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PERCEPTIONS OF DISASTER RISK AND VULNERABILITY IN RURAL TEXAS*

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ABSTRACT

Rural areas are uniquely vulnerable to a variety of hazards given their social and economic composition. Economic reliance on agriculture and natural resource extraction increases vulnerability to certain types of natural hazards such as drought, wildfires, and floods. Moreover, rural communities often lack adequate resources to prepare for and respond to disasters. Using data from the Texas Rural Survey, the U.S. Census, and the Spatial Hazards Events and Losses Database for the United States; this research explores questions related to risk perception, vulnerability to disaster, and perceptions of community efficacy in a rural context. Results indicate that rural Texans show greatest concern for drought, wildfires, tornadoes, and severe winter weather. However, perceptions of risk were not necessarily a reflection of historical or future risk or perceptions of community efficacy. This article concludes with comments on the relevance of these findings for community emergency preparedness planning and resilience in rural settings.

The frequency and intensity of natural disasters in the United States have increased markedly over the past 50 years (Cutter and Emrich 2005; Prelog 2012). While estimates of financial losses vary widely (Mileti 1999), reliable estimates indicate that U.S. losses from weather-related disasters alone exceeded $1 trillion between 1980 and 2011 (Smith and Katz 2013). The U.S. state of Texas routinely experiences a variety of natural disaster events, and annual financial losses attributable to catastrophic disasters in Texas are often the highest in the country (Insurance Council of Texas 2009, 2010). Human losses from Texas natural disasters are also notable with conservative estimates indicating that Texas has lost nearly 2,000 lives and sustained more than 23,000 injuries from natural hazards since 1960 (Hazards and Vulnerability Research Institute 2013).

That natural disaster losses in Texas are so substantial is, in part, due to the relative size of Texas' population and its degree of urbanization. Texas' population is the second largest in the country. The state's 25.1 million people are concentrated

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in the fourth (Houston), seventh (San Antonio), ninth (Dallas), and eleventh (Austin) largest U.S. cities, and these cities are routinely affected by large natural disaster events. Yet, Texas' rural population is also substantial at approximately 3.85 million people (U.S. Census Bureau 2010a), a population larger than that of 26 other U.S. states.

Rural areas may be considered especially vulnerable to a variety of hazards given their social and economic composition (Cutter, Boruff, and Shirley 2003). Rural communities' reliance on agriculture and natural resource extraction (Johnson 2006) increases their vulnerability to certain types of natural hazards such as drought, wildfires, and floods (Mileti 1999). Furthermore, rural communities often lack adequate resources to prepare for and respond to disasters, making them uniquely vulnerable (Cannon 1990; Cross 2001; Weisner et al. 2004). To better understand vulnerability, risk, and risk perception in rural settings; this research had three central questions. First, what types of disasters and natural hazards are of greatest concern to rural residents? Second, do these concerns correspond with historical disaster impacts? Third, how do risk perceptions correlate with perceptions of community efficacy in response to disaster?

This paper is organized as follows. First, we provide an overview of the literature germane to issues of vulnerability, risk, and disaster preparedness in a rural setting. Second, we provide a demographic overview of rural Texas, as well as a brief comparison of non-metro and metropolitan counties in the state and a comparison of rural Texas counties to the rural United States as a whole. Third, we detail the methods used in this research, including descriptions of our data collection methods and secondary data sources. Fourth, we discuss our findings relevant to the research questions proposed above. Finally, we discuss our findings and the limitations of our study, and propose future directions for research.

VULNERABILITY AND RISK IN A RURAL SETTING

The few studies on rural risk and disaster vulnerability reveal that rural areas are unique as to types and levels of vulnerability to the impacts of disasters (Alston 2007; Brennan and Flint 2007; Mason 2011; Saenz and Peacock 2006). Restricted access to resources needed to face disasters can constrain rural communities' capacity to mitigate the effects of disasters and to recover from them when they do occur. Furthermore, low-cost rural places are home to people with characteristics that increase vulnerability to impacts of disaster, such as lower incomes, lower levels of education, and livelihoods that depend on resource-based occupations. This section explores the types of vulnerability present in rural areas, how these may be

related to perceptions of risk, and possible impacts on rural emergency preparedness.

Types of vulnerability

Vulnerability can be evaluated based on three social and ecological elements: the presence of hazards, individual-level characteristics, and community-level variables. The first type of vulnerability, simply put, points out that people are not vulnerable if a hazard does not exist. If hazards are present, vulnerability depends on the degree of threat these hazards pose. For natural hazards, like floods, considerations would include, for example, the flooding history of a given location. Therefore, the vulnerability of people and property to flooding in an area is assessed based on the likelihood that flooding will occur. Often called the "exposure model of vulnerability" (Burton, Kates, and White 1993), this type of vulnerability may be equated with a geographic history of hazard events. Regarding this type of vulnerability, rural places may be considered less vulnerable than urban areas because fewer people and infrastructures are at risk (Cross 2001). However, physical vulnerability in rural areas is more nuanced. Because rural economies are often tied to industries such as agriculture or resource extraction, the productive materials associated with these industries (e.g., crops and woodlands) are more vulnerable to certain types of disasters (Flint and Luloff 2005; Johnson 2006).

The second type of vulnerability is based on a suite of individual-level characteristics shown to enhance or diminish a person's vulnerability to hazards. Factors such as employment status, occupation type, income, education level, age, gender, race, ethnicity, type of residence, home ownership, insurance coverage, and automobile ownership, among others have all been linked to greater or lesser vulnerability to hazards (Cutter et al. 2003; Thomas et al. 2013). These characteristics are largely the result of social inequality—characteristics that mediate between a person's exposure to an environmental hazard and their ability to respond to the stress of exposure. Although not all rural areas are the same demographically, certain individual-level characteristics do enhance rural residents' vulnerability. Specifically, rural areas have higher percentages of people living in poverty and lower per capita incomes than do urban areas. Rural residents also have lower education levels, are older, and are more likely to occupy manufactured housing (Johnson 2006).

Variables that influence vulnerability are not limited to individual-level characteristics. Community-level variables also influence vulnerability to hazards. These are characteristics of the social, economic, and institutional contexts in which

people are embedded. For example, Hewitt (2000) pointed out the importance of local land-use regulation and building codes to levels of vulnerability. The capacity of local residents to communicate, cooperate (Flint 2004), and prepare for emergencies (Flint and Brennan 2007) also influences vulnerability levels of individuals and their communities. Economic diversity is also an important community-level indicator of social vulnerability or lack thereof. Specifically, rural areas that rely on only one or two economic sectors are generally viewed as more vulnerable to the effects of disasters (Wilson 2010). Rural areas are also considered more vulnerable to hazards than urban areas because of relative lack of infrastructure, resources, and political clout (Brennan and Flint 2007). Geographically isolated, remote locations may be required to wait days before outside assistance and additional resources arrive. Additionally, in rural areas reliant on natural resource-based economic activity to provide jobs and sustain local services, hazards affecting the natural environment may have particularly dire social and economic consequences. However, a view that assumes that rural areas are always more vulnerable than urban areas is overly simplistic.

