THESIS

ELDERLY MIGRATION AND NATURAL DISASTERS

IN THE UNITED STATES FROM 1960 TO 2010

Submitted by

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ABSTRACT

ELDERLY MIGRATION AND NATURAL DISASTERS IN THE UNITED STATES FROM 1960 TO 2010

The United States is a rapidly aging society. As a larger proportion of the population enters into the retirement years, it is likely that a larger portion of the nation's migrants will be elderly. Over the last four decades, natural disasters have also been increasing in frequency and scale across the United States. This thesis draws together two different data sets in order to test the relationship between the two variables, elderly migration and natural disaster loss. The purpose of this thesis is to examine whether migration patterns among the elderly are influenced by natural disaster risk across the country.

After a brief introduction, the thesis offers a review of the literature regarding elderly migration in the United States and an exploration of the particular vulnerabilities that the elderly face before, during, and after natural disasters. Then, the thesis reviews the relationship between migration and natural disasters, specifically focusing on climate change, economic development, and amenities.

Natural disaster data ranged from 1960 to 2000 and elderly migration data ranged from 1970 to 2010. A fixed effects panel regression model was used to measure the effect natural disaster damage on elderly migration patterns at the county level. The previous decade's disaster damage data was measured against the following decade's elderly migration patterns. The analysis showed statistical significance between several of the variables but little substantive

effect between natural disaster damage and elderly migration across the United States measuring across multiple variables of natural disaster data including per capita damage, number of events experienced and number of extreme events experienced.

As the elderly continue to comprise a larger proportion of the population and as migration rates continue to rise among this age group, an understanding of the unique relationship between this age group and the risk of natural disasters will help at-risk communities more effectively prepare for extreme events. Although there are limitations to this project, the research contributes to the emerging research field of elderly migration and natural disaster vulnerability.

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INTRODUCTION

An Overview of the Problem

The United States is a highly mobile society. Migration across the country is a common phenomenon that results in regular shifts in the demographic composition of various locations (Greenwood 1985). Even in light of this regular movement, a portion of the population that is often not included in discussions of migration is the elderly population. This represents a gap in our understanding, as the elderly population in the United States is growing rapidly compared to the rest of the population. As the elderly become a larger proportion of the demographic makeup of the country, their migration patterns will have greater impact on locations that either receive or lose this population group. At the same time, natural disaster frequency and magnitude has increased rapidly over the last five decades (Gall et al. 2011). Areas that have been historically at risk to natural disasters are only becoming more vulnerable as populations grow and economic development places more people and infrastructure in the path of various hazards. The purpose of this thesis is to measure whether or not an area's propensity to natural disasters has an effect on elderly migration patterns in the United States.

Since the turn of the twentieth century, the United States population age 65 and over has increased more than 11-fold compared to only a 3-fold increase among the rest of the population (Hobbs and Damon 1996). In 1994, for example, there were 33.2 million elderly (here and throughout the thesis defined as those ages 65 and over). By 2011, there were 41.4 million (a 24.7% increase) and the size is projected to increase to 79.7 million by 2040 (Administration on Aging 2012). Because of this rapid growth, the elderly population will move from representing 13 percent of the total population to over 19 percent by 2050 (Vincent and Velkoff 2010). The oldest old (defined as persons age 85 and over) increased by 274 percent between 1960 and 1994, compared to a 100 percent increase in the population 65 and over, and only a 45 percent increase for the population as a whole (Hobbs and Damon 1996). The oldest old age group, who are most likely to be frail and to suffer from chronic health conditions, is projected to increase from 5.7 million in 2011 to 14.1 million in 2040 (another 147% increase) (Vincent and Velkoff 2010). These statistics illustrate that over the past century, the elderly population in the United States has grown at a significantly higher rate than the general population. That trend is only going to continue and accelerate in the twenty first century as the Baby Boomer generation continues to enter into that age group.

Historically, younger people have been more likely to migrate, both in general and specifically in the United States. The motivations for migration are generally linked to the labor market (Greenwood 1975). That is why the majority of migrants in the United States are young adults, who are often relocating for a new job (Greenwood 1975). However, as the elderly population grows, the number of migrants in this age group has also been dramatically increasing. Between 1960 and 1970, elderly migration remained constant at around 4 percent of the elderly population, and grew at a slower rate than the population growth overall in that age group. However, between 1970 and 1980, the rate jumped 50 percent in migrants over the age of 60 resulting in an increase in the migration rate to 4.6 percent, since the population in that age group only grew another 29.4 percent during that same time period (Longino et al 1984). Between 2002 and 2009, the percentage of the elderly who migrated to a new home (in the one year prior) increased from 4 percent to nearly 6 percent, almost a 50 percent increase (Schachter 2004, Ihrke et al. 2011). So the trend is pointing upward in the rate of elderly choosing to migrate to a new area in the future, and as the total population of the elderly continues to grow rapidly, so also will the number of elderly migrants.

Why the elderly are migrating is an interesting question. The elderly are not linked to the labor market in the same way as the young. Moreover, they have higher homeownership rates and lower proportional poverty rates when compared to younger age groups (Conway and Rork 2006, Administration on Aging 2012). This makes what is compelling their migration patterns different from the younger generations, and thus an important research topic in migration studies.

The majority of internal migration in the United States is to the South and West, mainly along the coasts, areas known for their high levels of vulnerability to natural disasters (Ihrke et al. 2011). The Northeast and Midwest regions of the country have significantly lower rates of in migration because they are often the regions that people leave as they head to the West or South. The elderly population tends to follow this trend, which is why this thesis is necessary to measure the effects natural disasters may have on elderly migration patterns.

Another trend of interest in this thesis is related to natural hazards and disaster losses in the United States. The past several decades have seen a dramatic increase in the severity and scope of impact of natural disasters. Since 1960, the dollar loss caused by natural disasters has grown exponentially (Cutter 2005. Gall et al. 2011). Over the past fifty years, natural disasters have resulted in economic losses in excess of half a trillion dollars, averaging $11.5 billion annually (Gall et al. 2011). Since 1990, the average yearly loss has risen to nearly $15 billion dollars, showing that natural disasters are on an upward trend in damage totals (Gall et al. 2011). Indeed, the first half of the 2000s resulted in more dollar losses by natural disaster than the entire decade of the 1990s (Cutter 2005). Over half of all the dollars lost as a consequence of natural disasters over the last 50 years has resulted from floods and hurricanes, primarily along the Gulf Coast and Mississippi River Valley regions of the country (Gall et al. 2011). These losses may be due to multiple factors including population growth, development in hazard prone areas, and climate related changes (Gall et al. 2011).

The elderly are not only of interest due to their migration patterns that may be affected by disasters, but also due to the unique vulnerabilities they may experience across the disaster lifecycle (Peek 2013). The elderly are more likely to be victims of natural disasters than younger generations due to social, physical, and psychological differences (Ngo 2001). When a powerful natural disaster hits the United States, the elderly are disproportionately killed (CDC-ARC 1997). Their higher death rates are due to a number of factors, including the fact that the elderly may not hear or receive warnings, may be less likely to have access to an automobile, may be more likely to be frail or otherwise experiencing physical challenges, and may be more likely to be dependent on caregivers. The immediate impact of a natural disaster hits the elderly harder than younger generations due to their increase risk of physical injury and psychological harm. Past research has also shown that the elderly may be the least willing group to receive aid due to personal resistance and other barriers such as access to requisite technology (Peek 2013).

The Data and Analysis

The purpose of this thesis is to test whether the elderly's migration patterns are influenced by natural disaster risk across the country. This thesis will use two different sets of data in order to test the relationship between the two variables, elderly migration and natural disaster loss. Elderly migration will be measured as a rate of migration and natural disaster loss will be measured as dollar loss. The research will be carried out through a statistical regression analysis to measure if natural disaster losses influence elderly migration. Elderly migration data will be compiled from the University of Wisconsin at Madison's Applied Population Laboratory (Winkler et al. 2013). Migration rates are given in decadal totals from the 1970s through the 2000s. Natural disaster loss data will be provided from the Spatial Hazard Events and Losses Database for the United States (SHELDUS) from the Social Vulnerability Institute at the University of South Carolina. The natural disaster data will consist of data on natural weather events such as floods and hurricanes and not on technological disasters or terrorist attacks. The scale of the research will be nationwide and cover the time period from 1960 to 2010.

Past research on elderly migration and the environment has concentrated on environmental effects such as pollution and other human-made hazards instead of naturally occurring weather events such as hurricanes and floods (Hunter 1998). Research on the determinants of migration has not focused on natural disasters but instead explore economic and social factors with only some attention on favorable climates such as sunny weather (Wiseman and Roseman 1979, Litwak and Longino 1987). This thesis will contribute to the growing literature focusing on the changing demographic composition of the United States and how it will affect a multitude of different academic fields of research.

Organization of the Thesis

The thesis is organized in six chapters. This first chapter is designed to identify the problem and highlight the purpose of the thesis. The second chapter offers a comprehensive literature review. The review consists of a discussion on the unique elements of elderly migration in the United States, specifying the motivations behind migration in general and specific to the elderly. The literature review also covers past research on the vulnerabilities of the elderly and disaster and summarizes past research on the relationship between migration and natural disasters. The third chapter summarizes the methodological approach of the research. The data sources for elderly migration and natural disaster loss are described along with the appropriate regression analysis that will be applied to test the effect that natural disasters have on elderly migration patterns at the county-level. A justification for using regression as the method for analyzing the data is also provided.

The fourth chapter of the thesis includes a summary of descriptive statistics for the two data sources. Elderly migration is described and mapped out primarily from the 2000s in order to identify and visualize the broad patterns in the United States in terms of elderly migration. This also allows for insights into the future projections and estimates on elderly migration. Chapter four also offers a summary of natural disaster loss data from 1960 to 2010. The specific types of natural disasters that are measured by SHELDUS along with the counties that have experienced the most dollar loss and number of events during that time period are presented.

The fifth chapter presents the statistical findings from the regression analysis to see how predictable elderly migration is when incorporating natural disaster loss at the county level. Variables such as age, race, ethnicity, and gender are controlled for in order to identify variation among different groups. The analysis shows how much error is reduced when natural disaster dollar loss and number of events in order to predict elderly migration patterns. Results showed statistical significance in the relationship between elderly migration and natural disasters, but were very small in producing real change in rates.

The sixth and final chapter offers a summary and discussion of the importance of the findings of the regression analysis. It also considers potential policy implications for counties experiencing high levels of in-migration of elderly and a high frequency of natural disasters and high dollar loss. If natural disasters do cause a reduction in the elderly migration rates in previous decades, future trends in elderly migration may be significantly affected by areas prone to natural disasters. As the nation continues to age and a greater proportion of the population is made up of the elderly, the vulnerabilities linked to this group of people will take greater levels of importance for emergency managers and community organizers during a natural disaster.

Chapter 2

LITERATURE REVIEW

Before analyzing the effect of natural disasters on elderly migration patterns, it is important to review the literature in several areas germane to my research. As such, this chapter will include a review of: (1) elderly migration patterns in the U.S.; (2) the vulnerability of the elderly to natural disaster; and (3) the effect of natural disasters on migration in general. With a firm background on these three areas, it will make it more possible to understand the potential social impacts of this research within the fields of migration, the elderly, and disasters in sociology.

Before proceeding, however, a caveat regarding the review is in order. Data on elderly migration shows that there are two distinct patterns among the elderly population. The focus of this study will be on the migration pattern that takes place between the ages of 60-74, which is largely comprised of "retirement migration," where migrants relocate to areas that provide greater levels of recreational utility and where physical limitations are not as much of a driving factor. The second migration patterns represented in the data takes place once the population moves to the age of 75 and older. Here physical impairment becomes more significant, resulting in a shift in the patterns of migration to return to areas previously lived in or movement towards family. In light of this, this review attempts to take in account differences across age cohorts of the elderly.

Elderly and Migration in the United States

The United States has always been a mobile society. The nation was founded, in part, in response to the idea that people should have the freedom to move to a new location that could offer a better life for them. This became especially true after the industrial revolution, where technology and economic growth gave incentive for people to move to the cities from rural communities in search of higher paying jobs.

Historically, employment has been the main driver for population migration. This is a result of the fact that the majority of migrants are young adults entering in the life phase that places particular emphasis on the importance on employment (Greenwood 1975). The elderly, however, are no longer as linked to the labor market due to retirement and “aging out” of the labor force. Thus, their migration decisions do not necessarily need to incorporate an area’s employment rates or wages to the extent that a younger person might (Wiseman and Roseman 1979, Litwak and Longino 1987).

Yet, the elderly often can and do move for a variety of reasons. As such, this section will discuss the potential factors influencing decision making processes among the elderly population when it comes to migration. To begin, it is important to understand fundamental reasons why any person may migrate. Scholars often argue that we can understand migration from two fundamental perspectives: the motivations for wanting to *leave* an area and the motivations for wanting to *move to* a new area. What are the reasons why an elderly person would choose to migrate? What external factors would drive an elderly person to leave the area they currently live in? What external factors draw an elderly person to a particular area? Have researchers found evidence of the inclusion of risk to natural disasters as a determinant of out-migration or in-migration? This last question is important for this research to see if the data reveals elderly migration patterns responding to natural disaster risk.

Despite the importance of these questions, especially in light of the growing elderly population in the U.S., only a limited amount of prior research has explored elderly migration patterns. This may be because the elderly have historically been viewed as a relatively homogenous group with little variation in the migration habits (Wiseman and Roseman 1979). Some research, however, has identified various reasons that cause the elderly to leave an area, such as retirement where the individual or couple is no longer linked to the labor market (Wiseman and Roseman 1979, Litwak and Longino 1987), cost of living concerns that are not necessarily connected to the labor market (Fournier et al. 1988), health concerns that limit functional independence (Longino et al. 1991), government policies that limit access to public goods (Tiebout 1956, Conway and Houtenville 1998), local tax burdens (Conway and Rork 2006), and the loss of independence that results in the elderly being institutionalized in a nursing home or assisted living facility in a different community or moving in with family (Hays et al. 2003). In addition to factors driving the elderly to leave an area, Wiseman and Roseman (1979) identified three different types of long distance migration for the elderly that help explain forces that would pull the elderly to a different area: amenity migration, return migration, and health-focused migration.

Amenity Migration

The first form of migration identified in the Wiseman and Roseman (1979) typology is amenity migration. This form of migration is generally the type of migration that takes place at retirement (which is the main driver of elderly migration). Based on a desire to live a healthy and fulfilling life after retirement, the elderly may seek out locations that offer them the most desirable amenities. For this reason, Retirement Communities advertise heavily to the elderly, displaying their amenities as the reason why people should move to their locations. Retirement Communities are often built in warmer climate regions of the country such as Florida, North

Carolina, Arizona, or California. This is because many of the activities that are offered at these locations are tied heavily to warmer climates, such as swimming or golf.

At retirement, the individual or couple is often at their highest point of personal wealth so they have the largest amount of options when choosing a new location where they might migrate. This allows the retired couple (as at this stage in life the elderly are often still married) the flexibility to decide their new location based off a variety of amenities that will maximize their personal utility and comforts. This has created areas of the nation that have become “havens” for retired people by having specific amenities or government policies that cater more to their age group (Conway and Houtenville 2003). States that have eliminated their estate taxes, such as Florida, Arizona, and Nevada, have become primary elderly migration destinations (Conway and Houtenville 1998). Conway and Rork (2006) tested the theory that an area’s taxes are a significant indicator of elderly migration; they were unable to conclude whether or not a state changing its estate tax drew elderly migration to the area or whether it was the elderly migration that influenced the state governments to eliminate the tax. Although the direction was unclear, the research showed a definite relationship between state tax and elderly migration.

