

ATTITUDE, DECISION-MAKING, AND BEHAVIOR AMONG A SMALL GROUP OF CITIZENS NEAR THE PATH OF THE SIREN, WISCONSIN TORNADO OF 18 JUNE 2001

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Abstract

A strong F-3 tornado devastated the northwest Wisconsin Village of Siren during the evening of 18 June 2001. The National Weather Service (NWS) issued a tornado watch, and severe thunderstorm and tornado warnings for Siren, but the emergency warning siren was inoperative. The survey team traveled to the disaster site several days after the tornado and surveyed the path of the tornado by ground and air. A field study utilizing a questionnaire helped in comprehending the nature of warnings and responses on the periphery of the tornado damage path. Administered through interviews, the standardized survey aided in gathering information on awareness, preparedness, monitoring of the developing extreme event, and perceptions of risk. The team identified common beliefs, behaviors, and attitudes for this "near miss" experience. Though this research utilized a small sample size of 30 individuals, it provided insight into people's responses to a relatively rare and dangerous event. The public should not rely exclusively on any one method of warning dissemination, especially one that may be vulnerable to electrical outages. While television is a very popular way of obtaining weather warnings, findings hint that NOAA weather radio remains a largely untapped and potentially successful resource if publicized properly in this part of the country.

1. Introduction

During the early evening of Monday, 18 June 2001, a strong F-3 tornado struck the northwest Wisconsin Village of Siren. The community of less than 1000 people (U.S. Census Bureau 2001) located 65 miles northeast of Saint Paul, Minnesota, sustained a direct hit from the storm. The National Weather Service (NWS) issued a tornado watch, severe thunderstorm warning, and a tornado warning for Burnett County. However, Siren's emergency warning system siren was inoperative due to a lightning strike weeks earlier. The path of the tornado began one-and-one-half miles east of Grantsburg, Wisconsin, three-eighths of a mile north of Highway 70 at

0106 UTC (Fig. 1). The tornado continued east through the Village of Siren in Burnett County before ending 34 miles from where it began. The tornado was up to one-half mile wide at times. Media outlets in the county reported 16 injuries and two deaths resulted from the tornado. This field study after the storm aids in understanding where the tornado traveled and the nature of awareness, warnings, and responses of citizens on the edge of the tornado damage path. Documenting and working with important details of this community's interaction with the storm, as well as garnering pertinent public information, including important lessons learned, yielded a unique opportunity to understand an unusual storm event in a close-knit community of northwest Wisconsin.

2. Background and Objective

Tornadoes routinely devastate both property and lives throughout the United States (Marshall 1993; Grazulis 1993). While some university researchers have concentrated on the physical nature of supercell thunderstorms and tornadoes (e.g., Fujita 1970; Bluestein 1999), others investigating the tornado hazard have considered the social aspects of tornado disasters (e.g., Kessler and White 1981; Burton et al. 1993; Mulilis and Duval 1997; Paul 1998; Balluz et al. 2000). Relatively recent research involving tornado victims has concentrated on those people most directly affected by the storm (i.e., those in the main path of the tornado), and whether people in such danger should favor ditches and ravines, or cars as a safer place than mobile homes (Schmidlin and King 1996).

After a tornado, people's perceptions and knowledge of the timing, magnitude, and location for severe storms may be altered. Attitudes about the meaning and effectiveness of warnings may generate personal vows toward greater vigilance, improved responses to warnings, or overall safer behaviors in the event of another such storm. Personal awareness of tornado risk may be elevated, at least until memories fade, and so pledges and commitment to future mitigation practices may appear