In fact, rural contexts may be more resilient in some ways than urban environments. Self-reliance born of isolation and limited social services often characterizes rural communities. Further, high levels of non-monetized social capital, such as strong ties within rural social networks and high levels of trust among community members, facilitates community cooperation and communication when a community is faced with adversity (see Wilson 2010). Strong social ties and frequent interaction among residents in rural communities have also been cited as contributing to rural resilience (Flint 2004; Miller 2007). Other factors like lower population density (Donner 2007) and closer, more interdependent, relationships with the natural environment (Flint and Luloff 2005) may also contribute to a greater ability to weather storms.

Perceptions of Risk

Understanding the social dynamics of risk perception is fundamental to disaster mitigation, response, and recovery policies (Slovic 1987). Like vulnerability, risk perception is influenced by sociodemographic variables (Peacock, Brody, and Highfield 2005). It is well documented that women express higher levels of risk perception than do men (Miceli, Sotgiu, and Settanni 2007; Miller 2012). Jones et al. (2013), in their recent cross-cultural study, argued that urban and rural cultural elements influence risk perceptions and that risk perception is higher in urban areas than in rural ones. Ritchie and Gill (2007) indicated that variables such as quality

of life, community wellbeing, and trust may also influence risk perception. Likewise, Fatti and Patel (2013) found that risk perception is influenced by levels of trust in local government. Effectively measuring risk perception is not an easy task. However, understanding how people assess risk, and to what degree, is an important step in designing effective warnings, encouraging residents to take preparedness steps for their own protection, and developing emergency management plans that address issues most salient to local residents.

Experience with hazardous events influences both individuals and communities. People living in areas that have endured hazardous events generally express higher levels of concern for those events (McSpirit et al. 2007; Miceli et al. 2007; Seigrist and Gutscher 2006). However, the presence of hazards does not necessarily lead to a perception of risk. In fact, when residents have experienced an event in the past without significant adversity, they often demonstrate complacency when similar events occur and may therefore be less likely to adhere to advisories or calls for mandatory evacuation (Halpern-Felsher et al. 2001). Other disaster scholars (Viscusi and Zeckhauser 2006; Yamamura 2012) have reported that risk perception seems unaffected by disaster experiences.

Therefore, the presence of information about a hazard and its potentially negative impacts does not necessarily result in perceptions of risk. Miceli et al. (2007) have drawn upon Loewenstein et al.'s (2001) model to explore how emotions influence cognitive processing of information about hazards to increase or decrease risk perception. Although Sjöberg (1998) explored the distinction between 'worry' and 'risk perception' to find only a weak correlation, we asked respondents about their level of concern about a variety of natural hazards. Sjöberg (ibid.) asked respondents about a variety of hazards, including many technological hazards. Some disaster scholars have argued that technological hazards invoke greater levels of fear, a more emotion-based dread, than natural hazards (Erikson 1994). This may have influenced the results.

Siegrist and Gutscher (2006) showed that risk perceptions of their respondents correlated with expert opinions, emphasizing cognitive evaluation of hazards. However, the work of Loewenstein et al. (2001) offers a model of risk perception based on how cognitive evaluations of risk are mediated by emotions. Other studies (MacLeod and Campbell 1992; Seigrist and Gutscher 2006) have tested forms of the "availability heuristic" in the hopes of understanding the observed disconnect between the potential for disaster and perception of risk. In sum, how individuals perceive risk is complex. More research is needed to adequately understand the processes involved and how they relate to the adoption of protective behaviors.

Disaster Preparedness

Experts on risk perception (Miceli et al. 2007; Seigrist and Gutscher 2006) have indicated that concern about hazards—perceptions of risk—may lead to forms of individual protective behaviors; such as developing household emergency plans, preparing emergency kits, monitoring weather alerts, and so forth. However, other studies have shown that the link between risk perception and disaster preparedness is weak at best (Lindell and Whitney 2000; Miceli et al. 2007; Siegrist and Gutscher 2006). While the connection between risk perception (or concern) and individual protective behaviors has been examined with mixed findings, the relationship between risk perception and community-level emergency planning is understudied. Are people more likely to be concerned about hazards if they are uncertain that their community is prepared to deal with them? Does knowledge of a community emergency plan correlate with concern? Is concern heightened when there is increased talk about an event occurring, as when an emergency management plan is presented or disaster response simulations take place? Or, is individual concern about disasters independent of community efforts to organize response activities? Does a community's experience with disaster events in the past affect levels of concern about those hazard types? These are questions we explore in the Findings section of the current paper.

Rural Texas

There are 254 counties in the state of Texas. Of these, 177 (69.7%) may be designated as rural (Non-metro) counties (Texas Department of State Health Services 2013).[1] These rural counties are concentrated in western Texas, although large regions in east and south Texas are also considered rural areas (see Figure 1).

Demographically, residents of rural Texas are significantly different from their urban counterparts. These rural counties are home to older residents, with lower levels of educational attainment and lower incomes than those living in urban areas of the state (see Table 1; U.S. Census Bureau 2010a, 2010b). Further, rural areas in the state usually have higher poverty rates and residents of rural Texas also are often disproportionately non-Hispanic white in comparison to their urban counterparts.

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[1]The Texas Department of State Health Services uses the metropolitan and non-metropolitan designation provided by the U.S. Office of Budget and Management. The terms "rural" and "non-metro" are used interchangeably. For a review of these designations, see "2010 Standards for Delineating Metropolitan and Micropolitan Statistical Areas" (U.S. Office of Management and Budget 2010).

