CLIMATE CHANGE KNOWLEDGE AND PERCEPTIONS OF GEOGRAPHY ALUMNI OF TEXAS STATE UNIVERSITY-SAN MARCOS

THESIS

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CHAPTER I

INTRODUCTION

No life on Earth escapes the influence of climate. Greater scientific consensus exists now than ever before on the occurrence of climate change due to human actions as reported by the Intergovernmental Panel on Climate Change (IPCC) (IPCC 2007b). Projected negative impacts on humans include changes to food and water supplies, patterns of disease, and severity of weather-related hazards (IPCC 2007a). Because the United States is one of the largest producers of greenhouse gases, the perceptions of Americans about the causes of, solutions to, and exigency of climate change could have global consequences (IPCC 2007b). As not all impacts will affect all places equally, a geographic perspective is a valuable viewpoint from which to analyze both the effects of climate change and affected individuals' perceptions on different regions and areal scales. Therefore, this thesis surveys the ways in which Texas State University-San Marcos (Texas State)geography alumni think about climate change today. The results may have implications for the types of future actions and planning taken in Texas in the public and private spheres.

In response to the growing scientific consensus on the occurrence of anthropogenic climate change, researchers have begun to examine the knowledge and beliefs of the public. Because support for mitigating policies and actions has been minimal in the United States (U.S.), gauging the level of concern among different groups of people may explain the apparent reluctance of Americans to respond to the increasing threat of climate change. Because public policy is often shaped by public perceptions, the purpose of examining risk perceptions of climate change is to learn how best to inform the public and policy makers about necessary mitigations and adaptations (Slovic 2004a).

Individuals who seek higher education in the field of geography all have an interest in patterns over space and time on Earth. These interests can range from human health and population, urban development, and physical and biological processes within the natural environment. Climate change is expected to have impacts on human life, non-human life, and many natural processes (IPCC 2007a). The Texas State core curriculum exposes students to many issues surrounding human-environment interactions (Texas State 2007a). Texas State geography alumni are an appropriate population to analyze because the programs within the Department of Geography prepare students to work in many fields expected to be impacted by climate change ranging from biogeography to urban planning (Texas State 2007a). Texas State is also

the largest source of geography graduates in the state of Texas (Texas State 2007b).

Assumptions may be made that this group of people has greater understanding of, and concern for, climate change. However, a college degree in geography does not presuppose either accurate knowledge of the causes and effects of climate change or the personal will to do anything about it. For example, whether a person studied urban planning or biogeography, they may not automatically see a link between their field and climate change. Bostrom et al. (1994, 959) maintain that "many controversies in risk communication arise when experts either underestimate or overestimate the public's knowledge."

By gathering survey responses from a sample of adults educated in geography, this study intends to gauge the levels of accurate knowledge and perceptions of personal and global risks from climate change to learn what perspectives they will bring to their roles as professional geographers. The state of Texas has been selected as the geographic area of study because it is the largest single producer of carbon dioxide in the United States according to the U.S. Energy Information Administration (EIA) (EIA 2008). Texas also has numerous vulnerabilities to the impacts of climate change (Field at al. 2007). As the largest geography program in Texas and with a large student population from Texas, geography alumni of Texas State University-San Marcos have been chosen to represent self-selected environmentally educated adults.

The state of Texas presents a relevant study area for the perceptions of climate change due to its overall contributions to global climate change and its population's vulnerability to the effects. Due to the oil and gas industry, the burning of coal for electricity, and the reliance on personal vehicles for transportation, Texas has outpaced all other states as the largest emitter of carbon dioxide from at least 1990 to 2005 (EIA 2008). Texas also demonstrates a unique range of geological and biological features (U.S. Environmental Protection Agency 2007). Texas' ecoregions have allowed the climate-sensitive industry of agriculture to become Texas' second highest resource-based sector (Texas Department of Agriculture 2009). With a 2008 population estimated to be above 24 million, Texas ranks as the second most populous state in the nation (U.S. Census Bureau 2009). Further, data from the National Oceanic and Atmospheric Administration (NOAA) indicate that over 5 million people reside in the coastal region vulnerable to hurricanes and sea level rise (NOAA 2009). According to available data in 1999, Texas had the highest rates of deaths and damages among all of the states from the combined effects of hurricanes, floods, and tornadoes (Thomas and Mitchell 2001).

Whereas a complete evaluation of the vulnerability to climate change in Texas is beyond the scope of this paper, a brief discussion of the existing natural hazards exacerbated by, and societal factors affected by, changes in climate patterns will illustrate the importance of studying

Texans' perceptions. For North America as a whole, the factors contributing to the vulnerability to climate change as noted by the IPCC include the over-allocation of water resources, increased urbanization and the associated urban heat islands, an aging population, and development and population growth in coastal areas (Field et al. 2007). Each of these trends is evident in Texas (Thieler and Hammar-Klose 2000, TWDB 2007, U.S. Census Bureau 2009). In addition to predicted impacts such as the spread of infectious diseases, higher rates of heat-related mortality, drier soils, and more wildfires and insect pests, Field et al. (2007, 620) note that "across North America, cities will experience more extreme heat and, in some locations, rising sea levels and risk of storm surge, water scarcity, and changes in timing, frequency, and severity of flooding."

Texas is subject to both pervasive hazards (e.g., drought) and intensive hazards (e.g., floods and hurricanes) that are expected to be exacerbated by climate change (Burton et al. 1993, Field et al. 2007). One of the fundamental expectations of climate change is a rise over time of surface air temperatures. By the end of the current century, mean annual air temperatures are expected to be 2 to 3 degrees Celsius higher in the southern and western United States with the summers having the highest rate of warming (Field et al. 2007).

The National Weather Service (NWS) reports that Texas is susceptible to flooding from severe storms and hurricanes (NWS 2003).

Texas is also expected to experience lower annual-mean precipitation rates with more extremes of floods and droughts (Field et al. 2007). According to the Flood Safety Education Project (FSEP), in most years, Texas already has the highest number of deaths and cost of damage in the nation due to floods (FSEP 2009). Central Texas is particularly vulnerable to flooding and has become known as flash flood alley (FSEP 2009, O'Connor and Costa 2003). Recently, some philosophical adjustments in the approaches to flood control have taken place. The federal government has begun to shift its flood control program from engineering solutions such as dams and levees to educational programs, building regulations in floodplains, and more effective forecasting and warning systems (Burton et al. 1993).

Drought is a pervasive hazard expected to increase in frequency (Burton et al. 1993, Field et al. 2007). The IPCC projects with high confidence that groundwater systems in the U.S. southwest will experience reduced and ceased flows due to over-allocation of water resources and a lack of recharge from precipitation (Field et al. 2007). The Texas Water Development Board (TWDB) reported in 2007 that, if no changes were made to usage policies and rates, a drought in 2060 would leave 85% of the population without adequate water and an accumulated economic cost over time of $98.4 billion (TWDB 2007). Notably, this report does not appear to have included an analysis of the potential impacts from climate change. Communities prepare for drought with

many mitigating techniques to protecting their drinking water supply such as extra reservoir capacity, voluntary and mandatory water use regulations, or education programs (Burton et al. 1993). Drought as a result of climate change may require more extensive mitigation techniques because of the long timeframe and greater severity with which the effects are expected to occur.

Texas has experienced some of the strongest hurricanes to hit a U.S. coast (NWS 2003). Based on historical frequencies, Texas can expect a hurricane to make landfall along its coast approximately once every six years (NWS 2003). Whether or not this frequency or the intensity of the storms changes as a result of climate change remains to be seen (Field et al. 2007). Common adjustments to the threat of hurricanes include land-use management, warning systems, evacuation routes, and building codes (Burton et al. 1993).

With approximately 20% of Texas' population living near the coast, sea level rise is a significant concern for Texas due to the low coastal elevation and low slope (Morton et al. 2004, U.S. Census Bureau 2009). The U.S. Geological Survey (USGS) has classified the vulnerability of the Texas coast to sea-level rise as a high to very high risk because of its tidal range and the geomorphology of barrier islands, marshes, and deltas (Thieler and Hammar-Klose 2000). Mean annual sea level at Galveston, TX, has risen by more than one-half of a meter since the 1920s (Field et al. 2007). The USGS reports that the rate of coastal

erosion is accelerating in some areas of the Texas coast, and wetland loss accounts for 75% of Texas coastal land loss (Morton et al. 2004).

Humans have a unique capacity to change their environment both through the daily choices they make and in response to risk (Slovic 2004a). Although the effects of climate change are expected to be experienced primarily as familiar natural hazards, climate change also belongs to a group of threats that was created by humans such as nuclear waste and toxic chemicals (Field et al. 2007, Slovic 2004a). Americans may be reluctant to link the high quality of life they have achieved over the last century, largely through the consumption of fossil fuels, to the predicted, negative impacts of climate change. This concession would require taking personal responsibility and making changes at individual, governmental, and societal levels. This thesis examines the knowledge and perceptions of an educated sample population within Texas to gauge their levels of concern for climate change at local and global scales.

CHAPTER II

LITERATURE REVIEW

Risk Perception

The theoretical framework within which this study examines people's thoughts about climate change is risk perception. Geography emerged from an emphasis on numbers and measurements during its quantitative revolution of the 1960s and 1970s with a broader look at the effect of human decisions over space and time (Gaile and Willmott 2003). Similarly, risk emerged from calculations of probabilities to encompass the intricacies of social values and individual feelings (Breakwell 2007, Mileti 1999, Rehman-Sutter 1998, Slovic 2004a, Wisner et al. 2004). Analysis of risk has roots in economics and the law with their emphasis on the probabilities of a positive or negative outcome of a given action (Rehmann-Sutter 1998). In contrast to this viewpoint of risk as a potential negative consequence of taking a chosen, voluntary action, risk began to be considered a passive danger over which the affected parties had little decision-making ability (Slovic 2004a). This change reflected

the public's growing concern of the potentially detrimental effects of new technologies such as nuclear power (Slovic 2004a).

Douglas and Wildavsky (1982) developed the cultural theory of risk perception, considered revolutionary by some, which calls for a consideration of social and cultural institutions as well as individual affect in the study of risk perception (Breakwell 2007). Risk can be viewed as the result of evaluating dangers on scales of knowledge and consent. Climate change, from this risk assessment point of view, falls into the most difficult ends of both scales in which both uncertainty and controversy prevail. They argue that social and political bias influence the way Americans prioritize risk. Explaining that a society must decide on the hierarchy of importance of different risks, Douglas and Wildavsky (1982, 194) maintain that "between private, subjective perception and public, physical science there lies culture, a middle area of shared beliefs and values." The necessary response to risk is to build governmental and social institutions with the flexibility to learn and to adapt over time to hazards with as much resiliency as possible (Douglas and Wildavsky 1982).

