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Shelter Life After Hurricane Katrina: A Visual Analysis of Evacuee Perspectives

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Nine survivors of Hurricane Katrina, who were residents in two Red Cross shelters, provided the researchers with a total of 90 Polaroid photographs of their lives in their respective disaster shelters. After they completed the photographic activity, they participated in semi-structured interviews about their individual photos. The following research questions were addressed to discover the emic (insider) perspectives of the shelter residents: a) what features of shelter life did the residents photograph and discuss; and b) what needs were evident in their photos and interviews? The results showed that the residents had particular needs related to a) privacy, b) interpersonal relationships, c) security, and d) outreach. The discussion covers recommendations for using visual research

methodologies to understand the needs of shelter residents and suggests practical implications for shelter managers and other professionals serving those displaced by disaster.

Key Words: Disaster relief, emergency shelters, qualitative research, visual research methods, Hurricane Katrina.

Introduction

On September 29, 2005, Hurricane Katrina devastated the coasts of Louisiana and Mississippi in the United States. Hurricane Katrina was a catastrophic event, unusual in its magnitude and scope, affecting an area the size of Great Britain. The massive diaspora of residents required extensive and creative establishment of shelters for over one million evacuees, taxing official response capabilities (Nigg, Barnshaw and Torres 2006). This study used an innovative visual methodology to capture emic (insider) perspectives on the shelter experience from the perspectives of residents in two rural Mississippi shelters. Following the literature review and methods sections, we present a thematic analysis of the photographs taken by shelter residents as revealed through both the photographs and interviews with participants. Results suggest that evacuees may experience particular socio-emotional needs for privacy, interpersonal relationships, security and outreach.

Literature

Relevant literature for this study is based on the psychology of displacement, disaster shelters and sheltering behavior. The following sections describe relevant findings and concepts from prior studies.

Psychology of Place. Much of the research literature on forced displacement following a natural disaster centers on theory related to "psychology of place." The psychology of place is based on the assumption that individuals strive for a sense of belonging to a place. According to Fullilove (1996), one's sense of belonging involves three psychological processes: place attachment (bond between

individual and beloved place), familiarity (developed cognitive knowledge of one's environment), and identity (sense of self found in selected residences). When these processes are threatened by forced relocation and loss of home, feelings of nostalgia, disorientation, and alienation may undermine mental health and coping ability. Studies do suggest that, in typical disasters, emotional and mental health needs are not excessive and that most victims do not require outreach (Tierney and Baisden 1979). Hurricane Katrina, by most accounts, was an atypical, even catastrophic event (Quarantelli 2005). However, due to a dearth of literature on such events, predicting shelter behavior of those most directly affected is difficult.

Burton, Winn, Stevenson, & Clark (2004) pointed out views of the "homeplace" that are important to understand when counseling African Americans. Their concept of "homeplace" includes family processes that occur in specific physical spaces that bring about feelings of empowerment, rootedness, ownership, and safety and that eventually shape residents' sense of identity. In short, places are "environmental contexts with real consequences for people" that represent a "significant symbolic locale," and answering critical questions about the self: Who am I? Where am I? Where do I belong? (Hummon, 1986 and 1990; Phillips 1995).

Turner (1967) described collective responses to forced relocation after natural disasters as a process involving the interruption and reestablishment of social structures. He described the solidarity found in reconstituted groups after a natural disaster as involving reduced tolerance for outsiders who do not share the sentiments and experiences of the disaster victims, and heightened social solidarity that results in gratitude for having survived and concern for others in the same situation.

Turner (1969) described the process that individuals experience as they move from one social world to another as starting with liminality (ambiguity) and resulting in communitas (feelings of equality, linkage, and group belonging). Jencson (2001) described the emergence of ritual "communitas" during and after a natural disaster as involving: a) acceptance of pain and suffering, b) the elimination of social status in favor of expertise and experience, c) the elevation of unlikely heroes, d) the elimination of prescribed gender roles in

favor of gender equity to get relief work done, e) elimination of distinctions concerning the ownership of private versus communal property, f) feelings of humility when given personal recognition for heroic deeds, and g) references to mystical powers.

Disaster Shelters. Two main types of shelters are described in the disaster literature: emergency and temporary (Quarantelli, 1982). Emergency shelters include those typically of short duration such as tents, cars, and lawns. Temporary shelters, on the other hand, include those provided by the American Red Cross and emergent types that occur in churches, community centers, and other locations. Residence in temporary shelters is often of longer duration than in emergency shelters.