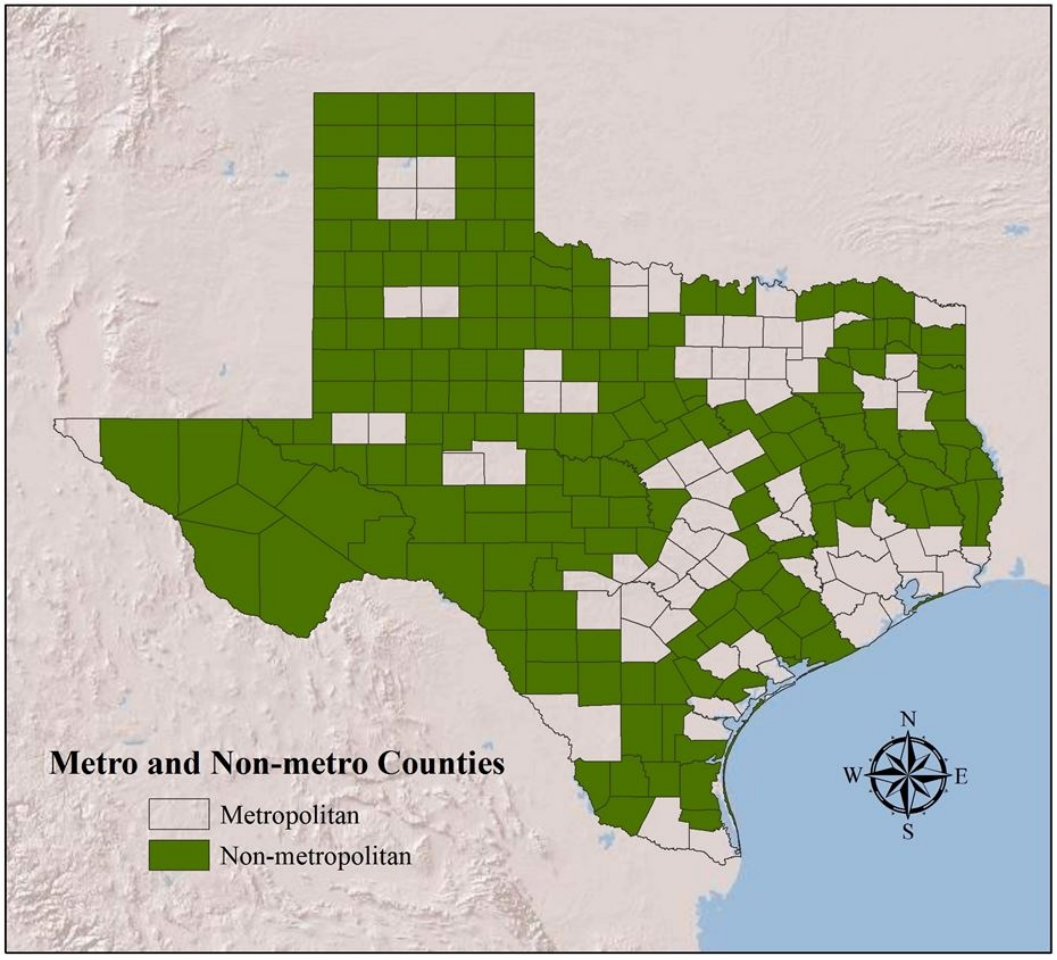

FIGURE 1. TEXAS COUNTIES AND METROPOLITAN/NON-METROPOLITAN DESIGNATIONS, 2012.

Yet these comparisons do not tell the entire story about rural Texas and its demographic composition. Rural Texas is notably different from rural America as a whole. The rural population in the United States is largely non-Hispanic white (79.6 %) and the largest minority group in rural America is African American (8.4 %), followed by Hispanics who constitute approximately 7.5 percent of the population. By comparison, the largest racial or ethnic minority group in rural Texas is Hispanic, which constitutes approximately 31.2 percent of the state's rural population. On average, rural Texans are also older and have lower levels of educational attainment. Rates of poverty are higher in rural Texas counties relative to other rural areas in the United States. Indeed, according to recent U.S. Census

TABLE 1. COMPARISON OF U.S. NON-METRO, TEXAS METRO, AND TEXAS NON-METRO COUNTIES.

SELECTED CHARACTERISTICS	NON-METRO	METRO	U.S. NON-METRO
Median age (2010)	39.8	36.1	41.5
Percent population age 65+	17.0	12.8	16.1
Percent population with high school diploma	75.5	81.6	81.2
Percent population with baccalaureate degree	15.7	21.3	23.3
Median household income	$39,779	$47,374	$38,767
Per capita income	$20,447	$23,991	$21,022
Percent living in poverty	19.3	17.3	17.2
Percent non-Hispanic African-American	7.9	12.0	8.4
Percent Hispanic	31.2	38.5	7.5
Percent non-Hispanic white	59.1	43.6	79.6
Percent non-Hispanic other	1.9	5.9	4.5

data, some rural counties in Texas have among the highest poverty rates and lowest per capita incomes in the country (U.S. Census 2010b). For example, some rural counties in Texas exhibit the highest poverty rates in the country (e.g., Starr—39.3% and Zavala—36.3%). Many rural counties in Texas are home to the highest concentrations of Hispanic Americans in the country—where the resident population exceeds 95 percent Hispanic.

METHODS

To better understand the perceptions of risk and vulnerability in rural Texas we used four data collection methods. First, data from the Texas Rural Survey were used to assess community members' perceptions of risk regarding nine different natural hazard types and of community disaster efficacy, and to acquire general demographic and household information. Second, data from the Spatial Hazard Events and Losses Database (SHELDUS) (Hazards and Vulnerability Research Institute 2012) for the United States were used to detail the historical impact of natural hazards in areas where respondents lived. Third, phone calls to community

emergency management professionals in rural communities were made to assess whether or not emergency management plans were in place in the respondents' communities. Finally, TIGER Line/Shapefiles from the U.S. Census (2010c) were coupled with the survey and hazard data to augment the analysis and generate thematic maps.

Survey Procedure and Respondents

The Texas Rural Survey was a self-administered mail survey conducted from July 2012 to October 2012. The survey was a 13-page mail-out and included 46 questions relevant to perceptions of rural and urban living, economic development, public services, health and healthcare issues, and natural disasters. The original sample included 4,124 randomly selected households living in 22 rural places throughout Texas. This sample was stratified in two ways. First, to ensure that various types of rural areas were included in the sample, three types of rural places were designated according to population size: 499 or fewer, 500–1,999, and 2,000–10,000. Second, seven "Rural Economic Development" regions designated by the Texas Department of Agriculture were used to ensure geographic representativeness of the sample. The sampling frame thus included one place in each of the three population categories for each of the seven regions and an additional community with a population of less than 499, which was selected from the western portion of the state.

The survey administration procedure used the Dillman (Dillman, Smyth, and Christian 2009) tailored design method. First, selected participant households were mailed an informational letter in both Spanish and English. The letter indicated that the participants had been randomly selected to participate in a university-sanctioned research project on rural Texas. One month after receiving the initial contact letter, the survey questionnaire was sent to the sampled households. Instructions accompanying the survey indicated that the survey was to be completed by the adult individual in the household who had most recently celebrated his/her birthday. Completion of the survey required approximately 40–50 minutes. Two follow-up mailings were sent to sampled households. A total of 712 completed surveys were returned, providing us a response rate of 17.3 percent. Table 2 provides the demographic characteristics of the respondents. Compared with Texas as a whole, our sample was substantially older (mean age = 61.75) and disproportionately female (59.9%). It also overrepresented non-Hispanic whites (85.9%) and married individuals (68.7%). Finally, respondents had higher levels of educational attainment and were less likely to be employed.

TABLE 2. DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS (n=712).