Slovic (2004b) maintains that risk assessment by experts and risk perceptions of the public are both inherently subjective and value-laden. He argues that "human beings have invented the concept risk to help them understand and cope with the dangers and uncertainties of life" (Slovic 2004b, 376). People tend to define the level of threat from a given

hazard on two scales: from known risk to unknown risk and from low risk to dread risk (Slovic 2004a). For lay people, the more they believe a hazard is a dread risk, the more they support action and regulation (Slovic 2004a). He also notes that Americans have become more risk averse as their daily existence has actually gotten safer (Slovic 2004a). The primary forces behind an individual's risk perception are affect, worldview, and level of trust in authorities (Slovic 2004b).

Natural Hazards and Risk Perception

Because the predicted, negative effects of climate change are expected to take the form of familiar natural hazards such as droughts and floods, a brief review follows of the theories of natural hazards, disasters, and vulnerability. Wisner et al. (2004, 50) maintain that "a disaster occurs when a significant number of vulnerable people experience a hazard and suffer severe damage and/or disruption of their livelihood system in such a way that recovery is unlikely without external aid." They emphasize the importance of incorporating social circumstances including politics, class, economics, gender, and race into disaster vulnerability assessment. They caution against focusing too much on the natural part of natural disasters. The levels of vulnerability come not from the natural disaster, but from the social conditions and distribution of power in the society (Wisner et al. 2004).

Burton et al. (1993) advocate the consideration of the roles of nature, technology, and society in the assessment of vulnerability and

the selection of appropriate mitigating action to risks from natural hazards. They maintain that humans have largely treated the environment as a set of resources to be exploited with technology and, in turn, increased the risk to humans. The more that technology and engineering allowed development of residences and industry in floodplains, on unstable soils, and over reclaimed coastal lands, the more vulnerable society became. Burton et al. (1993) measure hazards with their magnitude, frequency, duration, areal extent, speed of onset, spatial dispersion, and temporal spacing. At one end of the scale, pervasive hazards are frequent, long-lasting, widely spread, slowly occurring, and spatially diffuse such as drought. At the opposite end are intensive hazards that are rare, sudden, sort-lived, small in area, and spatially concentrated such as hurricanes and tornados. Whereas their comment is focused on developing nations, Burton et al. (1993, 28) make a compelling point that may be applied to the threats from climate change: "If no new action is taken now and if efforts are not made to develop an appropriate policy, the culpability for increasing damage tolls, added to an already heavy loss of life, will rest entirely with human acts of omission and not with extreme acts of commission that occur in the natural environment."

Mileti (1999) echoes Burton et al. (1993) in viewing technology as a potential enhancing and mitigating factor for natural hazards. According to Mileti (1999), the three systems that interact to determine the impact

of natural events in a particular place are the physical environment, the community's social and demographic patterns, and the built environment. He maintains that "losses from hazards – and the fact that the nation cannot seem to reduce them – result from shortsighted and narrow conceptions of the human relationship to the natural environment" (Mileti 1999, 2). He advocates an approach called sustainable hazard mitigation in which communities become responsible for managing their growth and development in a way that allows them to survive a disaster with a minimum of loss and assistance from outside sources (Mileti 1999). Communities must involve all stakeholders to improve environmental quality and their residents' quality of life while developing resilience, strong economies, and equity (Mileti 1999). He recommends six steps toward improved hazard preparation and mitigation: (1) recognize the dynamic, global systems that combine with infrastructure and societal factors to create disasters; (2) recognize that humans have responsibility for the losses caused by natural hazards; (3) expect conditions, and the necessary mitigation steps, to change over time; (4) take a forward-thinking perspective; (5) recognize the influence of social and demographic characteristics; and (6) adopt policies and practices that encourage sustainable development (Mileti 1999).

Climate Change and Risk Perception

In response to greater scientific consensus on the occurrence and effects of climate change, researchers have employed various methods to

evaluate perceptions of climate change from a variety of populations ranging from the general public to highly educated lay people, policy makers, and experts. Following below is a selected review of literature representing the breadth of questions and approaches to measuring risk perception, knowledge, and willingness to act on the issue of climate change.

Climate Change Perceptions over Time

Professional public opinion polls provide longitudinal data, although not always at consistent time intervals, from which to identify trends. One of the earliest polls to solicit opinions on the greenhouse effect was conducted by Opinion Research Corporation in March 1981 (Roper Center 2009). When survey participants were asked how much they had heard about the greenhouse effect, 62% of respondents replied with "none at all" (Roper Center 2009). Few people today claim to have never heard of climate change, but responses to the Gallup Poll's question about Americans' beliefs in anthropogenic climate change since 2001 show little change over time (Gallup Organization 2009). Consistently, 61% of people surveyed indicated human activities were the main cause. Responses indicating natural causes increased slightly from 33% to 35% over time.

Figure 1 shows the results from Gallup when people were asked to evaluate their own understanding of climate change from the nine surveys taken between 1992 and 2007. Despite four assessment reports

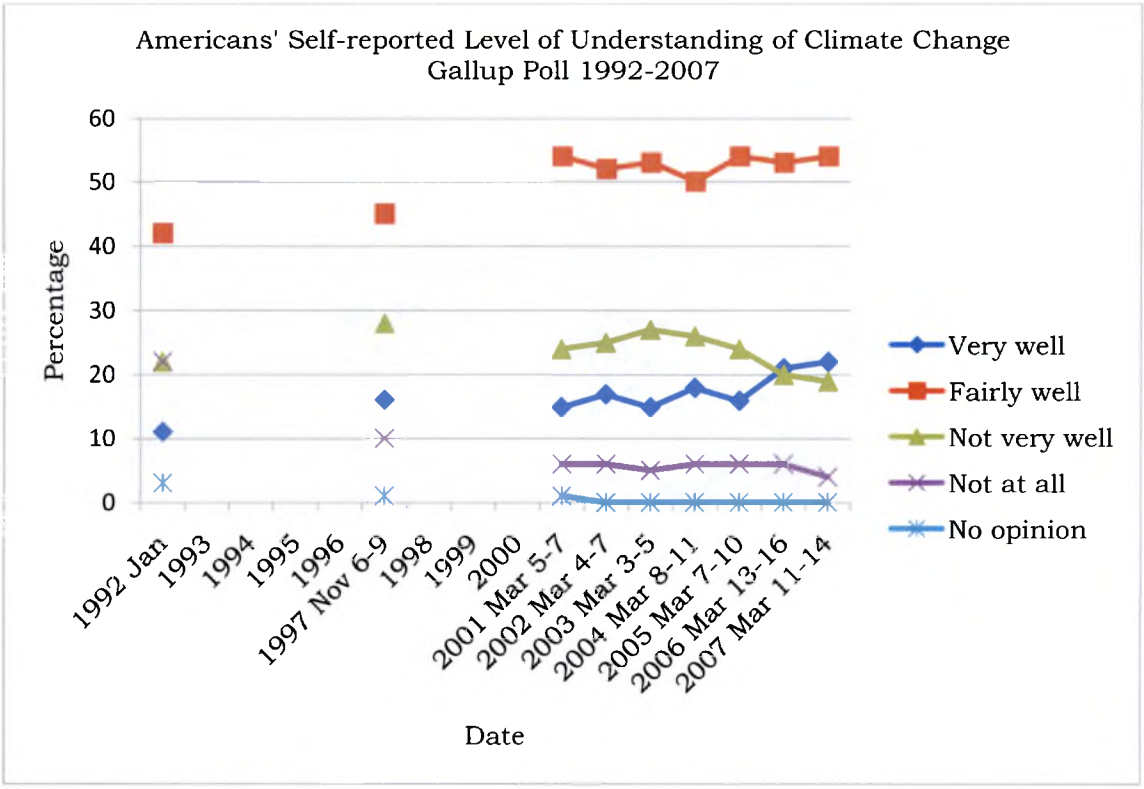

Figure 1. Results of Polls by the Gallup Organization from 1992 to 2007.

from the IPCC with increasing levels of consensus and concern, self-reported understanding has changed little over time (Gallup Organization 2009, IPCC 2007a). The most notable changes include a recent increase in the percentage of people evaluating their understanding as "very well" and a decrease over the same time period of "not very well" responses.

Over time, the results to the Gallup Poll question (Figure 2) regarding when the respondents thought the effects of climate change may or may not be experienced show a general, but not steady, trend of more individuals perceiving effects from climate change as already happening from 48% in 1997 to 60% in 2007 (Gallup Organization 2009).

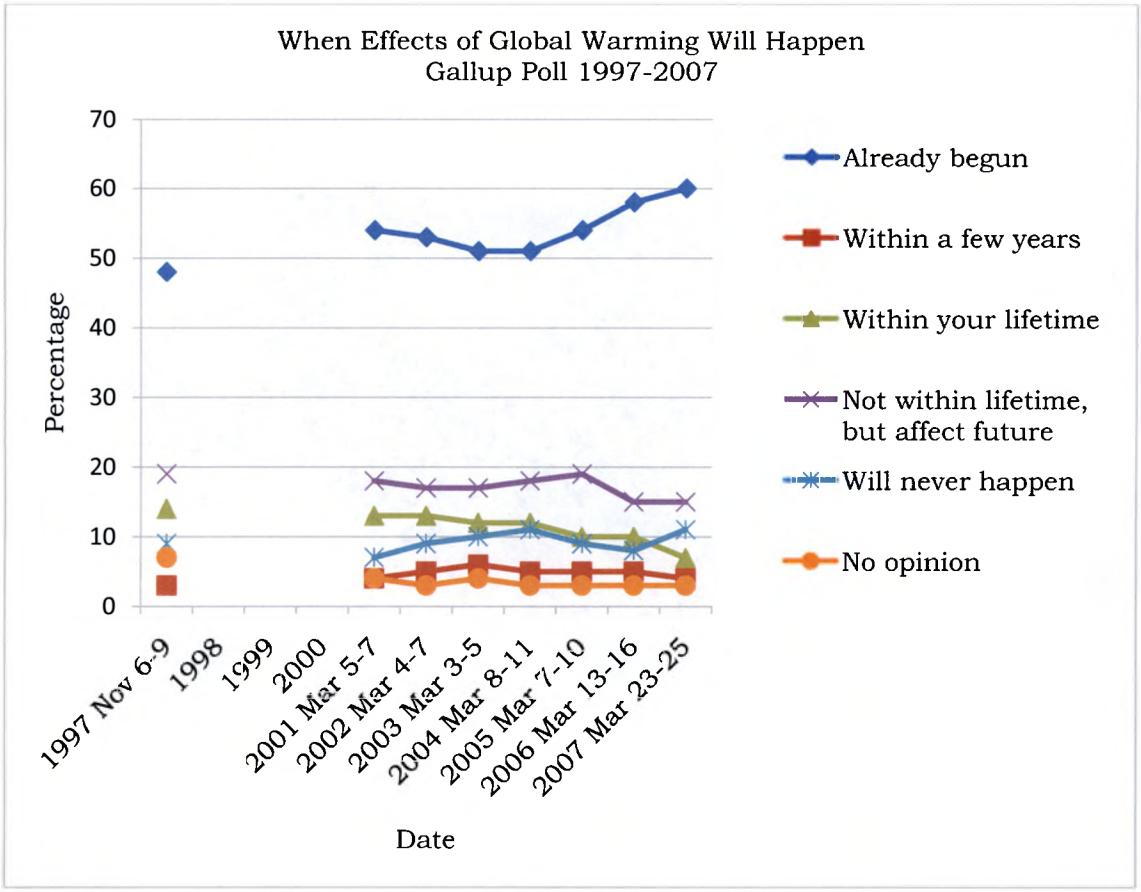

Figure 2. Responses to a Gallup Poll Question Regarding the Timing of Climate Change Effects.