A large portion of migration research focuses on the theory first proposed by Tiebout (1956) that people respond to an area’s access to public goods and will “vote with their feet” by migrating away from areas that restrict access to public goods and move to areas that have greater access to public goods. For general patterns of migration, this is applied largely to the government role in assisting access to the labor market for employment seeking migrants; this theory, however, could also be applied to retirement migration where access to Medicaid or the presence of end-of-life taxes may attract or deter elderly migrants. Conway and Houtenville (1998) tested Tiebout’s (1956) theory of people “voting with their feet” on local government policy with elderly migration patterns. Their study showed mixed results where origins' location policies may drive the elderly to leave; the destination's policies did not establish a significant effect on the elderly's choice. Other amenities such as warm climate, access to hospitals, public welfare, Medicaid, and low local crime rates do seem to significantly influence elderly migration (Conway and Houtenville 2003).

A large category within an area's list of amenities is the cost-of-living (COL) or the average inflation adjusted income needed in order to maintain a certain standard of living or quality of life in any given area. Fournier, Rasmussen, and Serow (1988) created a regression model based on 1970 and 1980 census data to test the significance of an area's COL to its level of elderly out-migration and in-migration. Their results showed that areas with a low COL had matching high levels of elderly migration to the area as compared to areas with a higher COL (Fournier et al. 1988). The researchers included several other variables to measure against the COL variables. The direction of the relationship between these variables and elderly migration varied between the different variables. The researchers included an analysis of crime rates in both the origin and destination locations and showed a positive relationship between crime rates and elderly migration, meaning that as crime rates increased in both areas elderly migration also increased. Other variables focused on climate and the locations of and access to natural amenities such as lakes or coasts. Access to coastal areas was negatively associated with elderly migration and access to lakes had a positive relation from the origin location and a negative relation with the destination location.

Return Migration

The second type of migration in Wiseman and Roseman's (1979) typology is return migration. Once the elderly retire, they may have the option to return to the location where they grew up and originally had to migrate away from as a result of work. While many younger people migrate to metropolitan areas in search of employment in their early life, upon retirement, these same individuals may have the option of returning to more rural or suburban areas where the lower cost of living and potential to return to family roots becomes more appealing.

Motivation to migrate back to areas closer to family to see grandchildren may also be the result of a decline in independence due to a loss of physical ability or through disease. Because old age can generate a loss of independence, the elderly may choose to or be forced to migrate to a location where their families live in order to find security, comfort, and care. Indeed, the physical demands of living independently may be too much for the elderly, thus requiring them to seek out family assistance (Wiseman and Roseman 1979). This motivation for return migration is often, though not always, linked to health related reasons for migration.

Health-Focused Migration

After the initial retirement period, the migration patterns of the elderly may shift to focus more on the needs of the elderly who may be experiencing a loss of independence due to loss of physical abilities that old age intensifies. Personal disability or chronic illness may cause the individual to seek out family or institutional assistance (Litwak and Longino 1987). Severe or protracted illness may limit the individual's ability to take care of herself and require her to seek an assisted living environment in an institution or with family (Wiseman and Roseman 1979). This also takes place when age causes physical decline to the point of independence loss. Other forms of physical difficulty could result through the death of a spouse. The vast majority of elderly in the United States lives independently and will continue to do so even after the death of a spouse, which is often the male. However, as the widow continues to age and experiences a loss of physical abilities, the likelihood of migrating to be closer to family increases in order to seek assistance due to loss of personal abilities (Longino et al. 1991). In the absence of family support, institutionalization may also be a driver of migration, where elderly either choose to move to a full-time or part-time setting or their family members move them to a nursing home or assisted living facility in order for the needs of the elderly to be met (Wiseman and Roseman 1979).

This health related move can often take place after an initial move due to retirement. Longino et al. (1991) tested this hypothesis that there is a "second move" that can take place after the initial "amenity move" that takes place at the point of retirement (Litwak and Longino 1987). Their analysis showed a relationship between the losses of ability to perform everyday functional tasks in the home to migrating to a new area (Longino et al. 1991). Individuals must then seek out assistance in order to maintain a comfortable livelihood, and migration is often the first step in that process. This category of migration is associated with the older elderly population, often measured as those ages 75 and over.

Elderly Vulnerabilities to Natural Disasters

Because this thesis is designed to test whether natural disasters may prompt migration, the next section of the literature review will address the vulnerability that elderly populations face during a natural disaster. To begin, a natural disaster can be defined as an "extreme event that originates in the biosphere, lithosphere, hydrosphere or atmosphere" (Alexander 2000:9) that threatens people or property (McGuire et al. 2002).

Natural disasters over the last few decades have revealed the extreme level of vulnerability of the elderly to natural disasters. When a natural disaster takes place that is powerful enough to kill, it is the elderly that are often disproportionately killed. The 1997 *Health Impact Surveillance System for Disaster Report*, a joint project of the Centers for Disease Control and Prevention and the American Red Cross, stated that consistently people ages 60 and older had the highest death rates of any age group during disasters (CDC-ARC 1997).

Recent events have driven home the vulnerability to death among the elderly. In 2005, Hurricane Katrina claimed the lives of over 1,300 persons and 67% were at least 65 years old, although the elderly population in the Gulf Coast region that was hit was only about 12% of the total population (Sharkey 2007). The 1995 Chicago heat wave claimed the lives of more than 700 people, and 73% of the heat-related deaths were among persons over the age of 65 (Klinenberg 2002). The 2011 Japanese earthquake and tsunami and the 1995 Kobe earthquake also resulted in disproportionate numbers of elderly killed as a result of the disaster (Associated Press 2011; Otani 2011).

Several factors contribute to the vulnerability of the elderly in disasters. Previous literature has shown that the elderly are uniquely vulnerable to natural disasters in just about all stages of the disaster process; this includes the preparation stage before a disaster, the immediate impact of a disaster, and the recovery and reconstruction stage after a disaster. The following will break down each of these elements in order to illustrate where the elderly stand in the face of natural disasters.

In the pre-disaster stage, the elderly experience additional vulnerabilities than the rest of the population in the areas of warnings and evacuations. The elderly can have added difficulty in hearing about disasters due to physical or cognitive impairments that restrict their ability to understand warning systems (Eldar 1992). Other variables that can limit the elderly's access to warning systems are diminished social networks that would allow the easy access to information, lack of behavioral patterns that work toward gaining the type of knowledge, and/or a lack of access to technology that has been promoted as a more effective means of disseminating and receiving warnings (Perry 1979, Chatfield and Brajawidagda 2013).

While social media and associated mobile technologies provide greater access to information, the elderly population may continue to be isolated due to their low access to such capabilities (Chatfield and Brajawidagda 2013). Research has shown a need to provide targeted outreach to the elderly population in order to get sufficient warnings out to them and avoid this specific vulnerability (Perry 1990). Other research, however, has disproved the unique vulnerability by showing that age is not a unique variable in predicting warning compliance, but age still remains an important variable when trying to understand the vulnerabilities that surround disaster warning systems (Perry and Lindell 1997).

In the event of a natural disaster, often times after the warning has been issued, an evacuation notice may be given to particular areas at risk for severe damage. Evacuation, which is the movement of people from one location to another in order to provide safety, is often the most relied upon method of saving lives in the event of a natural disaster. Elderly populations face unique barriers to evacuating and may be caught in the path of a disaster due to their inability to properly evacuate. The elderly are disproportionately disabled, often times requiring special assistance when it comes to moving to a new location for safety. Indeed, nearly 36 percent of adults ages 65 and over have a disability (U.S. Census Bureau 2012). For the elderly living in nursing homes or hospitals, this is often not a problem as those facilities are geared towards protecting the disabled elderly. The vast majority of the elderly, however, still lives at home and not in a facility designed to take care of them. Over 40 percent of the elderly over the age of 60 now report that they live alone (U.S. Census Bureau 2012). These factors greatly exacerbate evacuation challenges for the elderly. When able to do so, the elderly population, similar to the rest of the population, tends to choose to evacuate to the homes of nearby friends and family members instead of choosing to go to a public shelter (Tierney, Lindell and Perry 2001). For those who do go to a public shelter, they often face challenges of lacking in their necessities such as eyeglasses or medications, thus depriving the elderly of much needed supplies during an emergency that would not be as big of a problem among such a large percent of the younger populations (Ketteridge and Fordham 1998).

These unique vulnerabilities set the elderly population apart from the rest of the population once an evacuation is posted for a community and deprives the community of resources to meet the needs of the elderly (Wilson 2006). The elderly that also choose to remain in their homes to ride out the event also face challenges due to their own disabilities and lack of ability to gather important information. This can lead them to being completely isolated from the rest of the world for days with no access to basic utilities or food (O'Brien 2003).

Once a disaster strikes, the elderly are often disproportionately affected by the emergency. As mentioned above, the elderly are killed in greater proportion to their population than younger age groups. The greatest factor that led to death in the Chicago heat wave of 1995, according to Klinenberg (2002), was the extreme isolation that the elderly population—and especially low-income African American males—faced in Chicago. Many of the victims were found in their apartments and their own neighbors had no idea that they were even home. The number of elderly that are also injured as a result of the natural disaster is also disproportionate to their overall population totals (Eldar 1992).

There are a number of factors that contribute to the vulnerability that the elderly face during a natural disaster (Peek 2013). Due to increased levels of physical disability, the elderly may be unable to quickly move to a safe location such as climbing a hillside or onto a roof in the event of a flash flood. Sensory impairment, such as loss of eyesight or difficulty hearing, may prevent the elderly from rapidly responding to warning signals. During Hurricane Katrina, many victims drowned in their homes where they attempted to climb into their attics and even attempt to cut holes into their roofs to escape the rising waters. The elderly can experience a lack of ability in sensing changes in body temperature that can lead to disproportionate death of the elderly as a result of extreme cold or extreme heat (Medina-Ramon et al. 2006).

As a result of the natural disaster, the elderly are also at greater risk of sustaining physical injuries after the initial impact and subsequent early recovery stage. The shock of the event leads to higher levels of psychological trauma among the elderly compared to younger generations (Jia et al. 2010). The elderly also have a lower physical threshold that can result in additional injuries soon after the impact and a heightened risk of serious illness developing as a result of the injury (Eldar 1992). The immediate physical effects of a natural disaster are apparent for the elderly and result in increased risk for loss of life during and immediately following a natural disaster. The psychological impacts of a natural disaster may also be threatening to the elderly as they are at risk of suffering more due to the traumatic exposure to the hazards (Norris et al. 2002). What this shows us is that the elderly are at a much higher risk of being damaged, both physically and psychologically, than younger generations and thus are significantly more vulnerable to natural disasters.

The short and long-term recovery stage of the disaster involves the difficult process of gathering what resources remain in the community in order for reconstruction to begin. It is at this point in the recovery process after a disaster that insurance companies and construction companies become involved for people looking to rebuild their homes and continue with their lives after the disaster. The elderly have the greatest difficulty in gathering necessary resources to recover.

Research has shown that the elderly often report greater amounts of economic loss than younger generations do (Friedsam 1961, Bolin and Klenow 1983) (although see Huerta and Horton [1978] for a contradictory finding). What is clear is that the elderly tend to lose irreplaceable items in greater proportion than younger generations, which can often result in higher levels of distress due to the loss of precious or sentimental things (Huerta and Horton 1978, Ketteridge and Fordham 1998).

Along with these findings that the elderly suffer greater relative loss, the elderly also tend to struggle more with acquiring adequate insurance coverage to replace what was lost in the disaster (Bolin 1982). Along with the lack of insurance, the elderly also are less qualified for low-interest loans for recovery (Bolin 1982). That creates a barrier that the elderly have to deal with when attempting to acquire the resources necessary to rebuild. When these formal institutions deny coverage and access to resources, the elderly are forced to turn to more informal sources for help such as family, friends, and neighbors.

Beyond the economic barriers that the elderly face during the recovery stage of a natural disaster are barriers produced through the psychological condition of the elderly and the stigmas and lack of information surrounding the options for assistance. The bureaucracy associated with government organizations, such as FEMA, can be overly confusing, resulting in the elderly not even attempting to acquire government aid (Huerta and Horton 1978). FEMA used to require that individuals travel to apply for assistance in person at application centers. This would be especially problematic for elderly who are disabled or lack adequate transportation (Childers 1999). The elderly also often lack information regarding the correct procedures and social networks that can assist them in filling out forms and turning in paperwork (Childers 1999). As a result of this lack of information and social networks that can encourage them, some elderly have developed a perceived stigma attached to accepting assistance from the government. They see it as "welfare" that would render them dependent on outside sources such as the government (Huerta and Horton 1978).

The purpose of this section of the literature review was to address the many aspects surrounding elderly vulnerability to natural disasters and was drawn heavily from work done by Peek (2013). At all stages of the disaster, from preparedness before the event to the long-term recovery efforts after the disaster, the elderly suffer from unique barriers and vulnerabilities that make it more difficult to prepare for, survive, and recover from a natural disaster. This thesis is examining elderly migration patterns in the United States to see if the elderly are migrating to areas with increased losses from natural disasters.

Cultural and socioeconomic consequences in the United States can result in the grouping of vulnerable populations and thus exposing them to greater risk (Phillips and Morrow 2007). This grouping of vulnerable populations will increase the risk of an area to a major natural disaster in the future. If the elderly are migrating to more vulnerable areas, why aren't government officials or cultural forces discouraging such movement? If the elderly are more vulnerable than younger generations, shouldn't they be migrating to safer areas of the country? Has there ever been clear evidence pointing to a change in migration patterns as a result of natural disasters in the general population? The final section of the literature review will examine these issues and questions.

Natural Disasters and Migration

Most previous research on how environmental factors, such as natural disasters, shape migration patterns has focused on how the impact of a major natural disaster immediately created a dispersion of people away from the impact area (Hunter 2005; Fussell et al. 2010; Weber and Peek 2010). It is important, also, to distinguish different categories of migration that can take place in the context of a natural disaster. There are those who are immediately displaced as a result of a disaster event, usually in the period of the first few months. This group does not fall into the category of migrants; instead they are usually called "evacuees" because it is expected that they will quickly return (Black et al. 2013). There are also forms of short-term migration, within a year of the event, and long-term migration (or permanent displacement) that may occur after a year or longer. It is rare, however, for studies to address these forms of long-term migration.

It seems to be generally expected that once recovery has occurred, migration patterns would return to previous rates. Indeed, very few studies look into the long term impacts of a natural disaster on the general migration to the area. There are virtually no studies at all that look into elderly migration. It is important, however, to understand the theories and models created around the immediate migration impacts caused by a natural disaster in order to infer a theory that could be implied to permanent migration shifts that natural disasters play a role in, particularly among a highly vulnerable population group such as the elderly.