VARIABLE	PERCENT	VARIABLE	PERCENT
Gender		Race/Ethnicity	
Male.	40.1	American Indian. . . .	1.2
Female.	59.9	African-American. . .	0.6
Education		Hispanic.	10.3
Did not complete HS.	5.1	White (non-Hispanic)..	85.9
High school/GED. . .	19.2	Other..	2.1
Some college.	26.1	Marital Status	
Associate/Vo-tech. . .	8.4	Married..	68.7
Bachelor's degree. . .	21.3	Cohabitation..	2.7
Post-graduate.	19.9	Divorced/Separated.	6.9
Employed		Single.	6.9
Yes..	46.9	Widowed.	14.7
Full-time.	38.4	Other..	0.1
Half-time.	8.5	VARIABLE	VALUE
No.	52.9	Median Age	63.0

Questions from the survey that were relevant to natural hazards and disasters included measures of concern about a disaster type affecting one's community, the respondent's perception regarding the community's ability to respond to and recover from a disaster, and whether the respondent had knowledge of a local disaster management plan. Specifically, a Likert-type question asked "How concerned are you about the following natural disasters affecting your community?" Disasters named included drought, dust storms, earthquakes, floods, hurricanes, landslide/debris flow, wildfire, tornado/wind storm, and severe winter weather. Response categories for the Likert scale included: not at all concerned; slightly concerned; moderately concerned; and very concerned.

Measures of perception of community efficacy from the survey included five Likert-type survey items indicating the respondent's general impression of the

community's ability to respond to or recover from a disaster (c. f., Benight 2004; Meyer 2013). Participants were requested to indicate their level of agreement with the following statements[2]:

- My community would rapidly distribute resources (labor, money, food) following a disaster. (*Resources*)
- People in my community will work well with each other during disaster recovery. (*Work Well*)
- Individuals and organizations are ready to respond to the community's needs following a disaster. (*Organizations*)
- Supporting those in greatest need after a disaster would be a priority for my community. (*Support*)
- My community would work toward common recovery goals following a disaster. (*Recovery*)

Survey responses to questions regarding concern about particular hazard types, knowledge of a community's emergency management plan, and perception of a community's willingness and ability to respond to a disaster are detailed in the findings section below.

Natural Hazard Data

The second source of data, SHELDUS, is considered the most comprehensive inventory of human and material costs associated with disasters occurring in the United States (Gall, Borden, and Cutter 2009). SHELDUS data used in this research included 51 years (1960–2010) of hazard impact data recorded at the county level. Specific measures include: the type (e.g., hurricane, winter weather, etc.) and number of recorded hazard events affecting residents in a county; inflation-adjusted value (2012) of property and crop damages from natural hazards in a county; and injuries and fatalities from natural hazards. The data were downloaded from the Hazards and Vulnerability Research Institute in the Department of Geography at the University of South Carolina (Hazards and Vulnerability Research Institute 2012).

[2] Keywords are indicated in parentheses for reference to the discussion of findings in Figure 2.

Emergency Management Plans

Following collection of the survey data, the researchers contacted local emergency management professionals in the areas surveyed to ascertain whether or not the sampled rural communities possessed emergency management plans, and whether those plans were available to the public. Occasionally, web searches revealed the existence of emergency management plans in an area. In others, direct contact with local emergency managers was necessary.

U.S. Census Data

Geographic and demographic data from the U.S. Census were acquired via internet download (U.S. Census 2010c). 2010 TIGER/Line Shapefiles, with accompanying demographic data, were employed to generate all geographic analyses in this research.

FINDINGS

In this section, we first detail the overall findings from the Texas Rural Survey that address the question of what hazard types are of most concern to rural Texans. Next, we use GIS analyses to clarify the historical impacts of the various hazard types and address the question of whether risk perception corresponds to historical impacts. Finally, we present our findings relevant to the relationship between risk perception, or concern about disasters, and respondents' perceptions of community efficacy in responding to disasters.

Concern about Disaster and Historical Impacts

When asked about their level of concern regarding various types of natural hazards, rural Texans indicated highest concern for drought, wildfires, and tornadoes, respectively. As a whole, rural Texans indicated relatively low levels of concern about landslide/debris flows, earthquakes, hurricanes, and floods. Figure 2 illustrates these results.

Statewide concern about disaster types does not necessarily correspond to historical impacts of these hazards in Texas. Table 3 provides a summary of hazard impacts for the years 1960–2010 for the state of Texas (Hazard and Vulnerability Research Institute 2012).[3] For example, financial losses from hurricanes are greatest

[3]Note that data on losses from hazards are considered conservative estimates and that not all hazards used in the survey are represented in the natural hazard losses provided by SHELDUS. Specifically, losses from earthquakes, landslides, and dust storms are absent in Table 3.