Less than 20% of evacuees from natural disasters usually end up in shelters (Quarantelli, 1982; Bolin & Stanford, 1990; Phillips, 1993). Those individuals and families with the means to do so secure hotel rooms or rental houses until depleting their funds. Katrina's effects exceeded these usual sociobehavioral responses, requiring that the Red Cross open an unprecedented number of shelters, with a significant number of non-Red Cross (usually faith-based settings) also providing temporary respite.

Studies reveal that social issues are also important in shelters. A study of one large tent city erected after Hurricane Andrew in 1992, with a population exceeding 2000 at times, revealed that ethnic conflict may arise between previously tense groups (Yelvington 1997). Involving residents in shelter management and encouraging them to participate in community governance may help to decrease discontent (Yelvington 1997). Culturally, providing food and involving residents in regionally or ethnically-familiar meal preparation may decrease conflict, aid parents with child care and symbolically evoke comfort (Phillips 1993). Social networks can provide support in adapting to shelter life, although widespread familial dispersion, as seen in Katrina, can also compromise social adaptation (Tierney, Lindell & Perry 2001).

Individuals who arrive at shelters have been shown to need economic and social assistance. Economically, it is known that low-income groups usually arrive at temporary shelters with tremendously depleted resources and often require external support to negotiate

their return to home or other more permanent placement (Lindell, 2004; Tierney, Lindell & Perry, 2001; Phillips, 1993). Economic deprivation marks the lives of those marginalized within society, particularly among rural residents, racial and ethnic minorities, the elderly, and the poor.

Harada (2000) studied the relationships among space, materials, and social interaction in shelters after the 1995 earthquake in Nishinomiya City, Japan. He observed that living in a shelter involves the creation of both collectibility and individuality through the use of space and materials in large (public) and small (private) spaces. He described shelter residents as a "big family" because they lived in common space and shared domestic work. On the other hand, because they were different from non-residents, space and materials prompted residents to undertake processes of both group identification and individualism. He observed that the large space was really a collection of small individual spaces, or the process of "making private space in the public shelter " (p. 208).

How persons negotiate interpersonal relationships and build "community" or "family" in disaster shelters is an under-researched topic. According to Oliver-Smith (1999), there is a serious lack of studies that tie human feelings after experiencing a natural disaster and practical action. However, research conducted in residential settings for individuals in drug and alcohol recovery (Olson, Curtis, Jason, et al., 2003), domestic violence shelters (Whitman, 1995) prisons (Loper & Gildea, 2004), and adult foster care homes (McCoin, 1985; Newman & Sherman, 1980), points out that residents negotiate stressful experiences by the social construction of surrogate families that provide feelings of solidarity and a sense of community. Whitman (1985, p. 23) described how over time women and children in domestic violence shelters "experience a sense of camaraderie and support from each other that enables them to create a unique style of family…they begin to assume the appearance of an extended family, drawing on each other for support." These behaviors serve as indicators of how victims demonstrate resiliency, re-acquire social capitol, and manage traumatic experiences (Tierney, Lindell, & Perry 2001).

Methods

This section describes and explains the innovative method used and describes the sampling procedures, research questions, data collection procedures and data analysis techniques.

Visual Research Methods

Social scientists who use visual research methods undertake an organized attempt to see how photographs encode data about values, norms, and practices often inaccessible in other data collection methods (Grady, 2001). Two visual methods were combined in this project in order to get a rich emic (insider) perspective on shelter life: native photography and photo-elicitation interviews. No studies were found that used either native photography and/or photo-elicitation to better understand the experiences of shelter residents after natural disasters.

Native Photography. Native photography, also called auto-photography and subject-generated photography, involves asking native or local informants to be involved in the production of visual images that are considered sources of data (Collier & Collier, 1986; Worth & Adair, 1972). The value of native photography is that the researcher is provided with a visual representation of the insider's view. In addition, asking informants to produce Polaroid images, which were the primary unit of analysis in the present study, provides rapid feedback to the informant and aids in processing the meaning of the photos, particularly in cross-cultural research (Blinn & Harrist, 1991).

Much of the research with native photography, and particularly those studies using instant cameras, has been in the areas of social and clinical psychology. The value of the instant photo in counseling is that it provides feedback to the patient and allows the patient and counselor to process the meaning of the photo immediately. Blinn (1987) suggested that using native instant photography with pregnant adolescents would improve their levels of self-esteem and possibly reduce repeat pregnancies. She proposed a series of eight weekly photographic assignments through which pregnant

adolescents would come to understand and deal with their feelings about becoming parents.