At the same time, fewer individuals in 2007 selected either "within my lifetime" or "not within my lifetime, but in the future." The number of respondents who think that the effects of climate change will never happen has fluctuated over time from a low of 7% in 2001 to 11% in 2004 and 2007. The number of individuals with no opinion has dropped from 7% in 1997 to 3% in 2007. These results may indicate that, among those who believe that climate change is a real phenomenon, their concern has shifted to some degree from viewing climate change as a future possibility to a current reality.

Measurements of the degree of threat from climate change have not been included in national surveys as often as the above matrices. However, when combining the Gallup Poll and Harris Poll results from 1997 – 2008 (Figure 3), a trend can be seen in a gradual increase of respondents expecting climate change impacts during their lifetimes as well as a decrease in the number of individuals who do not feel the threat (Gallup Organization 2009, Harris Interactive 2009). An interesting disparity exists between the percentage of people who believe effects are already being felt (60%, Figure 2) and the percentage who perceive a threat in their lifetimes (approximately 35%, Figure 3). Perhaps this anomaly demonstrates that people do not necessarily perceive climate change as negative.

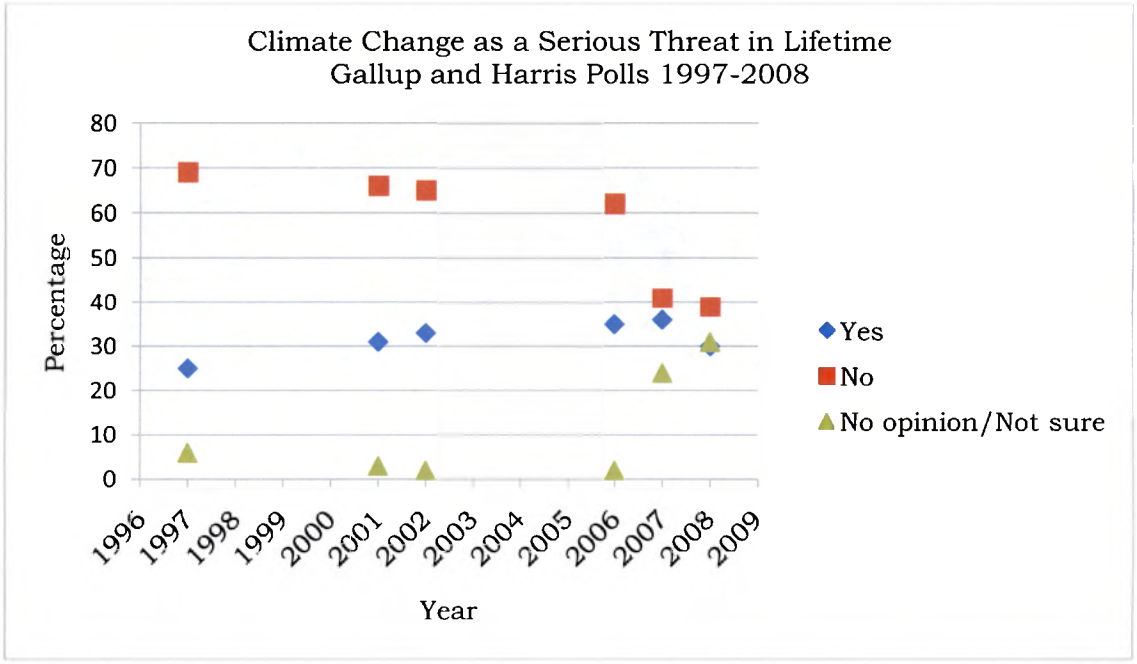

Figure 3. Perceptions of the Lifetime Threat from Climate Change in the Gallup and Harris Polls.

Climate Change, Humans, and Action

Henry (2000) used informal interviews to gauge the perceptions of a self-selected group of visitors to a global warming exhibit at the Smithsonian Institute. The author interpreted the visitors' comments and identified three patterns of belief (Henry 2000). First, many people strongly associated ozone depletion with global warming (Henry 2000). Second, many who believed in global warming thought that the effects would be sudden (Henry 2000). Third, many visitors seemed reluctant to consider that human action could affect the world's atmosphere (Henry 2000).

Viscusi and Zeckhauser (2006) conducted an internet survey of law and public policy graduate students at Harvard University to assess their risk perceptions, their willingness to pay for mitigation policies, and the degree to which their personal biases and scientific uncertainty influenced their concern for climate change. Notably, respondents' knowledge of climate change was not evaluated (Viscusi and Zeckhauser 2006). Regression analyses were conducted to identify any correlations with variables including gender, 2004 presidential election outcome prediction, the level of mitigation policy support, car ownership, and country of citizenship (Viscusi and Zeckhauser 2006). Consistent with the studies mentioned above, greater policy support was predicted by greater perceived risk (Viscusi and Zeckhauser 2006). Whereas being male predicted less perceived risk from climate change, males also had a

greater willingness to pay for mitigation policies (Viscusi and Zeckhauser 2006).

In a companion study to Jaeger et al. (2000) and Kasemir et al. (2000), Stoll-Kleemann et al. (2001) used integrated assessment focus groups to attempt to clarify disparities between belief and climate change and willingness to take action. Adult groups in Switzerland, chosen by a stratified random sampling technique, were shown an interactive computer model relating to climate change. Following a written questionnaire and group interviews, participants made collages depicting a future involving reduced-energy use and a business-as-usual future (Stoll-Kleemann et al. 2001). Common themes identified by analyzing responses include an unwillingness to change lifestyles, a belief that individual action is insignificant, the hope for technological solutions, as well as distrust of and lack of support for government action (Stoll-Kleemann et al. 2001).

Climate Change Perceptions and Environmental Concern

Several researchers have made contributions to understanding the relationship between general environmental concern and perceptions of climate change. O'Connor et al. (1999) examined relationships between perceived risk of climate change, level of concern for the environment, and willingness to vote for or personally to act upon mitigation efforts. These authors evaluated responses to a mail survey of a random sample of U.S. residents using factor and regression analyses. Results indicated

that risk perception and environmental beliefs demonstrate independent influence on predicting willingness to act and support for policies (O'Connor et al. 1999). Knowledge of climate change was a significant predictor of intentions to act and to vote (O'Connor et al. 1999). The authors note that "people assess the consequences of climate change differently from their general environmental beliefs" (O'Connor et al. 1999, 466).

In a follow-up study to O'Connor et al. (1999), Bord et al. (2000) conducted a mail survey on a random sample of American adults. To test the hypotheses against the responses, the authors built five multivariate models and used least-squares regression for the statistical analysis (Bord et al. 2000). A majority of respondents attributed climate change to both real and false causes (Bord et al. 2000). Respondents also perceive global warming as a greater risk to society than to themselves, but global warming remains a lower risk than the other environmental issues presented (Bord et al. 2000). Whereas a majority of participants showed concern for the environment in general, the degree to which this variable predicted concern for climate change specifically was minimal (Bord et al. 2000).

Climate Change Perceptions over Space

Whereas few studies have taken a spatial approach to analyzing climate change perceptions, public opinion polls have shown differences among people living in urban, suburban, and rural areas of the United

States (U.S.). One telephone survey conducted by the Pew Research Center for the People and the Press (2008) indicated that a majority (53%) of urban residents attribute climate change to human causes in comparison to 46% of suburban residents and 37% of rural residents. This same survey also showed differences among U.S. regions. A slight majority of residents of the Northeast and West regions cite human causes whereas 44% of Midwest residents and 43% of people in the South respond in the same way.

Evidence suggests that Americans in general feel climate change is more of a potential problem for other people and places. Leiserowitz (2005) focused his study on the perceptions of risk from climate change held by the American public in order to investigate the existence of a disparity between what the experts consider dangerous and the level of threat felt by the public. In a mail survey, respondents were asked to rate the likelihood of effects of climate change on standard of living, availability of water, disease, and the environment as a whole (Leiserowitz 2005). Using content analysis to interpret open-ended questions, Leiserowitz (2005) categorized respondents as alarmists, moderates, and naysayers. Whereas most Americans believe in, and have concerns about, climate change, he concluded that the public considers the dangers of climate change to have greater effects on distant places and the non-human environment (Leiserowitz 2005).

Perceptions in the Highest Greenhouse Gas Emitting States

Perception research has been conducted in three of the four highest carbon dioxide emitting U.S. states. In a complex study in Ohio, the fourth highest state, a survey was administered to measure the degree to which belief, attitude, and certainty influence the extent to which people perceive climate change as a nationally serious issue in the United States (Krosnick et al. 2006). This study combined modeling and surveying techniques. First, a model was constructed on the premise that the level of seriousness individuals prescribe to climate change can be predicted by individuals' beliefs in the occurrence of climate change, their attitude about whether the effects will be positive or negative, and the degree of certainty in their beliefs. Second, to test the model, the researchers conducted one telephone survey on a random national sample of adults and another telephone survey on a random sample of adult residents of Ohio. Regression analyses were performed to identify significant correlations. Results indicated that an individual is more likely to describe climate change as a serious issue if one believes that climate change is real, its effects will be negative, and if one expresses a high degree of certainty in these beliefs. Respondents indicated the highest levels of concern with sea level rise, food and water availability, animal species extinction, and natural scenery degradation. Researchers explained that individuals who view climate change with greater

seriousness tend to support government mitigation policies (Krosnick et al. 2006).

For a study in Pennsylvania, the state with the third highest levels of carbon dioxide emissions, Bostrom et al. (1994) structured their climate change perception research around two methods of mental models interviews and questionnaires. The first mental models interview study enlisted staff and students at Carnegie Mellon University and the second involved attendees at a local automobile show. The questionnaire was completed by teenagers and adults in Pittsburgh, Pennsylvania. In both the interviews and questionnaires, open ended questions encouraged participants to describe their understanding and beliefs in their own words. A form of content analysis was then used to analyze the material by recruiting expert judges to compare the responses with definitions provided by climate change experts. Results indicated that most people believed in climate change, but they confused actual and false causes as well as major and minor causes. Additionally, a majority of respondents believed consequences will be generally negative, but fewer individuals felt any personal risk (Bostrom et al. 1994).

