the highest level of schooling that they have completed according to the categories. The respondents were asked an open-ended question about their occupation, in broad terms, and their responses were categorized according to the 2000 Standard Occupational Classification System by the Department of Labor. The majority of the respondents (37.3%) reported having a bachelor's degree or higher and all 59 individuals have at least a high school diploma or equivalent (Table 7.24). The two study sites have a similar distribution of educational attainment, but Siesta Key has a slightly higher percentage of individuals with a bachelor's degree, at 44.8%, compared to the 30% at Fort De Soto.

Table 7.24. Education Level of Respondents

	Fort De Soto		Siesta Key		Total	
Highest Level of Schooling	**N**	**%**	**N**	**%**	**N**	**%**
High School Diploma or Equivalent	4	13.3	5	17.2	9	15.3
Some College	7	23.3	6	20.7	13	22.0
Associate's or Technical Degree	4	13.3	2	6.9	6	10.2
Bachelor's Degree	9	30.0	13	44.8	22	37.3
Graduate or Professional School Degree	6	20.0	3	10.3	9	15.3
Total	30	100.0	29	100.0	59	100.0

Appendix A: Question 27

Although there are fairly even numbers of respondents within all of the occupational categories, there are a couple of industries that stand out (Table 7.25). The highest number of respondents reported having a management-related occupation (15.3%), and the second most common category is sales and related occupations (10.5%).

Table 7.25. Occupational Categories of Respondents

	Fort De Soto		Siesta Key		Total	
Occupational Category	**N**	**%**	**N**	**%**	**N**	**%**
Management	4	13.3	5	17.2	9	15.3
Business & Financial Operations	3	10.0	2	6.9	5	8.5
Computer & Mathematical	0	0.0	1	3.4	1	1.7
Architecture & Engineering	1	3.3	2	6.9	3	5.1
Life, Physical, & Social Science	1	3.3	0	0.0	1	1.7
Community & Social Service	1	3.3	0	0.0	1	1.7
Legal	1	3.3	1	3.4	2	3.4
Education, Training, & Library	4	13.3	1	3.4	5	8.5
Healthcare Practitioners & Technical	3	10.0	2	6.9	5	8.5
Healthcare Support	1	3.3	3	10.3	4	6.8
Protective Service	1	3.3	0	0.0	1	1.7
Personal Care & Service	0	0.0	1	3.4	1	1.7
Sales & Related	2	6.7	4	13.8	6	10.2
Office & Administrative Support	3	10.0	2	6.9	5	8.5
Construction & Extraction	3	10.0	0	0.0	3	5.1
Installation, Maintenance, & Repair	0	0.0	1	3.4	1	1.7
Transportation & Material Moving	1	3.3	2	6.9	3	5.1
Retired or Not Employed	1	3.3	2	6.9	3	5.1
Total	30	100.0	29	100.0	59	100.0

Appendix A: Question 28
Note: Occupational Categories are based on the 2000 Standard Occupational Classification System (US Department of Labor).

The aforementioned descriptive analysis provides interesting information about the respondents at the two beaches and how they responded to the various survey questions. A more in-depth analysis, however, is required to test the relationships discussed in the hypotheses of Chapter Four. The following chapter (Chapter Eight) provides a statistical base for analyzing the hypothesized relationships, as well as supplemental qualitative information from the surveys, interviews, and the newspaper analysis.

Chapter Eight: Data Analysis and Discussion

Introduction

While the descriptive statistics provide a foundation from which to understand the sampled population, a more in-depth analysis is required to address the research questions and accompanying hypotheses discussed in Chapter Four. Several non-parametric statistical tests are used, depending on the relationship being analyzed. Non-parametric statistical methods were chosen because the overall sample size is not large enough to satisfy the underlying assumptions of parametric statistical tests and because most of the data are either nominal or ordinal.

Contingency Table Analysis was used with categorical or dichotomous variables to test for the homogeneity of the two sample distributions being compared. The Spearman's rho (or Spearman's rank correlation) was used to test potential monotonic relationships between variables. Finally, the Wilcoxon rank sum test was used to determine whether two independent groups had the same distribution of responses. The results and discussion are organized according to three of the four research questions and the posed hypotheses from Chapter Four. In addition, the summary and further discussion at the end of each section integrates the data from the semi-structured interviews. The fourth research question, related to the newspaper content analysis, is discussed in Chapter Nine.

Perceptions of Risk and Social Factors

The purpose of the first research question was to analyze the public's perception of risk concerning Florida red tides and to determine how perceptions vary between different social groups. Hypotheses were made in Chapter Four concerning an individual's awareness and experience, gender, level of education, occupation, and age, as they relate to varying perceptions of risk.

Awareness and Experience

Individuals less cognizant of red tides were hypothesized to perceive risk differently from those more familiar with red tides. Specifically, individuals who accurately described some aspect of Florida red tides were expected to attribute less risk to the effects, such as the risk of eating seafood. Survey respondents were asked in an open-ended question to describe the potential causes for red tides or to simply state what they thought comprises a red tide. I took their responses and categorized them into causes and effects. The effects mentioned were ignored for this part of the analysis, and were instead grouped with the responses from the next question specifically asking about red tide effects.

The terms used by respondents were kept unchanged and were categorized as either "familiar" or "unsure." Respondents were classified as "familiar" if they mentioned at least one quality about Florida red tide that is either factual or agreed upon by scientists. This included such terms as: algae, algal bloom, plankton, dinoflagellate, kills fish or sea life, microscopic plant organism, or naturally occurring. Those classified as "unsure" included individuals who mentioned they were unsure or mentioned other qualities not directly linked to red tides. Some of these terms included: pollution, runoff, phosphate mining, bacteria, chemicals, jellyfish, or warm water.

Table 8.1 indicates that individuals considered more familiar with red tides do not respond significantly differently about the severity of their health symptoms from those less cognizant. The Wilcoxon rank sum test (*W*) was used for each of the one-tailed hypotheses tests. Familiar individuals rated the risk of eating seafood during a bloom significantly lower than unsure individuals at the 0.01 level. The overall level of concern does not differ significantly between the two groups. Therefore, one aspect of the hypothesis is supported, which is that people who are more aware of red tide characteristics are more likely to understand the actual risk of eating seafood during a bloom. To reiterate, uncertainty about the characteristics of red tides may lead to uncertainty about the safety of consuming seafood during a bloom, resulting in perceptions of elevated risk.

Table 8.1. Comparisons of Familiarity and Risk Perceptions

Risk Questions	Mean Score Familiar	Mean Score Unsure	*W*	p-value
Severity of health symptoms	2.31	1.92	675.0	0.16
Risk of eating seafood during bloom	2.28	3.46	668.0	0.01***
Level of concern	3.41	3.81	761.0	0.19

*** Significant at the 0.01 level.
Note: Scores were based on a 1 to 5 scale.

Table 8.2 shows the results of both familiar and unsure respondents when asked about the opinion statements related to red tides and management strategies. A two-tailed test for difference revealed there were no significant differences between the two groups. This suggests that although many individuals are unsure about red tides, they still respond similarly to red tide characteristics as those who describe red tides more accurately. Perhaps those individuals did not feel confident enough with their knowledge to respond to the open-ended question about red tides, but did have an opinion about some of its qualities or potential management strategies.

Table 8.2. Comparisons of Familiarity and Opinion Statements

Statements Related to Red Tides	Mean Score Familiar	Mean Score Unsure	*W*	p-value
Naturally Occurring	3.86	3.69	663.5	0.25
Occurring more frequently	3.83	3.69	701.5	0.64
Lasting longer & more severe	3.83	3.62	683.0	0.43
Affected by urban growth	3.10	3.23	790.5	0.70
Any control method	3.62	3.73	808.0	0.94
Control methods with unknown impacts	2.07	2.31	759.0	0.34
Stricter runoff & pollution regulations	4.76	4.69	722.0	0.88
More research before anything	4.48	4.42	725.5	0.96

Note: Scores were based on a 1 to 5 scale.

In addition to familiarity with red tides, it was hypothesized that individuals who reported being affected by Florida red tides would also report a higher level of concern about red tides. Individuals who answered yes to the question asking if they have ever been affected by red tides (see Appendix A, Question 11) were classified as “affected,” while those who answered no were classified as “unaffected.”

As shown in Table 8.3, there are significant differences between affected and unaffected individuals, using one-tailed tests. Not surprisingly, those who reported being affected also rated the severity of health symptoms as much higher. As indicated by the mean score of 1.00 for unsure individuals, most who did experience health symptoms also answered yes to the question about whether they had been affected by red tides. Interestingly, affected individuals rated the risk of eating seafood during red tides as less risky than those who were not affected by red tides. This could be because individuals who reported being affected by red tides may also be more likely to seek out information about the potential health impacts of red tides, leading them to more accurate information concerning the safety of seafood consumption. As hypothesized, affected individuals did indicate that they were more concerned about red tides than those unaffected. There is, however, only a slight difference in mean rankings which is significant at the 0.10 level.

Table 8.3. Comparisons of Experience and Risk Perceptions

Risk Questions	**Mean Score Affected**	**Mean Score Unaffected**	***W***	**p-value**
Severity of health symptoms	2.68	1.00	297.0	0.00***
Risk of eating seafood during bloom	2.62	3.28	962.0	0.08*
Level of concern	3.78	3.22	424.5	0.07*

* Significant at the 0.10 level.
*** Significant at the 0.01 level.
Note: Scores were based on a 1 to 5 scale.

Two-tailed tests for differences between the two groups revealed few significant differences between the responses of those affected and unaffected to the opinion statements about red tides. Significant at the 0.05 level, individuals who reported being affected by red tides more strongly agreed with the statements that red tides are occurring more frequently and are lasting longer and are more severe (Table 8.4). Perhaps it is because of the increased experience of affected individuals that they feel red tides are lasting longer, becoming more severe, and occurring more frequently. In addition, there is a somewhat weaker significant difference (0.10 level) between the two groups concerning the use of control methods with unknown impacts. Affected respondents more often disagreed with this statement than those who have never experienced any effects from red tides.

Table 8.4. Comparisons of Experience and Opinion Statements

Statements Related to Red Tides	Mean Score Affected	Mean Score Unaffected	*W*	p-value
Naturally Occurring	3.81	3.72	466.0	0.47
Occurring more frequently	4.03	3.22	386.0	0.03**
Lasting longer & more severe	3.97	3.22	375.5	0.02**
Affected by urban growth	3.05	3.39	983.5	0.32
Any control method	3.51	4.00	982.0	0.31
Control methods with unknown impacts	2.00	2.56	946.5	0.09*
Stricter runoff & pollution regulations	4.73	4.72	464.0	0.29
More research before anything	4.57	4.22	431.0	0.11

* Significant at the 0.10 level.
** Significant at the 0.05 level.
Note: Scores were based on a 1 to 5 scale.

Gender

It was hypothesized in Chapter Four that women and men not only perceive risks differently, but also that women attribute greater risk to the effects of red tides, such as the dangers of eating seafood and the health impacts. The Wilcoxon rank sum test (*W*) was used to test for differences between the responses of men and women relative to the questions targeting perceptions of risk. Table 8.5 displays the results from the question asking respondents about the likelihood that each scenario would prevent them from visiting the beach. A two-tailed test for difference revealed no significant differences in the responses of men and women. Interestingly, both men and women indicated that an active red tide bloom is just as likely, if not more, to prevent them from visiting the beach as an impending tropical storm or hurricane.

Table 8.5. Comparisons of Gender and Beach Visits

Scenario	Mean Score Men	Mean Score Women	*W*	p-value
Expected tropical storm or hurricane	4.61	4.47	679.5	0.81
Rain	4.04	3.75	1017.0	0.31
Too crowded	2.96	2.61	1024.0	0.37
Cold weather	3.43	3.14	1041.0	0.53
Active red tide blooms	4.39	4.53	649.0	0.71
Dead fish on beach	4.30	3.89	1015.0	0.27

Note: Scores were based on a 1 to 5 scale.

Table 8.6 displays the results of the one-tailed tests, which tested the hypothesis that women perceive greater risk associated with the effects of red tides. The results indicate that women and men do not attribute different levels of risk to the danger of eating seafood during a red tide bloom or the overall level of concern about red tides. There is some difference, however, in the rated severity of health symptoms between men and women. Significant at the 0.10 level, women rated the severity of their health symptoms slightly higher than men. This is consistent with the stated hypothesis that women attribute greater risk to the health impacts of red tides.

Table 8.6. Comparisons of Gender and Risk Perceptions

Risk Questions	Mean Score Men	Mean Score Women	*W*	p-value
Severity of health symptoms	1.78	2.38	573.0	0.09*
Risk of eating seafood during bloom	2.74	2.91	627.5	0.38
Level of concern	3.48	3.69	585.5	0.15

* Significant at the 0.10 level.
Note: Scores were based on a 1 to 5 scale.