A natural disaster is an event that can potentially cause widespread destruction in its wake that can permanently alter the future of a community. However, a natural disaster can also lead to rapid economic expansion (Skidmore and Toya 2002). The result of a destructive natural disaster may bring about economic, human, and social capital investment that can place a community on the road to greater wealth accumulation than before the disaster. Skidmore and Toya (2002) found a high correlation across dozens of nations between increased levels of investment and higher frequencies of natural disasters. So even though a natural disaster causes destruction and disruption in the immediate aftermath, the long-term period has often seen heightened development and improved levels of wealth for the local affected communities. While there is mounting evidence of a net economic benefit of a natural disaster on a community, it is important to remember that vulnerable groups disproportionately suffer and have harder times recovering and may struggle to ever recover at all (Ngo 2001).

What barriers exist in society that may make it difficult for vulnerable groups to migrate away from disaster prone areas? What societal aspects actually promote residence despite the risk? The clearest sign of this taking place in the United States is the massive migration of elderly to hurricane prone Florida. Between 1980 and 1990 alone, Florida coastal counties grew by 781% (Bartlett et al. 1999). Yet at the same time, the Florida coast has experienced several destructive hurricanes in recent decades. What contributes to this apparent irrational decision making process? For starters, there are many other amenities located in this region that make it a desirable migration destination for the elderly and others (Conway and Rork 2006, Fournier et al.

1988). A warm climate and friendly tax system for the elderly create a large benefit for migrating to Florida that likely greatly outweighs any potential cost of being impacted by a hurricane. This trend is likely to continue well into the future where people continue to migrate to coastal regions and build up cities along the coast that will result in even greater economic loss when a natural disaster takes place.

People have a tendency to respond to hazards that they perceive, and a lack of perception can result in individuals making what appears to be irrational decisions by migrating to hazard prone areas (Slovic 1987). However, hazards risk can be so low compared too many other concerns that it can appear to be an irrational response when migrants move to hazard prone areas. Hunter (2005) lists several reasons why individuals might not migrate from hazard-prone areas. Specifically, she argues that any individual may:

1. Not be aware of hazard;
2. Be aware, but do not expect a disaster;
3. Expect a disaster, but do not anticipate loss;
4. Expect loss, but not serious loss;
5. Expect serious loss and have undertaken, or are planning to undertake loss reduction actions;
6. Expect loss, but have accepted as costs of gaining locational benefits;

The elderly may fit into any of these categories where a lack of information may keep them unaware of the potential danger, or they may not believe that an impact would be so severe to cause them to lose considerable wealth or property. Expectations play a large role in the decision making process and when the danger is not fully understood or perceived then the elderly may be more willing to migrate to an area despite its propensity to natural disasters. For the young old and those recently retired, the wealth that they may have amassed over the course of their lifetime may leave them feeling safe enough that the cost of living in a hazard prone area is worth it through the gaining of amenities such as a warm climate.

Among those that do migrate due to natural disasters or other environmental effects, they tend to be older, members of female-headed households, and minority group members characterized by low levels of income and educational attainment than the general migration population (Morrow-Jones and Morrow-Jones 1999). This makes sense in light of the fact that the younger and wealthier would have an easier time going about rebuilding and recovering from a natural disaster. This trend is also seen on a more global scale where it is the poor that are often forced to leave an area after a destructive disaster has taken place (Osterling 1979).

Much of the limited available research focuses on populations already living in hazard prone areas or populations that have migrated as the result of a natural disaster (Morrow-Jones and Morrow-Jones 1991). This type of research often focuses on how much of a "push" factor a natural disaster plays in the decision making process of a migrant. While my research incorporates this same line of thought and analysis of migration data, it will also look at whether or not an area's propensity to natural disasters becomes a deterrent against other "pull" factors that may draw the elderly population to migrate to the area. On a state wide level it would appear that it is not a significant factor at all considering that the majority of migrants of all ages in the U.S. are migrating to coastal regions that are heavily prone to natural disasters. There are many factors that play into this trend, but my research hopes to narrow the focus down to just natural disasters and how much they influence elderly migration. My research hopes to look more closely at the county-level to see if there is a significant difference between counties that have varied degrees of risk such as the difference between coastal counties in Florida and inland counties.

Chapter 3

METHODS

This chapter describes the data collection, variable definition, and analysis used to examine relationships among the variables discussed in the previous chapter. The research uses data from 1960 to 2010 and for all 50 U.S. states and the District of Columbia. The outcome variable is the county's elderly migration rate, with key predictors being natural disaster dollar losses and number of disaster events.

General Hypothesis of the Study

This project examines how natural disaster losses affect the rates of elderly migration. The previous chapter showed that the elderly have specific vulnerabilities before, during and after a natural disaster, so we would expect the elderly to avoid areas that experience high levels of disaster losses, either by avoiding migrating to these areas or choosing to migrate away from them.

As the United States continues to age, issues of the elderly being affected by natural disasters will become a more prominent issue for researchers to address. At the same time, the previous chapters showed how natural disaster losses are only expecting to increase in the coming decades and will affect more areas of the country. No previous research has measured the effect that natural disaster losses in an area have on future elderly migration rates. This thesis sets out to fill the void in existing research.

This thesis assembles data on elderly migration rates and on natural disaster losses in order to test the hypothesis that there is a 'significant effect' in the relationship between natural disasters and elderly migration, where a conclusion could be draw indicating that areas that experience higher amounts of disaster losses also experience lower elderly migration rates by measuring data from 1960 to 2010 With an understanding of the effect over the previous decades, it will then be possible to discuss the future implications regarding how natural disasters will affect elderly migration rates. The research will be carried out through a statistical regression analysis to measure if natural disaster losses effect elderly migration.

Description of the Data

The unit of analysis for this study was counties in the United States. The sample consisted of 3,088 counties measured at four different waves in time, 1970, 1980, 1990 and 2000. This produced what is considered an "N-dominant" sample for panel regression where a large group of individual units are measured at only a few points in time (Finkel 2008). Both migration and natural disaster data was drawn from all 50 states plus the District of Columbia. As of 2000, the starting point for the latest county level migration data, there were 3,087 counties plus the District of Columbia.

The predictor variables in the analysis were natural disaster dollar damage amounts and number of disaster events experienced by the county. The outcome variables are of migration rates among the elderly population in terms of population totals and considering demographic groups based on age, gender, and race. Migration data was given in decade totals, as compared to yearly or 5-year periods. In order to avoid an overlap of the migration data with the natural disaster data, the previous decade's natural disaster data was analyzed with the next decade's migration data. For example, the 1960s disaster damage data was analyzed with the 1970s elderly migration data. This removes errors in time order where data from natural disasters are not measured against elderly migration that took place before or during the event.

The data was gathered from two different sources. Migration data came from the University of Wisconsin at Madison's Applied Population Laboratory (Winkler et al. 2013), which provides such data as totals for each decade for 1950 through 2010. Here, I used only data from 1970 to 2010 because the corresponding disaster data was available from 1960 to the present (Gall et al. 2011, Winkler et al. 2013). Migration rates were separated into five-year age cohorts (e.g., 0-4, 5-9 … 75 and over). This study gathered data from the age cohorts 60-64, 65-69, 70-74, and 75 and over. Other demographic categories including gender and race were also measured in the different migration rates.

The natural disaster data was provided by the Spatial Hazard Events and Losses Database for the United States (SHELDUS) from the Hazards and Vulnerability Institute at the University of South Carolina (Hazards & Vulnerability Research Institute 2013). SHELDUS is a county-level hazard data set that includes 18 different natural disaster types by providing dates of the event, property and crop loss estimates, and injury and fatality estimates for every natural disaster event in the nation (SHELDUS 2013).

To begin with a discussion of the elderly migration data, it is first important to define what I mean when I refer to a migration rate. The migration rate allows for an examination of how much of a role elderly migration into the area has on the demographic composition of the county within the specific age group being analyzed as compared to simply looking at absolute numbers. A migration rate for each county is calculated by dividing the total net migration number in the specified age group by the estimated population total for the county of destination of that age group, and then multiplying by 100. The net migration is the number of out-migrants subtracted from the number of in-migrants to produce a net gain/loss for the county. The estimation of the elderly population from which the migration rate is taken from is projected at the end of the decade. For example, if a county had a net migration total of 1,500 among individuals ages 65 through 70, and the estimated population of individuals 65 through 70 at the end of the decade was 20,000, then the migration rate for that county would be 7.5. A migration rate can be negative or positive reflecting whether a county experienced more in-migrants (+) or out-migrants (-).

The migration rates for elderly populations were also available in different demographic categories. The access to this data allowed for the analysis to measure differences in these demographic groups. The first groups involved differences in age. The elderly population can be broken into two different age groups. The retirement age elderly, those ages 60-74, can be measured separately from the older old, or those ages 75 and over. This distinction is important to make in light of the literature review describing a difference in the migration patterns of these two different age groups. As previously detailed, the young old migrate for reasons of retirement and recreation compared to the older old who tend to migrate for health reasons. For the rest of the thesis, when I refer to the retirement group, I am referring to the elderly group that is between the ages of 60-74. The older old group will be those in the 75 and over age group.

The next demographic category that had its own measure in the analysis was between males and females. Sex may also play a role in elderly migration and natural disasters, particularly among the older old of whom a higher percentage are female widows living alone. Because of this, separate regression models were created where one measured only for elderly males and the other measured only for elderly females with the same break down in age groups.

Because disasters affect persons of color differently than whites (Fothergill et al. 1999), race is an important demographic characteristic to analyze when establishing a relationship between natural disasters and elderly migration. Consequently, I analyzed elderly migration rates separately for different racial groups in the United States. Here, generally following U.S. Census practices, I categorized race as: white, black, and other. While there are several additional categories for race in the U.S. Census Bureau, all the other group are too small to be analyzed individually and therefore and grouped together under the category "other".

In the current study, predictor variables included the following. First, I included a measure of the disaster experience of each county in the U.S., in each time period, is needed, with measurement of both the severity and frequency of the effect. To measure the severity of disaster experience, I used estimates of monetary losses associated with all disasters experienced by each county in each year from 1970 to 2010. A natural disaster is defined here as any event caused by natural conditions that fit into the National Climatic Data Center's categorization and results in economic damage or loss of life (Hazards & Vulnerability Research Institute 2013). Relevant data was available from SHELDUS, which provides data on natural disasters, including avalanches, coastal events, droughts, earthquakes, flooding, fog, hail, heat, hurricane/tropical storms, landslides, lightning, severe storm/thunder storms, tornadoes, tsunamis, volcanoes, wildfires, wind events, and winter weather events. It does not cover technological or willful disasters such as nuclear reactor meltdowns or terrorist attacks. Because of this; I focus here only on the effect of natural disasters.

SHELDUS also offers government calculated totals of damage losses in U.S. dollars at the county level, from 1960 to the present. Direct dollar losses from natural disasters are gathered by the National Climatic Data Center (Hazard & Vulnerability Research Institute 2013). While the data provided in the database is comprehensive with respect to direct losses, it lacks any measurement for indirect, insured, or uninsured losses (Gall et al. 2011). Losses presented in the data are the most conservative estimates from a range of estimates generated, meaning that if an event takes place in a certain county and the government source provides an estimate of loss between $50,000 and $100,000, SHELDUS will present the losses for that county at $50,000. When an event takes place across several different counties at the same time, SHELDUS will total the estimated dollar loss and simply divide that amount equally for each county, regardless of whether or not one county was more substantially affected by the event than others. While this does not provide a complete figure for disaster loss for a specific county, it does offer a comprehensive measurement for direct losses for both property and crop losses at the county level.

From the SHELDUS data, four variables were developed and used as predictor variables in the regression analysis. The first variable was simply the number of natural disasters, or events, that the county experienced over the course of the decade. This variable was included to measure whether or not elderly migrants react to areas that have experienced more events as compared to areas that have not experienced as many events.

The next variable for natural disasters involved the dollar loss figures provided in SHELDUS. In order to make a better measurement of damage intensity, I normalized these damage amounts according to the population of the county, to develop a per-capita damage measure. The rationale here is a given monetary amount of damage would be much worse if it arose from a smaller population of people. For example, if Loving County, Texas (population 82 in 2010) experienced a natural disaster that resulted in one million dollars in losses, the county would be decimated, while this same amount in Los Angeles County (population 9.8 million in 2010) the event would cause less than one dollar of damage per person.

In order to account for the difference in population sizes across counties, a variable was produced that measured the dollar loss per person in the county for every year in the study (U.S. Census). Yearly county population estimates were available from 1970-2000 (U.S. Census), but were not available for 1960 through 1969. For those years, an estimate of the population for the counties was generated by quadratic interpolation using population data for 1950, 1960 and 1970. Although not ideal, this was the best estimate possible.

The final two variables from the natural disaster data both involved measurements of extreme natural disasters experienced in the county. I define an extreme event here as a natural disaster that experienced dollar losses greater than the 90th percentile. It is reasonable to think that if a county experiences natural disasters that produce an average amount of damage, it would not have much effect on the population. Extreme events, however, may dramatically alter the condition of the county and result in a change in the migration patterns of the elderly. So a new variable was created that counted how many times a county experienced a natural disaster that resulted in a dollar loss total greater than the county's 90th percentile, that is the number of natural disasters that experienced dollar losses in the top 10 percent of losses in the decade. Another variable was made the same way, measuring the number of events the county experienced that were in the 90th percentile based off of the national average of dollar losses caused by natural disasters. These variables would show if a county has experienced many extreme events over time whether that has more of an effect on elderly migration than the typical dollar losses that the county experiences on a regular basis.

Challenges and Limitations

Before proceeding, I outline some of the key challenges associated with this analysis. The analysis of county level data over a large period of time presents many challenges that needed to be overcome before the analysis could take place. Some of the challenges that occurred when using county level data are that county borders change over time and different states incorporate counties and cities in different ways so that statistical data is collected differently. As the unit of analysis is the county and the measurement is extended over four decades, these challenges needed to be corrected before the regression analysis could take place. Often, new counties were created by breaking free from other counties. In the context of this research project, that was not a difficult challenge to overcome. As this project analyzes a county's natural disaster data in one decade to the county's elderly migration data in the next decade, if the county did not exist during one of those time periods, it was simply omitted from the analysis and not included in the final result. When sufficient natural disaster data and elderly migration data was present in the county for the time period studied, it was included in the final results. However, there were also a number of cases where counties merged together to become a new county. When a new county was created and an old one was no longer in existence, the natural disaster data often had the error of dividing the data between the new county and the old county. This took place even when the old county no longer existed. So the duplicated counties had to be found, isolated, and eventually deleted in order to restore the accuracy of the data.

The next challenge to analyzing county level data that needed to be addressed before the regression analysis could take place was the issue of different definitions to what constitutes a county in each state. The issue with such distinctions does not alter the formation of this study but was necessary to address on a conceptual level to avoid any confusion when referring to counties in the United States. In Alaska and Louisiana, for example, counties aren't called counties but are instead referred to as boroughs and parishes, respectively. In terms of the unit of analysis, there is no difference between a borough, parish, or county. This challenge of analyzing county level data was more on the conceptual level and was discussed to avoid future confusion of terms.

There were also differences in some states in terms of the relationship between cities and counties. The state of Virginia is one that required additional attention due to the alterations needed in the data before analysis could take place. Virginia does not incorporate major cities into the counties and therefore elderly migration and natural disaster data was recorded separately. Before any analysis could begin, cities needed to be added back into the county in which they were geographically located. This presented no difficulty in regards to the migration data as data was simply added into the county net migration figures and recalculated the new rates for the combined county and city.