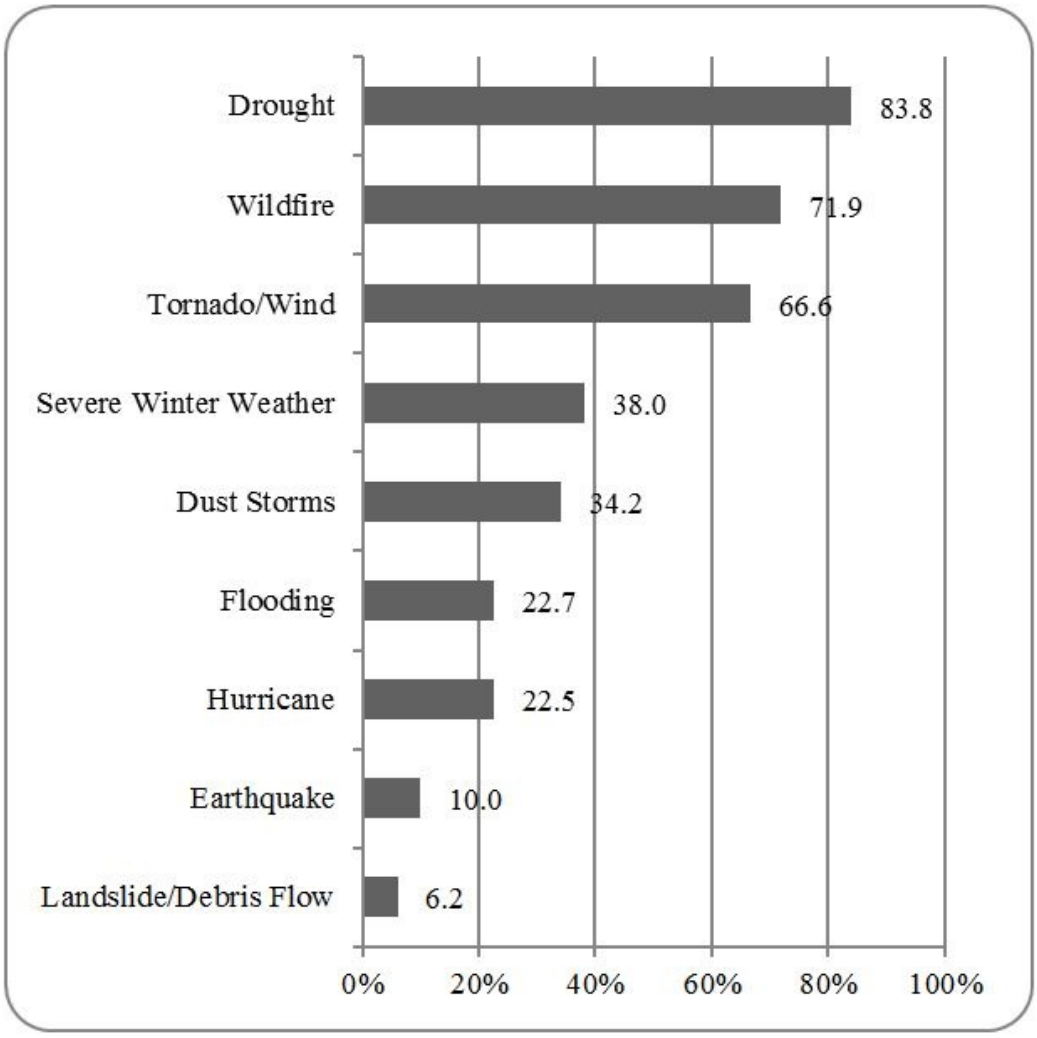

FIGURE 2. NATURAL DISASTER CONCERN: PERCENT MODERATELY OR VERY CONCERNED

in Texas, with more than $18 billion in property damage and $2.4 billion in crop damage attributed to hazards of this type. Yet high levels of concern about drought and tornadoes may not be misplaced. Historically, crop losses from drought exceed $9 billion, and tornadoes have been especially injurious to residents in Texas and have cost Texans nearly $10 billion.

Comparing the respondents' level of concern about flooding and the historical impacts of floods also indicates that, while Texas has had historically large human and financial losses from hazards of this type, historical exposure does not necessarily translate into concern. The same is true regarding winter weather in

TABLE 3. HISTORICAL IMPACTS OF SELECTED HAZARD TYPES IN TEXAS: 1960–2010.

	FATALITIES	INJURIES	PROPERTY DAMAGE (IN MILLIONS)	CROP DAMAGE (IN MILLIONS)
Drought.	0	0	$730	$9,186
Flood.	684	7,425	$5,030	$1,551
Hurricane.	151	2,884	$18,200	$2,451
Winter weather. .	155	2,257	$628	$541
Tornado/Wind. .	450	7,431	$7,010	$667
Wildfire.	18	59	$116	$176

Texas. Winter weather has been historically damaging; however, rural Texans indicate low levels of concern for this hazard type.

Geographic Information Systems analysis provides more nuanced findings relevant to a discussion of the relationship between exposure and level of concern about natural hazards. A comparison of concern about drought and hurricanes and their historical impacts most clearly illustrates this relationship. While concern about the drought is widespread in the state, geographically drought has been localized in the northeastern and southern regions of Texas. Here, historical impacts do not translate into higher levels of concern. In contradistinction, historical exposure to hurricanes does translate into heightened levels of concern about this hazard. Figures 3 and 4 illustrate this relationship.

As the GIS analysis demonstrates, the discrepancy between historical impacts and level of concern is mediated by both the hazard type and historical geographically-specific impacts. In Table 4, zero-order correlation coefficients confirm this finding and indicate that higher levels of concern about flooding, hurricanes, and winter weather are associated with historical frequency of hazard events of these types. There is no statistically significant relationship between historical exposure to drought, tornadoes, and wildfire and level of concern for these hazard types.[4]

[4]Analysis for spatial autocorrelation (Moran's I) among counties on "number of events" indicates statistically significant levels of spatial dependence. Respondents in counties with relatively high (or low) numbers of historical impacts exist in a "neighborhood" of counties with similar hazard profiles.

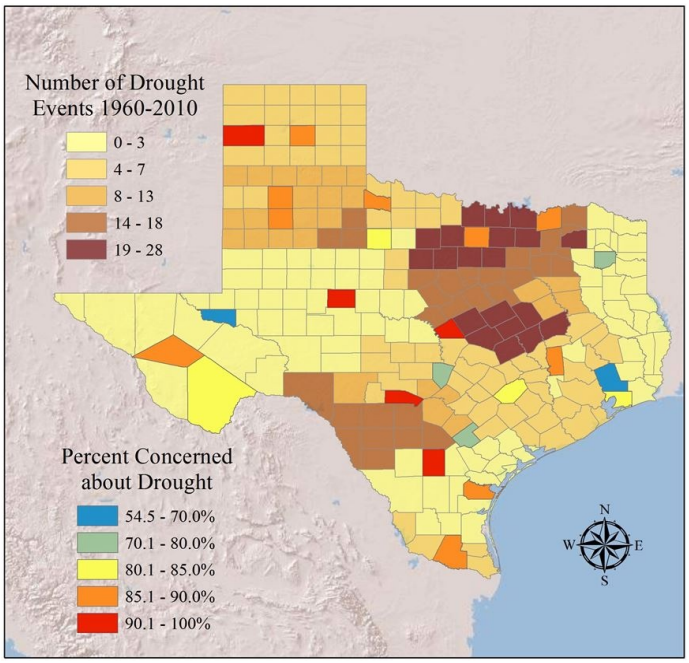

FIGURE 3. FREQUENCY OF DROUGHT AND RESPONDENT CONCERN ABOUT DROUGHT

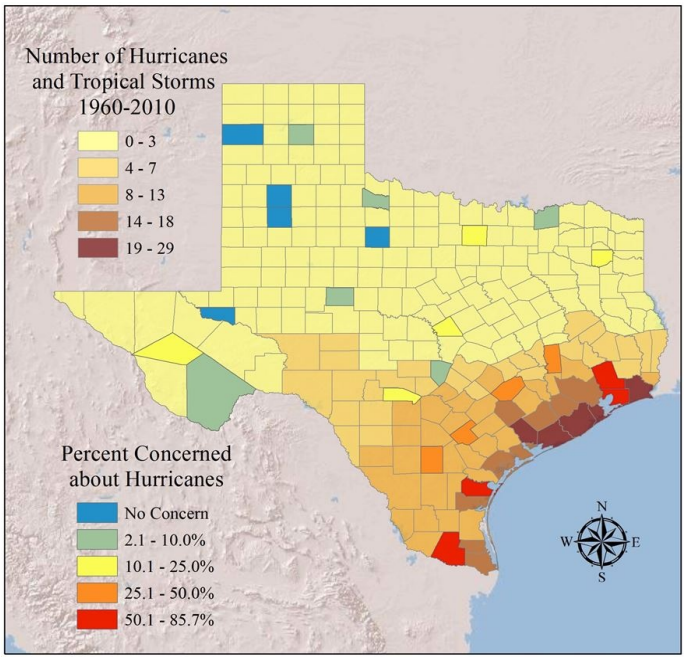

FIGURE 4. FREQUENCY OF HURRICANES AND TROPICAL STORMS AND CONCERN ABOUT HURRICANES

TABLE 4. CORRELATION BETWEEN HISTORICAL NUMBER OF HAZARD EVENTS AND CONCERN ABOUT ASSOCIATED HAZARDS.