Table 8.7 displays the results of two-tailed tests used to test for differences between the responses of men and women to several statements about red tides. There is no significant difference between women and men for most of the statements, including those related to the nature of red tides and the potential for control methods. There is a significant difference at the 0.01 level between responses of men and women concerning whether or not more research should be done before doing anything. Women seem to agree more strongly with this statement than men, suggesting that men may be less patient in waiting for more research before something is done about red tides.

Table 8.7. Comparisons of Gender and Opinion Statements

Statements Related to Red Tides	Mean Score Men	Mean Score Women	*W*	p-value
Naturally Occurring	3.91	3.69	872.0	0.66
Occurring more frequently	3.87	3.69	853.0	0.44
Lasting longer & more severe	3.48	3.91	578.0	0.24
Affected by urban growth	3.39	3.00	817.0	0.15
Any control method	3.83	3.56	858.0	0.50
Control methods with unknown impacts	2.04	2.28	597.0	0.40
Stricter runoff & pollution regulations	4.57	4.84	592.5	0.19
More research before anything	4.09	4.72	524.5	0.01***

*** Significant at the 0.01 level.
Note: Scores were based on a 1 to 5 scale.

Age

It was hypothesized that older individuals would attribute higher risk to the effects of red tides, particularly to the health effects. The Spearman's rho (r_s) test was used to determine if an increase in age would lead to an increase in the rating of each risk. Each of the age categories provided in the survey (see Appendix A, Question 29) was given a rank code, with 1 given to the youngest group (18 – 25) and 7 to the oldest group (75 and older). The highest rating for each of the questions was a 5, which was associated with greater risk, greater concern, or strong agreement. If the Spearman's rho (r_s) value is close to +1, it indicates a positive relationship and if it is closer to -1, it suggests a negative relationship between the two variables.

Table 8.8 shows the results from the question regarding the likelihood each scenario would prevent individuals from visiting the beach. A two-tailed test revealed that older individuals are more likely to avoid the beach when it is raining than younger individuals. It appears that younger individuals are more likely to avoid the beach when there are dead fish, as indicated by a weak negative correlation (-0.244) which is significant at the 0.10 level. There is no significant relationship between age and the likelihood of a red tide bloom preventing individuals from visiting the beach.

Table 8.8. Comparisons of Age and Beach Visits

Scenario	r_s	p-value
Expected tropical storm or hurricane	-0.124	0.35
Rain	0.342	0.01***
Too crowded	-0.043	0.75
Cold weather	0.033	0.81
Active red tide blooms	-0.040	0.77
Dead fish on beach	-0.224	0.09*

* Significant at the 0.10 level.
*** Significant at the 0.01 level.

Table 8.9 indicates that the reported severity of health impacts increases with age, as hypothesized. This was a one-tailed test, and the Spearman's rho value was 0.405 which indicates a moderate positive correlation significant at the 0.01 level. The reported risk of eating seafood during a bloom and the overall level of concern, however, are not significantly correlated with age.

When asked about opinions regarding statements about red tides and management strategies, there was no significant correlation between age and response (Table 8.10). This indicates that age does not play a large role in how individuals feel about the nature of red tides or the potential for control or management efforts.

Table 8.9. Comparisons of Age and Risk Perceptions

Risk Questions	r_s	p-value
Severity of health symptoms	0.405	0.00***
Risk of eating seafood during bloom	-0.059	0.34
Level of concern	0.130	0.17

*** Significant at the 0.01 level

Table 8.10. Comparisons of Age and Opinion Statements

Statements Related to Red Tides	r_s	p-value
Naturally Occurring	0.004	0.98
Occurring more frequently	-0.014	0.92
Lasting longer & more severe	0.028	0.84
Affected by urban growth	-0.013	0.93
Any control method	0.118	0.39
Control methods with unknown impacts	-0.040	0.78
Stricter runoff & pollution regulations	0.191	0.16
More research before anything	0.177	0.20

Education

Similar to the age variable, Spearman's rho was used to test for monotonic relationships between individuals' education level and their responses (Table 8.11). The highest rating of risk was a 5 and was associated with higher levels of risk or concern. Levels of education were also assigned rank values, with 1 being up to 12th grade with no diploma and 6 having a graduate or professional school degree.

As shown in Table 8.11, individuals with higher levels of education are more likely to avoid the beach when it is too crowded. Those with lower levels of education are less likely to avoid the beach during a tropical storm or hurricane. Regarding the two scenarios with active red tides and dead fish on the beach, there is no significant correlation between a person's level of education and the likelihood it would prevent him or her from visiting the beach.

Table 8.11. Comparisons of Education and Beach Visits

Scenario	r_s	**p-value**
Expected tropical storm or hurricane	-0.226	0.09*
Rain	0.134	0.31
Too crowded	0.299	0.02**
Cold weather	0.183	0.17
Active red tide blooms	-0.095	0.48
Dead fish on beach	-0.007	0.96

* Significant at the 0.10 level.
** Significant at the 0.05 level.

It was hypothesized that individuals with higher levels of education would attribute less risk to health impacts and seafood consumption, and would be less concerned about red tides. There is, however, no monotonic relationship between individuals' education levels and their perceived risk, as shown in Table 8.12. It appears that increased education does not lead to perceptions of decreased risk related to red tides.

Table 8.12. Comparisons of Education and Risk Perceptions

Risk Questions	r_s	p-value
Severity of health symptoms	0.044	0.37
Risk of eating seafood during bloom	-0.055	0.35
Level of concern	0.027	0.42

Table 8.13 indicates only one significant relationship between education and the statements related to red tides. Individuals with higher levels of education tend to agree more strongly with the statement that red tides are lasting longer and are more severe, which is significant at the 0.10 level. Overall, a person's level of education does not appear to play a significant role in his or her opinions regarding the occurrence of red tides and the potential for management or control efforts.

Table 8.13. Comparisons of Education and Opinion Statements

Statements Related to Red Tides	r_s	p-value
Naturally Occurring	-0.130	0.34
Occurring more frequently	0.148	0.28
Lasting longer & more severe	0.254	0.06*
Affected by urban growth	0.187	0.17
Any control method	-0.007	0.96
Control methods with unknown impacts	-0.178	0.19
Stricter runoff & pollution regulations	0.076	0.58
More research before anything	-0.196	0.15

* Significant at the 0.10 level.

Occupation

The purpose of this variable was to determine if individuals working in certain industries are more likely to attribute greater or less risk to the effects of red tides than others. Since the question was open-ended, people could respond how they preferred which led to some responses being too general. For instance, many of the respondents stated that they worked in management, but did not specify the type of industry. The responses were categorized according to the 2000 Standard Occupational Classification System in order to provide some organization to the list of occupations. There were only a few categories with more than three or four respondents and so it was difficult to make distinctions between different occupations (see Table 7.25).

Given the circumstances, I chose to only test a hypothesis with health-related occupations. This includes healthcare professionals and technical occupations, as well as healthcare support. The hypothesis, therefore, states that individuals employed in health-related occupations are more likely to attribute greater risk to the effects of red tides.

Table 8.14 displays the results of one-tailed Wilcoxon rank sum tests that tested for differences between individuals employed in health-related industries with all other individuals. Individuals in health occupations rated each of the risk questions significantly higher than those not employed in health industries. The rated severity of health symptoms is significant at the 0.05 level, as is the level of concern about red tides. The risk of eating seafood during a bloom was rated as a much greater risk by those in health occupations, which is significant at the

0.01 level. It should be noted, however, that there only 8 out of 55 individuals that reported working in health industries. Nevertheless, the significance of the differences should be noted for future analyses.

Table 8.14. Comparison of Health Occupations and Risk Perceptions

Risk Questions	Mean Score Health	Mean Score Others	*W*	p-value
Severity of health symptoms	3.13	1.96	1246.5	0.03**
Risk of eating seafood during bloom	4.13	2.62	1223.0	0.01***
Level of concern	4.25	3.49	1235.0	0.02**

** Significant at the 0.05 level.
*** Significant at the 0.01 level.

Summary and Further Discussion

Results from testing the first set of hypotheses are highlighted below:

- Individuals who are more familiar with Florida red tides and its causes find eating seafood during a bloom less risky than those who are not able to correctly identify red tide characteristics or causes.
- Although individuals who have greater experience with the effects of red tides are more concerned about red tides in general, they consider eating seafood during a bloom less risky than those with no experience with effects.
- Individuals with more experience with red tide effects tend to agree more strongly that red tides are occurring more often, lasting longer, and are more severe than those with no experience with effects.

- Women and older individuals tend to rate the health symptoms experienced during a bloom as more severe than men and younger individuals.
- Women more often agree that more research should be accomplished before doing anything about red tides than men.
- Individuals in health-related industries attribute higher risk to health symptoms during a bloom, the danger of eating seafood during red tide, and the overall level of concern about red tides.

It is apparent that there is some relationship between the level of uncertainty and perceptions of risk, which is exemplified by individuals who were unable to accurately describe some aspect of red tide also attributing greater risk to eating seafood during a bloom. This was introduced by Slovic (1973) who determined that familiarity is a key factor in risk perception, and that higher levels of uncertainty lead to higher risk perceptions. This suggests that a person's uncertainty concerning event characteristics could lead to amplification of associated risk, in this case the risk of eating seafood during a red tide. By amplifying the risk of eating seafood, individuals could potentially pass this message on to other unfamiliar individuals, the resulting behavior of which could contribute to the "halo effect." This one indicator is not enough to conclude whether an individual is uncertain, but additional indicators are discussed in later sections.

It seems as though direct experience with the impacts of red tides causes higher levels of concern for individuals, which can be expected if those impacts include health effects. Increased or continuous experience with the effects may also lead individuals to believe that red tides are occurring more often, becoming more severe, and lasting longer. Individuals who have experienced impacts may be more likely to seek out information concerning red tides, especially if they experienced health effects that they were concerned about. Perhaps by seeking more information, individuals would also come across messages concerning the risk of eating seafood during a bloom. For instance, individuals throughout Florida are encouraged to call the Marine and Fresh Water Toxin Disease Reporting Hotline when they experience health symptoms. Upon calling, they are directed to an automated message that provides additional information about red tides and all associated health risks.

The finding that women attribute higher risk to health effects is consistent with the theory that women and men can have different levels of concern over the same risks, as proposed by Gustafson (1998). As an example, two of the male interviewees with whom I spoke said that they would still come to the beach during a bloom, but would definitely not bring their family or their dog. Both interviewees were accompanied by a woman, both of whom said they would absolutely avoid the beach during a bloom because it can be unbearable. From this, women are shown to be potential amplifiers of risk, especially related to the health effects. However, elevated concerns about health effects may be more closely related to whether the person is facing the risk alone or while caring for others (e.g., children). Also interesting, men seem more impatient with waiting for more research before doing anything about red tides. One male interviewee stated, "a good plan today is better than a perfect plan tomorrow."

The rated health symptoms during a bloom increased with older ages, which correspond with research that shows that elderly people have intensified perceptions of risk because of increased health concerns (Tobin, 2005). I spoke with a female interviewee who worked as a public housing coordinator at a high rise apartment complex for elderly people located close to the beach. She said that during red tides, the elderly residents, most of whom have chronic illnesses or other health issues, typically complain about respiratory irritation because the wind carries the toxins through their often open windows. The residents, therefore, are now notified of the presence of a red tide bloom and provided with masks to filter the aerosolized toxin particulates.

The finding that individuals employed in healthcare professions consider ride tide effects riskier than others suggests that perhaps there is some bias stemming from the work they do. For instance, one respondent who was an emergency room registered nurse in Tennessee informed me that she has dealt with many people coming back from Florida who complained of itchy red skin from red tides, which is not typically attributed to this type of algae bloom. Although she has never experienced any health effects, she felt very concerned about red tides in general and attributed greater risk to eating seafood during a bloom. In addition, by associating itchy red skin with Florida red tide, she may amplify the health risk in the form of a warning to patients or other individuals visiting Florida. Whether it is due to witnessing the health effects from blooms first-hand or the overall concern for the health and well-being of others, it is apparent that there is some relationship between those employed in health-related industries and their perceptions of risk.

Another example of the potential for occupation to influence perceptions is from the conversation I had with one interviewee. The person I spoke with said he used to be a charter boat captain, but had to change careers because his business suffered due to the regular occurrence of red tides and hurricanes. He mentioned that during blooms, there was an overall lack of customers and resulting loss of revenue. When asked to describe red tide, he talked about how it has been accelerated by human activity and fertilizer runoff. Although he does not eat crustaceans and shellfish, he considers them to be very dangerous to eat during a red tide because they cannot swim to cleaner waters like fish. It is apparent from this conversation that this person has been strongly influenced by the type of work he used to do when it comes to perceptions of red tides.