Natural disaster data in the state of Virginia posed another challenge that needed to be corrected before analysis could begin. While elderly migration is easy to track within artificial boundaries, natural disasters are rarely contained within these boundaries. Several counties may simultaneously experience a single natural event that produces a disaster and in the context of Virginia, cities and their surrounding counties would often experience the same event. When combining Virginian cities with their surrounding counties, the natural disaster data created errors during the combination. Some of the city level data were simple duplicates of the county level data and needed to be deleted. Other cities had unique data points that needed to be added to the county level data. This method was simple to use in terms of the dollar damage data; however, the number of events data was not as simple of a solution. It was difficult to determine whether or not the events variable were duplicates between cities and counties or their own separate measurements that needed to be combined. So in order to provide the least biased estimate of the number of events for the Virginian counties was to take an average between the county and cities and presenting that as the new combined number of events variable.

The migration data for the study was presented in 10-year intervals, where a migration rate for a county was the rate for the county for an entire decade. Natural disaster data was presented in yearly totals, which created a difference in the two data sources. The natural disaster data was then compiled into 10-year intervals to avoid any errors in time series. Because the research spans several decades, the analysis will build on the migration and natural disaster data from the past that could reveal patterns for estimating future rates. The length of time also works into some of the basic assumptions of my hypothesis. I am presuming that potential migrants respond more to the cumulated history of disaster experience. It is not likely that a single year of disaster data would prove significant in relation to elderly migration, so expanding the analysis to include the previous decades worth of disaster damages to the next decade's elderly migration rates, may provide a greater level of significance and a longer term migration analysis in which to study.

Analysis of the Data

A panel regression was selected as the method for the analysis. A panel regression analyzes longitudinal data by measuring data through time by taking set points in time, or waves, to measure changes in the data over time (Finkel 2008). This measurement is taken into effect for the elderly migration data and natural disaster data by measuring previous disaster data to the following elderly migration data. The waves of time in the model are at the start of the decades: 1970, 1980, 1990, and 2000. For example, natural disaster data in the 1960s is measured against elderly migration data in the 1970s to analyze if the effects of natural disaster in the previous decade result in decreased or increased elderly migration rates in the following decade.

Panel regression offers two different ways of measuring the effects within the model. The two are fixed effects and random effects models; I used a fixed effect panel regression analysis, which accounts for the repeated measurement of continuous outcomes over time (Finkel 2008). The fixed effects panel model used here controls for all the unique characteristics of each county that do not vary over time which if not controlled may confound any relationship between the elderly migration data and the natural disaster data (Finkel 2008). Only the variation of the explanatory variables within county, over time, is reflected in the analysis. There are many unique features of each county that may influence the outcome variable in some way; this is known as unobserved heterogeneity (Finkel 2008). For example, climate may affect elderly migration rates, but it is a relatively constant and unmeasured (unobserved) feature that is not included in this model. The fixed effects model takes note of the fact that these unobserved variables may produce different intercepts for each unit of analysis and incorporates that into the model (Finkel 2008). This is done by assuming that the individual effects of each county produce its own intercept in the regression equation (Finkel 2008). In order to do this, the regression equation takes the “unit-level means” of all observed variables, including the unobserved heterogeneity over time. Since the unobserved variables are considered stable over time, the mean measure of the error term is subtracted out (Finkel 2008: 576). The produced means are then subtracted from the observed variables. The fixed effects model makes use of all of the over-time variation in the predictor variables by subtracting out the unit-level means (Finkel 2008).

Separate panel models were constructed for each of the different measures of elderly migration based on the different demographic characteristics included in the study. This resulted in six separate panel models in the analysis. The panel regression model used four predictor variables drawn out of the natural disaster damage data. Variables used included:

1) Square root of the total number of disaster events experienced in the county over the course of the decade. (The square root was taken in order to reduce the right skew of the distribution.)

2) Per capita measurement of dollar damage experienced in the county that was experienced in total over the course of the decade.

3) The number of times the county experienced a natural disaster that resulted in dollar damages greater than the 90^{th} percentile of the county's average dollar damage during the decade.

4) The number of times the county experienced a natural disaster that resulted in dollar damages greater than the 90^{th} percentile of the national average dollar damage during the decade.

Before the analysis was done for the research, the following chapter presents descriptive data of elderly migration rates and natural disaster dollar losses at the county level across the time period being studied. This was done in order to help the audience understand the different trends in elderly migration and natural disasters that lead to this study.

Chapter 4

ANALYSIS OF DESCRIPTIVE DATA

With this literature review as background, I now begin to look at descriptive data on elderly migration and natural disasters. This will show how elderly migration has shaped the demographic composition at the county level and how natural disasters have affected certain areas in the United States. After this description, I present a regression analysis of the effects that natural disaster damage has on elderly migration. The following sections describe elderly migration patterns across the United States from 1970 to 2010 and review natural disaster damages at the county level during the same time period. Data is provided in yearly and decadal totals and in the form of rates in order to allow for comparisons across counties of different size. Throughout the chapter, data is presented in charts and maps in order to provide a clearer picture of the different trends being discussed.

Elderly Migration in the United States

This section draws on data from the Applied Population Laboratory at the University of Wisconsin at Madison to describe elderly migration patterns (Winkler et al 2013). Below, I discuss specific locations that have gained or lost substantial numbers of elderly through migration by presenting tables displaying the migration rates for different elderly groups. For this research project, the migration rates are calculated by dividing the net migration total of the age group by the estimated population total of that age group and then multiply that figure by 100. Migration is the movement of people from one location to another. The net migration rate is in relation to the receiving location of the migrants. Before focusing on specific locations to which the elderly are migrating, I will give a brief overview to the national trends of elderly migration rates.

The elderly population ages 65-74 can be referred as the retirement age group due to the high percentage of retired workers in this age group. Persons in this group typically have higher levels of personal wealth, and are not tied to the labor market. These factors contribute to higher migration rates for this age group compared middle-aged adults. The latest migration data for this age group has shown a dramatic increase in the migration rates for this age group. The percentage of counties in the U.S. experiencing a positive growth in this age group through migration has risen. In the 1970s, 69 percent of U.S. counties experienced a positive migration rate in this age group, but the 2000s that percentage had increased to 83 percent. These increases are spread across the country, but are more common in counties outside major metropolitan areas. States experiencing the largest increases in elderly migration are Florida, California, Arizona, and Nevada, though many counties in every state are also experiencing large increases. The counties that they are migrating to within these particular states are, for the most part, newly established suburban retirement communities. These communities are not specifically established to be for retired persons but due to a variety of factors, the elderly population is attracted to them. Evidence for this trend is shown in data from 1970 to 2010. Florida has had the largest migration rates among the elderly, for the past several decades, and within several of its counties, but in the past twenty years, western states such as Arizona, Nevada, and Utah have experienced increasing migration rates among the elderly in certain counties.

For those ages 75 and over, the data show very different trends in migration patterns. Over the last four decades, migration rates in this age group have been low or negative in most U. S. counties. In the 1970s, only 55 percent of counties had positive migration rates in this age group, and by the 2000s, that percentage had decreased to only 46 percent. There are a couple of conclusions that can be drawn from this data. First, is that the older elderly are migrating to a fewer number of places, thus creating greater concentrations of this age group in particular areas. Another conclusion could be that due to increases in medical technology and financial security, this older age group may be more capable of living alone before the need to migrate for health or financial reasons requires them too. This is a very general overview of the national patterns of elderly migration, but a better understanding of locations and motivations comes from examining data at the state level. For organizational purposes, the two different elderly age groups will be discussed together with time acting as a separating factor in the descriptions below. I will be focusing on the top 10 counties in migration rates for the different age groups in order to represent the locations that are experiencing the largest changes in the demographic composition of the population through elderly migration. This will contribute to the overall research when migration rate data is compared against natural disaster damage data.

At the county level within states, migration rates for the 75 and over age group are much smaller than for the younger elder age group. County's populations of 75 and over are less affected by migration then the elderly group ages 65-74. So there are fewer 75 and over migrants then there are 65-74 aged migrants and the county population is less altered by that migration. The states with counties with high levels of migration in this age group are more spread out across the country than the younger age group. These patterns can be seen in the top 10 counties in migration rates for the elderly ages 65-74 and 75 and over. As shown in Table 1, 9 of the top 10 counties for migration among those 65-74 are in Florida, and within that, three counties (Hernando, Citrus, and Pasco) had rates above 300 in the 65-74 age group, meaning that for every 100 persons in that age group in the population during the 1970s, an additional 300 moved to those locations during that time period. Elderly populations in those counties grew at an incredible rate as a result of the large influx of retired persons moving to Florida. For those 75 and over, 7 of the highest 10 migration rates are in Florida counties, with counties in Nevada and New Mexico also receiving a large number of the oldest old. The 75 and over age group saw lower rates potentially due to how older elderly tend to migrate less due to physical disabilities that restrict their residential mobility.

Table 1: Top 10 Counties with the Highest Migration Rate Ages 65-74 and 75 and over, 1970s

County, State	65-74 Rate	County, State	75 and over Rate
1. Hernando, FL	411	1. Carson City, NV	107
2. Citrus, FL	365	2. Citrus, FL	85
3. Pasco, FL	324	3. Hernando, FL	78
4. Flagler, FL	285	4. Martin, FL	78
5. Martin, FL	254	5. Douglas, NV	73
6. Charlotte, FL	205	6. Sandoval, NM	72
7. Collier, FL	180	7. Brevard, FL	72
8. Ocean, NJ	177	8. Collier, FL	69
9. Highlands, FL	172	9. Clay, FL	62
10. Palm Beach, FL	168	10. Glades, FL	60

The 1980s showed very similar figures to that of the 1970s. As shown in Table 2, 9 of the 10 highest county migration rates for elderly 65-74 were in Florida, as was true in the 1970s. Migration rates in the 65-74 age group were still very high in several Florida counties but were smaller than in the previous decade. Hernando County in Florida was still the highest elderly migration rate for those ages 65-74 but the overall rate to the population was nearly half as large as in the previous decade.

For those 75 and over, the 7 of the top 10 counties were still in Florida, but counties in Georgia, Montana, and Utah also contained counties with high rates of elderly migration. Rates in this age group remained considerably smaller to the younger age group.

Table 2: Top 10 Counties with the Highest Migration Rate for Ages 65-74 and 75 and over, 1980s

County, State	65-74 Rate	County, State	75 and over Rate
1. Hernando, FL	243	1. Washington, UT	92
2. Flagler, FL	234	2. Hernando, FL	78
3. Highlands, FL	154	3. Flagler, FL	64
4. Washington, UT	150	4. Fayette, GA	60
5. Charlotte, FL	146	5. Wibaux, MT	55
6. St. Lucie, FL	135	6. Highlands, FL	55
7. Citrus, FL	132	7. Indian River, FL	53
8. Indian River, FL	121	8. St. Lucie, FL	53
9. Martin, FL	119	9. Osceola, FL	48
10. Marion, FL	117	10. Collier, FL	47

During the 1990s, as shown in Table 3, there was a shift in the location of higher migration rates among the elderly. Florida still possessed 5 of the top 10 for the 65-74 age group, but now several western states have counties in the top 10, including Arizona, which has 2, Nevada, Utah and New Mexico. The 75 and over age group also saw more diversity in the location of counties with the largest migration rates with locations in the north, west and south. Migration rates similar in size to the previous decades except that the 75 and over age group saw an increase in the migration rate in a few specific counties including Sherburne, Minnesota, Douglas, Colorado, and Rockwell, Texas.

Table 3: Top 10 Counties with the Highest Migration Rate Ages 65-74 and 75 and over, 1990s

County, State	65-74 Rate	County, State	75 and over Rate
1. Sumter, FL	207	1. Sherburne, MN	157
2. Washington, UT	160	2. Douglas, CO	130
3. Nye, NV	151	3. Rockwall, TX	109
4. Flagler, FL	131	4. Nye, NV	87
5. Collier, FL	121	5. Loudoun, VA	85
6. Mohave, AZ	105	6. Somervell, TX	83
7. Pinal, AZ	104	7. Fayette, GA	78
8. Lake, FL	97	8. Columbia, GA	77
9. Lincoln, NM	95	9. Collin, TX	71
10. Highlands, FL	94	10. Williamson, TX	70

The 2000s saw a very similar spread in the location of larger migration rates to the 1990s, as shown in Table 4. The 65-74 age group had 5 of the top 10 counties from Florida, 2 counties from Arizona and one county from Ohio, Nevada, and Utah. The rates of migration in the top ten remained similar in size to the 1990s as the top county had a migration rate of 288 and the last county on the list had a migration rate of 82. The 75 and over age group saw an anomaly in one county that uniquely separated it from the rest of the top ten as well as the previous decade's migration rates. Madison, Mississippi saw a migration rate 400% larger than the other counties in the top 10. The reasons why this county experiences such a large increase in elderly through migration is unclear. The top counties were spread out in more states compared to the younger age group with 4 of the top 10 in Texas.

Table 4: Top 10 Counties with the Highest Migration Rate 65-74 and 75 and over, 2000s

County, State	65-74 Rate	County, State	75 and over Rate
1. Sumter, FL	288	1. Madison, MS	453
2. Flagler, FL	120	2. Rockwall, TX	110
3. Pinal, AZ	108	3. Wibaux, MT	103
4. Washington, UT	98	4. Forsyth, GA	90
5. Marion, FL	92	5. Douglas, CO	87
6. Nye, NV	91	6. Collin, TX	85
7. Noble, OH	90	7. Loudoun, VA	81
8. Highlands, FL	88	8. Denton, TX	79
9. Lake, FL	86	9. Kendall, TX	78
10. La Paz, AZ	82	10. Lincoln, SD	75

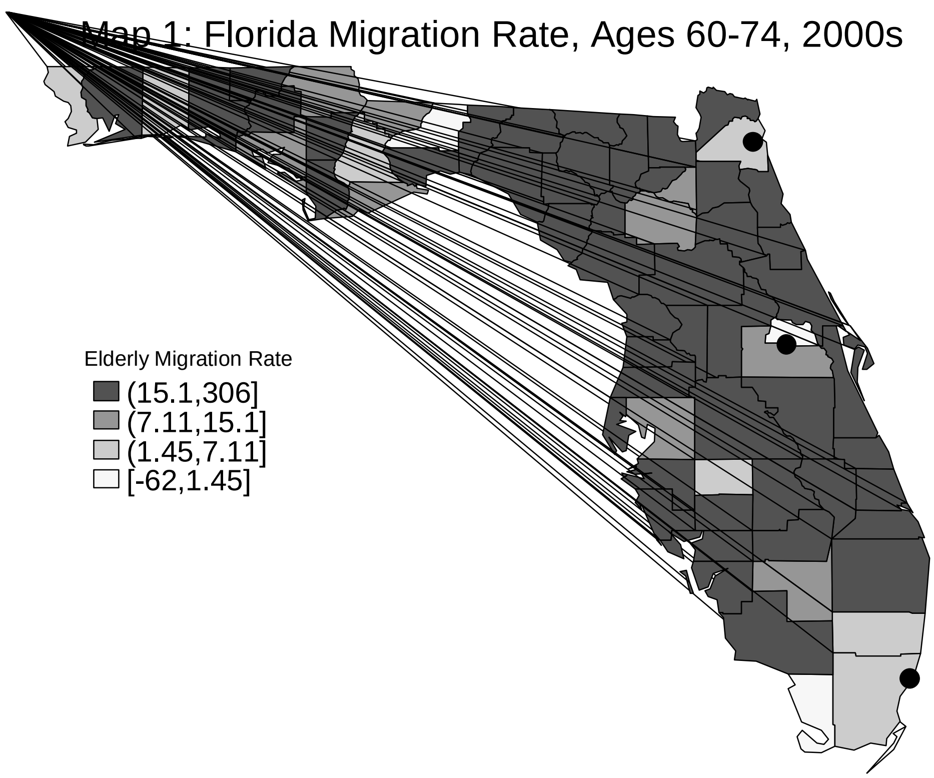
The data presented above illustrate several important patterns for consideration. Since the 1970s, the migration rate among the top counties in the U.S. has decreased slightly but in terms of an overall migration rate through time, the migration rates have stayed very similar from decade to decade. First, the areas of the country that experienced the largest number of elderly migrating and also contained the largest migration rates at the county level during 1960-2010 included the South, particularly counties in Florida and Texas, and in the Southwest in counties in Arizona and Nevada. Second, the two different age groups of the age 65-74 and 75 and over Experienced different rates of migration, with the younger old moving more frequently than the 75 and over group (although the 2000s evidenced a noticeable shift in this pattern).