In California, the nation's second highest carbon dioxide emitting state, Michaud (2007) examined the role of trust in various governmental and non-governmental organizations in Californians' knowledge, perception, and policy support related to climate change (EIA 2008). California remains a major producer of greenhouse gases, but the state

government has been a national leader in emission regulations (Michaud 2007). A majority of Californians believed that effects have already begun, but 25% felt that effects would never happen. These results are consistent with beliefs held by the general public, but California differs in the degree of belief that climate change has been induced by human activities with 25% believing it is a natural phenomenon versus 75% of Americans as a whole. Despite California's more stringent regulations, trust in state government was not a significant predictor of climate change beliefs. The level of trust in environmental organizations proved to be a strong predictor of both belief in anthropogenic climate change and support for government mitigation policies (Michaud 2007).

Perception and Place Vulnerability

Although few studies have examined perceptions within specific U.S. states, an example is given here of research conducted in North Carolina, a state vulnerable to both sea-level rise and weather-related hazards. Apple (2007) interviewed 200 fifth through eighth grade students in North Carolina to gauge their levels of knowledge of climate change to help a museum design an exhibit aimed at that age group. Whereas only 22% of the children described accurate causes of climate change, 29% identified scientifically predicted effects. Approximately 75% of the students believed climate change is happening and 63% believed humans could slow or stop it. As seen in most surveys, confusion exists about the relationship of ozone depletion to climate

change. Whereas the researcher did not indicate how frequently students mentioned effects that may directly impact North Carolina such as sea level rise and weather-related hazards, approximately 18% responded to a question about how people's lives would change with flooding or loss of land. Another 15% cited negative changes in the weather. These results suggest that education about climate change in North Carolina has limited effectiveness and has not related the issue well to effects expected in this Atlantic state (Apple 2007).

In an effort to compare knowledge of climate change and support for mitigation policies of Americans with relation to where they live and the degree of negative impact expected from climate change in that place, Zahran et al. (2006) conducted a telephone survey and received complete responses and residence locations for 511 adults in the U.S. The researchers created a geographic information system (GIS) database, with data compiled from various national and international sources, to identify areas of vulnerability to climate change for the variables of temperature rise, sea level rise, carbon dioxide emissions, and natural hazards. A regression model factored in the climate vulnerabilities and demographic data, and the results showed some challenging implications for policy makers. Support for climate change policy involving increased personal costs was predicted by living in areas already showing a rise in temperature as calculated with U.S. Heat Stress Index Data. Residents of areas subject to weather-related natural hazards were also more likely

to support emission-reducing policies. Both of these groups were more likely than others to identify the correct causes of climate change. However, residents of areas with higher rates of greenhouse gas emissions showed less support for government policies. Most surprisingly, residents within three miles of a coastline also showed lower levels of support for climate change mitigation policies. For this particularly at-risk population, state and federal governments face challenges to gain the acceptance of potential mitigation and adaptation strategies (Zahran et al. 2006).

In a companion study, Brody et al. (2008) used this geographic approach to identify relationships between the vulnerability of locations to climate change and perceived levels of risk of residents. To measure locational risk, variables included such factors as distance from coastline, natural hazard injuries and fatalities, forest fires, floodplains, and economic damage from disasters. Using bivariate correlations and multiple regression analysis, the researchers determined that distance from a coast predicted less perceived risk from climate change. Variables related to weather and natural hazards showed only weak predictive value on risk. Consistent with the results from Zahran et al. (2006), total local and state greenhouse gas emission rates did not correlate with perceptions of risk (Brody et al. 2008). When breaking down the emission rates to a per-capita measure, residents of higher-rate areas actually perceived less risk than residents in lower-rate areas (Brody et

al. 2008). Considering the lower levels of policy support of residents near a coastline shown by Zahran et al. (2006), this study showed a surprising result of these residents perceiving greater risk from climate change (Brody et al. 2008). Residents within a 100-year floodplain, however, showed lower levels of perceived risk than people living outside floodplains (Brody et al. 2008). These spatial analyses suggest that many geographic and demographic factors combine to confound the issue of climate change perceptions in the U.S.

Wilbanks and Kates (1999) argue that climate change must be studied at both global and local scales, but they caution that generalizations at either scale may over- or underestimate causes and effects. Considering North Carolina again, Wilbanks and Kates (1999) found that most adults participating in a focus group study did not connect their lifestyles with global climate change. Perhaps one reason for the slow acceptance of climate change as an important issue is directly related to geographic scale. Many Americans may have difficulty taking the broad, global concepts typically communicated in the media about climate change and applying them to their personal actions and local environment. In this way, personal risks seem less conceivable and, therefore, personal action less necessary.

CHAPTER III

METHODS

This study sought to evaluate further the relationship between environmental education and perceptions of climate change as previously researched by Bord et al. (2000) and O'Connor et al. (1999). The supposition that Americans consider climate change to be a greater problem for other people and systems and for geographically distant places than for themselves, as suggested by Leiserowitz (2005) and Bostrom et al. (1994), was also investigated. As reported by Viscusi and Zeckhauser (2006), the role of gender as a potential factor in the levels of perceived risk was also examined.

To gather the most effective data from which to extrapolate results to the target population of Geography alumni of Texas State University-San Marcos, a survey method was selected for this study. According to O'Connor et al. (1999, 462), "information and awareness are essential for problem definition, appropriate attributions of blame, and knowing the appropriate behaviors." This study focused on measuring the knowledge

and level of concern for climate change among adults educated in Geography at Texas State University-San Marcos.

Study Population

This study targets alumni of the Geography Department of Texas State University-San Marcos with a survey of the attendees of the 2009 alumni reunion. This educated group has a wide range of interests and specialties, but each has completed the core curriculum of at least one physical geography course and one cultural geography course (Texas State 2007a). This curricula, combined with the other course work, is expected to have provided at least a basic education in the complexities of the relationship between humans and the environment.

A strong connection between these alumni and the state of Texas exists. Texas State began as a regional college and, although its national reputation is growing, Texas remains the primary source of students (Texas State 2009). According to the Office of Institutional Research, over 94% of the Geography graduates in the last 10 years came from Texas (Texas State 2009). Recent alumni surveys indicate that a majority of graduates remain in Texas (Texas State 2009). Because this group is self-selected by choosing both to complete Geography degrees at Texas State and to attend the alumni reunion, caution is advised in extrapolating their responses to a larger population.

Survey Design

Questionnaire surveys have long been used in geography for environmental perception studies (McLafferty 2006). The survey in this study (Appendix A) followed the Dillman Method as fully as possible to encourage participation and completion (Dillman 2000). Approximately five questions were designed to measure respondents' knowledge of the causes and effects of climate change, and five questions addressed risk perception for different geographic scales ranging from local to international. Participants were personally invited to take this written survey. Most questions in this self-administered survey offered fixed-response options on a five-point Likert scale (Dillman 2000, McLafferty 2006). Demographic information was gathered on graduation year, geography concentration, gender, and zip code. Considerations of ethnicity and political viewpoints were beyond the scope of this study. To acquire meaningful and comparable results with multi-component questions, care was taken to draft the questions with clear and discrete response options to allow participants to offer their opinions with a minimum of ambiguity. Prior to conducting the survey, the survey instrument was granted exemption from the formal review process by Texas State's Institutional Review Board under application number EXP2009M9967.

Data Analysis

Analysis consisted primarily of non-parametric and descriptive statistics to summarize the results and attempt to identify trends associated with demographic and geographic variables (Dorling 2006, Montello and Sutton 2006). Because most responses were values on a five-point Likert scale, this ordinal scale allowed for analysis including distributions and value frequencies (Burt and Barber 1996, McLafferty 2006). Frequency distributions for both knowledge and perception responses have been shown for the sample as a whole. Possible relationships have been explored between accurate knowledge of climate change and associated issues as well as gender and concentration of study using chi-square analyses of homogeneity. The chi-square tests were used to examine whether male and female participants, or those with training in a particular geographic concentration, were more or less likely to respond in certain ways to various issues than would be expected by chance (Caldwell 2007).

Chapter IV

RESULTS

Analysis of Survey Responses

From a list of five options, respondents were asked to select which environmental problem they considered to be the most important for both Texas and the world (Figure 4). The five options were water pollution, climate change, species extinction, garbage/landfills, and air pollution. For the world, most respondents chose climate change (47.4%) followed by water pollution (34.2%). Species extinction, garbage/landfills, and air pollution were each chosen by fewer than ten percent of the people with 7.9%, 5.3%, and 5.3%, respectively. The prioritization of environmental issues for Texas showed marked differences compared to the world as water pollution was selected most often (44.7%) followed by air pollution (26.3%). Climate change and garbage/landfills each received 13.2% of the responses and species extinction received only 2.6%.

In the second question, respondents were asked to indicate the level of scientific consensus that they believed exists regarding climate

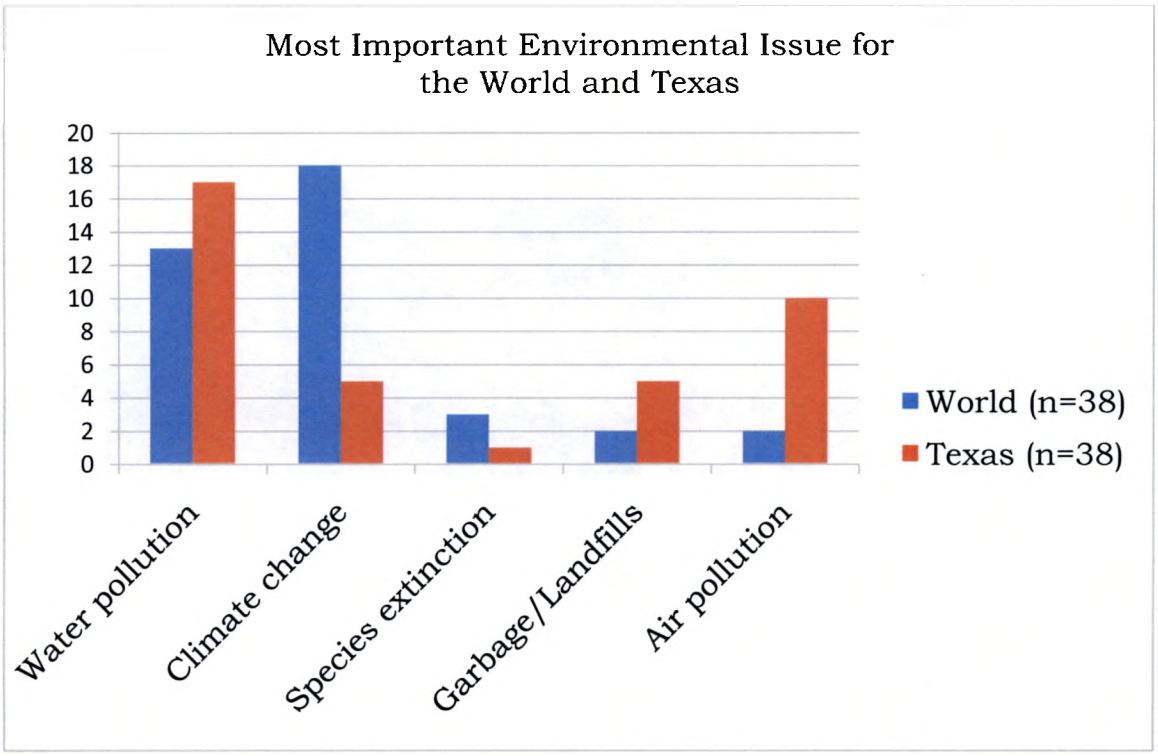

Figure 4. Distribution of Alumni Responses to the Question Asking Them to Identify the Most Important Environmental Problem Facing both the World and Texas Today.

change. A majority (56.1%) indicated that most scientists agree about the occurrence of climate change. Another 29.3% believed that there are approximately equal levels of agreement and disagreement among scientists. For the response option of most scientists disagreeing, 12.2% believed this to be true. At the extreme ends of the scale, no one responded that all scientists disagree, and only 2.4% responded that all agree.