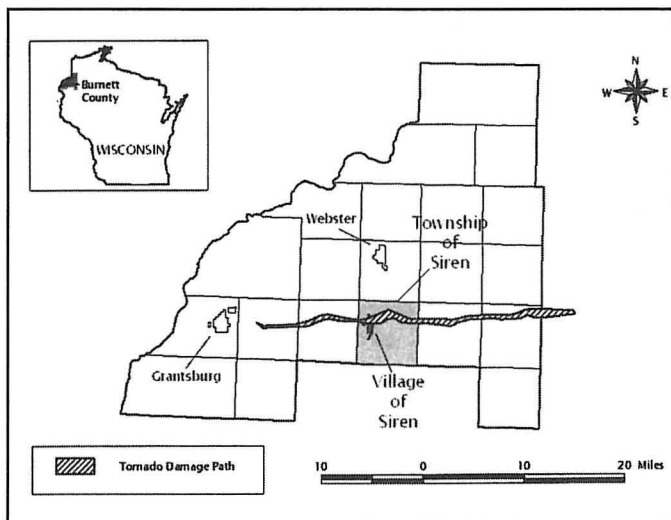


Fig. 1. The approximate damage path of the 18 June 2001 tornado is shown across Burnett County in northwestern Wisconsin.

strengthened. Mitigation efforts may be threefold in nature, ranging from infrastructural (installing either tornado safe rooms or storm clips to roofs), to behavioral (heeding warnings, sheltering or evacuation), to technological (acquiring a weather radio for instance).

Investigation into the behavior, awareness, and response of those involved in “near misses” or “close calls” with these dangerous storms is likely warranted. “Close calls” or “near misses” are herein defined as peoples’ experiences next to the periphery of a tornado damage path. The exact position relative to the path of the storm can affect personal decision-making and actions taken. Locations near the periphery of the tornado damage path can allow the uninjured residents or those with minor injuries a fresh opportunity to make new choices about preparing and mitigating for a future disaster. Therefore, it is very important to comprehend the nature of these “near miss” experiences.

3. Methodology

Several days after the Siren, Wisconsin tornado of 18 June 2001, a research team from Texas State University in San Marcos, Texas traveled to the disaster zone where the tornado had caused significant damage, injuries, and loss of life. The group surveyed the path of the tornado by ground, on foot and in an automobile. The damage path was also viewed by air with a small airplane, noting the starting and ending points of the tornado in order to map the event. Pertinent details of the damage path were recorded with the aid of conventional and digital cameras and digital video. The team sought out residents near the periphery of the path of tornado damage who had experienced the storm but did not bear its full brunt. Those still present and occupying their largely undamaged homes were eligible for interviews. One adult representative for each household was interviewed where and whenever possible.

Preparedness, monitoring of the developing extreme event, perceptions of the event and risk from future

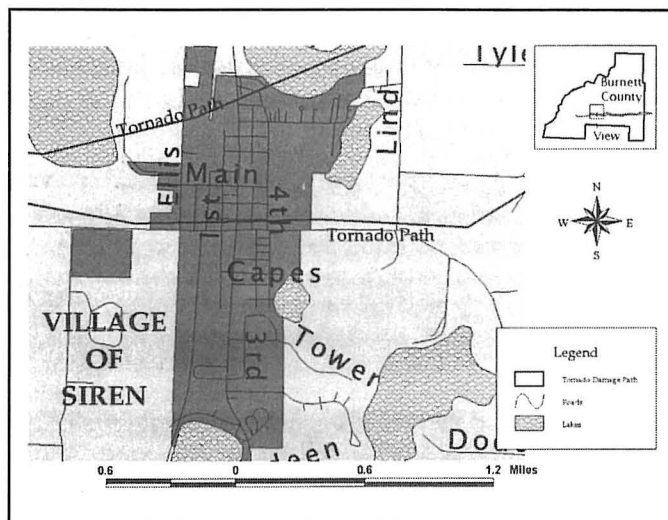


Fig. 2. Map of the Village of Siren, in Burnett County, Wisconsin indicating the 18 June 2001 tornado path bounded by two solid black lines marked ‘Tornado Path’. Citizens in residences south of the tornado path (the lower half of the map) were surveyed for this study.

events were assessed through informal interviews. This was accomplished using a standardized set of questions developed in anticipation of such a disaster (see Appendix). The study-area homes were likely subjected to gusty winds, hail and lightning, but overall, experienced very minor storm damage, if any. The research team interviewed one resident in each of 30 households. The team attempted to survey additional homes, but some homes were simply unoccupied during the four-day visit. Fortunately, the sample of the population surveyed, though not statistically significant, represents at least ten percent of the approximately 300 occupied residences that survived the storm in the Village of Siren, Wisconsin. The team gathered data regarding household characteristics, warnings, responses to warnings, and possible future responses in the event of another tornado. While not everyone surveyed answered every question posed to them, the study group nonetheless provided unique insights into a fundamentally unusual event.