It is clear from the results of both the quantitative and qualitative analysis that how individuals perceive risk is influenced by social characteristics. The categories by which the individuals are grouped (e.g., male, female, older age group), however, do not capture all influential factors through cognitive processes. For instance, while women may appear to amplify health risks, it may be more related to whether the person (man or woman) acts as a caregiver to others. As discussed above, men who were with their families did not consider coming to the beach during a bloom safe. Likewise, those in health professions appear to amplify health risks, which may also be due to caring about the health and well-being of others. Conversely, older individuals appear to be amplifiers of health risks as well, yet this may be more related to their perceived vulnerability to the health effects. Further research should isolate older aged individuals with respiratory or other related health conditions from those without in order to determine whether the influence is more related to age and accompanying experience, or to perceived vulnerability to the health effects.

Associated Causes and Impacts

The purpose of this research question was to determine what causes and impacts people associate with red tides. Hypotheses from Chapter Four were formed based on differences between the two beaches, Fort De Soto and Siesta Key, and whether people were Florida residents living near the Gulf Coast. Contingency Table Analysis was used to test for differences between the groups since the variables are dichotomous.

Familiarity with Red Tides

Two hypotheses were made in Chapter Four concerning an individual's familiarity with red tides and their causes: (i) there will be a difference between the two beaches in how accurately individuals describe red tides and their causes, and (ii) Florida residents living near the west coast will have a more accurate understanding of red tides and their causes than individuals living farther inland or Florida visitors. Using the same categories as discussed previously in this chapter, individuals who described red tides somewhat accurately were coded as “familiar,” while those who did not mention a proven aspect of red tide were coded as “unsure.”

Contingency Table Analysis was used to test for differences between Siesta Key and Fort De Soto, the results of which are shown in Table 8.15. The results indicate that there are no significant differences between the two beaches in how accurately the respondents describe red tides and their causes.

Table 8.15. Comparison of Beaches and Familiarity with Red Tides

	Fort De Soto	Siesta Key	Total
Familiar with red tides?	**Count (%)**	**Count (%)**	**Count (%)**
Yes	14 (50.0)	15 (55.6)	29 (52.7)
No	14 (50.0)	12 (44.4)	26 (47.3)
Total	28 (100.0)	27 (100.0)	55 (100.0)

Pearson Chi-Square = 0.170
P-value = 0.68

Table 8.16 shows the results from the second hypothesis test. Individuals living near the beach were classified as Florida residents who indicated living within 60 miles of the beach. Florida residents who lived farther than 60 miles from the beach were considered farther inland and were combined with Florida visitors to form the second group. The results reveal no significant differences between the distance individuals live from the beach and how they describe red tides and its causes. Since the question of proximity was asked in reference to the each of the study site beaches, some respondents who live within 60 miles of other west coast beaches may be overlooked in this classification.

Table 8.16. Comparison of Proximity and Familiarity with Red Tides

	Live within 60 miles of beach	Live farther than 60 miles of beach	Total
Familiar with red tides?	**Count (%)**	**Count (%)**	**Count (%)**
Yes	19 (50.0)	10 (58.8)	29 (52.7)
No	19 (50.0)	7 (41.2)	26 (47.3)
Total	38 (100.0)	17 (100.0)	55 (100.0)

Pearson Chi-Square = 0.367
P-value = 0.55

Experience with Red Tide Effects

The second part of the two hypotheses from Chapter Four suggested that there would be differences between the two beaches, as well as between Florida residents living near the beaches as opposed to those living farther inland and Florida visitors, in how individuals have been affected by red tides. Comparisons were initially accomplished by separating the respondents based on whether they answered yes or no to the question asking if they have been affected in any way by red tides.

Table 8.17 illustrates that there is a significant difference between the two beaches on whether personal impacts from red tides were experienced by the respondents (significant at the 0.10 level). These findings support the hypothesis and indicate that there are more individuals at Siesta Key who have been affected in some way by red tides.

Table 8.17. Comparison of Beaches and Experience with Red Tide Effects

	Fort De Soto	Siesta Key	Total
Affected by red tides?	**Count (%)**	**Count (%)**	**Count (%)**
Yes	16 (57.1)	21 (77.8)	37 (67.3)
No	12 (42.9)	6 (22.2)	18 (32.7)
Total	28 (100.0)	27 (100.0)	55 (100.0)

Pearson Chi-Square = 2.658
P-value = 0.10 (Significant at the 0.10 level)

Results for the second hypothesis are shown in Table 8.18. There appears to be no significant differences between residents living in proximity to the beach and those living farther away or Florida visitors in whether they have been affected by red tides.

Table 8.18. Comparison of Proximity and Experience with Red Tide Effects

	Live within 60 miles of beach	Live farther than 60 miles of beach	Total
Affected by red tides?	**Count (%)**	**Count (%)**	**Count (%)**
Yes	28 (73.7)	9 (52.9)	37 (67.3)
No	10 (26.3)	8 (47.1)	18 (32.7)
Total	38 (100.0)	17 (100.0)	55 (100.0)

Pearson Chi-Square = 2.295
P-value = 0.13

Perhaps this open-ended question does not capture “experience” with red tide effects since many of the people reported that red tides have prevented them from activities, but they have never been present on the beach during a bloom. Therefore, responses were regrouped into whether or not individuals mentioned any type of health impact within their open responses. Table 8.19 shows the results of the test for difference between the two beaches and mention of health impacts. There are significant differences between the two groups at the 0.01 significance level. Siesta Key has considerably more individuals reporting health symptoms than at Fort De Soto.

Table 8.19. Comparison of Beach and Mention of Health Impacts

	Fort De Soto	**Siesta Key**	**Total**
Health impacts mentioned?	**Count (%)**	**Count (%)**	**Count (%)**
Yes	6 (21.4)	16 (59.3)	22 (40.0)
No	22 (78.6)	11 (40.7)	33 (60.0)
Total	28 (100.0)	27 (100.0)	55 (100.0)

Pearson Chi-Square = 8.20
P-value = 0.00 (Significant at the 0.01 level)

Table 8.20 indicates that there are no significant differences between individuals living closer to the beach and those living farther away. There is almost twice the number of respondents living within 60 miles of the beach as those living farther away (or Florida visitors); therefore, this may have been too uneven a sample to make this comparison of personal health impacts. Additionally, the lack of differentiation between proximity to these two beaches as opposed to other west coast beaches could also explain why significant differences were not found in this comparison.

Table 8.20. Comparison of Proximity and Mention of Health Impacts

	Live within 60 miles of beach	Live farther than 60 miles of beach	Total
Health impacts mentioned?	**Count (%)**	**Count (%)**	**Count (%)**
Yes	15 (39.5)	7 (41.2)	22 (40.0)
No	23 (60.5)	10 (58.8)	33 (60.0)
Total	38 (100.0)	17 (100.0)	55 (100.0)

Pearson Chi-Square = 0.014
P-value = 0.91

Summary and Further Discussion

The major findings from the second set of hypotheses are highlighted below:

- There appears to be no differences in how accurately individuals describe red tides and their causes between Fort De Soto and Siesta Key, and between residents living closer to the beach and those living farther away.
- There are no significant differences in the number of individuals who reported being affected by red tides between those living closer to either of the two beaches and those living farther away.
- Significantly more individuals from Siesta Key reported being affected by red tides than at Fort De Soto.
- There are more individuals at Siesta Key who openly mentioned health impacts than at Fort De Soto.

Although the results do not indicate spatial differences in how accurately individuals describe red tides, the descriptors used to define red tides and their causes still provide meaningful results. For instance, descriptive analysis from Chapter Seven (Table 7.9) indicated that 40.7% of the total sample mentioned an algal component, and 39% mentioned some type of pollution or runoff. Many of the people who suggested that red tides are potentially caused by some form of pollution or runoff also correctly identified red tide as being a naturally-occurring algal bloom. They felt that although it may occur naturally, that it may also be accelerated or instigated by human influence in the form of pollution or runoff. One interviewee felt confident that red tides were largely caused by ground pollution, agriculture, and fertilizer from people's yards. He further emphasized that the primary culprit is the fertilizer runoff from people's yards, and mentioned his disgust with deed communities that require green lawns year-round. When asked who should be responsible for control or management efforts, he immediately stated that "Big Agriculture" should do something about it.

About 22% of the total sampled population also identified red tide as some type of bacteria (see Table 7.9). Some of these individuals mentioned both bacteria and algae, indicating that there is some confusion over what exactly comprises a red tide. Many of the respondents seemed unsure of how to answer the question about red tide causes and instead asked me what they are. I told them I could not answer until after the survey, but they seemed hesitant to respond for fear of giving a wrong answer. It is clear that although there are many individuals who are able to describe accurately one aspect of red tides, there are still uncertainties and confusion over what exactly a red tide is and what can be called potential causes.

The initial results indicated that there was a difference between the two beaches and experience with impacts, with Siesta Key having more experience with impacts. Impacts, however, included whether red tides have prevented individuals from activities or plans. Approximately 46% of the total sample mentioned that they avoid the beach during red tides or that they have been unable to go to the beach in the past during a bloom (see Table 7.11). This does not necessarily mean that they have experienced the impacts directly. After considering only the mentions of health impacts, there is clear evidence that individuals at Siesta Key have far more experience with the health impacts from red tides. This question did not ask whether or not they have experienced health impacts, but most individuals who indicated some degree of health symptoms in the subsequent question also described their symptoms in this open-ended question. Some of the differences between the two beaches could be attributed to their locations along the shore and differential exposure to high *K. brevis* concentrations.

There appeared to be no significant differences between individuals living near either of the two beaches and those living at farther distances (or Florida visitors) in whether they reported being affected by red tides. The same was true for mentions of health impacts. The number of respondents living within 60 miles of one of the beaches was almost double the number of those living farther away and Florida visitors. The sample, therefore, may have been too uneven to provide meaningful insight into how living closer to the beach influences an individual's knowledge of red tides or experience with the impacts.

Perceptions of Risk and Place-Specific Contexts

This research question sought to explore how perceptions of risk vary spatially, relative to the two study sites and proximity to the beach. Hypotheses were made in Chapter Four concerning differences between the two beaches, whether or not individuals are Florida residents, and the distance residents live from the beach. The Wilcoxon (*W*) rank sum test was used to test for differences in perceptions between the two groups of Siesta Key and Fort De Soto, and Florida residents and visitors. The Spearman's Rho test was used to determine if the perceptions of risk have a monotonic relationship with the distance between residences and the beach.

Siesta Key vs. Fort De Soto

Individuals at Siesta Key and Fort De Soto were hypothesized to perceive risk differently relative to the effects of red tides. A two-tailed test for difference revealed a significant difference (at the 0.01 level) between the two groups in how individuals rated the severity of their health symptoms during blooms (Table 8.21). Siesta Key respondents reported more severe heath symptoms than those at Fort De Soto. This corresponds to the previously discussed finding that individuals at Siesta Key mentioned a higher number of health symptoms than at Fort De Soto when asked the open-ended question about red tide impacts.

Table 8.21. Comparison of Beaches and Risk Perceptions

Risk Questions	Mean Score Fort De Soto	Mean Score Siesta Key	*W*	p-value
Severity of health symptoms	1.54	2.74	610.5	0.00***
Risk of eating seafood during bloom	3.18	2.48	659.5	0.09*
Level of concern	3.54	3.67	769.0	0.79

* Significant at the 0.10 level.
*** Significant at the 0.01 level.

Significant at the 0.10 level, individuals at the two beaches also responded differently about the risk of eating seafood during an active red tide bloom (Table 8.21). Respondents at Siesta Key do not find eating seafood during a bloom as risky as the respondents at Fort De Soto. The overall level of concern about red tides is rated nearly the same for individuals at both locations, with no significant differences in responses.

Table 8.22 shows the results of the comparison of the two beaches and the level of agreement with the opinion statements about red tide and potential management strategies. A two-tailed test for difference revealed no significant differences between the two groups and how they responded to the statements. Differences in opinion may not be captured by using the entire sample from each study site.