In question three, respondents were offered five options taken from a variety of environmental threats and asked to indicate for each if they

believe that it causes climate change (Figure 5). For vehicle emissions, coal-fired electrical plants, and deforestation, high levels of respondents believed that these affect climate change with 95.1%, 100%, and 97.6%, respectively. For nuclear radiation, a slight majority (56.1%) did not believe that it is a cause. However, with 19.5% responding yes and 24.4% responding with not sure, the sample as a whole shows a fair degree of uncertainty about nuclear radiation's relationship to climate change. The highest degree of uncertainty among the group was seen when considering the role of toxic chemicals. Whereas only one fifth (19.5%) of respondents identified this as a cause, a plurality of 41.5% indicated that they were not sure about toxic chemicals' relationship to climate change.

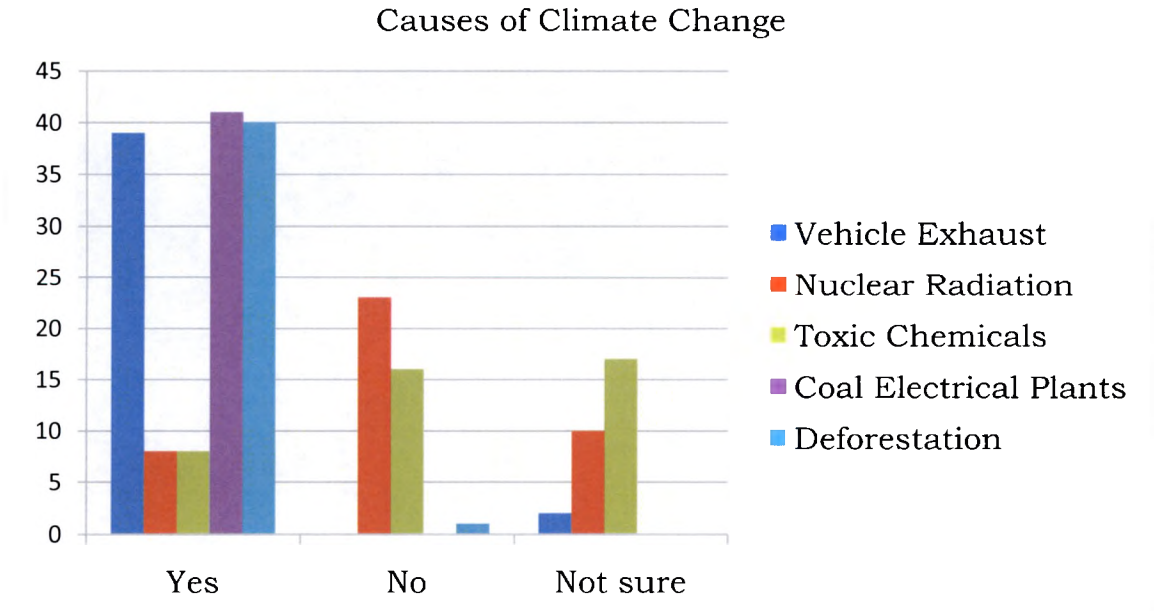

Figure 5. Distribution of Alumni Responses to Question Asking Them to Determine whether or not the Given Options Contribute to Climate Change.

Question four asked participants to indicate whether or not each of five items were actual, predicted impacts of climate change (Figure 6). A majority of respondents correctly identified sea level rise (92.7%), rising surface air temperatures (85.4%), and more drought (75.6%) as impacts currently predicted by most climate change scientists. Most participants (75.6%) also believed that more severe hurricanes will occur in the future although scientific consensus does not exist about such an impact at this time. If respondents did not choose "yes" for the impacts, the general tendency seemed to be to choose "not sure" as this option

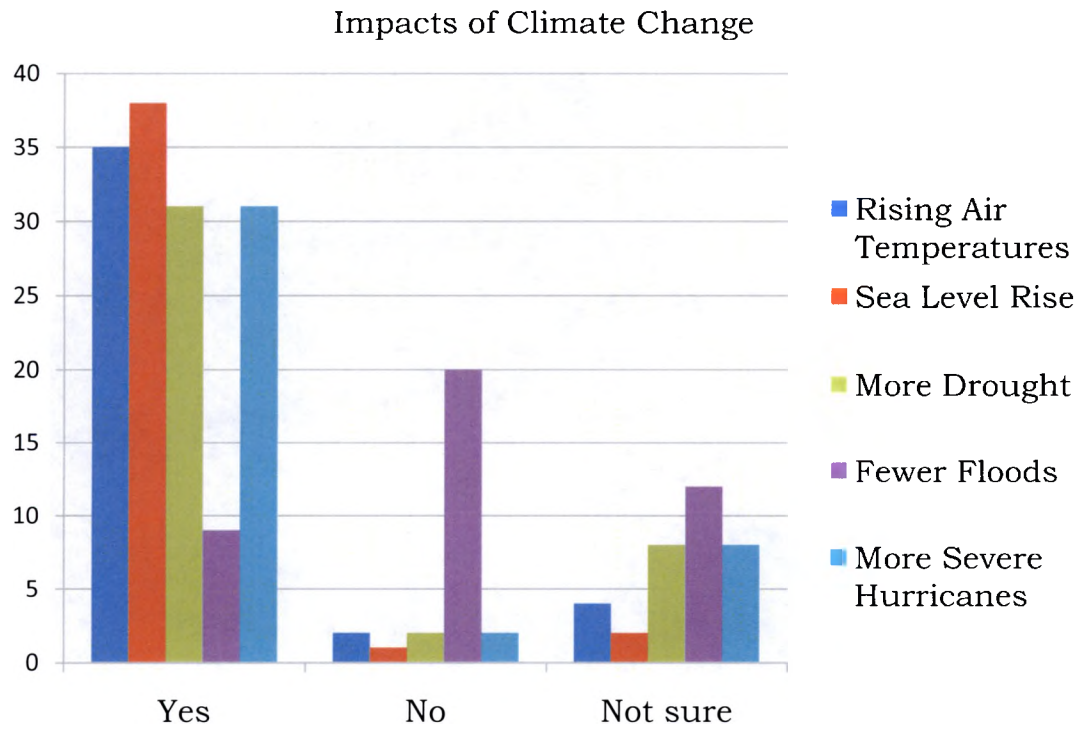

Figure 6. Distribution of Alumni Responses to Question Asking Them to Determine whether or not the Given Options Are Expected Impacts of Climate Change.

garnered more responses than "no" for each option except with regard to fewer floods. For the fewer flood impact option, 48.8% correctly chose "no." This impact option also showed the most uncertainty with 29.3% of respondents selecting "not sure."

For question five, respondents were presented with a list of five U.S. states and asked to indicate which state they believed to emit the most carbon dioxide annually. The list showed the five highest emitting states according to the Environmental Protection Agency (EPA 2008). Just over half of the respondents (55%) correctly identified Texas as having the highest annual carbon dioxide emissions. California received the next highest number of votes (27.5%), followed by Pennsylvania (12.5%), and Ohio (5%). No one selected Florida.

When asked in question six to indicate the level of importance they gave to the suggestion that industrial nations reduce their greenhouse gas emissions, 87.8% of the respondents answered on the important end of the scale with a majority of the total (63.4%) selecting "extremely important," and another 24.4% choosing the option that corresponds to "somewhat important." The options for "not at all important" and "somewhat unimportant" garnered only one response each.

Respondents were then asked in question seven to indicate their levels of concern for the potential impact of climate change on six different items: plants and animals/ecosystems, food supply, coasts,