4. Tornado Path and Survey Population

The Village of Siren straddles west-to-east two-lane State Highway 70 at its intersection with State Highway 35. Siren’s central business district extends northward along Highway 35 with businesses geared toward tourism, primarily fishing and hunting. The tornado traveled east paralleling State Highway 70 and was nearest to that road as the storm roared through the main part of the village (Fig. 2). The damage in the Village of Siren and its 36-square mile township was consistent with F-2 and F-3 damage ratings (Fujita 1971). Considerable damage occurred where roofs were torn off houses with some walls destroyed, some cars were rolled to the point of destruction, and most trees in a very wide area were either snapped, uprooted, or leveled. Also, poorly constructed rural buildings and those structures with wide-span roofs were destroyed, particularly the ice hockey rink.

Though winds may not have exceeded 200 mph, the tornado nonetheless severely impacted a 6-block residential area to the east of the downtown area. Half of the Village's 400 homes and 40 of its businesses were damaged or destroyed. Little residential development existed before the tornado to the north of the damage path, in an area where the village yields to lakes and forestland. So, the sizeable subdivision of residential development suitable for this study included a 15-square block area to the southeast of the intersection of State Highway 70 and State Highway 35 and a 9-square block area to the southwest of this intersection.

The Village of Siren is a small community in forested Burnett County, Wisconsin. The population of 874 is ethnically homogenous, i.e., 98% White with 2% American Indian. The population remains stable, economically lower middle class, and is composed of a significant number of retiree and other elderly residents (U.S. Census Bureau 2001). The average annual gross household income for 1998 was reported as approximately \$20,350 (Wisconsin Department of Revenue 1999). The average age of the village population in 2000 was 42 with 30 percent of the population being 62 or older. Sixty percent of the 413 occupied housing units were occupied by homeowners. Lastly, 47% of the village households include children (U.S. Census Bureau 2001).

5. Results

The initial results included an understanding of the demographics of the study sample. More than 80% of the study group represented households that had primarily one or two adults in permanent residence. During this early evening tornado in northwestern Wisconsin, most adults were at home, but in several cases, no one was home. More than half of the respondents did not have children living in the house. Only about one-third of the households actually had children at home during the storm.

About 66% of the 30 people questioned were home during the storm on the evening of 18 June 2001. Although one person knew nothing of the devastation until the next day, more than 50% were aware that a tornado had damaged the village within five minutes of the tornado's passing. Similarly, more than 50% of those interviewed on the periphery of the damage path believed that the tornado had hit or damaged their home. The most common reasons given to explain these beliefs included the sound of the wind and the other attendant noise associated with the storm (i.e., falling trees and the sound of hail hitting windows, roofs of houses, and sheds).

With respect to weather watches and warnings, more than 80% of the survey population said that they had received some form of an official warning that day and 100% felt that they had been warned in some way. The source and type of National Weather Service watches and warnings received by the sample population varied. Around one-third were alerted to danger by a severe thunderstorm warning indicating imminent and potentially dangerous thunderstorm threats from hail, heavy rain, high winds and possibly a tornado. Another approximately 33% of the group stated that the tornado watch

had warned them earlier in the day by outlining a potential threat for tornadoes later that day. Seven people said they were warned by an actual tornado warning.

The two most popular ways to receive watches and warnings were through television and telephone. About 33% of those surveyed received their warning from television, primarily through Minneapolis-based broadcast networks, while another approximately 33% received their warning over a telephone. The remaining individuals received their warning through word of mouth, by simply observing the sky, or by way of a police scanner or a pager. With respect to the amount of advance warning time, only four people said that they had less than a minute of warning time. Most people had plenty of time to protect themselves. One individual reported having more than 30 minutes of advance warning time.