Table 8.22. Comparison of Beaches and Opinion Statements

Statements Related to Red Tides	Mean Score Fort De Soto	Mean Score Siesta Key	*W*	p-value
Naturally Occurring	3.89	3.67	740.0	0.78
Occurring more frequently	3.71	3.81	780.5	0.95
Lasting longer & more severe	3.71	3.74	742.0	0.80
Affected by urban growth	3.00	3.33	726.0	0.30
Any control method	3.68	3.67	751.0	0.93
Control methods with unknown impacts	2.36	2.00	718.0	0.50
Stricter runoff & pollution regulations	4.79	4.67	700.0	0.16
More research before anything	4.25	4.67	716.5	0.16

Florida Residents vs. Visitors

Two hypotheses were made concerning the differences between Florida residents and visitors: (i) Florida residents will rate the impacts and level of concern higher than visitors, and (ii) Visitors (non-residents) are expected to attribute greater risk to eating seafood during a bloom. A one-tailed test revealed there is not enough evidence at the 0.10 significance level to support the hypothesis that Florida residents rate the impacts and level of concern higher than visitors (Table 8.23). In addition, the results do not suggest that residents attribute lower risk to eating seafood than visitors.

Table 8.24 shows the difference between the two groups and their opinions to the statements about red tides and management strategies. A two-tailed test for difference was used to compare the responses between residents and visitors. Significant at the 0.01 level, Florida residents agree more strongly that Florida red tides are occurring more frequently, and lasting longer and becoming more severe. Visitors agree more strongly that red tides are naturally occurring (0.05 level).

Table 8.23. Comparison of Residency and Risk Perceptions

Risk Questions	Mean Score FL Residents	Mean Score Visitors	*W*	p-value
Severity of health symptoms	2.00	2.58	1157.0	0.14
Risk of eating seafood during bloom	2.84	2.83	1190.5	0.39
Level of concern	3.60	3.58	1203.0	0.49

Proximity to Beach

Chapter Four provided a hypothesis which stated that Florida residents living closer to the beach would attribute greater risk to the effects of red tides than residents living at farther distances. The Spearman's Rho one-tailed test was used to determine if the ranked risk decreases with increasing distance from the beach. Distances between the beach and homes were ranked according to the categories provided in the survey to where increasing distance generated higher ranks.

As indicated in Table 8.25, there is a significantly negative relationship between distance to the beach and the ranking of health impacts at the 0.01 level of significance. With a moderate negative correlation coefficient (-0.472), it appears that the closer the resident lives to the beach, the more severe they rate the health impacts experienced. Conversely, the results suggest that residents living closer to the beach attribute less risk to eating seafood during a bloom than those who live at farther distances. There appears to be no relationship between the levels of concern and how close to the beach individuals live. While this does not account for whether individuals live near other west coast beaches, the results nonetheless indicate that there is a relationship between an individual's proximity to one of the beaches and how he or she perceives the associated risks.

Table 8.24. Comparison of Residency and Opinion Statements

Statements Related to Red Tides	**Mean Score FL Residents**	**Mean Score Visitors**	***W***	**p-value**
Naturally Occurring	3.60	4.42	1102.5	0.03**
Occurring more frequently	4.05	2.75	170.5	0.00***
Lasting longer & more severe	3.93	3.00	221.5	0.01**
Affected by urban growth	3.12	3.33	1172.5	0.50
Any control method	3.56	4.08	1151.0	0.26
Control methods with unknown impacts	2.23	2.00	318.5	0.71
Stricter runoff & pollution regulations	4.70	4.83	1174.5	0.37
More research before anything	4.42	4.58	1203.0	0.98

** Significant at the 0.05 level.
*** Significant at the 0.01 level.

Table 8.25. Comparisons of Proximity to Beach and Risk Perceptions

Risk Questions	**r_s**	**p-value**
Severity of health symptoms	-0.472	0.00***
Risk of eating seafood during bloom	0.206	0.09*
Level of concern	-0.140	0.186

* Significant at the 0.10 level.
*** Significant at the 0.01 level.

Table 8.26 indicates that residents living at closer distances to the beach more strongly agree with the statement that red tides are lasting longer and are more severe, which is significant at the 0.01 level. In addition, increasing proximity to the beach also corresponds to responses of stronger support for more research before doing anything about red tides (significant at the 0.10 level). There are no other significant monotonic relationships between proximity to the beach and opinions concerning the statements related to red tides and potential management strategies.

Table 8.26. Comparisons of Proximity to Beach and Opinion Statements

Statements Related to Red Tides	r_s	p-value
Naturally Occurring	0.101	0.52
Occurring more frequently	-0.212	0.17
Lasting longer & more severe	-0.372	0.01***
Affected by urban growth	-0.065	0.68
Any control method	-0.146	0.35
Control methods with unknown impacts	0.049	0.76
Stricter runoff & pollution regulations	-0.168	0.28
More research before anything	-0.278	0.07*

* Significant at the 0.10 level.
*** Significant at the 0.01 level.

Summary and Further Discussion

The results from the above hypotheses tests are summarized below:

- Individuals at Siesta Key tend to rate the severity of their health impacts higher than individuals at Fort De Soto.
- Individuals at Fort De Soto consider eating seafood during a red tide bloom more risky than those at Siesta Key.

- There are no significant differences between Florida residents and visitors in how they rate the effects and level of concern for red tides.
- Although more visitors feel that red tides are naturally-occurring, it is Florida residents who more strongly agree that red tides are occurring more often, lasting longer, and are more severe.
- Florida residents living at closer distances to the beach report health impacts as more severe, but consider eating seafood during a bloom less risky than residents at farther distances.
- Florida residents living closer to the beach tend to agree more strongly that red tides are lasting longer and are more severe, and that more research should be done before anything is done to remediate red tides.

It is evident from these results that place-specific contexts influence a person's perceptions of risk. There are distinct differences between the sampled individuals from the two beaches, Fort De Soto and Siesta Key. Siesta Key is surrounded by numerous condominiums and hotels along the beach, as well as residential and commercial areas within the entire barrier island. Conversely, Fort De Soto is a protected county park that does not allow the building of residences, hotels, or condominiums, and is separated from the rest of Pinellas County by a bridge. These differences alone can help explain why there are more people affected by red tides at Siesta Key than at Fort De Soto. Over 60% of the Florida residents at Siesta Key live within 10 miles of the beach, while only 12.5% of residents live at that distance at Fort De Soto (see Table 7.3). Living closer to the beach increases the likelihood of experiencing the impacts of red tides.

Although there is no definitive explanation for the different perceptions surrounding the safety of seafood consumption during a red tide, one plausible explanation is that Mote Marine Laboratory is in Sarasota. Mote regularly provides information to the media and other sources for the public about the effects of red tides. Of the 13 respondents who affirmed that they are aware of existing control or management strategies, six said that they are aware of research efforts at Mote, five of whom were at Siesta Key (see Table 7.18). This suggests that the effective communication of red tide information may prove to be a key factor in whether or not individuals' perceptions and consequent behaviors contribute to the "halo effect."

There are not many differences in perceptions of red tide effects between Florida residents and visitors, but there are differences of opinion. Visitors agree more strongly that red tides are naturally occurring, while residents more often agree that red tides are occurring more often, lasting longer and are more severe. Perhaps residents amplify these concerns because they feel more impacted by red tides and hear news about them more often. Since this type of red tide is most common in Florida, it can be expected that news about them is more frequent within Florida and especially along the coast where they are most severe.

Whether residents hear about red tide in the news, experience it directly, or just hear about it from people within their community, presumably the repeated exposure to red tide issues gives many the impression that red tides are more common than ever. Two interviewees with whom I spoke told me that they believe red tides are occurring more often because, since they have moved to the area, there has been a bloom every year and they did not hear as much information in the news about red tides before moving.

The relationship between a person's proximity to the beach and his or her perceptions of risk relative to the effects of red tides can be explained similarly to the differences between Florida residents and visitors. Individuals living closer to either of the two beaches tend to agree more strongly that red tides are lasting longer and are more severe than those living farther inland. This corresponds to the idea that being in closer proximity to areas prone to red tides can also lead many to believe that they are becoming more of a nuisance. Unlike the comparison of residents and visitors, the evidence does suggest that individuals living closer to the beach rate the health impacts higher than those living away from the beach. This finding is related to the previously discussed results that living closer to the beach increases the likelihood that an individual will be exposed to red tides and their aerosolized toxins. In addition, perhaps by experiencing the effects directly, individuals are more likely to seek out information about red tides and their effects. This could lead them to more accurate sources of information that would explain the actual risk of eating seafood.

Chapter Nine: Analysis of Newspapers

The goal of the newspaper analysis was to determine how newspapers contribute to the information available to the public about red tides. The primary hypothesis was that newspapers from the Siesta Key area would portray red tides more accurately than those from the Fort De Soto area. Accuracy in this case includes using the correct terminology and conveying the actual impacts clearly. In addition, there were several main topics of discussion in the two newspapers that will also be addressed as they relate to the responses of the survey participants. The two newspapers used in the analysis were the *Sarasota Herald-Tribune* and the *St. Petersburg Times* because these were the two most commonly cited sources of information by survey respondents. The two newspapers will be discussed separately, followed by a discussion of the information provided from both newspapers combined.

Context

Although the analyzed newspaper articles only represent a sample of the total red tide coverage, there does appear to be an increase of relevant red tide articles when blooms are most prominent and less after the blooms dissipate. To provide context for the information provided in the articles, there was an active bloom recorded along the west coast of Florida every year during the period of time that articles were collected. Articles were collected from January of 2004 until July of 2007. During that time, there were three major blooms near the Tampa Bay and Sarasota areas. The 2004 bloom was only in the Tampa and Sarasota areas in the first few months, with the bloom mostly out of the area by March. In 2005, high concentrations of *K. brevis* were recorded in every month along the southwest coast of Florida, and continued into January and February of 2006. This bloom, which lasted approximately 13 months, is considered one of the most severe red tides on record (Mote, 2005). The 2006 red tide season was less severe, but high concentrations could be found in the summer months through December. Finally, cell counts for 2007 indicated that there were localized areas of medium to high concentrations near the Sarasota area primarily in January, but only very low concentrations in the Tampa Bay area.

Sarasota Herald-Tribune

The information provided in the 48 articles from the *Sarasota Herald-Tribune* is discussed in terms of the four most prominent themes as they relate to the topics from the surveys. These four themes include specific descriptions of red tides, fishing or seafood topics, health effects, and pollution issues.

Descriptions of Red Tides

Although one reporter did refer to red tide as “bacteria,” most of the articles accurately described red tides as “algal blooms,” “toxic algae,” “Karenia brevis,” or “red tide algae” (see Appendix C). Descriptions of red tides included “pesky blooms,” “dreaded algal bloom,” “infestation,” “an intense and stubborn red tide,” “the outbreak,” and “periodic explosion of algae.” This negative terminology gives an overall impression that a red tide is more like a persistent disease than a naturally-occurring algae bloom. As one of the top ten stories for 2005, one sub headline read “Red tide plagues region,” before going on to talk about “the outbreak” that began in January and lasted all year (December 31, 2005).

Fishing and Seafood Topics

Red tides were typically associated with massive fish kills and marine mammal mortalities, but were also discussed in terms of the impacts on recreational fishing or on shellfish. The overall message – that seafood is safe to eat during red tides with the exception of illegally harvested bivalve shellfish – was completely missing from the sampled articles. One article from March 3, 2005 stated that “red tide is algae that sometimes grow into massive blooms that kill fish and poison clams.” While clams are dangerous to eat during a bloom, this message conveys that they are the only dangerous bivalve shellfish and that all clams should be avoided. So long as clams and other bivalves are harvested from commercially regulated beds, they are safe to eat during red tides. There was only one other mention of seafood, which included a brief 23 word article on February 11, 2005 that reported a ban on harvesting shellfish, but did not elaborate on what that means for the public. All other references to fish were related to the fish kills caused by either red tides or oxygen-depleted “dead zones." Without specifically discussing the affected seafood and the potential risk, individuals are left to determine for themselves whether or not they should consume certain types of seafood during a bloom.

Articles pertaining to recreational fishing typically took the approach of encouraging anglers to find clean waters rather than give up hope of catches during red tides. This message was primarily conveyed by sports writer, Steve Gibson, who wrote five of the sampled articles. On July 17th, 2005, he wrote, "The vision is a fish-killing blanket of red water that virtually shuts the industry down. Nothing could be further from the truth." Later on September 18, 2005, he wrote, "Even during the worst of outbreaks, there are areas to fish and fish to be caught." Gibson tried to convince anglers that red tide blooms can be patchy and that fish can be found in cleaner waters. Another article, written by Amy Abern on July 2, 2004, talked about the winner of the World's Richest Tarpon Tournament. The winner of the tournament commented on the apparent lack of tarpon and other fish in recent years, saying that she believed red tides and outboard motors have helped scare away the tarpon. It appears that there may be conflicting views about fishing conditions during red tide blooms that may be confused by the large amount of dead fish that have occurred during red tides. Not all types of sportfish are killed by red tide, and a red tide does not always lead to fish kills, so perhaps the sports writers should continue to convey this message to the public so as to prevent people from assuming the worst fishing conditions.