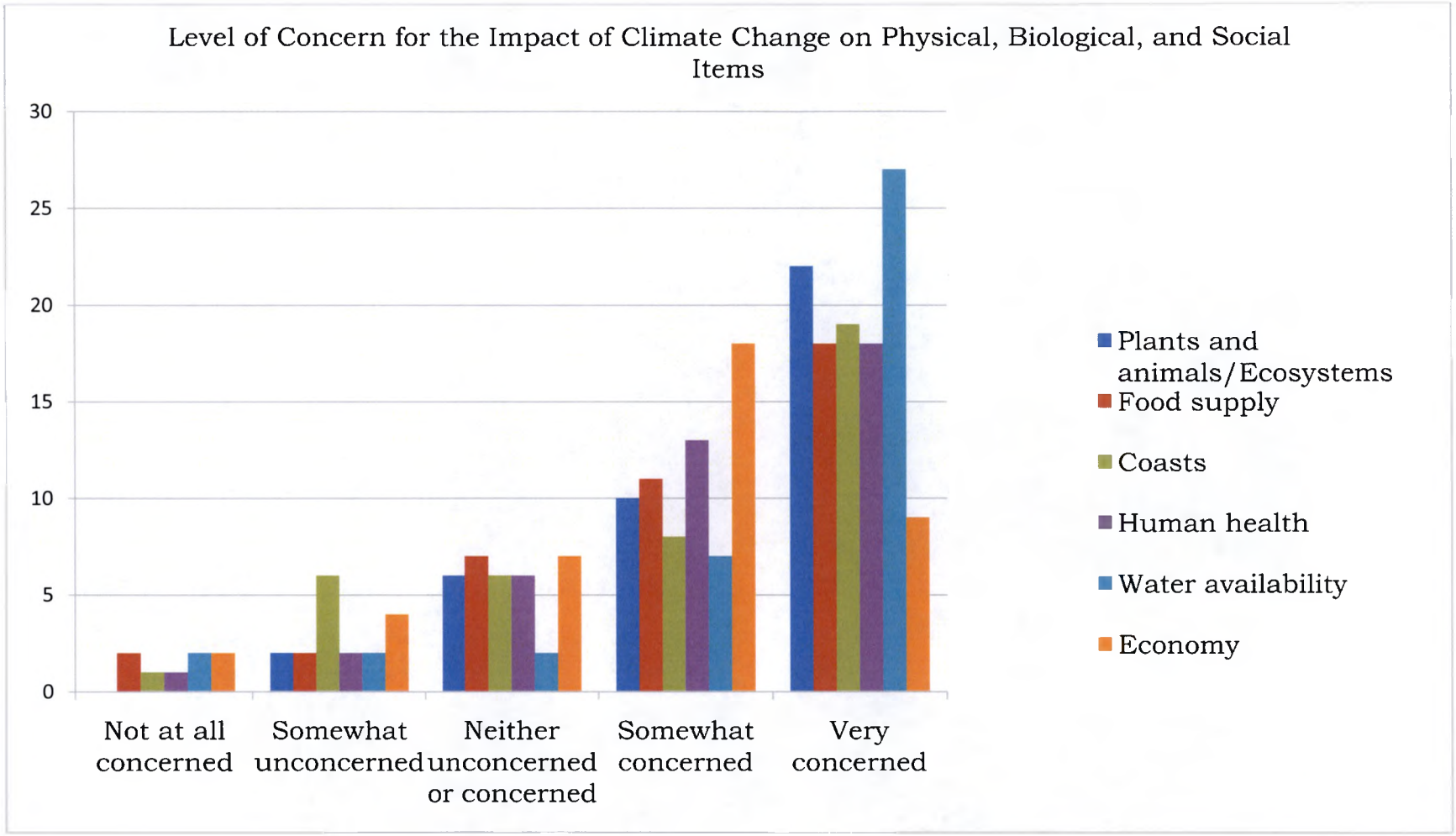

Figure 7. Responses by Alumni to Question Asking Them to Identify Their Level of Concern for Different Items with Relation to Climate Change.

human health, water availability, and the economy (Figure 7). When combining all of the "somewhat concerned" and "very concerned" responses, all categories received a majority. All categories, except the economy, also received more "very concerned" responses than any other response. Ecosystems and water availability each received a majority of responses in the "very concerned" category with 55% and 67.5%, respectively. The results for water availability showed the least ambivalence with only 5% responding at the middle of the five-point scale. Each other category showed 15% to 17.5% of responses at the middle of the scale. Whereas coasts showed high levels of concern, this option also received the most responses at the low-concern end of the scale with 17.5% of the respondents answering either "not at all concerned" or "somewhat unconcerned."

Question eight attempted to measure the perceived seriousness of climate change at different geographic scales (Figure 8). The number of "very serious" responses increased steadily as the geographic scale widened with only the world receiving a majority (60%). If considering the totals of "somewhat serious" and "very serious" responses, each category showed a majority, but responses for the community (65%) and Texas (75%) were lower than for the United States (87.5%) and the world (85%). At the community scale, the responses were most evenly distributed across the five-point Likert scale.

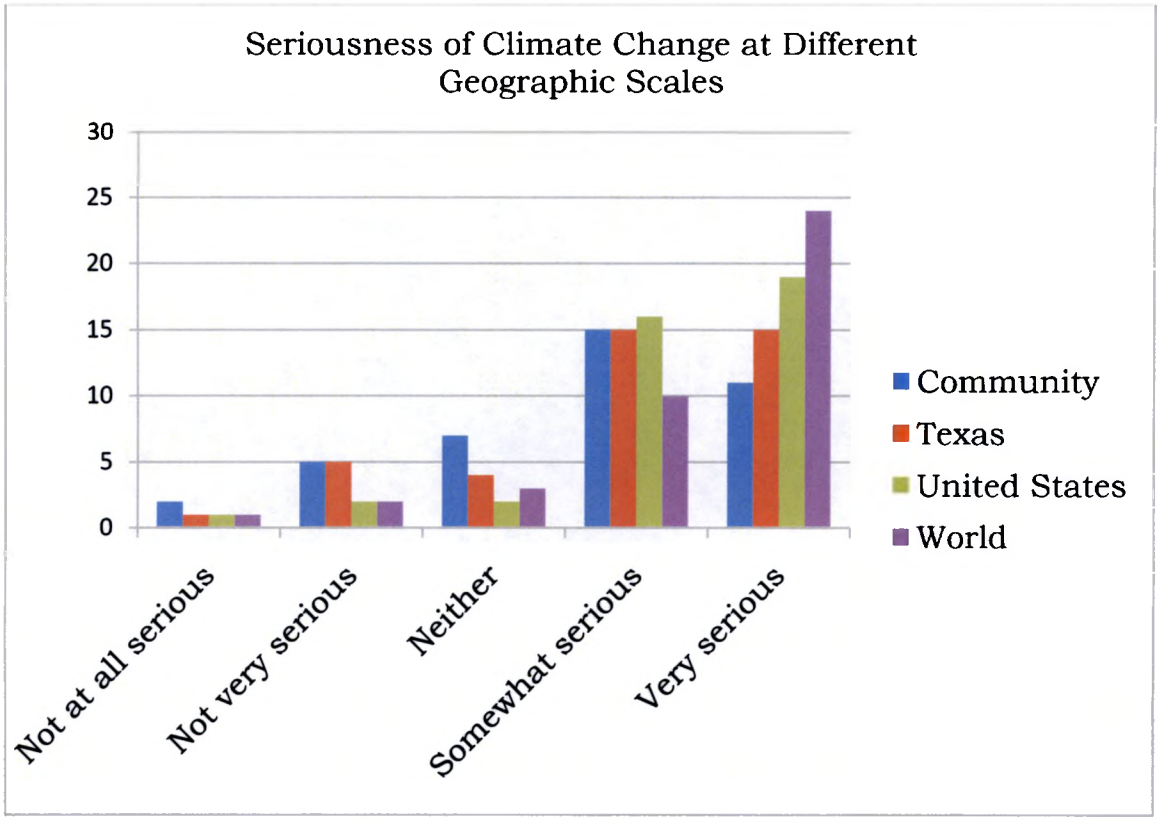

Figure 8. The Levels of Seriousness with Which Respondents Perceive Climate Change.

In questions nine and ten, participants were asked to evaluate how informed they believed other people and themselves to be (Figure 9). The participants largely rated other people's knowledge toward the lower end of the scale with 7.7% of respondents measuring other people as "not at all informed," 51.3% selecting "not very informed," 35.9% choosing "somewhat informed," and 5.1% marking "very informed." No one rated other people as completely informed. As might be expected, the self-evaluation results showed a marked shift toward the more-informed end of the scale with a majority (57.5%) believing they were "very informed," 30% were "somewhat informed," and 12.5% were "completely informed."

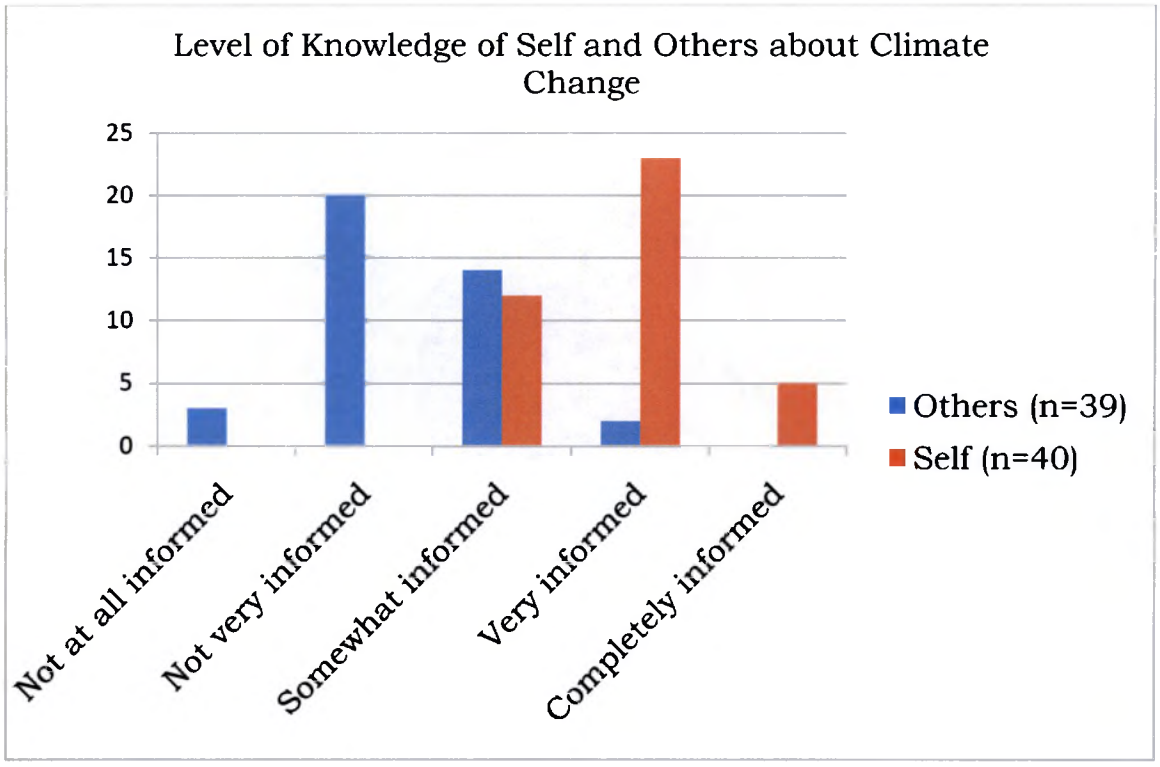

Figure 9. Evaluation of Respondents of how Informed They and Others Are about Climate Change.

No one evaluated their own knowledge as either "not at all informed" or "not very informed." By examining the difference between each subject's responses for themselves and others, the results show that only one participant rated their own level of knowledge lower than other people's. Three people considered their knowledge to be equal to other people's knowledge. A vast majority (80%) rated their own knowledge to be one or two points higher on the scale than other people's knowledge.

Question eleven asked respondents to identify which of six options about the expected timing of the occurrence of climate change best reflected their personal views. Respondents overwhelmingly chose

"already happening" (86.5%). Almost 92% selected one of the three responses that suggested the occurrence within the span of their lifetime. Only three participants (8.1%) chose the option that deferred the occurrence to future generations, and no one selected either the "never happen" or "unsure" options.

Questions twelve and thirteen attempted to gauge participants' levels of environmental concern by asking them to indicate if, and for how long, they consider themselves to be environmentally aware. All but one participant identified themselves as environmentally aware. The range of years for which participants considered themselves to be environmentally aware was from three to thirty-eight years. The most frequent response was ten years, and the average for the group was 13.3 years.