Ammerman and Fryrear (1975), Fryrear, Nuell, and White (1977), and Milford, Fryrear, and Swank (1983) developed a process known as "self-confrontation" in which patients in therapy are asked to take pictures of themselves and then analyze their reactions to the photos. Fryrear and his colleagues have demonstrated the effectiveness of this technique in improving the social skills, self-concepts, and social competencies of adolescent males. Ziller, Vern, and de Santora (1988) compared the psychological niche of children of poverty and affluence. Youths in Mexico City were asked to take sets of photos each showing "who you are." They found that the psychological niche of the poor children was focused on others, while that of the affluent children was focused on themselves. Ziller (2000) reported on a counseling technique involving photo-self-narratives to make concrete the process of self-talk. Patients are encouraged to redo their photo-narratives over time.

Photo-Elicitation Interviews. Our second strategy, photo-elicitation or photo-interviewing, involves showing informants pictures of themselves, their history, and/or their environments and asking them to discuss what they see. According to Suchar (1989), photo-elicitation is a type of interrogatory process in which the photo is used as the question, stimulus, or probe. There are three main purposes for the use of photo-elicitation in social research: a) to reveal the ethno-meanings of the informant; b) to reveal aspects of the informant's social psychology that are not revealed by other methods; and c) to examine the meanings of significant behaviors and social processes that are evident in the informant's life. Collier (1967) described photo-elicitation as advantageous because it yields additional amounts of data not otherwise available to the researcher.

The photos used as the basis for ethnographic interviews can be classified according to their sources. They can be classified into photos that: a) are produced by the researcher specifically for the investigation at hand (Bunster, 1977; Collier & Collier, 1986); b) are possessed by the informants already, such as family snapshots (Blinn, 1988); c) are secured by the researcher from other sources, such as museums, mass media, and private collections (Teckenberg,

1982); and d) are produced by native informants as requested by the researcher (Blinn & Harrist, 1991).

Blinn and Harrist (1991) combined native photography and photo-elicitation interviews in a study of college women. They asked women who entered college for the first time when they were over 25 years of age to take 10 Polaroid pictures over a two-week period in response to the prompt: "What is your life like?" Semi-structured interviews were conducted with each informant about her photos. Three research questions were addressed: a) what content and themes are evident in the photos taken by college women; b) How do college women portray the balance between their home and school lives in their photos; and, c) how do marital status and parenthood influence the number and types of photos taken by the college women? The results revealed that these women had three different types of temporal rhythms in their lives that resulted in role overload and guilt.

Sample

Nine residents from two similar Red Cross shelters in rural Mississippi volunteered to participate in this project. The Red Cross shelter managers suggested the residents whom the researchers approached about participating. The researchers read each volunteer the recruitment script that was approved by the Committee for the Protection of Human Subjects, and all of them agreed to participate. They were informed that they would have to select, title, and discuss 10 of 20 photos. They were also informed that they would be allowed to keep 10 of the 20 photos as an incentive to participate. Permission to conduct the study was previously secured from the regional Red Cross office and each of the local shelter managers. The shelters were 10 miles apart in Northeastern Mississippi, 240 miles from the Gulf Coast where the hurricane hit. One shelter was a former assisted living facility and the other was a former liberal arts college. Both were empty facilities that were cleaned, adapted, furnished, and made available to hurricane victims by community volunteers. The shelters were similar in providing private rooms, institutional kitchen facilities, group dining facilities, lounge areas,

laundry rooms, and security stations. All data collection took place in the respective shelters. All of the residents were in various stages of being moved to other temporary housing, including hotels, FEMA-provided camp trailers, and homes of community volunteers.

Table 1 gives a description of the sample, all of who had experienced 100% loss of their homes. There were four males and five females, including four African-Americans, four Whites, and one bi-racial resident. Their ages ranged from 18 to 78. In addition, most of the residents had been in multiple facilities since the hurricane and had been at the present shelter for six weeks. Four had evacuated from their homes prior to the hurricane and five had remained in their homes or the homes of friends during the hurricane. The five who did not evacuate prior to the storm experienced life threatening flooding that forced them to their roofs where they remained for days before being rescued by volunteers from the two communities where the shelters were located. They spent between two and four days with no food or water prior to being found.