To better describe the patterns in elderly migration in the United States, I offer a graphical representation of the data, using maps to illustrate the geographical differences in migration rates persons age 65 and older. The maps were provided from Winkler et al. (2013) from the same website that the migration data was collected. While previous decades were available to be mapped out, only the 2000s migration rates were presented here to show the overarching pattern of elderly migration across all the decades and provides a more concise discussion. To present all of the previous decades included in this study in this format would make the presentation of this data too long and redundant. I specifically selected certain states or regions that best represent the dynamic of elderly migration during this time period. The Maps I present include the state of Florida because it has received the largest number of elderly migrants over the past four decades and contains several counties with the largest migration rates in the country. Other maps included regional areas to show how whole portions of the country were receiving or losing elderly migrants based on age. The upper Midwest, Pacific Northwest, and the Southwest regions all contained easily noticeable changes in the elderly migration rates based on age. The following presents these maps with a brief discussion as to what they contain.

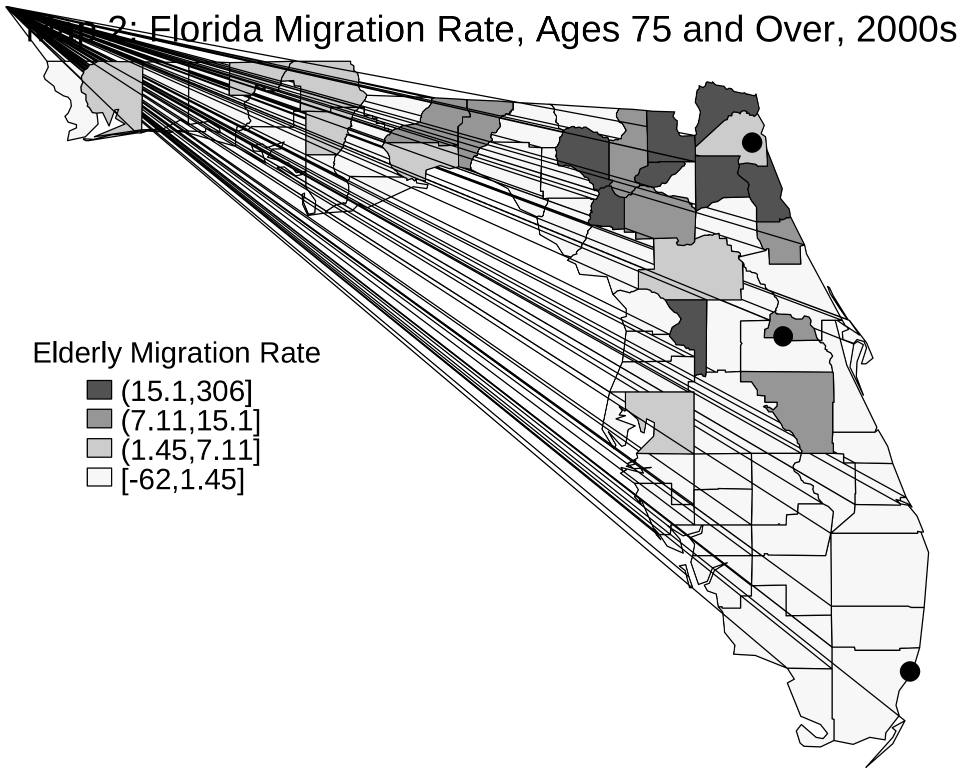
The following maps present elderly migration rates in two different age groups. The first map for each region will show the elderly migration rates for the elderly population in the ages of 60 to 74. The second map for each group contains elderly migration data for the group ages 75 and over. The darker shaded counties, as described in the map legends, represent high levels of positive migration rates of elderly migration, while the lighter shades are used for the smaller or even negative migration rates. As you will see below, the patterns of elderly migration differ dramatically between these two age groups

The first map is of the state of Florida, Map 1, representing the 60-74 age group and Map 2 the 75 and over group. Across the state, 64 out of the 66 counties in Florida experienced a positive gain in population from 2000-2009 for the age group 60-74 through migration, and many of them had high migration rates, resulting in dramatic changes in the population's demographic composition. Positive growth occurred in nearly all counties.

. The map shows some of the densely populated urban areas such as Jacksonville in the northeast and Miami in the southeast as having a smaller migration rate, which matches with the idea presented in Chapter 2 that this age group tends to migrate away from densely urban regions, the black dots on the map are the metropolitan areas in the states. Yet, the vast majority of counties on the map showed large positive migration rates.

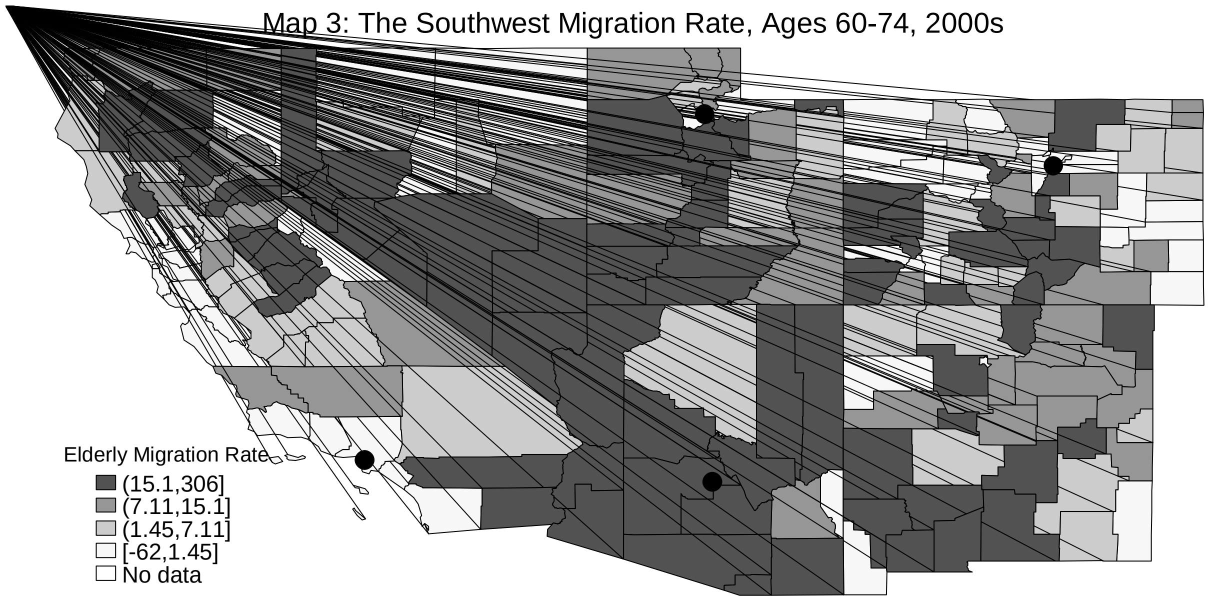


Map 2 shows Florida's elderly migration rates for the 75 and over age group. Comparing the map showing migration rates among the elderly ages 60-74 to the elderly 75 and over, the location for larger migration rates as well as negative migration rates is noticeably different. Instead of a majority of counties experiencing net gains in migration, 40 of the 66 counties in the state experienced a net loss migration. The older elderly show a greater concentration through migration with the fewer number of counties having a large positive migration rate and several counties having large negative migration rates. Florida sees this concentration in the central and northeastern regions of the state, near major metropolitan areas.



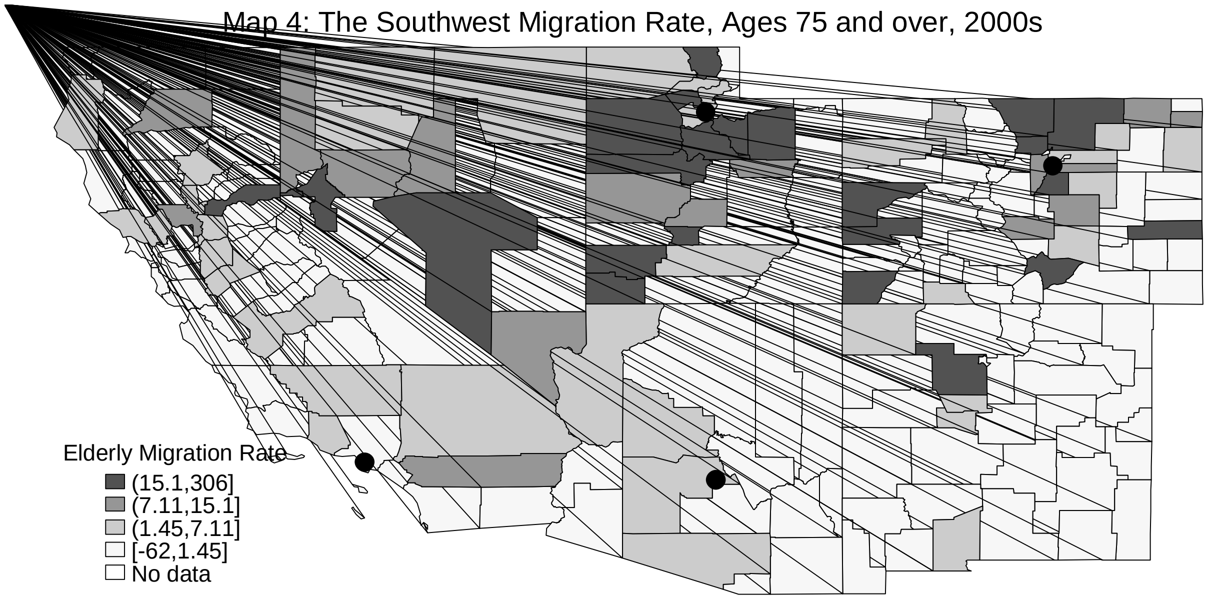
As shown in Maps 3 and 4, the Southwest region of the country, particularly the states of Arizona and Nevada have also experienced widespread growth in the number of elderly within nearly all counties in those two states. 14 out of 15 counties in Arizona experienced positive growth through migration during the decade of the 2000s for the age group 60 to 74, while the same occurred in 13 out of 17 Nevada counties. California always has large numbers of migrants entering into the state, but the rates were comparable due to the large population already living there. The black dots on the map are the cities of Denver, CO, Salt Lake City, UT, Phoenix, AZ, and Los Angeles, CA. Here, Phoenix appears to be an anomaly compared to other large cities where the elderly are actually being drawn there.

Map 3: The Southwest Migration Rate, Ages 60-74, 2000s

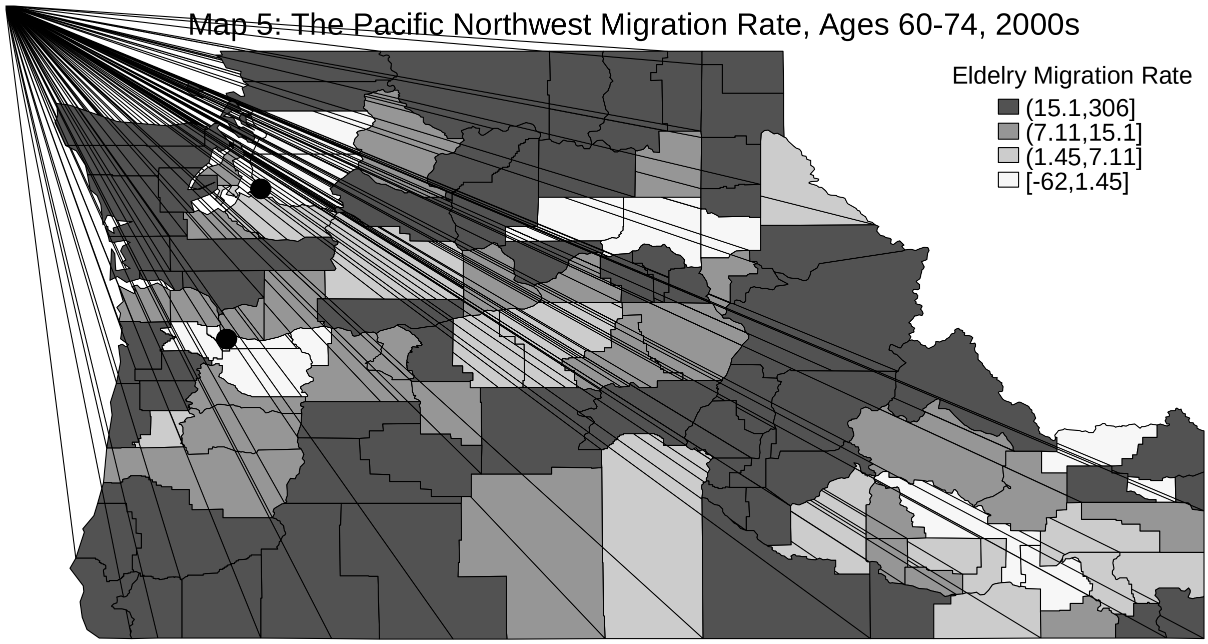


Similar to Florida, several counties throughout the Southwest experienced a negative migration rate among those ages 75 and over and a greater concentration of counties with positive migration rates, as seen in Map 4. This region of the country, along with the counties in Florida, saw a greater concentration of elderly in this age group through migration as only a few counties had a positive migration rate, resulting in an increase in that county's elderly population through migration while a majority of counties had a negative migration rate, resulting in net loss in population in those locations for that age group due to migration.