More than 75% of those warned generally or strongly agreed that their warnings had given them enough time to seek safe shelter. The most common complaint was that the tornado struck quickly. Also, because a lightning strike during the previous month rendered the village's emergency siren inoperable, and there was an interruption of the village electricity 20 minutes prior to the tornado, some residents in Siren, Wisconsin were unfortunately never aware of the National Weather Service's tornado warning. Approximately 66% of those warned were fairly pleased with the applicability of their warnings to their own personal circumstances, generally or strongly agreeing that the tornado warning was adequate for them and their specific location. However, when participants were queried if they believed that the "overall" tornado warning for the whole village was adequate, 50% of the study group voiced their dissatisfaction.

About 80% of those interviewed stated that they had a preset plan of action in the event of a tornado. The most popular preset plan of action was going to their basements (75%), while other plans included moving to a closet, the lowest room, a bathroom, or a crawl space. A little more than 50% of those with preset plans of action actually followed their plans. Some of those that did not were either not at home, sheltered in an alternative location, watched the storm from their porch, or were simply unaware a storm was bearing down upon the village.

A majority felt safe in their actions to evade or reduce the impact of this particular tornado. However, 33% of the study group moved to an interior room, bathroom, or a closet for safety during the experience. At least 50% of the study group sought out or gathered family members before moving to their safe place. No individual moved to a motorized vehicle for safety, nor did they leave a car, truck, or motor home. No one moved to a low-lying depression or ditch. About 50% of the study group attempted to visually verify the tornado threat before taking personal, protective action. Of those that watched for the tornado, more than 50% of them observed the sky for between 1 and 5 minutes. Eight people claimed to have seen the tornado, with most of those limiting their actual viewing of the tornado to less than five minutes. Nobody that the research team interviewed, however, videotaped or photographed the tornado. Most people left their windows alone before seeking shelter from the tornado. Only one person intentionally opened them.

A 50% share of the study group believed that their chance of experiencing another tornado at their given location was less than 10 percent. With respect to future response and mitigation, more than 50% of the study population said they would respond differently in the event of a future tornado. The most frequently cited actions that people would undertake to prepare for another tornado threat included the acquisition of a National Oceanic and Atmospheric Administration (NOAA) weather radio and reliance on television for timely weather information and warnings. Few people were planning on making modifications to their homes.

When asked if there were any outstanding lessons learned from their close call with the tornado, the responses were varied. Concerns voiced included the desire for better warnings and information relating to the storm. While only one person mentioned that there is too much "crying wolf" or false alarms in weather warnings, another suggested that people should consider severe thunderstorm warnings as serious indicators of tornadoes. Others recommended being more aware of the weather, listening to and watching television for warnings, and heeding those warnings (i.e., being more vigilant in taking cover). Indeed, people developed a new respect for these severe convective storms, proffering to all that tornado disasters can happen to anyone and to always have a basement. Some felt that a tornado is the "most powerful thing," a lot more powerful and messy than people might think.

Other comments regarding outstanding lessons learned were more practical and sometimes philosophical. Some residents noted that volunteering and recovery requires a lot of effort, and that the Red Cross responds quickly. Another believed that it is always important to have generator back-ups for both home and the village. Others cautioned to be careful walking around after tornadoes, to watch out for clean-up machinery in the area, and to avoid downed and live power lines. Indeed, at least one indirect death was apparently attributable to electrocution by a downed live wire. While at least one individual wanted to see a tornado, another indicated the desire to protect their children from daily harm. Others noted that after a terrible event like a tornado, most people are generous and good. Interestingly, one man took shelter under a worktable in a metal shop when the tornado struck. During questioning, he stated that there is too much time spent working in life, that he ought to have more fun, and if he has to die in the future, he does not want to do it at work.

6. Discussion

Unique aspects of this "near miss" tornado experience to the study group in the Village of Siren, Wisconsin include the fact that some residents that had positive beliefs in the adequacy of their own personal warning also had concerns that the overall tornado warning for the community was unsatisfactory. This is likely due to the fact that while the tornado did not directly affect their precise location, nearby places sustained a direct hit from the storm, and perhaps more importantly, there appeared to be an emphasis and implied dependency on being able

to hear a working siren in this small community. This perception emerged fairly clearly in the informal interviews that surrounded questioning, although it was not addressed specifically in any one question.