Of the nine residents, there were two intact families (#1-3 and their two grandsons; #7 and her two children). Only the adults participated in this project. Two residents were rescued with relatives

Table 1: Description of Shelter Residents

Resident	Gender	Age	Home	Race	# of Shelters Since Katrina	# of Wks in Current Shelter	Family
1	M	65	New Orleans	A	1	6	Husband of #2, father of #3
2	F	58	New Orleans	A	1	6	Wife of #1, mother of #3
3	F	41	New Orleans	A	1	6	Daughter of #1- #2, two sons
4	M	21	MS Coast	W	3	6	Mother was in a different shelter
5	M	51	MS Coast	W	4	3	No Family
6	M	48	MS Coast	W	2	3	Evacuated with mother
7	F	34	MS Coast	A	2	6	Evacuated with two children
8	F	78	MS Coast	W	3	6	One daughter still on the coast
9	F	18	MS Coast	M	2	6	Evacuated with cousin and aunt but separated

A = African-American W = White M= Multi-racial

but were separated from them during relocation (#8 and #9). One had no family (#5), one evacuated with his elderly mother who then experienced kidney failure and was placed in a medical facility in the same community as his shelter (#6), and one did not live with his mother when he was rescued but eventually made telephone contact with her and learned that she remained in a shelter on the Gulf Coast (#4). None of them experienced the death of a family member as result of Katrina.

Resident #5 was both blind and an amputee. The visual methodologies were adapted to accommodate his needs. A volunteer pushed him in his wheelchair and took the photos he requested. Resident #8 was 78 years old and in failing health. The methodology was adapted in a similar way with a volunteer taking the pictures that she pointed out. Both of them were able to participate in the photo-elicitation interviews.

Research Questions

Given the scant literature on life in disaster shelters, hypothesizing how residents might define and interact in this space was challenging. We had two expectations when we began this project, based on the existing research. First, it was expected that, given the magnitude and scope of Hurricane Katrina, residents would arrive at shelters in relatively depleted circumstances, potentially experiencing disrupted relationships with significant others, and manifesting some issues related to their displacement. And second, we expected that residents would demarcate personal space and that they would attach meanings to spaces in and around their shelters. The following research questions were addressed to discover the emic perspectives of the shelter residents: a) what features of shelter life did the residents photograph and discuss; and b) what needs were evident in their photos and interviews?

Procedures

The methodology developed by Blinn and Harrist (1991) to combine native photography and photo-elicitation interviews was

followed because how residents in disaster shelters describe the use of personal and public spaces and build "family-like" interpersonal relationships in response to needs has not been adequately explored with more traditional social science methodologies.

Nine evacuees from hurricane Katrina, who were living in two shelters in rural Mississippi, were approached about participating in this project and all agreed. They were given Polaroid cameras for five days and asked to take photos that documented "What your life is like in the shelter." After the residents completed the photography, the researchers conducted one-to-one photo-elicitation interviews in the respective shelters. The residents each took 20 photos. They were asked to select 10 pictures that they wanted to discuss with the researcher and were allowed to keep the other 10 photos as an incentive to participate. The researchers did not see the 10 pictures the residents chose to keep. The following made up the semi-structured interview protocol for this qualitative project:

1) Please tell us your hurricane story. How did you end up in this shelter?
2) As you look at each of the 10 pictures you have selected to talk about, please describe:
    a. Why you took this picture.
    b. What this picture shows.
    c. What title you would give this picture and why.
    d. How this picture makes you feel.

The interviews each lasted approximately one hour and were audiotaped for later transcription. The 90 (10 each per 9 residents) photos were collected for further analysis by the researchers. The researchers took detailed field notes after each visit to the shelters. The residents took the project seriously. When recruited into the study, resident #8 appeared traumatized to the point of being unshaven, unclean, and unaware of his physical or hygenienic needs. When the researchers returned to conduct the interview, he had shaved, had asked the volunteers take him to get a haircut, and had changed to clean clothes. He remarked that "this is important" and that he was ready to talk.

Data Analysis

Data analysis was based on the combined information gained from five sources: a) the content of the photos as observed by the researchers, b) the content of the photos as described by the residents, c) the titles of the photos given by the residents, d) the content of the audio-taped interviews, and e) the field notes that the researchers compiled after visiting each shelter multiple times to arrange for the project and conduct the interviews. Data analysis was inductive (see Erlandson, Harris, Skipper, et. al., 1998) and took place in two steps according to the methodology described by Blinn and Harrist (1991). The two-step process involves allowing the multiple sources of data (visual and verbal) to reveal themes and subthemes. These are then submitted to an inductive data reduction process based on theoretical and conceptual frameworks in the literature.

First, the five sources of data about each resident were reviewed, and the most frequent themes and subthemes in the photos were identified by discussion and consensus among the researchers. This step was atheoretical and involved calculating frequencies of each theme and subtheme across the sample. Several specific themes, expressed as needs, emerged from the second step of our analysis.

Second, the researchers validated their categorizations of expressed needs using two methods. The first method involved frequently returning to the five sources of data for confirmation of tentative findings. Triangulating the data from the five sources aided in the data reduction process across the themes and subthemes. The second method involved discussion of interpretations among the researchers concerning the theoretical perspectives (e.g., attachment to place and social context) until consensus was reached.