Map 4: The Southwest Migration Rate, Ages 75 and over, 2000s

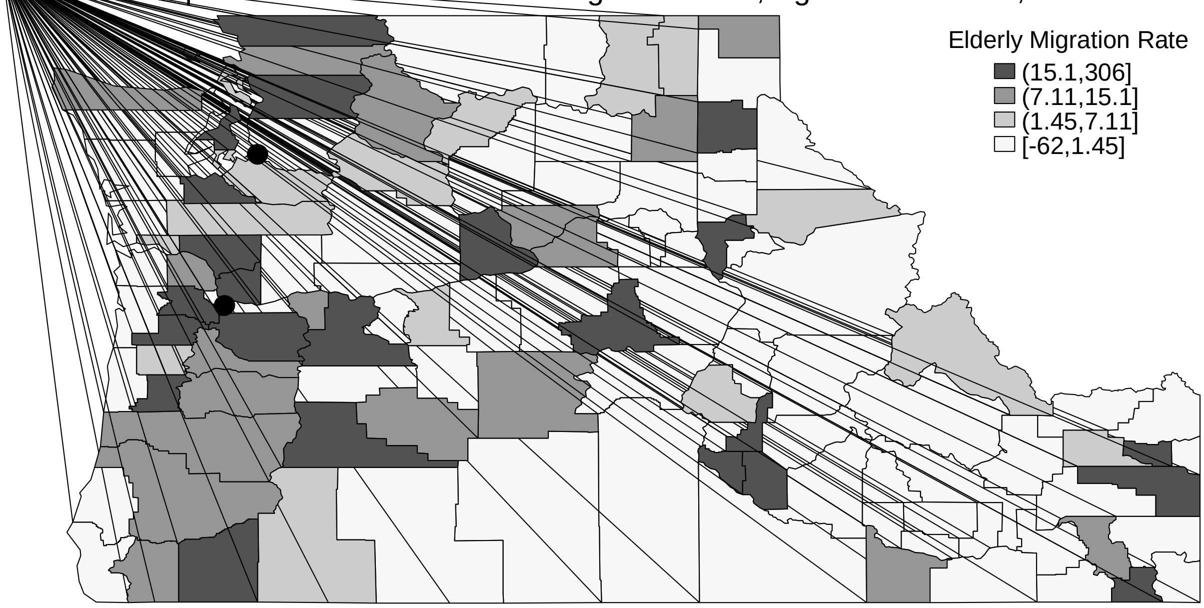


As seen in Map 5, elderly migration rates in the Pacific Northwest for the ages 60 to 74 show a wide variety of counties, both mountain and coastal, experiencing net gains in elderly migration. Counties near major metropolitan areas tended to have a smaller net gain in this age group or even a net loss in elderly migrants. The lighter shaded counties in Oregon are the Portland metropolitan area and the large darker shaded counties in the state of Washington in the western end of the state are the metropolitan area of Seattle. This map show, as was true in the other maps, that high elderly migration rates are geographically widespread within regions, that is, they are not concentrated in any particular location.

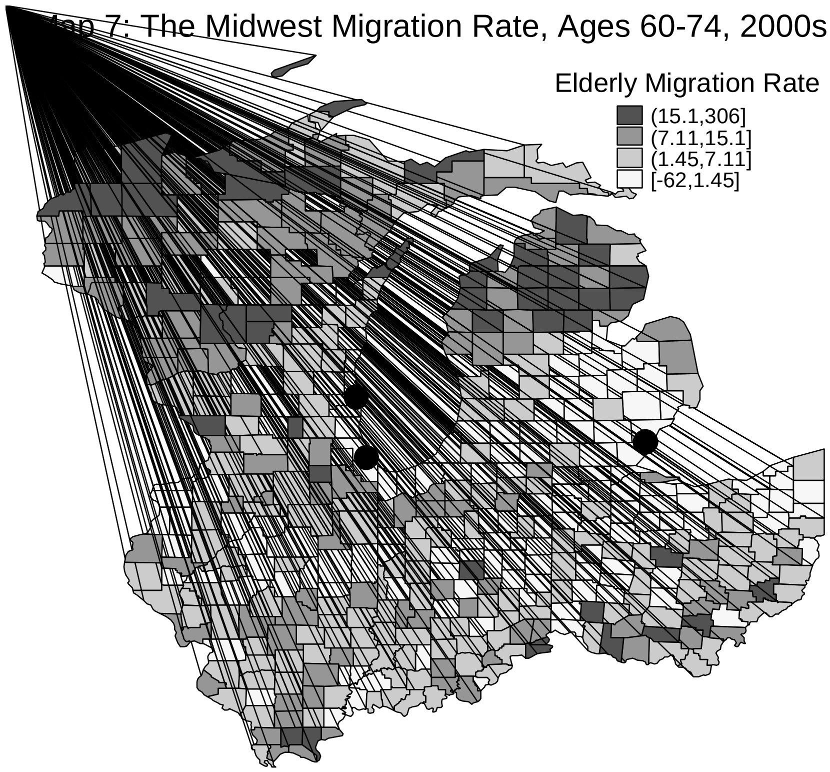


As seen in Map 6, the older elderly migrants are becoming more concentrated in just a few counties while the vast majority of counties in this region have negative migration rates There is a greater concentration of counties with net gains in migration from this age group and it appears in this map that counties in close proximity to major metropolitan areas were the primary counties still experiencing net gains in elderly migrants.

Map 6: The Pacific Northwest Migration Rate, Ages 75 and over, 2000s

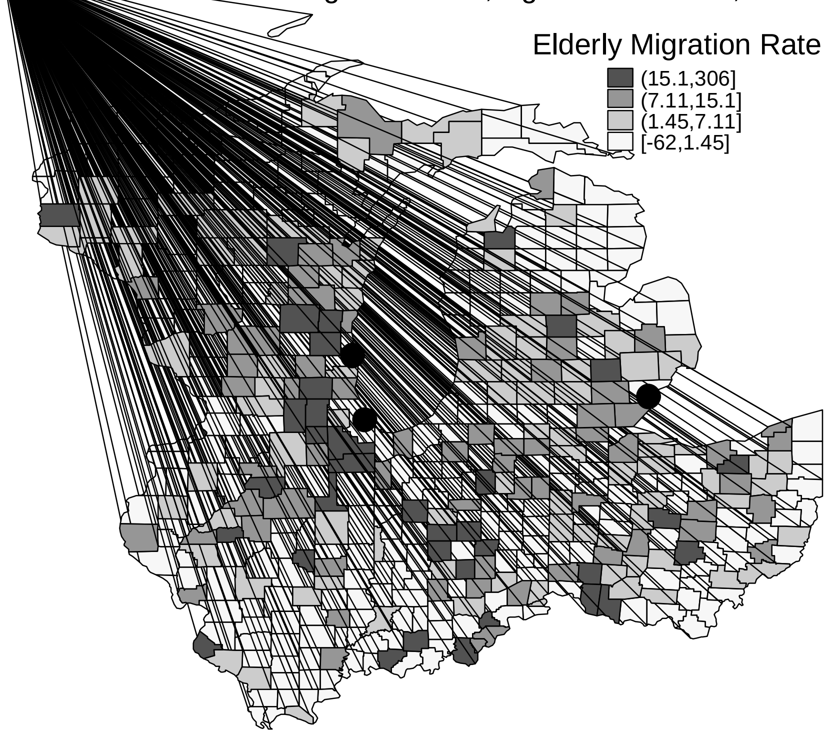


Map 7 shows migration data for elderly ages 60 to 74 that appears to be different when comparing to the previous maps for this age group. Here, instead of a majority of counties experiencing positive migration rates, more northern counties appear to be experiencing more positive migration rates then the southern counties, for example in Michigan. This does, however; follow the similar patterns in the other parts of the country. In Michigan, the more densely populated areas are in the southern portion of the state, yet the northern counties had larger positive migration rates. The city of Detroit, located in the southeastern part of the state saw negative migration rates resulting in a decline in that area's elderly population through migration. This does follow along the same lines as the previous maps showing the migration rates for this age group.



Map 8 shows the same region but focuses on the migration rates of the 75 and over age group. As the map shows, the patterning of migration in this region for the older age group is in near reversal to the younger age group shown in Map 7. For this older age group, the counties that experienced higher in-migration rates for the younger age group here show higher out-migration. This region of the country also display the more general pattern in which persons with high migration rates for 75 and over are in different areas than for 60 to 74 age group. Higher migration rates among the old-old also more commonly occur close to metropolitan areas, and are found within a smaller number of counties.

Map 8: The Midwest Migration Rate, Ages 75 and over, 2000s



The purpose of this previous section was to show how these migration patterns for these two age groups are affecting specific regions of the country. By looking at maps, it helps orient the reader to better understanding what the data presented in the tables of this chapter implies and how the data analysis in the following chapter has real world implications.

Up to this point, I have mainly focused on where elderly migrants are going. Top 10 tables gave a snapshot to which counties and regions of the country were experiencing the most dramatic changes to their populations through elderly migration. The maps showed largely where the migrants were traveling spatially. The maps also showed where the migrants were leaving. This next section will go in the opposite direction of the previous section by providing top 10 tables for counties experiencing the most negative migration rates, resulting in population loss of the specific age groups. Tables in this section will be presented in the same way as the above section. Top 10 counties with the largest out migration figures will be provided from the 1970s, 80s, 90s, and 2000s. When we turn to counties that are experiencing the most out migration of the elderly, distinct patterns also emerge. The trend of United States' internal migration has been a movement towards greater levels of urbanization. This trend has been happening for over a hundred years now. The past several decades of elderly migration continues to follow this trend, particularly in which counties and regions are experiencing the largest negative migration rates of the elderly.

When we looked at the top 10 counties for in migration there was a large difference between the migration rates of the younger aged group, those 65 to 74, and of the older age group, those 75 and over, where the younger group had larger migration rates than the older group. Table 5 begins the analysis of the top 10 counties in *out*-migration during the 1970s for the two different age groups. Here, that difference disappears. Among the top counties for out-migration, the rates for the 65 to 74 age group and the 75 and over group are virtually equal. The regions of the country experiencing the most out migration are also virtually the same between the two age groups and remain relatively consistent over these three decades. Data is again presented at the county level. As shown in Table 5, 6, and 7, West Texas, rural and mountainous counties of Colorado, Nevada, New Mexico and Arizona, and the Northern Great Plain states of the Dakotas and Nebraska contained the majority of the counties with the top out migration rates among both groups.

Table 5: Bottom 10 Counties with the Lowest In-Migration Rate, Ages 65-74 and 75 and over, 1970s

County, State	65-74 Rate	County, State	75+ Rate
Loving, TX	-69	Billings, ND	-76
King, TX	-67	Petroleum, MT	-67
San Juan, CO	-65	Glasscock, TX	-60
Eureka, NV	-54	McMullen, TX	-57
Lake, CO	-41	Summit, CO	-50
Terrell, TX	-40	San Juan, CO	-50
Greenlee, AZ	-40	Mineral, CO	-48
Summit, CO	-38	Banner, NB	-45
Jackson, CO	-35	Storey, NV	-44
Reagan, TX	-34	Lake, CO	-42

Table 6: Bottom 10 Counties with the Lowest In-Migration Rate, Ages 65-74 and 75+, 1980s

County, State	65-74 Rate	County, State	75+
Kiowa, CO	-44	Loving, TX	-100
King, TX	-41	King, TX	-79
Shannon, SD	-34	San Juan, CO	-50
Loving, TX	-33	Glasscock, TX	-42
Daggett, UT	-33	Sioux, ND	-41
Alpine, CA	-31	Petroleum, MT	-40
Banner, NB	-29	Kenedy, TX	-40
Greenlee, AZ	-28	Shannon, SD	-38
Issaquena, MS	-28	Grant, NB	-36
Ziebach, SD	-28	Terrell, TX	-35

Table 7: Bottom 10 Counties with the Lowest In-Migration Rate, Ages 65-74 and 75+, 1990s

County, State	65-74 Rate	County, State	75+ Rate
San Juan, CO	-47	Loving, TX	-67
Kenedy, TX	-40	San Juan, CO	-56
Los Alamos, NM	-35	Menominee, WI	-56
Billings, ND	-33	Banner, NB	-55
Glasscock, TX	-32	Sioux, NB	-54
Lander, NV	-29	Blaine, NB	-51
Ziebach, SD	-26	Kenedy, TX	-50
Slope, ND	-25	Slope, ND	-50
Harding, SD	-25	Sioux, ND	-49
Loving, TX	-25	Grant, NB	-49

Table 8: Bottom 10 Counties with the Lowest In-Migration Rate, Ages 65-74 and 75+, 2000s

County, State	65-74 Rate	County, State	75+ Rate
St. Bernard, LA	-63	St. Bernard, LA	-75
Aleutians West, AK	-51	Aleutians West, AK	-57
Aleutians East, AK	-46	Issaquena, MS	-56
Orleans, LA	-34	Orleans, LA	-51
Los Alamos, NM	-34	Cameron, LA	-51
Cameron, LA	-32	Blaine, NB	-51
Issaquena, MS	-32	Buffalo, SD	-51
Lake and Peninsula, AK	-24	Zapata, TX	-50
Valdez-Cordova, AK	-24	Mineral, CO	-46
Hartley, TX	-24	Cottle, TX	-46

In examining *out*-migration rates, one distinct and simple feature of the top 10 large county rates is how much smaller they are in absolute size than the corresponding top 10 for *in* migration. While the highest levels of in-migration were large sometimes as large as 300-400 (i.e. 300-400 more in-migrants than out-migrants per 100 existing residents in the county), the top 10 out-migration rates rarely broke 100 and were often less than 50.

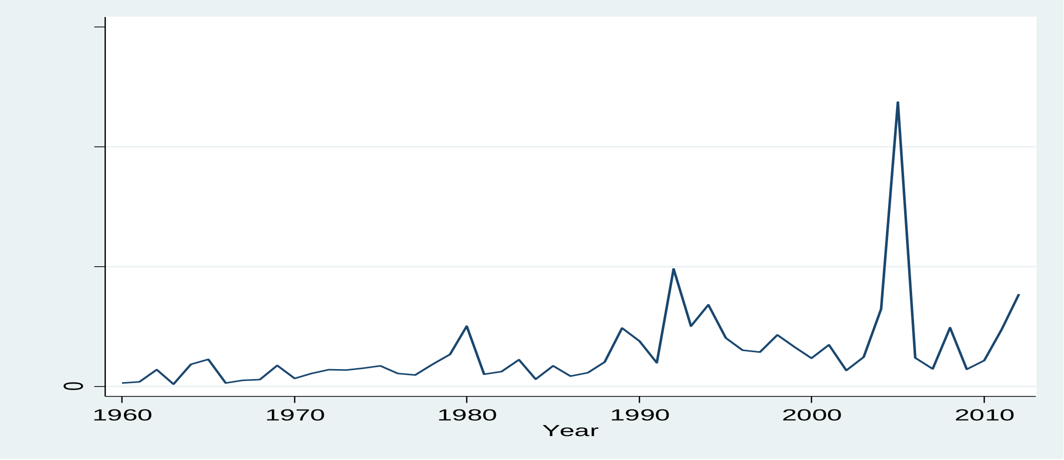
There are multiple reasons for this difference. Because the figures presented above are rates and not net numbers, counties with the larger negative migration rates often have smaller populations of elderly to begin with. Many of the counties in the lowest in-migration tables have very low total populations and even smaller elderly populations.

The purpose of the above sections was to provide basic descriptive statistics on elderly migration patterns in the United States for the previous four decades. The data show that the largest migration rates are located in warmer, retirement focused counties in states such as Florida, Arizona, Nevada and California. Within those regions, the group entering into retirement, those ages 65 to 74, is migrating to suburban and rural counties and away from the major urban centers. Once the elderly age into the older age group that is characterized more by loss of physical independence or the development of a disability, the migration pattern becomes more concentrated in a fewer number of counties located back towards urban areas, yet not directly back into those urban areas.