Health Effects

The majority of the articles that discussed the effects of red tides did talk about the potential for respiratory effects. Some articles, however, failed to elaborate on the extent of the effects. For instance, a news update on February 1, 2005, stated, “Visitors to the beaches are likely to experience irritation when west winds blow onshore.” While this article does mention the effect of wind, it does not provide any detailed information about what constitutes “irritation.” In addition, on January 8, 2007, Kate Spinner wrote, “The poison can cause breathing problems for people with asthma.” It is helpful to mention that asthmatics may have more trouble breathing, but instead of calling it aerosolized toxins, she refers to it as “poison.” This term could send the message that the red tide toxins are something that can kill humans or accumulate in the body over time causing eventual illness. For visitors or people new to red tides, this portrays an extremely negative image of red tides and their health impacts. Additional issues with wording involve the reporters not mentioning that respiratory impacts are not always a problem with every bloom or at every nearby beach, or even with every individual. Some people are more prone to the health effects than others, and the severity of the symptoms are largely dependent on the direction and strength of the onshore winds.

Dermal irritation is a symptom that is not always linked to *Karenia brevis* red tides, and reports of skin irritation are not well documented. Amy Abern, however, wrote an article on March 10, 2005 about her experience while at a party on Manasota Key a month prior. After calling red tide a “bacteria,” she wrote, “Red tide sounds like a way to describe the sun setting on the ocean, not germs and bacteria waging war against living, breathing creatures.” She went on by telling readers, “Your eyes water, sinuses swell and – if you’re extra lucky – you get a bonus throbbing headache.” After being on the beach during a bloom all day, the next day she said she began to develop bumps on her neck and face, which later began to hurt and leak fluid. The emergency room doctor diagnosed her with a skin infection, but after viewing the website www.redtidealert.com, she was convinced that red tide was the culprit. While there have been a few documented cases of dermal irritation during a red tide, Abern did not mention being in the water and essentially diagnosed herself. At the beginning of the article, she wrote that red tide “should bear a title more reflective of its nature, like red dread or phlegmatic curse.” This use of extravagant language throughout the article completely obscured the effects of red tides for anyone who may have been unaware of the health effects. Not only did she incorrectly refer to red tide as “germs and bacteria,” she also based her entire article on information from a website that has not been linked to *Karenia brevis* red tides conclusively.

Pollution Issues

Out of the 48 analyzed articles, 9 discussed the potential for pollution or nutrient runoff to influence the frequency, severity, or duration of red tides. There is confusion, however, over whether or not these claims are supported by scientists. Science writer, Cathy Zollo, stated on November 2, 2005 that “There is wide agreement in the global scientific community that nutrient pollution from a variety of sources contributes to harmful algal blooms, or HABs." Meanwhile, in two other articles by contributing writer, Kate Spinner, it is clearly stated that there is wide debate in the scientific community over this topic. On January 8, 2007, Spinner wrote, "Scientists debate the role nutrient pollution plays in the algae's growth to bloom status, but all algae need nutrients, such as nitrogen and phosphorus to survive." These two statements convey different opinions of scientists, yet they both discuss the role of nutrients in the growth of algal blooms, not specific to the Gulf's *Karenia brevis*. What is missing from this picture is that although nutrients do contribute to algal blooms, there are many questions about whether human-derived nutrients influence the severity, duration, or frequency of *K. brevis* blooms.

One confounding factor in the publicity of the 2005 red tide bloom is the coinciding dead zone that occurred along the coasts of Mississippi and Louisiana. Dead zones occur seasonally in warmer months when oxygen levels in the Gulf become too low to support marine life in or near the bottom waters. Nutrient-rich waters from the Mississippi River fuels algae growth that eventually settles in bottom waters and begins to decay, consuming large amounts of dissolved oxygen (NOAA, 2007). Where the confusion lies is that the algal blooms are not always specific to *K. brevis* blooms, and a *K. brevis* bloom does not always cause or contribute to dead zones. The 2005 red tide bloom, however, caused large amounts of dead fish that also contributed to the already existent dead zone, creating a direct link between *K. brevis* blooms and the dead zone that may still have people confused.

On February 25, 2007, Eric Ernst wrote about the dead zone and red tide and also spoke with a representative for the Sarasota Sierra Club. The representative stated that he believed the 2005 red tide caused the dead zone. The article continued by stating that politicians are “pleased to attribute red tides to ‘natural causes’ and to dismiss mounting evidence that algal blooms have gotten more frequent, more intense and more long-lasting because of human activities.” He then compared the topic of red tides to “the way global warming was viewed 15 years ago.” The year before, Cathy Zollo wrote on June 21st about the 2006 Red Tide Forum, and began the article with the following title: “Answers few at forum on red tide – One activist said experts didn’t seem committed to cleanup” (see Appendix B). She then referred to the Sierra Club activists at the workshop who were “waiting for the featured scientists to utter just one sentence about the link between pollution and red tide.” This seems to illustrate the disconnect between what scientists are saying about pollution and red tides, and what other people are assuming as factual.

Considering that the 2005 bloom was one of the longest and most severe red tides on record, it is no surprise that its occurrence left many people seeking explanations. Interestingly, the articles discussing the role of pollution did not appear within the sampled articles until late 2005 and most were written in 2006 and 2007. The duration and severity of the 2005 red tide bloom appears to have instigated conversations about the potential causes or influences of red tides. To illustrate this, an August 8th, 2006 article states "The last red-tide outbreak lasted 13 months, making it one of the worst on record. It sparked public discussion and scientific debate about what fuels red tide and what to do about it." In addition, NOAA forecasted the 2007 dead zone to become one of the largest on record (NOAA, 2007), which could have also provoked more conversation about the role of nutrient pollution and red tides. It appears that since dead zones have been linked to both algal blooms and nutrient pollution, many are creating a causal link between Florida red tides and nutrient pollution as well.

St. Petersburg Times

The 50 articles from the *St. Petersburg Times* are discussed in terms of red tide descriptions, fishing reports, the effects on sea turtles and manatees, and the effects on tourism. These were the most commonly discussed topics in the articles. Since the keyword search included any article with "red tide" in the text, many of the sampled articles mentioned red tide briefly in reference to other topics instead of providing relevant red tide information. This was true for some of the *Sarasota Herald-Tribune* articles as well, but to a larger degree in the *St. Petersburg Times*.

Red Tide Descriptions

There were 32 articles talking about some aspect of red tides or the impacts, yet only 12 of the articles described a red tide. The remaining 20 articles talked about red tide as if everyone knew exactly what a red tide means.

Those that did elaborate did so fairly accurately, calling it “Karenia brevis,” an “algae bloom,” “toxic algae,” “microscopic algae,” or “algae blooms” (see Appendix C). There were not many catchy phrases used to describe red tides. Instead the writers said it was “a higher-than-normal concentration of a naturally occurring algae” or “microscopic algae that produces toxins.” However, one article posted on August 23, 2005, described red tide as “a bloom of microscopic algae that appears as a sheen on the water and bleeds lethal toxins.” By stating that it appears as “sheen” on the water makes it sound more like a spill than an algal bloom. More importantly, “bleeds lethal toxins” sends a confusing message about the brevetoxins from *K. brevis*, making it sound like a person could die from being in the water during a bloom. There were very few mentions of human health impacts, most of which merely stated that it caused respiratory irritation. This did not include information about what types of effects can be experienced, or the severity of the symptoms. This obviously does not provide any indication that the health effects from red tides are being clearly described to the public.

Fishing Reports

Articles discussing the fishing conditions or other recreational fishing topics were quite abundant in this newspaper sample. Appendix B shows headlines such as “Daily Fishing Report,” “Captain’s Corner,” “Great Catch,” “Sideline,” and several others that are essentially a fishing captain’s or sports writer’s update on the fishing conditions despite red tide. The “Daily Fishing Report” and “Captain’s Corner,” along with a few other articles, were all written by local fishing charter captains. Many of these fishing articles provided a positive outlook on the impact of red tide on certain fish populations. For instance, Chad Carney wrote the following on July 22, 2005: "Nature springs back quickly, and after the red tide is gone the baitfish will reappear along with the predators." The opinion that baitfish and other fish populations will soon return after red tide leaves the area is shared by the other captains as well. By August of 2005, there were more negative reports about the status of baitfish and sportfish, but most of the captains still suggested that fish would soon return.

Effects on Marine Animals

One of the most prominent topics within the sampled St. Petersburg Times articles was the impact of red tide on sea turtles, as well as dolphins and manatees. Beginning on August 10, 2005, there were an increasing number of articles related to sea turtles as they kept finding washed up turtles either dead or very sick and in need of care from the local aquariums. By August 23, 2005, Susan Aschoff wrote, "In the waters of the Gulf of Mexico from Pasco to Sarasota counties, something is killing endangered sea turtles at five times the normal fatality rate." She went on to talk about how scientists blamed red tide for the sudden increase in turtle mortalities, and stated "Some experts are calling 2005's Red Tide the worst environmental disaster in the gulf in 30 years." On September 23, 2005, Terry Tomalin quoted a scientist saying, "It could be 50 years before we know what affect this Red Tide outbreak will have on the overall turtle population." By mid-December, red tide was being blamed for 40 manatee deaths for March of 2005 alone. On January 13, 2006, Rodney Page reported a FWC study that determined 396 manatees died in Florida waters in 2005, 81 of which were blamed on red tide. The combined reporting of damage to the fish population and increased mortalities of marine mammals and turtles was by far the most prominent news concerning red tide from the sampled articles. Though the intentions may not be to alarm the public, the overall spike in coverage about all of the mortalities and damages to populations of these popular marine animals must have conveyed the alarming message that something is terribly wrong with the Gulf.

Effects on Tourism

There was a lot of discussion about the effect that red tides had on tourism, many of which used the topic to solicit more money and attention to the issue. One headline from a December 3rd, 2006 article read, “Red Tide leaves bad taste in visitors’ mouths.” The article then referred to a previous article in November, “The article states repeat visitors are coming back less frequently. Nowhere is there a mention about Red Tide. That seems to be a possibility.” The writer (no name mentioned) went on to say that the St. Petersburg Times “should investigate accounts of pollution dumping by the phosphate industry in the gulf like those discussed at www.redtidealert.com.” In another article on November 12, 2005, it was said that red tide “created negative publicity for tourism along the Gulf Coast, after guests arrived at their beach hotels and discovered the sea was making them sneeze and sniffle.” Other mentions about tourism included the fear that the red tide would either prevent tourists from coming to the area or redirect them to other destinations. On June 21, 2006, an article written by Paul Snider announced the closing of an Irish bar along the beach. Snider said, referring to the owner of the bar, “he saw the writing on the wall last year when Red Tide curbed tourism as much as had the threat of hurricanes.” This clearly gives the impression that the local economy is feeling the effects of red tides, especially that of 2005. The increased publicity of these and other secondary impacts from red tides may also leave many people feeling as though red tides devastate Florida’s Gulf Coast each time they come through.

Summary

The major observations from the analysis of the two newspapers are highlighted below:

- It appears that articles with relevant red tide information are most abundant during active blooms.
- There is an overall lack of information about the safety of seafood consumption during red tides, with only two references in the *Sarasota Herald-Tribune* and none in the *St. Petersburg Times*.
- Sports and contributing writers from both newspapers seem to be conveying a positive and accurate message about the effects of red tide on the fish populations and recreational fishing.
- The *St. Petersburg Times* lacked sufficient coverage and information about the potential health effects caused by the aerosolized toxins of red

tides. Both newspapers left many ambiguities when discussing the respiratory effects during red tides.

- The *Sarasota Herald-Tribune* writers tend to use more extravagant or dramatic language to describe red tides, whereas this is not as noticeable in the *St. Petersburg Times* articles.
- The issue of nutrient pollution as a potential cause or trigger for red tides is a popular topic within the *Sarasota Herald-Tribune*, but there are only a couple of articles in the St. Petersburg Times that addressed this topic.
- There appears to be confusion surrounding the relationships between dead zones, red tides, and nutrient pollution, with many of the writers discussing the topics of dead zones and red tides interchangeably.