Reviewing the field notes, the photo-elicitation interview data, and the residents' titles for their photos provided unique insights into the residents' needs. For example, initially the photographs of dining areas were placed into a single subtheme under "shelter facilities." However, the interviews revealed different ethno-meanings of that same area to the residents. One resident stated that she took the picture to show what the dining room looked like. A second resident took an almost identical photo and described it as meaningful because it was

where they gathered to share their feelings with the other residents and community volunteers.

Results

The remainder of this paper examines the themes and sub themes as revealed in the data analysis. These results are presented first as a series of four themes, followed by a case example that illustrates how a single individual expressed the themes.

Themes and Subthemes in Photos of Shelter Life

Table 2 shows that the 90 photos were placed in four themes and 27 subthemes. The themes, in order from most to least frequent, were: shelter facilities (45 photos), interpersonal relationships (23 photos), outreach (12), and shelter supplies (10).

The themes and subthemes identified in the photos provided data that were further reduced to reveal victims needs for: a) privacy, b) interpersonal relationships, c) security, and d) outreach as a result of experiencing trauma and loss of homes, neighborhoods, communities, jobs, support networks, etc. Each type of need is discussed below.

Privacy. The residents sought privacy and peace where they could process the devastation and stress they had recently experienced as well as think about rebuilding their lives. One big decision that they contemplated was whether to rebuild their homes or move away from the Gulf Coast. They met the need for privacy by being able to shut out the world in their private rooms and by walking around the grounds of the facilities, including sitting by a pond or among the trees. Resident #5, who had been rescued from his roof, took a picture of the closet in his room (see Figure 1) and titled it "My Secret Spot." The following quotation is how he described this photo and why he took it:

> "I find myself spending time in my closet. I don't know why or how I got there. It is a secret place where I can talk to God and go over the things I went through during the hurricane. I feel very safe in there…very quiet…very private. It is like a magnet that draws me to that spot. I realize how fortunate I am to be here in this shelter."

Table 2: Classification of Residents' Photos

Themes (# of Photos)	Subthemes (# of Photos)
Shelter Facilities (45)	Bedrooms (13)
	Outdoor areas (6)
	Lounge areas (5)
	Dining room (5)
	Building entrance and grounds (4)
	Children's play areas/toys (3)
	Laundry room (2)
	Kitchen (2)
	Dog kennels (2)
	Security systems (2)
	Halls (1)
Interpersonal Relationships (23)	Community volunteers (10)
	Other shelter residents (8)
	Red Cross staff (5)
Outreach (12)	Informational bulletin boards (3)
	Community transportation (2)
	Telephones (2)
	Computers (2)
	Newspapers (2)
	Mail (1)
Shelter Supplies (10)	Food (3)
	Medical supplies (2)
	Baby care items (1)
	Drinking water (1)
	Hygiene items (1)
	Linens (1)
	Mattresses (1)

Interpersonal Relationships. The residents revealed needs for both one-to-one relationships and group solidarity. They formed one-to-one friendships with Red Cross volunteers, community members, and other shelter residents and often referred to them as surrogate "family" in the interviews. Since this study took place while they were preparing to leave their respective shelters, several cried during the interviews, discussed how much their new friends meant

Figure 1: Privacy

to them, and stated that they planned to keep in touch as they went their separate ways. The photos included the friends themselves as well as where the two of them met to talk and "share a few laughs." These locations included outside on the grounds, in the shelter lounge areas, and in the community volunteers' homes. Resident #3 was in the shelter with her two children, ages 9 and 11 years. She took a photo of one of the community volunteers and titled it "my friend," describing her as "an angel and she brought me over to her house one day. We are family now."

In addition to one-to-one friendships, the residents took pictures that represented group solidarity. Ten photos showed group gathering areas that became informal places for the residents to tell their disaster stories, listen to others' stories, and find solace in that they were not alone in their trauma. Four residents described the individuals at these gatherings as "Family." The gathering places included dining areas, lounge areas, outdoor picnic tables, and entrances to the shelters (see Figure 2).

Resident #9 took a picture of an empty picnic table and titled it "memories." She stated that she took the photo because "everybody sits there and talks about the bad stuff that's going on... It makes me feel comfortable, almost like family, because we always sit there and talk about stuff."

Figure 2: Interpersonal Relationships

Five photos were taken of the dining rooms to show unity and group cohesiveness during meals. Resident #1 titled his photo of the dining room "Communicating." He stated:

> "The dining room is where we eats [sic] at and I think the dining room is where we all get a chance to all be together and talk to each other …if you have a problem then you can tell the guy next to you."