Natural Disaster Damage in the United States

The intensity and magnitude of natural disasters in the U.S. has increased over the past fifty years. This final section in this chapter will describe data on natural disasters in the United States at the national level as well the county level, with description of economic costs of damage is, with data shown from the 1960s to the 2000s. Figure 1 shows the overall trend of natural disaster damage (2012 constant dollars) time at the national level as calculated from the data provided by SHELDUS. Dollar damage has been increasing year to year with some incredibly large increases in damage in the 1990s and 2000s. Whereas the average annual dollar damage in the 1960s was about $4.8 billion, that figure increased to about $7.18 billion for the 1970s, and about 10.4 billion by the 1980s. With several destructive hurricanes and earthquakes in the 1990s, an even more dramatic increase occurred, with an annual mean for the decade of $22.7 billion. A similar spike in major natural disasters took place in the 2000s as well. These dollar increases in natural disaster damage are far greater than population growth in these areas, resulting in much larger per capita damage over time.

Figure 1: Average Annual Dollar Damage from 1960-2012



The following tables present the counties that experienced the largest dollar losses through natural disasters during the decades in this study. The top 10 counties in dollar losses during these time periods provides a very brief snapshot of some of the areas of the country that experienced the most damaging disaster. These tables, along with the previous tables on elderly migration rates provides information on the parts of the country experiencing both trends, adding support to my thesis hypothesis. Table 9 presents the largest single dollar loss figures at the county level from 1980 to 1990. While the nation experienced many natural disasters that caused billions of dollars in damage in the 1980s, dollar figures losses in the 1990s were significantly larger. The 1990s was marked by two major events: in 1992, Hurricane Andrew ripped across the southern tip of Florida destroying several communities and greatly affecting the Miami-Dade metropolitan area. In 1994, the Northridge earthquake rocked Los Angeles, resulting in the largest disaster damage dollar loss, to date, for a single county at over $30 billion in Los Angeles County alone. The large increase in disaster damages in several counties can be seen in a comparison between the 1980s top counties for disaster damage to the 1990s. The comparison clearly shows how more destructive disaster became in the 1990s.

Table 9: Natural Disaster Damage Dollar Losses Comparison 1980s to 1990s

County, State	Year	Dollar Damage (2012 Adjusted)	County, State	Year	Dollar Damage (2012 Adjusted)
1. Skamania, WA	1980	8,961,000,000	1. Los Angeles, CA	1994	30,990,000,000
2. Cowlitz, WA	1980	3,391,000,000	2. Collier, FL	1992	10,640,000,000
3. Charleston, SC	1989	1,947,000,000	3. Broward, FL	1992	10,640,000,000
4. Santa Cruz, CA	1989	1,388,000,000	4. Monroe, FL	1992	10,640,000,000
5. San Mateo, CA	1989	1,388,000,000	5. Miami-Dade, FL	1992	5,318,000,000
6. Monterey, CA	1989	1,366,000,000	6. Grand Forks, ND	1997	4,309,000,000
7. San Benito, CA	1989	1,366,000,000	7. Kauai, HI	1992	2,954,000,000
8. Santa Clara, CA	1989	1,366,000,000	8. Alameda, CA	1991	1,176,000,000
9. Alameda, CA	1989	1,366,000,000	9. Okaloosa, FL	1995	1,176,000,000
10. Marin, CA	1989	1,366,000,000	10. Escambia, FL	1995	1,176,000,000

The most notable disaster in the 2000s was Hurricane Katrina, whose estimated total damage of $81 billion made it the most destructive natural disaster in our nation’s history and contributed to increasing the decade’s average annual dollar damage to about $24.5 billion. While broad in impact, Katrina hit many parishes in Louisiana and counties in Mississippi particularly hard, putting them in the decade’s top 10 for damage, as can be seen in Table 10.

Table 10: Top 10 Counties Disaster Dollar Losses 2000-2009

County, State	Year	Dollar Damage (2012 Adjusted)
1. Linn, IA	2008	7,998,000,000
2. Lafourche, LA	2005	7,091,000,000
3. Jefferson, LA	2005	7,091,000,000
4. Plaquemines, LA	2005	7,091,000,000
5. St. Bernard, LA	2005	7,090,000,000
6. Orleans, LA	2005	7,090,000,000
7. St. Tammany, LA	2005	7,089,000,000
8. Jackson, MS	2005	5,504,000,000
9. Harrison, MS	2005	5,504,000,000
10. Hancock, MS	2005	5,504,000,000

The latter half of this chapter was designed to present the counties that experienced the highest natural disaster losses in the United States over the last 50 years. While the top 10 counties in each decade only presents the most extreme cases of natural disaster, the data does show the overall trend of increases in natural disaster damage. These extreme cases were located mainly in specific areas of the country such as California and Florida. Counties located in these states also contained some of the larger migration rates. An understanding of the location of extreme natural disasters and elderly migration is the underlining focus of this thesis and will be addressed through the statistical analysis portion of the thesis in the following chapter.

Chapter 5

DATA ANALYSIS AND FINDINGS

Now that we have a more thorough understanding from the literature on the motivations behind the elderly's decision process to migrate to a new area as well as the unique vulnerabilities that the elderly have to deal with when facing a natural disaster event, it is now possible to turn to the data analysis portion of the thesis to examine my hypothesis on the relationship between elderly migration patterns in the United States and natural disaster damage. The previous chapter presented statistics describing patterns of elderly migration in the United States over the previous four decades, and the location of natural disaster damage since 1960. Contrary to what might be expected, those simple descriptions did not reveal any obvious evidence that the elderly consider disaster vulnerability in making migration decisions. In this chapter, however, I use more complex statistical modeling techniques (a fixed effects panel regression) to examine whether natural disaster damage effects on elderly migration patterns in the United States at the county level. A previous decade's worth of natural disaster damage and number of events are measured against the following decade's elderly migration rates. This was done in order to test the hypothesis that elderly migrants have considered an area's exposure to natural disasters when making the decision about whether or not to migrate to an area.

Fixed Effects Model and Variable Definitions

As discussed in the methods section of the thesis, because data here concern counties' migration and natural disaster experience measured in decade totals at four different points in time, a fixed effects panel regression model is appropriate. This model recognizes the non-independence of counties that are repeatedly measure over time and it also controls for all the non-measured distinct features of each county. It is quite reasonable to assume that natural disasters are correlated to some degree with other factors within individual counties, such as region of the country, climate, and levels of economic development.

When dealing with over 3,000 counties, it is reasonable to assume that there is quite a large amount of variability between all the counties in the United States that have no relation with natural disasters. Previous research has shown that elderly migration is influenced by many different types of variables (Fournier et al 1988, Conway and Houtenville 1998, Conway and Rork 2006). A fixed effects model allows for the removal of that variability in order for the regression model to just focus on the relationship between the independent and dependent variables.

As mentioned in the previous chapter, the regression model was designed using four predictor variables created from the natural disaster data to be measured with outcome variables created from elderly migration data. Per capita dollar loss and number of events experienced were used in the model to measure whether a county's level of exposure to natural disasters could be used to predict future elderly migration. The other two variables measure the number of extreme events a county experiences in comparison to the county's own decade average and to the nation's average. The elderly migration data was also broken down into different demographic categories to see if different people groups were affected by natural disasters compared to each other.

<u>Panel Regression Findings</u>

The first panel regression analysis examines the effect natural disaster damage has on counties' elderly migration rates across elderly all age categories, race and gender. The results

(Table 11) show that while relations between several predictors and the migration rates are statistically significant, the size of the coefficients is quite small.

Table 11: Coefficients and Standard Errors from Panel Regression Model of Elderly Migration on Various County Characteristics

	60 and over	60-74	75 and over
Number of Events	-0.449	-0.579	-0.310
	(0.060)**	(0.072)**	(0.066)**
Per Capita Damage	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)
Extreme Events for County	0.344	0.548	0.158
	(0.125)**	(0.151)**	(0.139)
Extreme Events for Nation	-0.358	-0.187	-0.378
	(0.127)**	(0.154)	(0.142)**
Constant	8.143	11.654	2.173
	(0.390)**	(0.471)**	(0.434)**
R^2	0.01	0.01	0.00
N	12,267	12,267	12,267

* p<0.05; ** p<0.01

The variable measuring the number of natural disasters that a county experienced showed a significant negative relation to elderly in-migration. However, the slope indicates that for an increase of one disaster event experienced by a county over the course of the previous decade, there would only be an expected decrease in the elderly migration rate of -.449, that is, a decrease of less than 0.5 migrants per 100 persons in the population. (Remember that the migration rate is measured by dividing the net number of migrants within the specified age group by the expected total population in that age group at the end of the decade multiplied by 100.) The per capita damage variable resulted in virtually no change in elderly migration across age groups, which goes against my hypothesis that higher amounts of damage would result in lower migration rates. While significance is present, due to the very large sample size of 12,267, the actual size of the coefficient shows that this variable doesn't have much of an effect on elderly migration rates.

I also considered the possibility that potential migrants react only to the number of extreme events that a county experienced, which is defined as natural disasters that were in the top 10% of dollar damage measured against the average that the county experienced in the decade and the average that the nation experienced. The 90th percentile was chosen in order to look at a range of extreme events that was large enough compared to the 99th percentile but not too large, compared to looking at the 75th percentile. However, the slope for extreme events for the county (see Table 11) were in the positive direction, meaning that additional extreme events experienced by the county resulted in an increase of .344 for the next decade's elderly migration in the ages of 60 and above. The extreme events compared to the national average variable produced a coefficient in the negative direction with a slope of -.358, meaning that an additional extreme event of this kind would result in a decrease of the elderly migration rate by .358 for ages 60 and above, as an example from the table. Again, you have to look at the size of the coefficients to see that the results do not translate into a large change in elderly migration since it is a very small change in the rate. When comparing the 60-74 age group with the 75 and over age group, coefficients are not much different from each other in terms of size, as seen on Table 11. Statistical significance does vary between the two but it is important to analyze whether or not the differences in the results produce actual change in the two different migration rates.

Because these results showed little effect of natural disaster damage on elderly migration in general, I wanted to test whether perhaps these effects are present in demographic subgroups, defined by gender and race. The elderly population is more heavily female than the rest of the population due to the higher life expectancy of females compared to males. While overall size of the female population compared to the male population may not matter in the relation with natural disasters and elderly migration, it is worth separating the two subgroups to see if the results from the previous table change. Tables 12 and 13 show the analysis of natural disaster damage data in relation to male elderly migration and female elderly migration, respectively, and are shown below.

Table 12: Coefficients and Standard Errors from Panel Regression Model of Elderly Migration on Various County Characteristics among Males

	60 and over	60-74	75 and over
Number of Events	-0.579	-0.772	-0.344
	(0.070)**	(0.089)**	(0.075)**
Per Capita Damage	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)
Extreme Events for County	0.427	0.786	-0.063
	(0.147)**	(0.186)**	(0.157)
Extreme Events for Nation	-0.408	-0.256	-0.409
	(0.150)**	(0.189)	(0.161)*
Constant	10.551	14.862	2.339
	(0.461)**	(0.581)**	(0.492)**
R^2	0.01	0.01	0.01
N	12,267	12,267	12,266

* p<0.05; ** p<0.01

Table 13: Coefficients and Standard Errors from Panel Regression Model of Elderly Migration on Various County Characteristics among Females

	60 and over	60-74	75 and over
Number of Events	-0.365	-0.439	-0.280
	(0.055)**	(0.064)**	(0.072)**
Per Capita Damage	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)
Extreme Events for County	0.281	0.352	0.324
	(0.115)*	(0.133)**	(0.151)*
Extreme Events for Nation	-0.302	-0.134	-0.311
	(0.117)*	(0.136)	(0.154)*
Constant	6.381	9.104	2.154
	(0.360)**	(0.416)**	(0.473)**
R^2	0.01	0.01	0.00
N	12,267	12,267	12,266

* p<0.05; ** p<0.01

The analysis of male's migration rates showed slightly larger slopes than females across all age groups. Again, however, the effects were quite small. For example, male elderly migration between the ages of 60 and 74 only showed a decrease of .772 for one unit increase in the square root of the number of events experienced by a county over the last decade (this variable was converted to the square root of the data in order to reduce the skew of the distribution). So overall, male elderly migration rates might react more to natural disasters than do those for females, but the difference are very small. The Per Capita measurement for natural disasters also resulted in a practically zero slope with no significance for both males and females. The two extreme events variables resulted in larger slopes for males than for females but were similar sizes and direction to the overall population analysis in Table 11. The results of these two regression analysis shows that while there is a slight difference in effect between males and females, the size of the effect is not very different than from the previous analysis or from each other.

Continuing to explore the possibility of effects within subgroups, I I next examined elderly migration rates separated by racial groups. Table 14 shows the results of the analysis among whites (These analyses only cover 1990--present, as migration rates are not available separately by race in the 1970s and 1980s). Slopes for the effect of natural disasters on elderly migration rates among white elderly, in each of the three migration age categories, were even lower than they were in the analysis of overall migration rates in Table 11. The direction also changed for the number of events variable, as t was a negative for the general population but is positive for this whites-only analysis. Per Capita Damage changed directions for white elderly compared to the overall population but the slope remained close to zero. The extreme events variables also resulted in smaller slopes compared to the overall population but were in the same direction as they were for the overall population. However, results showed very little actual change in the migration patterns due to natural disaster damage. The next subgroups in this analysis will be different racial groups, which are used to test whether the same effects exist for these groups as it does for the overall population.

Table 14: Coefficients and Standard Errors from Panel Regression Model of Elderly Migration on Various County Characteristics among White Elderly

	60 and over	60-74	75 and over
Number of Events	0.147	0.122	0.291
	(0.093)	(0.106)	(0.274)
Per Capita Damage	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)*
Extreme Events for County	0.317	0.356	0.108
	(0.158)*	(0.179)*	(0.466)
Extreme Events for Nation	-0.116	-0.084	-0.419
	(0.151)	(0.171)	(0.443)
Constant	3.507	7.796	-2.049
	(0.605)**	(0.685)**	(1.777)
R^2	0.00	0.00	0.00
N	6,151	6,151	6,151

* *p*<0.05; ** *p*<0.01

Table 15: Coefficients and Standard Errors from Panel Regression Model of Elderly Migration on Various County Characteristics among Black Elderly

	60 and over	60-74	75 and over
Number of Events	-0.314	-2.591	-6.350
	(1.380)	(1.750)	(15.110)
Per Capita Damage	-0.007	-0.005	-0.008
	(0.005)	(0.007)	(0.062)
Extreme Events for County	0.321	-1.634	-30.808
	(2.475)	(3.198)	(27.381)
Extreme Events for Nation	1.139	3.210	30.839
	(2.380)	(3.088)	(26.398)
Constant	8.919	26.025	40.535
	(8.984)	(11.412)*	(98.463)
R^2	0.00	0.00	0.00
N	5,295	5,079	4,881

* *p*<0.05; ** *p*<0.01

Table 15 shows the results for black elderly migration in the United States. The size of the slopes suggests some interesting conclusions. The group aged 60-74 and oldest old group also have larger slopes for the number of events variable, compared to white elderly, where for the younger group each additional event experienced by the county resulted in a decrease of 2.5 in the migration rate and the oldest old group had a decrease of 6.3 in the migration rate. The Per Capita Damage variable resulted in larger slopes compared to the overall population but was still very small. For example, for the group aged 60-74, each additional dollar of damage per resident would result in a decrease in the migration rate by just .005. The results from the extreme events variables can be used to draw interesting conclusions for the oldest old age group. Here the extreme events experienced compared to the county average were associated with a large decrease in the elderly migration rate. For example, the group aged 75 and over had a slope of over -30, meaning that, for every additional year that the county experienced a natural disaster that resulted in more damage than 90 percent of what the county experienced during the decade, the migration rate expected to decrease by more than 30. However, the slope for the 90th percentile relative national experience in this age and race group was nearly identical but in the positive direction, where each additional year that the county experiences an extreme event on the national average results in an increase of around 30 per one hundred elderly migrants. While the regression analysis of African American elderly migration rates resulted in larger slopes than for the overall population or for the white population, the same limitation that existed for the analysis of the entire population still prevent a distinct conclusion as to whether or not the African American elderly population is more effected by natural disasters when choosing where to migrate too. The slopes of the variables were larger in size but also resulted in larger standard errors, thus limiting the conclusion that can be drawn from the statistical significance.