NOAA weather radio reception in and around Siren at the time of the tornado was very weak, so no one interviewed received a National Weather Service warning through NOAA weather radio. Television sets also proved ineffective in disseminating an actual tornado warning for the Siren storm. Since the electricity went out approximately twenty minutes before the tornado struck, most people knew only of a tornado watch issued much earlier in the day or of a severe thunderstorm warning issued on television within the hour prior to the tornado. Even when receiving phone calls from friends and relatives about a tornado or hearing of a tornado warning over a fire/police scanner, many waited for a confirmation from Siren's siren, which, as mentioned earlier, was inoperable. A new NOAA weather radio transmitter slated to serve the area that encompasses Siren, Wisconsin was on order at the time of the tornado.

Unfortunately, a majority of people attempted to visually verify the tornado before taking shelter in a basement. In fact, some residents did not take adequate cover until they noticed trees starting to go down near and around them. The National Weather Service does not recommend searching for a tornado before taking action. Many regretted opposing this safety recommendation, stating that they realized it was a "stupid" response that they would refrain from doing in the future. The Siren tornado was at least partially shrouded and obscured by curtains of rain by the time the tornado struck the village, and so was not visually apparent to most people. Given the long summer day, improvements in film emulsions, and enhanced video cameras of today, most residents would have had little if any problem recording the images of a tornado on film or video, had there actually been something resembling a typical "funnel" in Siren. This is especially true given the ample amount of time that some residents spent on their front porches searching the sky for a funnel cloud during the low-contrast storm.

Some residents on the south side of village near the edge of the damage path viewed the rotating thunderstorm with a low cloud base and a mostly rain-wrapped tornado that was largely blocked by trees. Indeed, some witnesses said that enough moisture and/or debris existed in the air such that they could see the wind effects. Essentially, persons looking west along State Highway 70 likely observed the southern and southeastern periphery of the large tornado due to a significant "clear slot" in the sky near the rear flank of the storm and the attendant very localized and strong backlighting.

Several people believed that they lived in a "mini tornado alley" that encompasses the region northeast of the Minneapolis-Saint Paul metropolitan area. This proved particularly surprising and fascinating given that this storm is the only documented significant tornado in the southern part of Burnett County in the last 50 years according to the National Weather Service in Jackson, Mississippi. Additionally, one might argue that the area remains one of the least affected by tornadoes along the Minnesota/Wisconsin border.

7. Conclusion

This field study enhances our understanding of the less-studied individuals involved in a "close call" with a tornado: a spatially variable and sudden onset event. Common beliefs, behaviors, and attitudes reflecting a "near miss" experience were identified among a small group on the periphery of a tornado path in Siren, Wisconsin. This examination of individual perception of responses to storm warnings suggests that it may not be prudent for the public to rely exclusively on any one method of warning dissemination, such as a community siren or television. Additionally, for this study group, the perceived risk of a future strong tornado is too low to illicit many modifications to houses such as roof clips or safe rooms. However, findings hint that NOAA weather radio remains a largely untapped and potentially successful resource if publicized properly in this part of the country. The detailed information collected herein relating to the Siren, Wisconsin tornado of 18 June 2001 can inform risk and emergency managers so that they may induce and reinforce more effective mitigation measures undertaken by the public. Future activities might include researching regional variations in both group thinking and behavior.

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Survey administered to residents of Siren, Wisconsin.

Where were you when the tornado struck?						
How many adults are in your household?		1	2	3	4	More than 4
How many were home during tornado?	0	1	2	3	4	Others?
How many children are in your household?	0	1	2	3	4	Others?
How many were home during tornado?	0	1	2	3	4	Others?
How many pets are in your household?	0	1	2	3	4	More?
How long after the storm were you first aware of the damages caused by the tornado?						
< 1 minute	1 – 5	6 – 10	11 – 15	16 -30	>30 minutes	
Did you, at any time believe that your home had been hit or damaged by the tornado?					Yes	No
If yes, please explain _____						