Security. Thousands of evacuees, including some in our sample, survived the New Orleans flood by being rescued from their rooftops. Perhaps not surprisingly, many of the residents expressed lingering insecurity about their physical safety as well as the ability to get needed food, water, and medical supplies while in the shelter. Two residents took photos of the front doors and the security desks at their shelters. They remarked how safe they felt because both shelters had 24-hour security systems and non-residents were screened before being allowed to enter.

The ten photos of shelter supplies were indicative of the need to know that their health and well-being were secure. The photos included supply closets, stocked shelves, boxes of MRE's or "meals ready to eat," crates of bottled water (see Figure 3), and delivery trucks bringing needed goods. Resident #6 took six photos that reflected his insecurity over having adequate supplies. He took

Figure 3: Security Related to Thirst

Figure 4: Security Related to Food

three photos related to food insecurity: a 24-hour snack bar in the shelter gym (see Figure 4), the shelter dining room serving line, and a storage room with boxes of MRE's. He described feeling good that the Red Cross and military were making sure that they did not go hungry or thirsty again.

Resident #6 also took photos of extra mattresses and a linen closet with towels and sheets. He stated that the photos made him feel that people were willing to donate items. Finally, he took photos of shelves of medical supplies and the Red Cross nurses who were available 24 hours a day. He stated: "residents can feel safe that if they get sick or injured they have a place to come to and they know they will be treated. It feels good to know that there is someone there if you have a medical need."

Outreach. When the residents were moved to their current shelters, the facilities were not ready. They lived in the shelters but were without "contact with the outside world" for more than two weeks as the shelters were being setup, wired for computers and telephones, and furnished. They took photos of televisions, telephones, and computers with Internet access and told us the photos showed their relief in being able to have contact with others, determine the condition of their homes, and apply to government agencies for assistance. They also took pictures of shelter mailboxes, informational bulletin boards (see Figure 5), and local newspapers. Resident #9, who was the youngest interviewee (18 years old), took several photos related to life outside of the shelter and reconnecting with her friends through a computer and cell phone. She also took a picture of a newspaper, titled it "Tragedy," and said that they read

Figure 5: Outreach, Informational Bulletin Board

about what Katrina had done in the state. Reading the newspaper made her feel "sad" because Katrina "ruined her life," and she "did not want to remember but she would always remember it." Finally, she took a picture of a Red Cross vehicle that was used to transport residents to places in the community and titled it "Freedom." She said that she needed to get away from the shelter and get out and see "normal" life.

Case Example

The case below provides additional depth into the meanings of the themes evoked through the visual methodology. Resident #4, age 21, took pictures and discussed all four mental health needs identified in this study. His prior experience involved being stranded in the flood with several other victims and watching eight people die. He attempted to save the life of a man but could not save him because there was no electricity for his breathing machine. They were rescued after four days without food and water.

Privacy

Resident #4 took a picture of his bed at the shelter and titled it "Freedom of Mind." He explained his picture this way:

> "My room is a place to go to be by myself and to think and put things back together, to focus and plan what's' next'? What is tomorrow? What should I do tomorrow to bring my life back to order? Everybody needs privacy. Sometimes it's stuff you don't want to bring up to other people in conversation."

Interpersonal relationships

He took a picture of a collage of pictures of all of the residents and titled it "Family" because he said it showed "unity" and that "everybody came together and formed one big family." The lesson learned from this experience was that "you have to appreciate the better things in life."

Security

Resident # 4 also took four photos that suggested insecurity over his physical safety: a) water and ice trucks; b) food trucks; c) daily supplies such as toilet paper, tissues, bandages, soap, and towels; and d) medical staff, because he remembered the lack of medical care that resulted in the death of others around him during the flood.

Outreach

Finally, he took three photos that showed a need to reach out to the rest of the world: a) newspapers; b) a cell phone; and c) a Red Cross van that shuttled shelter residents to church, Wal-Mart, the doctor, etc. Concerning the shuttle, he said:

> "You just want to get out a bit even if it is just walking around Wal-Mart. It is the freedom to be able to go and not be dependent on other. Transportation is a big thing because you can make your own choices about what clothes to buy and not have to depend on donations."

Discussion and Synthesis

These findings concurred with the literature on community responses to natural disasters from two bodies of literature on place attachment and interpersonal relationships. Much of that previous research has been conducted in communities at large, rather than in disaster shelters. It is clear that, in this study, shelter residents were actively engaged in creating a sense of "place," defining the larger spaces around them, and in using the shelter to redefine and renegotiate important social and psychological dimensions of their lives. Their photos made it clear that they experienced a sense of "ambiguous loss" (Boss, 1999, 2006) as they were cut off from information about their friends, families, homes, and communities when they first arrived at the shelters.