Newspapers are often criticized for their inaccurate or exaggerated portrayal of events, ultimately influencing the public's perceptions. According to the social amplification of risk framework (Kasperson et al., 1988), media is one of the amplification or attenuation "stations" that translate risk messages to the public. Whether or not these two newspapers play a significant role in the process of either amplification or attenuation of risk for the survey respondents cannot be determined conclusively from this analysis. There is evidence, however, of a relationship between the information provided in the newspapers and the responses from the surveyed public. Examples include the lack of information about seafood consumption, the relationship between pollution and red tides, and the notion that red tides are increasing in frequency, severity, and duration. Whether these newspapers amplify or attenuate risk appears to be dependent on what would be considered news-worthy topics for their target audience. For instance, the Sarasota Herald-Tribune discusses the health impacts more frequently and in greater detail perhaps because Sarasota area (including Siesta Key) appears to experience the health impacts from red tides more frequently. Likewise, news concerning manatee and turtle deaths seemed to amplify public concerns, but the Clearwater Aquarium was the facility taking care of these animals and so the news is more specific to that location's audience.

One of the most significant problems with both of the newspapers is the lack of consistent and explicit information about the potential health risks to people. While the Sarasota Herald-Tribune does appear to cover health information more often, there are still ambiguities that could confuse readers. Respiratory irritation is a common symptom for individuals near beaches, but the presence of symptoms and the severity are largely dependent on other factors. For instance, wind speed and direction are perhaps the most significant factors contributing to where the aerosolized toxins will be experienced. Winds can change over the course of the day and the effects experienced from the toxins will, therefore, be largely dependent on localized weather patterns. In addition, not all individuals experience health effects every time a bloom is near, and the severity of the symptoms varies greatly between individuals. It is important, therefore, not to make sweeping statements that suggest that everyone will definitely experience severe symptoms when there is a red tide present.

Additionally, newspapers and other media should make it clear where blooms are present and where respiratory irritation is likely to be experienced.

The threat of getting neurotoxic shellfish poisoning (NSP) from affected bivalve shellfish is largely prevented by state monitoring of shellfish beds. Nevertheless, providing information to people about the actual threat of NSP should remain an important priority for media. Results from the surveys indicate that individuals know there is a risk from eating seafood during a bloom, but they do not always understand which types of seafood are affected. It is clear from the sampled articles that the risk of seafood consumption during a bloom is not being accurately portrayed, if at all mentioned. To avoid any unnecessary secondary impacts from amplified risk, journalists should make it clear that seafood is not dangerous to eat during red tides unless affected bivalves are illegally harvested and consumed.

Similar to the responses of survey participants, many of the articles state that red tides are becoming more frequent, lasting longer, or becoming more severe. This was especially true during the 2005 bloom, when the impacts were most severe and the bloom seemed to last forever. This notion often leads many to question what could be fueling their increasing occurrence and severity. Hence, the debate about the influence of nutrient pollution became center stage as many individuals were looking find solutions to the phenomenon. Add the much publicized “dead zone” to the mix, and the debate was soon convoluted by the lack of differentiation between the two phenomena. By discussing the two topics interchangeably, a causal link was drawn between nutrient pollution and red tides. In other words, since the 2005 dead zone was fueled by red tide and dead zones are triggered by nutrient pollution, many were quick to draw the connection between an increase in nutrient pollution and red tides. Although red tides can lead to or worsen existing dead zones, journalists should take the time to understand and then explain the differences between the two phenomena in their articles. This is not to say that the role nutrient pollution should not be discussed in the media, but it is important to address it without making unfounded claims.

Chapter Ten: Conclusions

The overall objective of this project is to provide an initial step for understanding the perceptions of individuals related to red tides. Four research questions and several accompanying hypotheses were put forth in Chapter Four. From the tested hypotheses, there are key characteristics identified that may influence whether individuals amplify or attenuate risk information:

- Women and older individuals may amplify the risk of health impacts and other risks because they feel more vulnerable to the health effects.
- Individuals in healthcare professions may amplify the risk of red tide effects, such as health impacts and the risk of seafood consumption due to the nature of their profession.
- Greater experience with the effects from red tides may lead individuals to believe that red tides are increasing in duration, severity, and frequency.
- Individuals who believe red tides are more frequent, severe, and lasting longer may feel more strongly about the influence of pollution on red tides, thereby becoming potential amplification stations to other individuals.
- Uncertainties about red tides may result in amplified perceptions of risk surrounding the consumption of seafood, contributing to the "halo effect."
- Place-specific contexts are influential in how individuals perceive and interpret risk information.

- The local newspapers may be potential amplification or attenuation stations that pass on information to the public about red tides.

The results of this research can be explained by the social amplification of risk framework (Figure 3.1). Once red tide occurs in a given area, assuming it is concentrated enough and the wind direction is onshore, those individuals living near or visiting the beach may be the first to experience the effects with respiratory irritation from the aerosolized toxins. Newspapers or other media are then likely to hear news of red tide either through these individuals, or by charter captains, or by the research institutes who are responsible for monitoring local waters for red tide presence. The message, therefore, is disseminated through the individuals who experienced impacts, the media, chartering companies, and research organizations, among others. Each of these sources is represented in the model (Figure 3.1) as sources of information and information channels, and each of them subjectively select event characteristics that are deemed meaningful to them.

As other individuals hear news of red tide, they not only receive the interpreted message from others, but they also impose their own biases and interpretations upon the message before passing it on to others. For instance, those in Sarasota may focus more on the health symptoms from red tides, while those in the Pinellas County area may focus on the impacts on marine mammals and sea turtles. Underlying the individuals' interpretations is the role of social and spatial contexts, as shown in this research to include gender, age, occupation, and place-specific characteristics. As individuals communicate with others, passing on and receiving additional risk messages, it is possible that the resulting responses and behaviors are significant enough to create a ripple effect of secondary and higher order impacts. In the case of red tide, such secondary impacts may include losses to local tourist industries from declined beach attendance, losses to seafood industries from the "halo effect," or even politicized concerns about coastal runoff and pollution that could influence both future research directions and policy decisions.

Thus, in the social amplification of risk framework (Kasperson et al., 1988), individuals are hypothesized to decipher risk messages subjectively according to their own rationale and beliefs before passing the information on to others. Influential factors in forming these perceptions of risk are said to include age (Tobin, 2005), gender (Gustafson, 1998), education, and place-specific contexts (Masuda and Garvin, 2006). The underlying processes of the framework are supported by this research, with clear indications that certain characteristics do play a role in whether individuals amplify or attenuate risk information. For instance, gender and age are important social factors that influence the formation of risk perceptions, particularly with the health risks from red tides.

The local newspapers appear to act as amplification and attenuation stations, through which pertinent scientific information is filtered and provided to the public as an interpreted risk message. The charter captains appear to attenuate the risks from red tides, while science writers and other contributors appear to amplify the risks. Individuals, upon receiving risk messages, are influenced by their own personal biases and interpretations, but may also be influenced by those of the social stations through which they obtain information.

This research identifies a new direction for the role of place in the formation of risk perceptions. The differences between individuals at the two beaches illustrate the sensitivity of place when selecting a study site. Red tides have affected Siesta Key and Fort De Soto differently, and the impacts, therefore, are also experienced in different ways. In order to determine whether individuals amplify or attenuate risk unnecessarily, the study site and the characteristics of the community should be investigated. This is illustrated by the content differences between the two newspapers, with each paper giving more attention to what appears to be most important to the people of that area. Hence, the character of the location and the type of information being discussed in local media contributes to how individuals filter and interpret risk messages.

Ultimately a person's location influences the extent of impacts felt by a particular hazard, which affects how he or she perceives the associated risk from the event and its impacts. For instance, where individuals live relative to the hazard-prone area will influence how often they are in contact with the hazard or with other individuals also experiencing the impacts from the hazard. Either by experiencing impacts, communicating with other impacted individuals, or by hearing more discussion in the local media, the individuals who are closer to the hazard are more likely to receive amplified messages or to create their own. The opposite (i.e., attenuation) could occur if by experiencing impacts, it would lead individuals to seek information about the hazard through more accurate sources. For example, the finding that individuals with more experience with red tide impacts also attributed less risk to eating seafood during a bloom invokes this question of whether they are seeking or have access to more accurate information sources.

Since red tide is in the early stages of research, many people (including journalists) may be confused about what can be said conclusively about the causes and impacts from red tides. Without clear communication of scientific findings, opinions about the causes and effects of red tides may instead be formed based on direct experience or hearsay from other affected individuals. It is easy to blame the journalists for not conveying the most accurate and pertinent information, but ultimately it is individuals – journalists, scientists, and the public – who become significant sources for the amplification or attenuation of risk information.

Limitations and Future Research Directions

Research concerning Florida red tides is burgeoning in many areas, yet research from social science and geographical perspectives is lacking. Much of the focus is on understanding the physical processes of red tides or the health and economic implications from the impacts. This research, however, is concerned with understanding how people – the general public – perceive red tides and the impacts. As red tides become more politicized by the very nature of their impacts, it is the opinions of the general public that will ultimately affect the outcome of proposed control and mitigation efforts. Whether people are encouraged to visit a red tide prone area, to eat all types of seafood during a bloom, or to agree to proposed mitigation or control efforts, the response and behavior of the general public has profound implications. The findings presented in this research, therefore, provide an initial step for understanding the public's perceptions surrounding red tides. In addition, the analysis of local newspapers also provides insight into areas for public outreach which may be lacking.

It is clear from this research that individuals may not be obtaining up-to-date, accurate information about red tides and the impacts. In particular, there are insufficiencies related to the safety of eating seafood during a bloom, the extent of the health impacts from aerosolized toxins, and the appropriate sources of information about the current status of red tides. There have been recent efforts to provide the public with information through the formation of websites, pamphlets, and hotlines, but the results from this research indicate specific areas that should be targeted. In addition, the growing consensus over the role of nutrient pollution should not be ignored simply because scientists are still debating the issue. There may be confusion over the role of nutrient pollution and the formation of dead zones instead of red tides, but regardless, the information provided from this research indicate that many people are in support of improved coastal pollution management strategies.

While this research provides useful insight into how individuals perceive Florida red tides, the implications may be specific to the west coast of Florida. Since the sample size was small and the interviews were limited to beachgoers, the results may be indicative of the type of people who attend the two west coast beaches. To determine if the results are generalizable to the larger population, future research should investigate the perceptions of individuals in other regions of Florida and a different sampling design should be used. For instance, red tides are also experienced along the panhandle and occasionally on the east coast; therefore, the perceptions of those individuals may indicate additional areas for improved risk communication. Additionally, a more in-depth analysis of local newspapers and other media may provide useful information as to how the discussions about red tides are formed and communicated to the public as risk messages.

Finally, this research has shown that the role of place-specific contexts cannot be overlooked. Masuda and Garvin (2006) first introduced the concept of place and place attachment as an influential factor in risk perceptions. The approach used to investigate the role of places has been modified in this research, yet continues to provide meaningful insight into the various ways that place can influence perceptions. Future research in this area should include a more in-depth exploration of how the various aspects of place and place attachments can influence perceptions of risk, as well as the use of improved methods for identifying key spatial components.

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Appendices

Appendix A: Survey Questionnaire

Florida Red Tides:
Public Perceptions of Risk

Conducted by Sara Allen
University of South Florida

Faculty Advisor:
Dr. Graham A. Tobin

Introductory Statement:

Hello, my name is Sara Allen and I'm a graduate student in the Department of Geography at the University of South Florida in Tampa. I am conducting surveys to collect data for my Master's Thesis. I would like to ask you some questions about your knowledge and experience with Florida's beaches. This study is not funded by any company or corporation, and I am not trying to sell you anything. This survey will only take about 10-15 minutes of your time. The results could be published. Your answers will be kept completely confidential and identifying information will not be collected or attached to this survey. The information obtained from this survey will only be used for statistical purposes. May I continue? Do you have any questions before we start?

If you have any questions or would like more information, please contact my advisor, Dr. Graham Tobin, at the University of South Florida at 813-974-4931. He can also be reached through email at gtobin@cas.usf.edu.

Appendix A (Continued)

Survey Number: ______

Section 1: Place-specific contexts:

The first set of questions is to determine how close you live relative to the beach and some of the reasons that draw you to this beach.

1. Do you live in Florida? **YES / NO**

If yes, continue. If no, skip to question 5.

2. Approximately how long have you lived in Florida? ______________________

3. Approximately how many miles away do you live from this beach?

< 10 miles	
10 – 20	
21 – 30	
31 – 40	
41 – 50	
51 – 60	
> 60	

4. How frequently would you say you visit this particular beach? _____________

If answer to question 1 is no, continue. Otherwise skip to question 7.

5. What state is your permanent residence? ______________________________

6. What best describes your reason for visiting Florida? (Check all that apply)

Vacation	
Seasonal residence (e.g., time-share, condo, vacation home)	
Work-related	
Visiting family or friends	
Considering moving to Florida	
Other (please describe)	

Continue with questions here:

7. What are the top three reasons that attract you to this particular beach?

1)

2)

3)

8. On a scale of 1 to 5, with one being least likely and 5 being most likely, how likely are the following situations to prevent you from visiting this beach?

a) Expected tropical storm or hurricane

1	2	3	4	5

b) Rain

1	2	3	4	5

c) Too crowded

1	2	3	4	5

d) Cold weather

1	2	3	4	5

e) Active red tide blooms

1	2	3	4	5

f) Dead fish on beach

1	2	3	4	5

9. Have you heard of Florida's red tides? **YES / NO**

If yes, continue. If no, skip to Section 3, question 26.