Drought events and concern about drought.	-0.03
Flood events and concern about flooding..	0.32***
Hurricane events and concern about hurricanes.	0.63***
Winter weather events and concern about winter weather	0.24***
Tornado/Wind events and concern about tornado/wind.	-0.04
Wildfire events and concern about wildfire.	-0.05

NOTE: *** $p < 0.001$

Concern about Disasters and Community Efficacy

Based on their responses to the questions concerning community ability to respond to disasters, rural residents in Texas generally have high levels of confidence that their communities will effectively respond if an event should occur. Figure 5 illustrates these findings.

Similar to concern about disaster impacts, however, findings regarding community efficacy were nuanced. Respondents were least likely to agree or strongly agree with the *Resources* statement, "My community would rapidly distribute resources (labor, money, food) following a disaster" (75.5%); but were most likely to agree or strongly agree with the statement, "People in my community would work well with each other during disaster recovery" (89.8%). The difference in responses to the *Resources* statement depended on community size. Analysis of variance (ANOVA) indicates statistically significant differences (F=2.42, p<0.10) among respondents in different-sized communities on this measure.[5] Specifically, those who resided in the smallest, most rural communities, with populations less than 500, were more likely to feel uncertain about their community's ability to effectively distribute resources following a disaster.

As for resident perception of community preparedness, most interesting were the responses indicating that respondents were not aware of an emergency management plan for their community. Indeed, 36 percent of places sampled natural hazards. Phone calls to local emergency managers and Internet searches

[5]ANOVA procedures were performed to explore any group differences on measures of perceptions of community efficacy for disaster response. Full ANOVA results are available upon request.

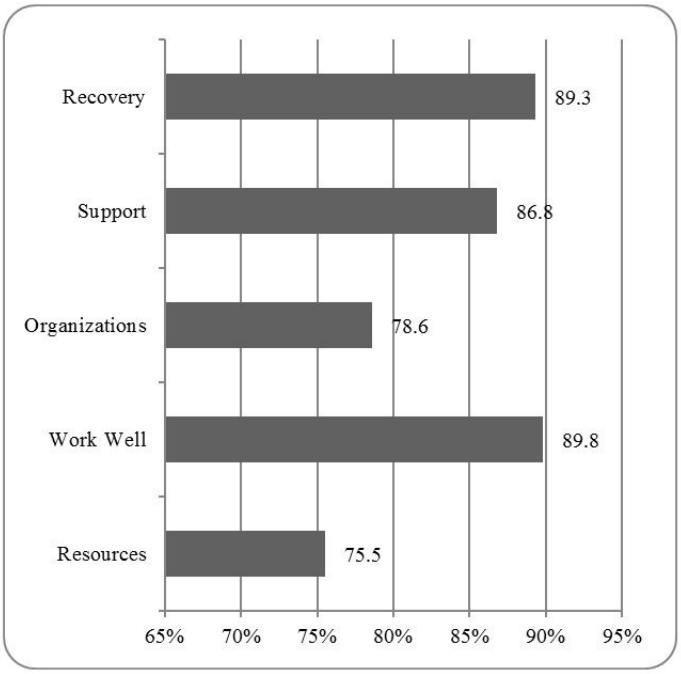

FIGURE 5. PERCEPTIONS OF COMMUNITY PREPAREDNESS: PERCENT AGREE OR STRONGLY AGREE WITH PREPAREDNESS STATEMENTS

indicated that all areas sampled did have a formal emergency management plan in place at the time of the survey.

As with the perception that the community would not be able to rapidly distribute resources following a disaster, knowledge of a community's disaster plan depended on community size. ANOVA indicates a statistically significant effect of community size on knowledge of a disaster plan (F=26.56, p<0.0001). Figure 6 illustrates this relationship. When viewed by size of place, more than 60 percent of residents in the smallest population category were unaware of local disaster plans.

While many residents did not have knowledge of the disaster plan, this did not mean that residents believed their community was ill-prepared for a disaster. In fact the data indicate the opposite. Point-biserial correlations between knowledge of the plan and perceptions of community efficacy indicate that residents who perceived high levels of community efficacy in response to disaster were less likely to have knowledge of their community's local disaster plans (see Table 5). The converse is also true. Respondents who indicated knowledge of a disaster management plan

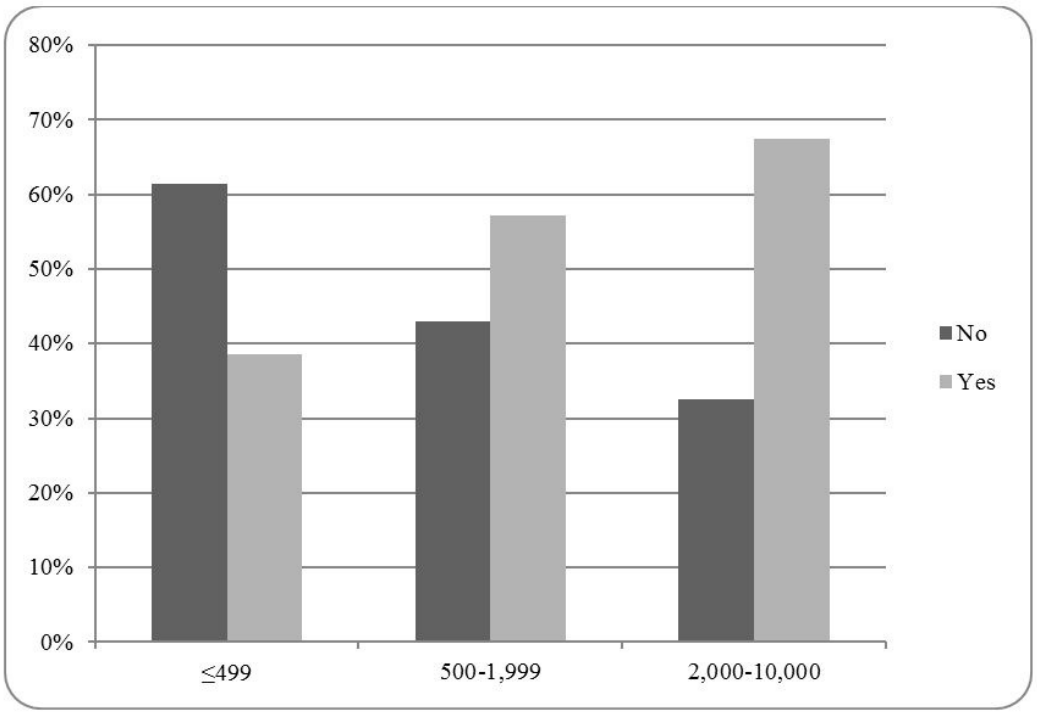

FIGURE 6. AWARENESS OF LOCAL DISASTER MANAGEMENT PLAN AND SIZE OF COMMUNITY

TABLE 5. POINT-BISERIAL CORRELATION BETWEEN MEASURES OF COMMUNITY EFFICACY AND KNOWLEDGE OF DISASTER PLAN.