Did you receive a warning before the tornado?		Yes	No
If yes, what types of warnings did you receive? (Mark all that apply)			
NWS Severe Thunderstorm Watch		NWS Severe Thunderstorm Warning	
NWS Tornado Watch		NWS Tornado Warning	
Non-specific warning		Other? _____	
What was the source of warning? (Mark all that apply)			
Television		Weather Radio	Commercial Radio
Siren		Visual	Telephone call
Word-of-mouth		Internet/E-mail	
Others? _____		Pager/Beeper	
How many minutes of warning time did you have before the tornado struck?			
< 1 minute		1 – 5	6 – 10
		11 – 15	16 -30
		>30 minutes	
To what degree do you agree with the following statement?			
The warning gave me enough time to seek safety.		Strongly Agree	Agree
If Disagree or Strongly Disagree, why?		Disagree	Strongly Disagree
		No safe place nearby	Family was dispersed
		Not prepared for tornado	Tornado hit too quickly
		Other? _____	
To what degree do you agree with the following statement?			
The tornado warning was adequate for my location.		Strongly Agree	Agree
If Disagree or Strongly Disagree, why?		Disagree	Strongly Disagree

Overall, do you believe the tornado warning was adequate for Siren?		Yes	No

Did you have an emergency action plan?	Yes	No				
If yes, what was your plan?			Move to basement or lowest interior room	Shelter in bathroom		
			Head to a storm shelter	Move to car or truck		
			Drive away from storm	Do nothing		
Did you follow your plan?	Yes	No				
If No, what did you do?						
Did you attempt to visually verify the tornado threat before taking action?	Yes	No				
If yes, for how many minutes did you look for the storm?						
< 1 minute	1 – 5	6 – 10	11 – 15	16 -30	>30 minutes	
Did you see the tornado?	Yes	No				
If yes, for how many minutes did you watch the tornado?						
< 1 minute	1 – 5	6 – 10	11 – 15	16 -30	>30 minutes	
Did you videotape or photograph the tornado?	Yes	No				
If yes, for how many minutes?						
< 1 minute	1 – 5	6 – 10	11 – 15	16 -30	>30 minutes	

Did you feel safe while videotaping?	Yes	No
Did you seek out or gather family members before moving to a safer place?	Yes	No
Did you open or close the windows in your home before the tornado passed?	Yes	No
Did you move to an interior room, bathroom or a closet for safety?	Yes	No
Did you move to a bathtub for protection?	Yes	No
Did you move to a motor vehicle (car, truck, or motor home) for safety?	Yes	No
Did you leave your motor vehicle for safer place?	Yes	No
If outside, did you move to a low-lying area (a ditch, culvert or ravine)?	Yes	No
Overall, did you feel safe in your actions to evade the tornado or reduce its impact?	Yes	No
How likely do you think it is that you'll experience a tornado again at this location?		
<10% chance 10 - 24% 25 - 49% 50 - 74% 75 - 100%		

FUTURE RESPONSES AND MITIGATION

Will you respond differently in the event of a possible future tornado?	Yes	No
If yes, what would you do differently? (Mark all that apply)		

- ☐ Spend less time looking at tornado
- ☐ Spend more time looking at tornado
- ☐ Acquire NOAA Weather Radio
- ☐ Rely on NOAA Weather Radio for weather information
- ☐ Rely on Internet for weather information
- ☐ Rely on TV for weather information
- ☐ Rely on commercial radio for weather information
- ☐ Seek shelter in lowest level of home
- ☐ Seek shelter in motor vehicle
- ☐ Contact relatives or friends
- ☐ Flee from tornado path
- ☐ Prepare plan of action
- ☐ Revise previous plan of action
- ☐ Do nothing
- ☐ Others?

Which, if any, of the following modifications do you plan to make to your home? (Mark all that apply)

- ☐ Build and use a tornado safe-room in your house
- ☐ Purchase and use an in-ground storm shelter for your property
- ☐ Install roof clips
- ☐ Build or buy a house of better construction
- ☐ Move to a safer part of the city or metropolitan area
- ☐ Move to a city with a lower probability of severe storms
- ☐ Others?

Rate the degree to which you agree with the following statement:

My future response to tornadoes will be better than in the past.

Strongly Agree Agree Disagree Strongly Disagree

Were there any outstanding lessons learned from your near-tornado experience?	Yes	No
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If yes, please describe: _____