The remaining five questions in the survey sought to gather relevant demographic information. Of the 39 participants who answered the gender question, 79.5% were male and 20.5% were female. This sample has a higher representation of male alumni than the percentage of male graduates (62.3%) since 1997, the year from which data are available (Texas State 2009). Participants were also asked to list the years in which they graduated with their geography degrees. Four alumni listed two degrees, and, therefore, the following analysis considered the number of years that have passed since their most recent degree. The range of years for this group extends from 1 to 26. The

majority (65%) received their most recent degree within five years which is suggested by the mode of one year. Another 15% of respondents graduated between six and ten years ago, and 17.5% completed degrees within sixteen and thirty years ago.

For the type of degree, participants with a Bachelor of Science made up a majority of 57.5%. Holders of a Bachelor of Arts were 27.5% of the group. Only 15% held a graduate degree, and these were split evenly between Master of Applied Geography and Master of Science. No participant reported having a Ph.D.

To classify the alumni further into geographic specialties, one question asked for their area of concentration in Texas State's program. The area of concentration represented by the greatest number of respondents was Resource and Environmental Studies with 40%. General geography (17.5%), urban and regional planning (15%), and cartography/geographic information science (10%) had the next highest representation. The smallest subsets of graduates were in water studies (7.5%), physical geography (5%), and geographic education (5%).

To determine where the participants lived, they were asked to supply their zip codes. Of the 41 respondents, 92.7% lived in Texas at the time of the survey, 2.4% lived in another state, and 4.9% declined to offer their zip code. The 38 residents of Texas came from three of the seven officially-recognized natural regions: Hill Country (71.8%), Prairies and Lakes (15.4%), and Gulf Coast (10.3%) (TPWD 2007). Texas State is

located in the Hill Country region. Although consistent with results from an institutional survey showing that most alumni remain in Texas, comparative data were not available to determine how well this sample's geographic distribution represented the alumni population's places of residence (Texas State 2009).

Chi-Square Analyses of Homogeneity

The next step of the analysis was to test for the existence of statistically significant associations between both gender and area of concentration and responses to certain questions. Because the response options were categorical on a five-point Likert scale, a chi square test of homogeneity was performed for the selected questions. For gender, the questions selected for analysis were scientific consensus (Q2), level of

Table 1. Results of Chi-Square Tests of Homogeneity: Comparing Responses by Gender

Question	N	x^2	P-value
2	39	4.714	0.318
7a	39	0.396	0.983
7b	39	4.435	0.350
7c	39	6.776	0.148
7d	39	4.089	0.394
7e	39	5.032	0.284
7f	39	2.542	0.637
9	38	0.840	0.933
10	39	2.224	0.695

concern for potentially impacted items (Q7), informed level of others (Q9), and informed level of themselves (Q10). In no case was a significant association found between gender and response (Table 1).

For area of concentration, the questions selected were scientific consensus (Q2), level of concern for certain items (Q7), informed level of others (Q9), and informed level of themselves (Q10). For these chi-square tests, the responses of participants with a resource and environmental geography concentration, as the largest subset and those expected to have coursework most relevant to climate change, were compared to responses from all other concentrations. As observed with gender, no significant associations were found (Table 2).

Table 2. Results of Chi-Square Tests of Homogeneity: Comparing Responses of Resource and Environmental Concentration Alumni with All Other Geography Alumni

Question	N	x^2	P-value
2	40	1.035	0.904
7a	40	3.485	0.480
7b	40	4.860	0.302
7c	40	1.952	0.745
7d	40	1.022	0.906
7e	40	3.613	0.461
7f	40	2.401	0.662
10	40	0.021	0.999

CHAPTER V

DISCUSSION

Knowledge of Climate Change

In many ways, the overall results were not surprising. In general, this group showed high levels of concern about climate change and fairly high levels of knowledge. Unlike the subjects of Henry's study (2000) who expressed reluctance about human actions causing climate change, this group readily recognized that human behavior has an effect. However, the measures of knowledge showed that over 40% of the people were not aware of the high level of scientific consensus, and some confusion exists about the effects of nuclear radiation and toxic chemicals. This result is consistent with other studies (Bord et al. 2000, Bostrom et al. 1994).

This sample population showed a high level of knowledge about the accurate causes of anthropogenic climate change. That this group generally recognizes the real causes is encouraging from the standpoint of mitigation policy creation because previous studies found a statistically significant relationship between accurate knowledge and

willingness to support policy and to act (O'Connor et al. 1999). Less certainty existed when presented with the options of nuclear radiation and toxic chemicals that most scientists do not associate as a potential cause of climate change. The level of uncertainty about these unrelated factors is similar to results found by Bostrom et al. (1994).

The results for the impacts were more mixed with relation to the current scientific predictions than responses about the causes. The highest levels of uncertainty were seen particularly with respect to flooding, drought, and hurricanes. In general, respondents seemed to show less certainty with the impacts compared to the causes. Whereas three of the five cause options received some "not sure" responses, each of the six impact options did.

Among this group of geographers, some encouragement may be taken from a small majority of respondents selecting Texas as the leading state for carbon dioxide emissions. However, more education is needed to increase awareness as nearly half (45%) of the respondents could not identify Texas as the highest carbon dioxide emitting state. This result may be one explanation for this group considering climate change to be a lesser threat to Texas compared to the world (Figure 4). O'Connor et al. (1999) observed that willingness to act and to support mitigation policies were predicted by having accurate knowledge of climate change. Greater knowledge of this region's role in climate change could clarify the importance of personal, industry, and government action to reduce

Texas' emissions and to foster support for greater emission-reduction policies and personal actions.

Not surprising was participants' evaluation of other individuals as being less informed than they were (Figure 9). Perhaps having completed a degree in geography brings not only an actual exposure to human-environment interaction issues, but also an expectation of higher levels of knowledge about environmental issues. In general, this group may have more confidence in their knowledge than is merited by the results.

Concern about Climate Change

Clear agreement exists among this group that industrial nations should take responsibility for their contributions to climate change and take steps to reduce their emissions. This result also gives some insight into the degree to which this group of alumni believes climate change is controllable (Slovic 2004a). If the participants did not feel that reducing emissions could have a mitigating effect on the negative impacts of climate change, they may have rated the importance lower.

Impacts on physical and biological systems showed higher levels of concern than impacts on the economy. The somewhat lower totals of higher concern for human health and food supply could show a level of faith in technological and societal solutions to minimize impacts on humans and society. Leiserowitz (2005) also observed that Americans showed more concern for the non-human environment. Respondents may also not be considering less obvious ramifications of climate change

such as widening ranges of disease-carrying insects or effects on agriculture such as wildfires and insect pests (Field et al. 2007). Showing some consistency with results reported by Krosnick et al. (2006), water availability showed the greatest levels of concern. This result could be explained by a heightened state of awareness about Texas' water supply during the extreme and exceptional drought conditions in central and south-central Texas at the time that this survey was conducted (National Drought Mitigation Center 2009). Because greater occurrence of drought is an actual, predicted impact identified by the majority of the respondents, this awareness may also serve to make water supplies seem more vulnerable.

Climate change is a topic of concern to these alumni, although more at a global scale than a local scale. Despite their education in geography, similar inaccuracies and uncertainties were seen in this study as have been reported in other studies of the general population (Bord et al. 2000, Bostrom et al. 1994). Because the potential effects of climate change range across all specialties of geography from urban planning to biogeography, one recommendation is that climate change be woven into the coursework to a greater extent in all areas of concentration to increase graduates' awareness as they prepare for careers. The fact that the chi-square tests for homogeneity for area of concentration showed no statistically significant associations suggests that information about climate change is reaching a broad range of Texas

State geography students. However, the strength of this argument is limited by the small sample size.

Is Climate Change too Familiar?

In addition to the unknown and unobservable qualities of climate change, perhaps one factor in the risk perception of lay people about climate change is that the forecasted consequences, while potentially dangerous, are familiar and already occur with some regularity such as drought, floods, and storms. Slovic and Weber (2002, 13) note:

> "The informativeness or signal potential of a mishap, and thus its potential social impact, appears to be systematically related to the perceived characteristics of the hazard. An accident that takes many lives may produce relatively little social disturbance (beyond that caused to the victims' families and friends) if it occurs as part of a familiar and well-understood system (e.g., a train wreck)."

When perceived as one hazard, climate change may be grouped with nuclear waste and terrorism as having risks that are unknown or not well understood (Slovic and Weber 2002). However, because direct connections can still only tenuously be made between climate change and actual events, and the projected events are familiar, perhaps these factors contribute to the generally low levels of action thus far taken by society. Climate change is typically projected to manifest as a combination of disparate, known-factor events over time and space, and is rarely portrayed as a single catastrophic, attention-getting event (Field et al. 2007, IPCC 2007a). However, considering that most disaster-related losses in the United States have come from weather- and climate-

related events, any change in the patterns of these events is worth the attention of experts and the public (Mileti 1999).

Climate Change as Controversy

Only a slight majority of respondents believed that most scientists agree that climate change is happening. This result, despite four increasingly urgent assessment reports from the IPCC, supports the contention by Slovic (2004a) that new evidence will not always overcome either denial of, or overreaction to, a particular risk. The remaining respondents may have also been influenced by media reports that have commonly given equal weight to opposing viewpoints (Stocking 1999). One limitation to the interpretation of the question about scientific consensus is that there is no specificity about whether or not the change is due to anthropogenic causes.

Similarly, for the question to gauge their personal view of the timing of climate change, this question did not specifically qualify climate change as a primarily anthropogenic phenomenon. As the survey was being conducted, a few participants verbally expressed a strong belief that the climate was changing due to natural fluctuations in atmospheric processes rather than a human-induced problem. Therefore, some explanation for the vast majority responding that it is happening now may include those who view climate change as a purely natural process that happens all of the time.

Whereas a complete assessment of the role of the media in climate change perceptions is beyond the scope of this study, portrayal of climate change by the media remains an important issue. In simplifying the message of a scientific study, the media often portray uncertainty as a temporary problem that, given more research and time, can be minimized (Stocking 1999). This viewpoint may encourage the audience to take a wait-and-see position. Stocking (1999)also notes that climate change is an issue to which equal weight has often been given both to the majority of scientists who agree on the occurrence and the few scientists who refute the claims with little explanation of the sources of controversy. As seen in the past with clean water and air initiatives, special interests in the form of industry and business organizations use media venues to deliberately highlight scientific uncertainty in their arguments against governmental regulation (Douglas and Wildavsky 1982). To this issue, risk perception researchers point to the role of trust as an important factor. As Macnaghten (2006, 136) argues, "we need to understand better the changing relationships of trust between individuals and expert institutions, and how these affect the ways people understand and respond to environmental risk."