Table 16 shows results for the "other" racial category, which comprises all persons not categorized white or black. Slopes and standard errors are larger in this table than in the overall population or the white population tables. For the 60 and over group, the slope for number of events indicated that each additional event was associated with an expected decrease of 3.8 in the migration rate of nonwhite/nonblack persons in that race/age category. Per Capita Damage resulted in a near zero slope for all age groups in this racial category. The largest effect on elderly migration is from the extreme events for the county variable for the 75 and over age group. The regression yielded a positive relationship where for each additional natural disaster experienced by the county that was greater than the 90th percentile of disaster experience produced a coefficient of 9.3. The y-intercepts for the other racial group were significantly different from the general population.

Table 16: Coefficients and Standard Errors from Panel Regression Model of Elderly Migration on Various County Characteristics among Other Elderly

	60 and over	60-74	75 and over
Number of Events	-3.837	-3.285	5.974
	(1.632)*	(1.454)*	(7.871)
Per Capita Damage	0.000	0.000	0.000
	(0.001)	(0.001)	(0.007)
Extreme Events for County	-3.250	-3.944	9.302
	(2.825)	(2.520)	(13.976)
Extreme Events for Nation	2.451	2.383	-1.617
	(2.684)	(2.388)	(13.233)
Constant	64.376	67.382	-28.657
	(10.580)**	(9.440)**	(51.354)
R^2	0.00	0.00	0.00
N	5,931	5,853	5,468

* $p<0.05$; ** $p<0.01$

The purpose of this chapter was to examine effects that natural disasters have had on elderly migration rates in the United States. The findings, which measure how much effect a decade’s disaster damage has on the next decade’s elderly migration rates, were mixed. While some coefficients were statistically significant, they were in almost all cases very small in relation to actual migration rates.

These results were relatively similar within demographic subgroups. Previous research has shown that different demographic groups experience natural disasters differently, and this research includes these different groups in the measurement of the effect natural disasters play on future elderly migration patterns (Fothergill et al. 1999, Ngo 2001, Peek 2013). The current analyses did show some differences between groups, particularly between African Americans and Whites. Also, natural disaster damage had a slightly larger effect on males than females but the difference was so small, it is difficult to draw any substantial conclusions. Further research may work to focus in on one of these groups to attempt to find more significant findings that may reveal potential social consequences worth studying.

The next chapter will turn to the concluding remarks of the thesis as well as stating what can be drawn from the findings of the analysis. The limitations of the study will also be addressed in order to provide a well-rounded critique of the study. Potential future research that could be drawn from this thesis will also be discussed. The role natural disasters play in the decision making process of migrants in the United States is a very small research field that requires more future work. As predictions circulate that more and more powerful storms will bring disaster to regions of the country, the preparedness and mitigation measures that people are willing to take will need to be discussed and analyzed more and more.

Chapter 6

SUMMARY AND CONCLUSION

This concluding chapter returns to the original problem statement that drove the thesis and discusses merits and limitations of this research project. The chapter begins with a background statement and a summary of the findings from the prior chapters. The limitations of the project and the implications for future research are also described in order to place this research project into the context of the body of literature on the subjects of natural disaster vulnerability and elderly migration. The hypothesis for the research was that elderly migration rates are affected by an area’s propensity to natural disaster losses.

Background of the Study

The population of the United States is aging rapidly. As a higher proportion of the population reaches the age of 60 and above, the vulnerabilities and social issues that affect people of that age group will become a larger social issue. This is especially true in regards to natural disaster vulnerability. As populations and infrastructure continue to grow and develop in hazard prone areas, more and more elderly will be exposed to ever more catastrophic events.

As mentioned in previous chapters, natural disaster frequency and scale is on the rise. The last four decades has experienced a steady rise in the number of disasters and amount of damage caused by these events in the United States (Gall et al. 2011). Fatalities have also been on the rise due to natural disasters. The elderly are disproportionately killed during natural disasters (CDC-ARC 1997) and are at risk to both acute- and slower-onset events. Along with the risk of death during a natural disaster, the elderly also suffer from several unique vulnerabilities that set this population apart from the younger groups (Peek 2013).

Elderly migration is a dynamic and multi-faceted aspect of United States mobility. Since the elderly are, for the most part, freed from the labor market, they may have more opportunity to choose where they want to migrate based on other factors, such as certain amenities like warm climates and recreational or outdoor opportunities. This amenity focused migration takes place immediately following retirement where the individual or couple is often at their highest level of wealth and therefore have the greatest level of choice when it comes to migration. As the elderly age and become more physically dependent, they may migrate back to their home or place of origin or to be closer to family where they can receive additional care. The oldest old elderly, those over the age of 75, have difficulty living alone, though most of them still do, so they seek out assistance from others and this often requires a move.

As noted above, the elderly are also uniquely vulnerable to the physical, social, and economic impacts of natural disasters. From early warning to long-term recovery efforts, the elderly face additional challenges that set them apart from younger population groups. The elderly suffer from increased levels of psychological, social, physical, and even life threatening impacts from a natural disaster. As the age structure of the United States shifts to an older population, more and more local, state, and national leaders will need to increasingly incorporate elderly vulnerabilities into their disaster recovery plans.

The relationship between migration and natural disasters is a growing area in disaster studies. As population growth, economic development, and environmental change takes place, more and more natural disasters will take place, affect more people, cause more damage, and result in larger groups of people migrating from disaster zones. Past research has generally focused only on the immediate migration that has been caused by a natural disaster. As this topic of research continues to develop, more longitudinal studies like the one represented in this thesis can and should take place to assess the long term effects of disasters on the migration patterns of the elderly.

Summary of Research Findings

Natural disaster data was collected from the Spatial Hazard Events and Losses Database for the United States (SHELDUS) from the Hazards and Vulnerability Institute at the University of South Carolina (Hazards & Vulnerability Research Institute 2013). Elderly migration rates were collected from the University of Wisconsin at Madison's Applied Population Laboratory (Winkler et al. 2013). Data was analyzed from the 1960s to the 2000s by collecting the data into four decadal total periods, the 1970s, 1980s, 1990s, and 2000s. Each period in time contained the previous decades natural disaster damage totals, measured in dollars, and the following decades migration rates all at the county level. For example, the 1970s contained the natural disaster damage amounts during the 1960s to be measured against the migration rates of the 1970s. Over 3,000 counties were analyzed in each of the four points in time.

Elderly migration data was presented in the form of rates, which was calculated by taking the net migration for the specific age group being focused on by the total population of that age group at the end of the decade and then multiplied by 100. The migration data was separated into several categories by the ages of the elderly being studied. Data was separated into three different age groups: ages 60 and over, ages 60-74, and ages 75 and over.

Descriptive statistics was presented in order to provide a basic summary of elderly migration patterns across the country during this time period. Florida and California are taking in large numbers of elderly migrants despite the fact that they are two of the most prone states to experience severe natural disasters. Data on elderly migration showed a greater spreading of the elderly population immediately following retirement across the country but then a more clustering effect for the oldest old. The southeast and western regions of the country are both receiving and sending the most elderly. This factor adds to the many different variables in greater economic development in these regions. These conclusions were showed through tables of the top 10 largest migration rates at the county level and the top 10 smallest migration rates as well as several maps showing different regions of the country.

Natural disaster data was presented in several different variables for analysis with the elderly migration rates. The dollar damage totals were for property damage and not crop damage resulting in the majority of disaster to be from flooding, hurricanes and earthquakes. One variable contained the number of natural disaster events that a county experienced during the decade. The other variables contained the dollar damage per capita amount for the county during the decade and the number of extreme events that the county experienced, extreme being defined here as the number of events that resulted in dollar damage in the 90^{th} percentile of the county's average experience and the nation's average experience. Natural disaster frequency and intensity, meaning larger dollar damage amounts, have been on the rise over the time period in the study across the entire nation. This thesis also showed that natural disasters have higher frequencies and intensity in the regions where the elderly are migrating.

A Panel Regression model using fixed effects was calculated to measure the effects a previous decade's natural disaster losses had on the following decade's elderly migration rates at the county level. Results from the analysis showed that a decade's natural disaster experience on the next decade's elderly migration rate resulted in statistical significance for several of the data points (in the context of a very large sample size), but were almost always so small as to indicate no substantively important relationship.

Previous research has shown that different demographic groups experience natural disasters differently, and in this research I used panel regression to examine age, race, and gender as a possible source of such differences in the effect natural disasters play on future elderly migration patterns (Fothergill et al. 1999, Ngo 2001, Peek 2013). The results showed some difference between groups, particularly between elderly blacks (and other minority groups) and elderly whites across all the different age groups; where the findings showed natural disasters having more of an effect on African American migration. Natural disaster damage had a slightly larger effect on migration among elderly males than elderly females across all age groups but the difference was small enough to be attributable to sampling error. The majority of coefficients from the different models were so substantially small as to make it difficult to draw any meaningful conclusions. Statistical significance was attained between several of the variables, but that was largely due to the size of the sample and the longer time period.

Limitations

This research was the first of its kind to isolate natural disaster losses as a variable to analyze the effects on elderly migration rates. The lack of definite conclusions that could be drawn from the data from the study highlights the limitations of the research as well as the need for future research. This thesis presented itself with several difficult challenges and limitations that require some discussion. When a sample size is very large, as it was in this study, connecting social significance with statistical significance becomes very challenging. This research project analyzed all counties in the United States, more than 3,000, over a four decade period, which resulted in several statistically significant outcomes in the regression analyses. However, equating that significance with a social significance that natural disaster damage truly has a large or significant effect on elderly migration would not be accurate. This leaves a considerable hole in the statistical analysis portion of the research project where statistical significance is often hypothesized into a social significance research question.

Another limitation was in the time span of the research. Each data point included an entire decade's worth of migration data and a decade's worth of natural disaster data. Each point spans 20 years of information. It is difficult to account for a natural disaster that took place, say in 1981, to have an effect on elderly migration rates in 1999. Future research can narrow the time span of study allowing for a more detailed relationship between the two data points.

There was considerable difficulty in applying the unique natural disaster damage variables to the elderly migration variables in order to properly conduct the regression analysis. The distribution of natural disaster dollar damage figures across time and space is incredibly skewed to the right due to the fact that a majority of counties for many of the years covered in the timeframe did not experience any disaster damage at all. Then at other times, some counties have experienced tremendous disaster damage ranging into the many millions of dollars.

The two extreme events variables measured data on natural disasters where a disaster resulted in a dollar loss that exceeded the 90^{th} percentile for the county's average and the national average. By comparing these two variables there is a possibility for an issue in multi co-linearity where the two predictor variables in the regression analysis are highly correlated. Any natural disaster that exceeded the 90^{th} percentile in the national average would also exceed at the county average as well, leaving the possibility of a double count.

Another important limitation to point out for this research is that while the hypothesis centered on how individuals decide where to migrate, the data provided is on a macro scale and cannot be used to describe individual preferences. So conclusions cannot be drawn for individuals in regards to the decision making process for migration. The results of this study can simply be used to infer the general patterns of elderly migration that effect individual migrants.

Indeed, there are many factors that may contribute to elderly migration at the individual level. Issues such as poverty can be a large influence on migration for any age group. Whether the migrants are poor or the area that they are migrating from or to have high levels of poverty can play a significant role. Data was not available at the individual level for poverty that could have been used in this research, so it was left out. Future research will have the opportunity to include this very valuable variable into future studies on elderly migration.

Contributions of Research

The research on the relationship between migration and natural disasters also needs to consider climate change, population growth, and development. As populations continue to develop on a global scale and settle and build in hazardous areas, research like that included in this thesis will become all the more important for decision makers to incorporate when creating policy that would benefit their populations the most. As environmental factors continue to be explored and human's relationship with the ecological world is further discovered, where we choose to live in relationship with the environment will become more and more important.

While there were limitations to this research project, the conclusions that can be drawn from the research contribute to the fields of natural disasters and elderly migration. The hypothesis for the research was that elderly migration rates are affected by an area's propensity to natural disaster losses. While the results of my research showed little substantial evidence that an area's propensity to natural disasters creates changes in elderly migration rates, the research still contributes to the growing research in elderly migration and natural disaster vulnerability. Research indicates that vulnerable locations to natural disasters will experience greater disasters resulting in higher dollar damages. Vulnerable populations living in these locations will only experience more loss as these disasters continue to take place. That is why research focusing on the elderly and their experiences in natural disaster will only continue to take greater importance in natural disaster research. At the same time the rising mobility of this vulnerable people group will require more attention for locations to focus on migration of the elderly and not just their aging population. This research was the first to try to isolate natural disaster dollar damage as a variable in predicting migration rates among the elderly at the county-level on a national scale over the course of the previous four decades. By measuring out the effect during the previous four decades through a panel regression model, a projection can be made to predict future effects natural disaster damage may have on elderly migration rates.

The two aforementioned changes of the societal structure and way of life in the United States was what lead me to conduct this research project to analyze the effect natural disaster damage had on elderly migration patterns in the 1970s, 1980s, 1990s and 2000s By looking at data from the past, it is possible to project the findings into the future to attempt to make an estimate towards the effects that rising natural disaster costs and higher levels of elderly migration might have on local, regional, and national governments and systems designed to protect and provide for populations in need during and after a natural disaster. Mitigation policies may also benefit from an understanding of the relationship between elderly migration and natural disaster costs so that communities can better prepare in such a way that benefits their unique populations the most instead of following a general pattern or procedure that may prove ill fitted for their populations. This thesis was designed to continue the conversation in regards to these very important questions that will impact more and more locations in the country due to these changing dynamics.

Future Research

As discussed in the limitations on the research, there were several holes in the research that could be used in future research to expand knowledge into elderly migration patterns and the vulnerabilities among the elderly to natural disasters. Elderly migration rates are affected by many different variables and are unique for each individual migrant. Moreover, regional variables play a significant role in the decision making process for elderly migrants. Both social and physical variables have significant effects. Social variables such as poverty were not included in this research due to issues in including variables that describe groups onto individuals. Future research that works to including the individual and community level of poverty in a location to the patterns of elderly migration rates will be very valuable in the field of elderly migration and natural disasters.

Research that is done to infer personal decisions always contain errors when you expand and analyze a large group of individuals. Because of this, my research cannot be used to predict an individual's decision to migrate away from a hazard prone area or to a location that has low levels of natural disaster damages. Future research can focus more on an individual level to gather evidence towards how an elderly migrant comes to the decision about migrating to a location.

The elderly are a very vulnerable group of people and the United States is expected to have a much larger proportion of its population in this age category for many decades to come. Research focusing on societal and environmental effects on this population will be immensely valuable for the country and for communities to better prepare for the future. It is my hope that this research project will contribute to this growing body of literature and help spark future research in this area.

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