Resources	-0.33***
Work well	-0.33***
Organizations	-0.41***
Support	-0.28***
Recovery	-0.34***

NOTE: *** $p < 0.001$

usually indicated lower levels of confidence that their community would respond well during a disaster event.

The final question addressed by this analysis concerns the relationship between respondents' perception of community efficacy and their concern about disaster. That is, since different hazard types typically upset routine community functioning

in different ways, there ought to be some relationship between levels of concern about different disaster types and perceptions of community efficacy. Are people more likely to be concerned about hazards if they are uncertain that their community is prepared to deal with them? To evaluate this relationship, zero-order correlations were calculated among the items measuring level of concern about disaster types and measures of community efficacy. Findings from this analysis are available in Table 6.

TABLE 6. CORRELATION BETWEEN LEVEL OF CONCERN AND PERCEPTIONS OF COMMUNITY EFFICACY.

	RESOURCES	WORK WELL	PEOPLE	SUPPORT	RECOVERY
Drought. .	0.07*	0.02	0.13***	0.03	0.07*
Dust.	0.02	0.06	0.06	0.07*	0.04
Earthquake.	0.05	0.04	0.03	0.01	0.03
Flood.	0.07	0.04	0.04	0.05	0.05
Hurricane.	0.04	0.03	0.00	0.00	0.00
Landslide..	0.05	0.06	0.05	0.08*	0.08
Fire.	0.02	0.00	0.10**	0.05	0.05
Tornado. .	0.01	0.00	0.07*	0.02	0.01
Winter. . . .	0.04	0.02	0.05	0.04	0.01

NOTE: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

As Table 6 illustrates, there are few meaningful relationships among survey items measuring level of concern for specific types of hazards and perceptions of community efficacy. Several exceptions are notable. First, there are small, but statistically significant positive relationships between uncertainty of community responses for the items *Resources*, *People*, and *Recovery* and concern about drought. That is, on average, respondents who indicated high concern about drought also did not agree with the statements "My community would rapidly distribute resources following a disaster," "Individuals and organizations are ready to respond to the community's needs following a disaster," and "My community would work toward common recovery goals following a disaster." Similar positive relationships exist among the following items: *Support* and concern about dust storms; *Resources* and

concern about flooding; *Support* and *Recovery* and concern about landslides; *People* and concern about fire; and *People* and concern about tornadoes. In sum, there are some relationships between level of concern about disasters and perceptions of community efficacy. That is, regarding some variables, people are more likely to be concerned about certain hazards if they are uncertain that their community is prepared to deal with them.

A final question regarding respondents' level of concern for disasters addresses the relationship between risk perception and knowledge of a community's emergency management plan. Specifically, does knowledge of a community emergency plan correlate with concern? As Table 7 illustrates, there is some relationship between these measures. For drought, higher levels of concern are associated with not having knowledge of a local emergency management plan. In contrast, higher levels of concern for flooding and hurricanes were associated with knowledge of an emergency management plan.

TABLE 7. POINT-BISERIAL CORRELATION BETWEEN KNOWLEDGE OF DISASTER PLAN AND CONCERN ABOUT DISASTER.

	KNOWLEDGE OF DISASTER PLAN
Drought.	-0.10***
Dust.	0.00
Earthquake.	0.01
Flood.	0.10**
Hurricane.	0.08*
Landslide.	0.01
Fire.	-0.02
Tornado.	-0.03
Winter.	-0.03

NOTE: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

In the next section we provide an overview of these findings and discuss their relevance to literature on disaster risk, risk perception, and vulnerability in rural settings.

DISCUSSION

A summary of our findings is relevant to a discussion of the three central questions proposed by this research. First, what types of disasters and natural hazards are of greatest concern to rural Texans? Second, do these concerns correspond with historical disaster impacts? Third, how do risk perceptions correlate with the perception of the community efficacy in responding to disaster?

Perceptions of Risk

Concerning our first question, residents of rural Texas are most concerned about drought, wildfires, and tornadoes. The concern about both drought and wildfires is exceptional and we believe this is indicative of rural life overall as these disaster types are more disruptive to rural areas than they are to urban ones. Nevertheless, these findings need to be considered in the context of the effects of "social history." The Texas Rural Survey was administered between July and October of 2012, a period when much of Texas was gripped by an exceptional drought. Indeed, the Texas drought of 2010-2012 garnered national headlines as farmers and communities struggled to cope with livestock and crop losses and providing water to their communities (e.g., Nielsen-Gammon 2012). The effects of this drought did not simply affect water supply and economic activity associated with it. The Texas drought created what disaster researchers often call a "complex emergency," where social and ecological disasters converge to multiply stress on the community (see Mileti 1999). Here, the exceptional Texas drought also created conditions whereby wildfires became ubiquitous throughout the state.

In September and October of 2011, Texas experienced its worst wildfire to date, the Bastrop County Complex Fire, which burned more than 36,000 acres and destroyed nearly 1,700 homes. In fact, the 2011 fire season in Texas is now considered the worst wildfire season on record in the state, with more than 31,000 wildfires recorded that year (Jones, Saginor, and Smith 2013). The combination of an exceptional drought and an explosive 2011 wildfire season may have heightened concern about wildfire and drought as respondents utilized an "availability heuristic" (Slovic, Fischhoff, and Lichtenstein 1979; Tversky and Kahneman 1973) when assessing risks associated with these disaster types. The use of availability when assessing risks means that people may judge an event as likely or common if its associated dangers are readily available in memory recall.

An additional comment regarding perceptions of risk about tornadoes is also necessary. Texas is known to have historically experienced several very damaging tornadoes. However, the damage, injuries, and loss of life associated with these

events are generally concentrated in the northern part of the state. Even so, respondents throughout the state indicated concern about this hazard type. Curiously, both 2011 and 2012 were very quiet years for tornado activity in Texas (National Climatic Data Center 2013) and this, by itself, may challenge the notion that respondents utilize an availability heuristic when responding to questions about disaster risk. However, other parts of the country experienced an extraordinary tornado season in 2011 and the early part of 2012; and those events were widely publicized (Cohen 2011; Rice 2012). Most notable was the Joplin, Missouri tornado in May of 2011 that took the lives of 158 people and injured more than 1,000 (National Climatic Data Center 2013). Therefore, the notion of the availability heuristic may not be exclusively associated with physical proximity, but may also be influenced by the extent of media coverage (c. f., af Wåhlberg and Sjöberg 2000).

Disaster Consciousness

The second question posed by this research asked whether participants' concern about different disaster types corresponded to historical disaster impacts near participants' residences. That is, does a community's or a neighboring community's exposure to natural hazards create a "disaster consciousness?" Findings indicated that perception of risk, or level of concern, was associated with historical impacts for flooding, winter weather, and hurricanes; but there was no relationship between level of concern and historical impacts related to tornadoes, wildfires, and drought.