The process they undertook in defining the meaning of their individual rooms and places of privacy versus places of group interaction represented what Harada (2000, p. 205) described as "constructing

private space (privacy) and social space (social interaction) in a public shelter." Harvey, Stein, & Olsen et al. (1995) supported this finding concerning the need for privacy when they asked 30 victims of flooding in the Midwest in 1993 to keep written narratives. Evacuees reported that they used private areas for prayer and reflection, similar to what respondents reported in the present study.

For multiple residents to define dining rooms and picnic tables as places for group sharing and building solidarity, rather than eating, suggests that the simple act of gathering the shelter community for meals represents much more. It is a reestablishment of the commons, a symbolic way to reattach socially and to develop a sense of communitas (Turner 1967, 1969). While by definition every photo reveals a sense of place and one's position in it, in the aftermath of a devastating event where residents lost homes, jobs, neighbors, neighborhoods, social networks, and even an entire city, it is revealing to identify the specific types of items and spaces they documented in their photos and the meanings they gave to each photo. Blinn and Harrist (1991) stated that the process of combining native photography and photo-elicitation interviews can be used to better understand individuals facing life transitions, such as those faced with living in the middle between a familiar lifestyle and an unknown future. The way informants portray and discuss these life transitions photographically can be indicative of their levels of adjustment and may suggest points of intervention for those engaged in providing shelter services.

Limitations

Sampling limitations need to be acknowledged in this research. The researchers were not allowed to present the project to the residents at large and ask for volunteers. The Red Cross staff suggested which residents the researchers could approach about participating, all of whom agreed. This sampling bias excluded residents who may have had different perspectives on shelter life.

In addition, the federal funds to conduct the study only became available as many shelters were closing or had already closed across the affected areas. The two rural shelters in this study were selected,

in part, because they were still operating and had sufficient numbers of residents to participate. Finally, it was an emotional time for the residents as they said good-bye to other residents, volunteers, and staff, and were moved to temporary housing. They were experiencing the loss of attachment to their shelters, and none of them were returning to their homes or communities. This emotionality may have influenced the photos they took and their responses during the interviews. Time sampling to capture different points in the shelter experience could prove insightful for future studies and provide practical insights, including time-specific points of intervention and assistance, for those supporting evacuees. Nonetheless, this methodology appears to be exceptionally effective in provoking ethno-meanings and useful for providing data that address policies, procedures and practices relevant to shelter management.

Recommendations

Shelter Management

It is recommended that shelter managers and volunteers plan their temporary facilities and services to meet the residents' needs for privacy, interpersonal relationships, security, and outreach as much as possible. This can be done by blocking off areas for privacy; allowing residents to keep personal caches of food, water, and medical supplies; purposefully arranging furniture to facilitate group solidarity; supplying residents with newspapers, telephones, computers, and televisions as quickly as possible; providing transportation for residents to spend time outside of the shelter; and displaying stockpiles of food, water, and medical supplies to reduce their insecurities.

Second, it is recommended that community volunteers be called on and trained to form one-to-one friendships with the residents. This could be accomplished through the establishment of formal mentoring programs pairing shelter residents with community individuals or families. Local groups could be brought into the shelters to provide games, group singing, crafts, etc.

Third, while race and gender have been studied as variables in relation to shelter life, age has been less examined. It is recommended that age

differences in reactions to shelter life and in levels of technological literacy be acknowledged and accommodated. Both residents #4 (21 years old) and #9 (18 years old) took more photos that stressed their need for contact with the outside world, including friends, than did those over 21. They took more photos of newspapers, cell phones, and computers with Internet access. They also both took photos of vehicles and discussed their need for periodic "freedom" from the shelter. The older residents did not express this need for freedom.

Visual Research

The visual methodologies explored in this study have not been used in similar contexts. They provided insight into the lives of the shelter residents in a way that non-visual methods alone might have missed. First, it is recommended that in future research, residents be asked to take photos longitudinally during their stays in various facilities. For example, if participants in this study had taken photos when they first arrived at the shelter, they may have revealed more of a sense of ambiguous loss (Boss, 1999 and 2006) that could have served as an intervention point for shelter services. They could take photos as they are moved from emergency shelters, to temporary shelters, and to community or FEMA housing to provide a more complete understanding of their total experience of displacement and as a way to process emotionally their loss and to express emotionally their needs. Such photo-therapeutic activity may provide a means of communication for those moving through a traumatic experience.