Section 2: Florida's red tides:

This set of questions is about Florida's red tides and their associated causes and impacts.

10. To the best of your understanding, what are the potential causes for Florida's red tides? ____
____
____
____
____

11. Have you been affected in any way by Florida's red tides? (*Have red tides ever prevented you from any activities or plans?*) **YES / NO**

If yes, continue. If no, skip to question 13.

12. How have you been affected by Florida's red tides? ____________________
____
____
____
____

13. On a scale of 1 to 5, with 1 being no symptoms at all and 5 being severe symptoms, how would you rate the health impacts you experience during an active red tide bloom?

No health impacts	Very little health impacts	Moderate health impacts	Somewhat severe health impacts	Severe health impacts
1	2	3	4	5

14. Do you eat seafood? **YES / NO**

If yes, continue. If no, skip to question 19.

15. I'm going to list types of seafood and you tell me whether or not you eat each type? (Check all that apply)

Seafood Types:	**Do you eat normally?**	**During a red tide?**
Mahi-Mahi (dolphin)		
Grouper		
Snapper		
Tuna		
Oysters		
Shrimp		
Lobster		
Scallops		
Crab		
Mussels		
Clams		
Other (please specify)		

16. Do you avoid eating any of the above mentioned seafoods during a red tide? (If yes, mark in second column in above table)

17. Do you avoid eating seafood during certain months of the year? **YES / NO**

If yes, continue. If no, skip to question 19.

18. What months do you avoid eating seafood? (Check all that apply)

January		July	
February		August	
March		September	
April		October	
May		November	
June		December	

19. On a scale of 1 to 5, with 1 being not at all risky and 5 being very risky, how risky do you think eating seafood is during a red tide bloom?

1	2	3	4	5

20. On a scale of 1 to 5, with 1 being not at all concerned and 5 being very concerned, how concerned are you about Florida's red tides?

1	2	3	4	5

21. Should something be done to manage or control Florida's red tides?
YES / NO

If yes, continue. If no, skip to question 23.

22. Who do you think should be responsible for management or control efforts of Florida's red tides? (Check all that apply)

Individuals	
Local community or city	
County	
State	
Federal Government	
Other (please specify)	

23. Are you aware of any existing management or control efforts? **YES / NO**

If yes, continue. If no, skip to question 25.

24. Briefly describe the existing management or control efforts that you are aware of? ____

____

____

____

____

25. Of the following statements, please indicate the level to which you agree on a scale of 1 to 5, with 1 being strongly **disagree** and 5 strongly **agree**?

	Strongly Disagree (1)	Somewhat Disagree (2)	Neutral/Not Sure (3)	Somewhat Agree (4)	Strongly Agree (5)
Florida's red tides are naturally occurring.	1	2	3	4	5
Florida's red tides are occurring more frequently.	1	2	3	4	5
Florida's red tide blooms are lasting longer and are more severe.	1	2	3	4	5
Florida's red tides are directly affected by urban growth.	1	2	3	4	5
Any potential control methods should be used to prevent red tides.	1	2	3	4	5
Control methods should be used even if the impacts of doing so are unknown.	1	2	3	4	5
There should be stricter regulations to prevent coastal pollution & runoff.	1	2	3	4	5
More research should be done before doing anything.	1	2	3	4	5

26. What is your primary source for information about beach-related news or conditions?

TV or Radio	
Newspapers	
Internet News or Red tide websites	
Friends or Family	
Local sources/Tourism Bureaus/Hotels or Motels	
NOAA, FWC, DEP (other state/federal agencies)	
Other (e.g., lifeguards)	

Section 3: Basic Demographic Information:

We are almost done. These last questions are simply used to gather some information about the group of people being interviewed. Again, all of this information is confidential.

27. Which of the following is the highest level of schooling you have completed?

Up to 12th grade, No Diploma	
High School Diploma or Equivalent	
Some College	
Associate's or Technical Degree (2 yr. degree)	
Bachelor's Degree (4 yr. degree)	
Graduate or Professional School Degree	

28. May I ask you what your occupation is, in broad terms? ________________

____

Appendix A (Continued)

29. Using the following categories, what is your age?

18-25	
26-35	
36-45	
46-55	
56-65	
66-75	
76 and above	

30. Participants Gender:

Female	
Male	

This completes the survey. Thank you so much for participating.

Appendix A (Continued)

Interview Questions (asked to every 4th respondent):

31. Would it be okay with you if I ask a few more specific questions based on some of your answers?

- When you talked about potential causes of Florida's red tides, were they based on a specific source of information?

- *If the answer to the first three statements of number 25 was agree or strongly agree:* Why do you believe that red tides are occurring more often and lasting longer? (cue: *based on personal experience, or hearsay?*)

- *If respondent avoids seafood during red tide:* How do you determine when to start avoiding seafood and when it is safe to eat again? What source do you usually get this information from?

- How often do you find yourself talking with other people about red tides or any of their impacts? Who do you typically get into these conversations with?

- *If formerly employed:* Does the occurrence of a red tide ever become an issue for the company you work for? If so, what does your company typically do in response to a red tide?

- When you first hear about a red tide bloom, how frequently would you say you read about or hear red tide related news?

Appendix B: Newspaper Headlines

St. Petersburg Times:

Date	Page	Word Count	Headlines and Sub Headlines
1/17/2004	3B	308	MICROSCOPIC INVADER: Red Tide a winter visitor
3/25/2004	4B	90	Red tide suspected in rash of dolphin deaths
5/19/2004	1D	925	Techies harness business potential
11/29/2004	3	785	A modern day joust: growth vs. nature - Do power boats and manatees mix?
2/18/2005	12C	379	Grouper are available in deep water
4/8/2005	7C	460	Water Conditions: Red Tide Subsides
6/22/2005	4	821	Triathlon is a success despite some adversity
7/1/2005	16L	32	Great Catch
7/4/2005	2B	1000	Wave of Reality
7/8/2005	5C	414	Sideline
7/13/2005	4	683	Clearwater team sailors race for titles
7/22/2005	8C	756	Daily Fishing Report
7/28/2005	9C	214	Daily Fishing Report
8/4/2005	11C	251	Daily Fishing Report
8/10/2005	3B	477	10 sea turtles die on county beaches
8/14/2005	13	661	Gulf waters are killing, sickening sea turtles
8/18/2005	9C	242	Daily Fishing Report

Appendix B (Continued)

8/23/2005	1E	2193	Turtle triage
8/26/2005	4	1335	Obituaries
9/2/2005	7G	305	Cooler water should trigger a bite
9/16/2005	6	122	Captain on Cleanup
9/23/2005	5C	719	Red tide takes toll on turtles
10/2/2005	1	798	Fighting against red tide
10/10/2005	7C	242	Captain's Corner
10/22/2005	1B	384	We need the rain, and like the cool
10/31/2005	3D	1057	AutoNation's boss takes stance for higher gas taxes
11/12/2005	3B	630	Away from beaches, Red Tide still lurking
11/26/2005	11C	209	Captain's Corner
12/17/2005	1B	338	Giving free information not a cost-free process
12/31/2005	1	754	You a news hound? Prove it
1/13/2006	5C	456	Bird-watching
2/10/2006	6C	398	Trout, sheepshead in action
3/10/2006	8C	612	Weather, baitfish improve flats fishing
4/6/2006	1B	1031	Devil Rays may play name game
5/26/2006	1B	683	Are we that attached to our cell phones? Um, hello
6/21/2006	6	412	Drinks are no longer flowing at Grace O'Malley's
7/8/2006	6	541	Arriving baitfish attract keepers

Appendix B (Continued)

7/15/2006	3	309	Mark the Balloon Guy to work magic at libraries
7/21/2006	7C	405	Sideline
8/1/2006	1D	450	Visitors bureau chief to retire
8/16/2006	7	380	Dead fish are from blast, not Red Tide
8/28/2006	7C	307	Captain's Corner
9/5/2006	1B	290	Red Tide doesn't ruin holiday
9/8/2006	5C	613	Grouper require proper timing and right baits
9/19/2006	3B	333	Experts: Red Tide's here, but it's mild
9/24/2006	1	637	County cranks up push for the Penny
10/3/2006	1B	364	Vila show to feature truly shipshape homes
10/14/2006	4	795	Pomps and circumstance
11/24/2006	6	573	He loved Ruskin…its people' Eugene McRoberts 1921-2006
12/3/2006	2D	1916	Red Tide leaves bad taste in visitors' mouths

Appendix B (Continued)

Sarasota Herald-Tribune:

Date	Page	Word Count	Headlines and Sub Headlines
3/4/2004	BV1	153	News Updates: Red tide eases off at region's beaches
7/2/2004	BCE1	552	Tiny tarpon, big payoff
2/1/2005	BS1	129	News Updates: Red tide causing irritation at beaches
2/11/2005	BC2	43	Red tide keeps away crowds -- human ones at least
3/3/2005	BS1	123	News Updates: Red tide bloom grows along three counties
3/10/2005	G3	814	For this princess of red tides, something foul is in the air
3/27/2005	BCE1	618	Emptying e-mailbox: red tide, dogs, teacher pay, political correctedness
4/13/2005	BV1	495	Seen & Heard
6/10/2005	C8	651	Lingering red tide creating woes for area anglers
6/29/2005	A12	365	A local laboratory - Focusing research on red tide makes sense
7/17/2005	C8	565	Red but not dead - Those willing to scout around can find areas of clean water and plenty of hungry redfish, snook and others
8/3/2005	BM1	537	Beach work scaring off visitors - Pace of dredging on Anna Maria upsets businesses
8/20/2005	A2	222	From Your Reader Advocate
9/1/2005	BS1	548	Red tide's latest victims or sea slug sex party?
9/13/2005	D3	240	Business Buzz
9/18/2005	C2	640	Seeing red - Despite red tide, redfish, snook, bluefish and other species are plentiful in Sarasota Bay and surrounding waters
10/1/2005	E1	665	Ferry ride floats to Egmont - For a day trip, try the ferry to Egmont Key
10/17/2005	A12	611	Red state, red tide - Researchers make their case for more funding

Appendix B (Continued)

11/2/2005	A1	719	Red tide takes a breather - The air is clear, the fish are alive and no one knows why
11/9/2005	A1	673	Will heat bills put a chill on tourist season? - Higher costs for heating, airline tickets could dent Northerners' vacation budget for Florida
12/9/2005	BC2	152	Briefs: Experts to answer questions about Gulf
12/31/2005	BS1	608	2005 - SOUTHWEST FLORIDA'S TOP STORIES
1/16/2006	A1	1537	WATERWAY WAITS FOR ITS SALVATION - Hudson Bayou offers the kind of water views that many in Florida gladly pay to see, but it harbors some dirty secrets
2/23/2006	BS1	661	Sea cow tallies get no respect - Neither side trusts numbers in the fight over protections for the state's manatees
4/2/2006	L24		(performing arts)
5/6/2006	D1	542	Sarasota County hotel prices increase as occupancy drops
6/3/2006	E1	581	Bugs aside, beach runs fun for whole family
6/28/2006	G7	168	Summer solstice
6/21/2006	BS1	896	Answers few at forum on red tide - One activist said experts didn't seem committed to cleanup
8/7/2006	A10	415	Troubled waters - Seize the initiative to protect the world's seas
8/21/2006	A1	797	Red tide's worst bloom this year: bad PR
8/25/2006	BS4	740	Sarasota High's Kiwanis Career Center in full swing
9/1/2006	C2	645	Don't let reports of red tide spoil your fishing
9/13/2006	BM1	536	(Seen & Heard)
9/17/2006	F2	760	Just another day in paradise
9/23/2006	E1	640	Turtle volunteer hatches plans on Caspersen Beach
10/2/2006	BCE4	2291	This week's events in your town
10/12/2006	G1	1077	Hermitage is hopping - New people, new ideas bolster artists' retreat

Appendix B (Continued)