Perception of disaster risk is an important predictor of whether people take precautionary measures or act to mitigate the effects of a disaster (Growthman and Reusswig 2006; Lindell 2000). The intellectual field of risk perception is replete with research investigating the complex interaction of individual psychosocial factors and experience and its effect on risk perception (e.g., Loewenstein et al. 2001; Whitmarsh 2006). While our research does not directly examine the psychosocial predictors of risk perception, it does seek to explore the relationship between the geography of hazard and its possible effects on risk perception. Previous research has shown that disaster characteristics (e.g., its size or type) and experience with specific disasters influence whether people believe they are at risk (Ho et al. 2008). As our findings suggest, however, living in hazardous regions may influence perceptions of certain risks but not others. Clearly, more research is needed to understand why relationships between risk perceptions and the geography of hazard exist for some hazard types but not others.

Perceptions of Risk and Community Efficacy

Relevant to our third question, overall, residents in rural Texas indicated high levels of confidence in their community's ability to effectively respond to a disaster event. Our analysis revealed that respondents who expressed uncertainty about community efficacy were also more likely to voice concern for specific hazards. Lack of awareness of a local emergency plan seemed to correlate with higher levels of concern for drought alone. Direct knowledge of a local emergency management plan, however, was associated with higher levels of concern for floods and hurricanes. These mixed findings may be the result of the question's wording. Residents were asked about their knowledge of a 'local disaster plan.' This phrasing is problematic since plans typically exist only at the county level so residents outside the county seats may be unlikely to be aware of plans. This would explain why many respondents were unaware of emergency management plans and presumably did not know how their local community would fit into the county plan in case of an emergency, although all counties represented in the sample reported having emergency management plans. Furthermore, as Scott, McSpirit, and Hardesty (2012) found in their analysis of emergency planning in rural West Virginia and Kentucky, knowledge of a disaster management plan does not translate into the perception of community preparedness. Our findings indicate similarly that having a local disaster response plan does not translate into perceptions of high community efficacy in response to disaster.

Further research on rural emergency preparedness is needed but clearly, if rural residents are not aware of emergency plans, it is improbable that they know what to do in case of an emergency. Rural residents may have planned on an individual or household level; but they may not be aware of shelters, supplies, services, evacuation routes, advisories, information sources, and so on if they are not apprised of emergency plans in place for their areas. These findings point to a need for more effective emergency preparedness communication strategies targeting rural populations.

Limitations

This research has several limitations that are worth noting. As was mentioned previously, perceptions of risk may be colored by the availability heuristic used by participants in assessing their levels of concern about different disaster types. Moreover, it is unclear if participants were, during the data collection period, personally affected by disasters. A second limitation of the research involves the relationship between historical disaster impacts and risk perceptions. Some disaster

types are highly localized (e.g., landslides) while others may be widespread (e.g., drought). Previous research indicates that a disaster's scope does have the potential to color perceptions of individual risk (Ho et al. 2008). Our assessment of participants' risk perception does not account for whether participants believed these events would affect them or the community as a whole.

Another limitation of this study is related to the characteristics of our sample. Respondents do not accurately represent rural Texas residents. Given that the people in the sample are more likely to be non-Hispanic white, more financially secure, more educated, and older than average for rural Texas, the results may be skewed toward less concern and more confidence in local governmental capacity for emergency response. However, since most of the respondents were women and women typically indicate higher levels of concern about risk, some discrepancy may be mediated. Finally, a low response rate on the survey remains a core weakness of the study. Further research should seek to remedy these limitations.

First, a longitudinal assessment of risk perceptions among rural Texas residents might address whether and to what extent salient events such as fire and drought influence survey responses about these types of hazards. Second, to address whether respondents had been personally affected by a disaster and whether such experiences have the potential to influence responses to survey questions, additional questions could be added to future surveys asking whether and how respondents had been affected. Third, to account for the difference in the demographic composition of the sample relative to the composition of the counties from which the samples were taken, future survey research might consider oversampling underrepresented groups such as Hispanics and nonwhite rural residents. Finally, although low response rates are common in mail survey research (Kanuk and Berenson 1975), options for online survey participation or additional monetary incentives might be provided to increase the response rate for future surveys.

CONCLUSIONS

Research into perceptions of disaster risk and vulnerability to disasters in rural settings demonstrates that "ruralness," broadly defined, has important consequences for those living in disaster-prone areas. Rural areas and their residents are uniquely vulnerable to certain disaster types such as drought and wildfires—disasters that have the potential to undercut the economic vitality of rural areas. Further, individual and community-level characteristics of those who reside in rural areas make them "socially vulnerable" to the effects of disasters. Characteristics such as

high poverty rates; lower income; and a lack of adequate infrastructure, resources, or political clout all increase rural residents' vulnerability to disasters.

Residents of rural Texas are characteristically different from their urban counterparts and from other rural areas in the United States. Many of these differences can be highlighted as characteristics that increase resident and community social vulnerability to disaster. As this research has shown, the relationship between disaster risk perceptions and historical disaster impacts is complex. These perceptions of risk are not only associated with historical experiences with specific hazards, but are also colored by the unique threat to rural communities that drought and wildfire represent. As our findings indicate, perception of community efficacy in responding to disasters may also be related to levels of concern about hazards—but this relationship varies across hazards. On some of these variables, size of place may be correlated with community efficacy—with residents in smaller rural places expressing more doubt about communities' abilities to distribute resources. Size of place is also important in the awareness of emergency management plans, as residents in the smallest rural areas were least likely to report awareness of plans. Curiously, residents' knowledge of a community disaster plan was not associated with a perception that the community could effectively respond to disaster events. This finding is especially relevant to a discussion of rural community resilience.

Community resilience is fundamentally about the ability to absorb or recover from an interruption of normal community functioning. Given rural resilience, various models have been proposed to clarify the environmental and institutional factors that increase a community's capacity to respond to disruption (e.g., Wilson 2010). Our research has highlighted one of these factors in rural Texas—social capital. While rural communities may be uniquely vulnerable to effects of a natural disaster, this does not mean they are unable to respond or recover. We propose that respondents who viewed their communities as effective responders to disasters are indicating high levels of trust in their community. High levels of trust among community members is often cited as facilitating effective response and recovery following disaster (e.g., Aldrich 2012). As such, community planning for natural disasters in rural areas should deliberately focus on facilitating the use of community trust in their response and recovery activities.

Although the results of the current study are helpful in highlighting the importance and complexity of rural areas, the results raise many questions. More research needs to be done to explore relationships among hazards, risk perception, and disaster preparedness in rural areas. Are rural residents preparing individually

or planning with neighbors for disasters? What are the perceptions of risk for technological hazards in rural areas? Disasters will clearly continue to affect rural areas. Ascertaining answers to these and other questions, and sharing this knowledge with local emergency managers and community members, may do much to increase the resilience of communities affected by disasters in rural areas.

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