One source of the pervasiveness of the controversy may be a general discomfort among Americans in conceding that each one of us, and our ancestors, has contributed to the current conditions while achieving an unprecedented quality of life (Beck 2000). Within this

concept, technology is both implicated and advocated. Advancing technology is responsible for the current quality of life in the U.S. (Douglas and Wildavsky 1982). Technology has also served both to increase Texans' vulnerability to climate change by allowing more people to move into coastal regions and floodplains and to mitigate threats through more effective warning and transportation systems (Burton et al. 1993). As Macnaghten (2006, 139) succinctly explains, for global environmental problems, there is "no one to blame and no one beyond blame." Further studies could explore if, and the degree to which, people feel that they must sacrifice their standard of living in order to address the problem of climate change.

Climate Change as a Priority

The results among this sample population suggest that environmental issues are evaluated differently at global and local scales. A dramatic difference exists between how these respondents viewed climate change as a problem for the world and for Texas (Figure 4). As suggested by the results, a clear geographic component is evident in the way this sample group perceives the risks of climate change. For these alumni, the world as a whole is at greater apparent risk than one's community. This result is consistent with the conclusions drawn by Leiserowitz (2005) that Americans think of climate change as a problem for distant places and for the non-human environment. Difficulty exists in identifying a causal relationship between local events and forecasts

and climate change (Field et al. 2007). The early and enduring label, global warming, encourages a broad view as well. Macnaghten (2006, 138) found that global issues such as climate change were often perceived by people to be "detached from everyday life, making it easy for them to turn off".

Whereas climate change was chosen most often as the leading environmental issue for the world, results for climate change at the geographic scale of Texas were far behind both water pollution and air pollution. Because 92.7% of respondents reside in Texas, this difference in scale could be explained by a greater daily awareness of water usage and availability and air quality that directly affect their behavior, sometimes in the form of governmental regulations, and health (National Drought Mitigation Center 2009). Also, due to some education in atmospheric processes from a physical geography course, climate itself could be understood by this group to be a complex global system. A need exists to continue the task of presenting the causes and impacts of climate change in a way that is relevant to each region and specific about regional mitigation and adaptation options (Field et al. 2007).

Douglas and Wildavsky (1982) argue that hazards must be prioritized in order to devote resources toward mitigation and adaptation. Climate change appears to have the opposite problem of another hazard created by technology, nuclear power. Whereas people view the threat of a nuclear accident with greater dread than experts express or actual

events demonstrate, the threats of climate change are being broadcast more loudly by experts while the public remains in a state of relative inaction (Slovic 2004a). Krosnick et al. (2006) and Viscusi and Zeckhauser (2006) explain that higher levels of perceived seriousness predict policy support and willingness to act. Until consensus is reached by individuals, government, and society that climate change ranks as a high priority among myriad natural and human-induced hazards, little action can happen.

The Role of Geographers in Climate Change Research

Because the potential negative effects on human health and livelihoods are significant, the impacts of climate change should be examined from the perspective of natural hazards research. However, caution is advised in treating climate change only as a natural hazard in the strictest sense of a negative impact on humans and societal systems. Negative impacts are predicted to affect human lives in many ways including damage to health, economic systems, and infrastructure. However, the broader impacts include effects to non-human life as well. Geography is well suited to this broad point of view as the philosophy and training of the discipline encourages looking for connections between living and physical systems over space and time.

Combined with the physical and societal factors in Texas today, climate change could trigger a number of natural hazards in the next few decades. Having an informed group of geography graduates in the

workforce, from city planners to environmental conservationists, could bring about necessary mitigation and adaptation strategies. Response to the threat of climate change requires not only a reaction to the various "symptoms," such as increases of droughts and floods, but also recognition of the responsibility of the individual to make behavioral changes in energy-use patterns (Mileti 1999). Any success in reducing atmospheric greenhouse gas levels can only manifest from a global response at all levels of society from governments and industries to individual people. Connecting the risks of climate change to people's regions of residence and to their daily lives may increase the seriousness with which people approach the topic (Macnaghten 2006). Rather than discussing climate change in broad, global terms, media outlets and academics might better serve the public by delving into the specific forecasts to identify the vulnerabilities of each region and communicating these as clearly and objectively as possible.

By incorporating discussions about climate change and making its causes and ramifications more relevant to each area of geography, from human studies to physical studies, graduates can enter the workforce armed with a more informed perspective to affect decision making. This recommendation echoes the call by the IPCC that "mainstreaming climate change issues into decision making is a key prerequisite for sustainability" (Field et al. 2007, 619).

Chapter VI

CONCLUSION

This study has discussed how climate change fits into the discourse of geography, natural hazards, and risk perception. A survey of alumni was conducted of the largest academic geography program in the country in the highest carbon dioxide emitting state in the nation. Many similarities to existing research were revealed in this study such as the existence of misconceptions about scientific consensus, confusion about causes, and uncertainty about the impacts of climate change.

Research should continue to identify the reasons that some educated and lay people lack sound knowledge of the causes and impacts of climate change and view it with less seriousness and urgency than experts do. Further studies could include a focus on participants' sources of news and information, willingness to take personal action or to support governmental policies, and a more complete evaluation of the effect of political and environment beliefs on perceptions of climate change. To address the issue of climate change being viewed as a problem primarily for distant places, one recommendation is to relate the

causes and impacts of climate change to individual's lives in region-specific ways.

From Gilbert White's use of a geographic perspective to study the physical and social facets of natural hazards to learn to protect more people from the dangers inherent in floodplains, geography remains an essential viewpoint from which to examine the physical, biological, and cultural aspects of climate change (Burton et al. 1993). Mileti (1999, 2) argues that "losses from hazards – and the fact that the nation cannot seem to reduce them – result from shortsighted and narrow conceptions of the human relationship to the natural environment." One of the main tenets of geography is to examine this relationship. Therefore, well prepared geography graduates will have many opportunities in their careers to incorporate considerations of mitigation and adaptation to climate change.

If, as Mileti (1999) maintains, the United States is more vulnerable to natural hazards than ever before due to economic and technological policies, climate change can only exacerbate the effects as it occurs in the current socioeconomic atmosphere. At the same time that Americans have become more risk averse, their resistance to the forecasted implications of climate change is difficult to understand (Slovic 2004a). To explain some of the skepticism and reluctance to take steps to mitigate climate change, people may simply be overwhelmed by the scale, uncertainties, and influential opponents of the issue. Macnaghten

(2006, 139) explains that his research into perceptions of global environmental threats revealed that "individual action tended to be seen as largely ineffective, due to the global scale of the problems, and the perception of powerful commercial interests intractably embedded in systems of self-interest antithetical to global sustainability."

The costs of climate change now, and in the near future, were not risks voluntarily assumed by this generation because the causes began several generations ago and have continued since. This time lag means that people today and in the future will be feeling the effects of decisions made by people in the past who were not aware of the risks to climate. Whereas the time may have passed to change the course of global climate change in a quick and significant way, agreement within the society is necessary as soon as possible to minimize the long-term effects. Right now, mitigation and adaptation to climate change are both voluntary in some respects. People can choose to take action now or not. As time passes, the degree to which this remains a choice for individuals and society is likely to decrease due to the increasing and potentially accelerating effects of global climate change.

APPENDIX A

Survey Instrument

All respondents acknowledged their consent to participate after reading a brief letter including an explanation that responses are confidential, no personal risks are anticipated, and their privacy will be protected. The researcher's contact information was provided along with an acknowledgement that the survey had been exempted from review by Texas State University's Institutional Review Board.

1. Which ONE of the following do you think is the most important environmental problem facing the world today and Texas today? Please circle your responses.

The world:	Water pollution	Climate change	Species extinction
	Garbage/Landfills	Air pollution	
Texas:	Water pollution	Climate change	Species extinction
	Garbage/Landfills	Air pollution	

2. To what degree do you think most scientists agree or disagree that climate change is happening? Please circle your response.

All disagree	Most disagree	About equal
Most agree	All agree	

3. Arguments have been made by scientists that global average air temperatures have risen slightly and will continue to increase for many years as a result of human activities. To the best of your knowledge, which of the following have been cited as contributing to this temperature increase? Please circle your responses.

a. Exhaust from cars and trucks Yes.....No ..... Not sure

b. Radiation from nuclear power plants Yes.....No ..... Not sure

c. Disposal of toxic chemicals in landfills Yes .....No ..... Not sure

d. Coal powered electricity plants Yes.....No ..... Not sure

e. Destruction of jungles and forests Yes .....No ..... Not sure

4. Scientists who specialize in the study of the Earth's climate have debated the possible effects of climate change. Which of the following kinds of changes in the global climate will take place?

a. Rising surface air temperatures .. Yes..... No ..... Not sure

b. Ocean levels to rise ..... Yes..... No ..... Not sure

c. More frequent droughts ..... Yes..... No ..... Not sure

d. Fewer floods ..... Yes..... No ..... Not sure

e. More severe hurricanes ..... Yes..... No ..... Not sure

5. Which state do you think produces the most greenhouse gases each year?

Ohio Florida California Texas Pennsylvania

6. How important do you think it is for industrial nations to reduce their production of greenhouse gasses?

Not at all important				Extremely important
1	2	3	4	5

7. In regard to <u>your</u> opinions on climate change, how concerned are you about impacts to each of the following items?

	Not at all concerned				Very concerned
a. Plants and animals/ecosystems	1	2	3	4	5
b. Food supply	1	2	3	4	5
c. Coasts	1	2	3	4	5
d. Human heath	1	2	3	4	5
e. Water availability	1	2	3	4	5
f. Economy	1	2	3	4	5

8. If nothing is done to reduce climate change in the future, how serious of a problem do you think it will be for **each** of the following areas? Please circle your response

	Not at all serious				Very serious
a. Your community	1	2	3	4	5
b. Texas	1	2	3	4	5
c. The United States	1	2	3	4	5
d. The world	1	2	3	4	5

9. Think for a moment about your discussions with other people and what you see or read in the news. How well informed do you think **most Americans** are about the issue of global climate change?

Not at all informed				Completely informed
1	2	3	4	5

10. How well informed do you consider **yourself** to be about the issue of global climate change?

Not at all informed				Completely informed
1	2	3	4	5

11. Which of the following six options best describes your views about climate change?

Already happening Will happen later in your lifetime

Will happen in next few years Will affect future generations

Will never happen Unsure

12. Do you consider yourself to be an environmentally aware person?

Yes No

13. If yes, for how many years have you identified yourself as environmentally aware? _____

14. Gender: Male Female

15. What year(s) did you graduate with your Texas State geography degree(s)? _____

16. What degree(s) did you get? (e.g., BA, MS, Ph. D.)_____

17. What was your concentration of study in geography?_____

18. Your zip code: _____

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