10/28/2006	BS1	703	First lady wows Sarasota crowd - Laura Bush visit supports Vern Buchanan for District 13 seat
11/6/2006	E1	572	Goodbye, your Pinkness
11/20/2006	BS1	1361	Saving oceans at top of his list
1/8/2007	BS1	615	Red tide levels down significantly - Misery caused by noxious algae in the Gulf declines in winter
1/27/2007	E1	634	Ride and dine - Local cyclists form a Lunch Bunch for monthly outings to local restaurants
2/25/2007	BCE1	769	So what can we do about red tide?
4/8/2007	C2	560	Red rebound - After two years of devastating red tide, resilient spotted seatrout are showing signs of recovery
5/6/2007	BM2	49	Sand Castles? Give Us a Real Challenge
6/16/2007	D1	609	Tourism budget could be reduced
7/20/2007	A1	807	Creeping Dead Zone - Fed by nitrogen and phosphorus, a lifeless area in the northern Gulf could grow to record size

Appendix C: Newspaper Quotes with Red Tide Descriptions

St. Petersburg Times:

Date	Descriptions
1/17/2004	“persistent bloom of Red Tide continues to befoul the waters”; "Red Tide is caused by a high concentration of microscopic algae. Fish die after sucking the toxic particles through their gills and into their bloodstream."
3/25/2004	“Red Tide is a higher-than-normal concentration of a naturally occurring algae that can kill fish and other marine life.”
5/19/2004	No description
11/29/2004	“red tide algae blooms that produce paralyzing toxins”
2/18/2005	“reports of patchy Red Tide”
4/8/2005	No description
6/22/2005	No description
7/1/2005	“Red Tide struck the area and drove off many, if not all, of the game fish”
7/4/2005	No description
7/8/2005	“Red Tide bloom is at a high level”; “Fish kills are evident all over the shore line, and respiratory irritation is very high.”
7/13/2005	“Red Tide’s dead fish”
7/22/2005	“Because of Red Tide, gulf waters from the shoreline to about 11 miles offshore have little to offer. But nature abhors a vacuum, and these waters again will teem with bait and fish.”
7/28/2005	“Red Tide affecting inshore fishing around the bay area”
8/4/2005	“the Red Tide hit hard”; “The bottom was littered with dead bait, small fish, crabs and invertebrates. There was almost nothing alive.”
8/10/2005	“’It's a good possibility the turtle mortalities are from Red Tide,’ said Dr. Janine Cianciolo, the aquarium's staff veterinarian. ‘(The) algae produces a toxin, and it's the toxin that kills them.’”; “noxious stench”
8/14/2005	“The toxin produced by algae in Red Tide usually only affects fish, but when the Red Tide lasts a long time, it can start to harm larger animals like sea turtles. Also as fish die off, their decomposition consumes oxygen in the water, multiplying the Red Tide's deadly toll.”
8/18/2005	No description

8/23/2005	“Some experts are calling 2005's Red Tide the worst environmental disaster in the gulf in 30 years.”; “microscopic algae that produces toxins”; “it poses a problem when its population explodes”; “Karenia brevis”; “a bloom of microscopic algae that appears as a sheen on the water and bleeds lethal toxins”
8/26/2005	No description
9/2/2005	“All the damage to the plants, corals and sponges from the Red Tide makes things look even worse with the absence of fish.”
9/16/2005	“(Red Tide) looks like coffee”
9/23/2005	“RED TIDE FACTS: Red tide is a microscopic algae (plant-like organism) in Florida called Karenia brevis or K. brevis. It produces a toxin that can kill fish and cause respiratory problems in humans. Red tide can last days, weeks or months, and can change daily.”
10/2/2005	No description
10/10/2005	“horrible Red Tide”
10/22/2005	No description
10/31/2005	No description
11/12/2005	“toxic algae, which kills fish, prompts respiratory problems in humans and leaves tourists complaining of ruined vacations”; “Red Tide is a naturally occurring algae that periodically affects the Gulf Coast.”; “It led to the death of thousands of fish, and also of birds that fed on them as they washed up to shore. It is blamed for the deaths of dozens of sea turtles. And it created negative publicity for tourism along the Gulf Coast, after guests arrived at their beach hotels and discovered the sea was making them sneeze and sniffle.”
11/26/2005	No description
12/17/2005	“Red Tide, memorably bad this year, was blamed for 40 of those (manatee) deaths.”
12/31/2005	No description
1/13/2006	“Of the (manatee) deaths in 2005, 81 were blamed on Red Tide”
2/10/2006	“Last year’s Red Tide hurt the trout population.”
3/10/2006	“Some say the Red Tide had a huge impact on trout population in that area”
4/6/2006	No description

Appendix C (Continued)

5/26/2006	No description
6/21/2006	"Red Tide had curbed tourism as much as had the threat of hurricanes"
7/8/2006	"Whether the fish were killed by Red Tide or left the area to avoid it, one thing is certain: they were almost completely gone and had not been returning quickly."
7/15/2006	"The Florida red tide organism, Karenia brevis, produces a toxin that can kill marine life and affect humans. The effects of red tide, such as dead fish and respiratory irritation in people, depend on the location and concentration of the red tide organism at a given time."
7/21/2006	"Karenia brevis, the algae bloom that causes Red Tide in Florida"
8/1/2006	No description
8/16/2006	No description
8/28/2006	No description
9/5/2006	"reports of Red Tide creeping in the area"
9/8/2006	No description
9/19/2006	"Red Tide algae blooms"; "acrid, sickening smell of rotting fish"
9/24/2006	"its (Red Tide) presence is bad for the community and a reason for tourists to go elsewhere"
10/3/2006	"Red Tide remained in medium to high concentrations off the coast from Tarpon Springs to Naples over the weekend, but a change in winds kept the dead fish offshore."
10/14/2006	"heavy hand of Karenia brevis, the strain of Red Tide common to the Gulf of Mexico"
11/24/2006	No description
12/3/2006	"coughing"; "dead, smelly fish at the beach"

Appendix C (Continued)

Sarasota Herald-Tribune:

Date	Descriptions
3/4/2004	“a strong red tide that caused coughing and wheezing on beaches”; “Ocean currents and tides can move red tide blooms, and winds can carry the airborne toxins either toward the beach or away from it.”
7/2/2004	No description
2/1/2005	“a patch of red tide”; “concentrations of the near-shore red tide bloom”; “likely to make area beaches unpleasant this week”; “Visitors to the beaches are likely to experience irritation when west winds blow onshore.”
2/11/2005	No description
3/3/2005	“a strong red tide…grew even stronger this week, littering some beaches with fish killed by the lack of oxygen caused by the bloom”; “Red tide is algae that sometimes grow into massive blooms that kill fish and poison clams. It also prompts reactions in people, including coughs and congestion.”
3/10/2005	“red tide sounds much too friendly”; “the bacteria that recently brought the demise of a 100-plus-pound goliath grouper”; “should be called ‘red dread or phlegmatic curse’”; “gunk”; “has wreaked havoc on the respiratory systems and sinus cavities of several local people and pets”; “germs and bacteria waging war against living, breathing creatures”; “hacking cough”; “Your eyes water, sinuses swell and – if you’re extra lucky – you get a bonus throbbing headache.”
3/27/2005	“Humans are not the only land mammals that suffer when red tide hits the Gulf.”; “Dogs get sick.”; “(dogs) suffered red tide poisoning either from breathing the toxins released by the algal blooms, from ingesting algal water or from eating dead fish that had accumulated the toxins”; “increasing frequency of algal blooms along the coast”
4/13/2005	“convinced that red tide is related to the flow of the loop current in the Gulf of Mexico and its proximity to shore”; “red tide outbreak”
6/10/2005	“The bloom seemingly has been around the area forever”; “the tide”
6/29/2005	“the neurotoxin called red tide”; “Red tide consists of toxic algae that kill fish and marine mammals and cause respiratory distress in people -- conditions all too familiar this year.”; “a red tide bloom can ruin a beach vacation or a chartered fishing trip”
7/17/2005	“Two of the dirtiest words in saltwater fishing are red and tide.”; “The pesky bloom seems to be more common and lingers longer than it did a few years ago.”; “The vision is a fish-killing blanket of red water that virtually shuts the (fishing) industry down. Nothing could be further from the truth.”
8/3/2005	“a beach season stricken by red tide”
8/20/2005	“infestation”
9/1/2005	“a bloom of toxic microscopic algae”; “Red tide and its secondary effects have led to mass deaths of speckled worm eels, horseshoe crabs and other species of bottom feeders.”

Appendix C (Continued)

9/13/2005	No description
9/18/2005	“Red tide, a dreaded algal bloom, is a fact of life along the Gulf Coast.”; “regular visitor that usually shows up once a year and dissappears after a week or so”; “robs the water of oxygen and results in massive fish kills”; “Of course, that's only if you believe red tide is an all-encompassing blanket that covers every square inch of water. That's just not so.”
10/1/2005	“the tide”
10/17/2005	“a toxic algal bloom that affects the Gulf of Mexico”; “Red tide kills fish and marine mammals, irritates the respiratory systems of humans and thins the numbers willing to shop in commercial areas close to beaches, reserve hotel rooms for a vacation, eat in waterfront restaurants or charter fishing boats.”
11/2/2005	“While red tide is natural in local waters, fishermen say the number and intensity of the blooms in recent years is not."; "Scientists looking at the same data about the west coast of Florida come to different conclusions about whether the tides have worsened in the last century.”; “It's killed millions of fish and record numbers of sea turtles along with dolphins and manatees.”; “There is wide agreement in the global scientific community that nutrient pollution from a variety of sources contributes to harmful algal blooms, or HABs.”
11/9/2005	No description
12/9/2005	No description
12/31/2005	“Red tide plagues region”; “red tide bloom”; “the outbreak”; “It has killed millions of fish and record numbers of sea turtles along with dolphins and manatees”; “the bloom led to a 2,000-square-mile dead zone”
1/16/2006	No description
2/23/2006	“An intense and stubborn red tide bloom was blamed for 81 (manatee) deaths.”
4/2/2006	No description
5/6/2006	“prolonged red tide outbreak of 2005”
6/3/2006	No description
6/28/2006	No description
6/21/2006	“red tides have become more abundant, and shellfish more scarce”; “karenia brevis”; “larger and longer-lasting red tide blooms of late”; “In 2005 a red tide bloom lasted 13 months and killed 89 manatees as well as dolphins, sea turtles and sea birds. It also caused extensive fish kills and led to a 2,000-square-mile dead zone.”

Appendix C (Continued)

8/7/2006	"a bloom of red tide, a term used for the toxic alga Karenia brevis"; "outbreaks could be both natural and cyclical"; "red tide can kill manatees, dolphins and fish; when red tide is picked up the wind or surf, it can cause respiratory problems for people"
8/21/2006	"red tide algae – Karenia brevis"; "But red tide and the ill effects of red tide are two different things. Whether red tide will make the beach unbearable has as much to do with wind direction and surf height as algae levels."
8/25/2006	No description
9/1/2006	"The pesky bloom isn't a blanket that covers every square inch of the Gulf of Mexico and area bays. In fact, this year's red tide is pretty patchy."
9/13/2006	"It leaves dead, stinky fish in its wake, prompts people to cough and can drive away customers from waterfront businesses."
9/17/2006	"toxic alga"
9/23/2006	No description
10/2/2006	No description
10/12/2006	No description
10/28/2006	No description
11/6/2006	No description
11/20/2006	"politically charged – red tide"; "It bloomed each summer as if it were scheduled."
1/8/2007	"Red tide algae naturally occur in marine waters in background concentrations. When the algae encounter conditions that allow them to feed and grow, they form a bloom. Generally, the algae prefer salt water, warm temperatures and calm waters."; "The algae's life cycle is short and when they die, they emit brevetoxin, a poison that kills dolphins, sea turtles, manatees and fish."; "caused respiratory problems and killed marine animals"; "In 2005, 92 manatees died from exposure to red tide."; "When the wind blows toward shore during red tide blooms, the poison drifts up to 1 1/2 miles inland. Even healthy lifeguards feel the typical cough and sometimes end up with a stuffy nose. The poison can cause breathing problems for people with asthma."; "Historically, red tide disappears, or at least drops, in the cool winter months."
1/27/2007	No description
2/25/2007	"periodic explosion of algae that often kills fish, birds and marine mammals, releases toxins into the air and turns the water a reddish hue"; "harmful algal blooms"; "mounting evidence that algal blooms have gotten more frequent, more intense and more long-lasting because of human activities"

Appendix C (Continued)

4/8/2007	“severe outbreak of the fish-killing bloom”; “another bout last year delivered the knockout punch (spotted seatrout population)”
5/6/2007	No description
6/16/2007	No description
7/20/2007	“Dead zones grow in the summer because the combination of warmer temperatures and high nutrient loads from spring runoff fuel enormous algal blooms that sink to the bottom of the Gulf and die. The decay process sucks oxygen from the water, suffocating any fish, shrimp or mollusks that become trapped in that area.”; “widespread bloom of red tide algae killed a massive amount of fish”