Second, it is recommended that a larger sample be involved in order to provide additional insights into the diverse perspectives based on such factors as age, race, gender, and disaster experiences prior to shelter residence. In terms of disaster experiences, did residents who had faced life-threatening situations or lost contact with family members take different types of photos?

Third, it is recommended that future researchers employ a clinical measure of trauma in order to explore the relationships between the content of the photos and interviews and the levels of need felt by the residents. This multi-method approach will help answer the following questions. Do residents with greater levels of trauma take

more photos of supplies due to physical insecurities? Do they take more photos of places that provide: a) privacy, b) friendship, and/or c) group sharing? In what ways does the visual process itself have therapeutic value and aid in the reduction of stress and trauma?

And fourth, future researchers need to examine the concept of "surrogate" families and extended families as they are formed in disaster shelters. This topic has not been researched in the family studies or family science field. Are they similar to surrogate families formed in other residential facilities such abuse shelters, veterans' homes, and adult foster care? What unique functions do they serve for residents?

Summary and Conclusion

To summarize, this research employed an innovative visual methodology to capture insider perspectives on shelter life in disasters. To insure that researchers understood the images, photographer/residents were then interviewed to explain their photographs. Thematic analysis and data-reduction techniques revealed that respondents expressed four key needs: privacy, interpersonal relationships, security and outreach. We conclude that visual research methods should be further explored as a productive route for gaining emic insights that enrich our understanding of shelter behavior, provide practical applications for shelter and emergency managers and, most importantly, help to establish an effective array of shelter services and policies for those displaced in disaster situations.

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Effective Response to Large-Scale Disasters: The Need for High-reliability Preparedness Networks

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A continuing preparedness challenge concerns leading, managing, and coordinating multi-agency disaster prevention and response efforts. Effective disaster prevention and response requires a network of preparedness agencies and organizations that functions as a single, high-reliability organization (HRO). High-reliability organizations have been studied extensively; however, the lessons learned in managing HROs have not been systematically applied to the management and operations of multi-agency and private sector organization networks required to respond to large-scale disasters. This paper develops and recommends a leadership and management

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model for creating and leading high-reliability preparedness networks (HRPNs). The paper demonstrates that the HRPN is key to effectively preparing for and responding to rapid onset disasters such as hurricanes, tsunamis, and mass casualty terrorist events as well as evolving disasters such as infectious disease outbreaks, famines, drought, insect infestations, social system failure, and economic depression.

Key Words: High-reliability organizations, preparedness, disasters, terrorism

Introduction

It is clear that the ability to respond effectively to large-scale disasters is beyond the capability of a single organization or institution. Therefore, a continuing challenge concerns leading and managing numerous government and private sector organizations' disaster prevention and response efforts and eliminating multiple chains of command, duplications of effort, and agencies working at cross purposes. The challenge has become even more daunting because of the increased number and consequences of large-scale disasters and the number of agencies and organizations that must be organized, coordinated, and managed. Effective disaster prevention, detection, containment, and response require a network of agencies and organizations that function as a single, high-reliability organization.

High-reliability organizations (HROs) have been studied extensively; however, the lessons learned in managing HROs have not been systematically applied to the management and operations of multiple government and private sector organization networks required in large-scale disasters. This paper addresses the organizational, management, and leadership requirements involved in planning for, preventing, detecting, containing, and responding to large-scale disasters and proposes the development of *high-reliability preparedness networks* (HRPN). The high-reliability preparedness network is the next generation of the HRO and the key, indeed requirement, to prepare effectively for and respond to large-scale rapid onset disasters such as hurricanes, tsunamis, and

mass casualty terrorist events, as well as chronic long-term disasters such as the combined AIDS, tuberculosis, and ethnic wars of the African subcontinent.

Large-scale Disasters

There are no universally accepted definitions of incident, accident, crisis, or disaster (Shaluf, Ahmadun and Said, 2003, Quarantelli, 1998), however, there is agreement that disasters are non-routine in nature, cause social unrest and produce victims in excess of available resources (Kreps and Drabek, 1996, Quarantelli, 1998). Although the scope of social unrest and problems differ among varying forms of crises and disasters; in the disaster, emergency, risk management, and crisis management literature; incidents, accidents, and crises are generally viewed as organization or industry-wide in scope and disasters are viewed as having community, regional, national, or international consequences. Further, this literature generally views incidents, accidents, and crises as human-initiated and disasters as either human- or nature-initiated.

Multi-causal, acute events with a broad scope of devastation are referred to as large-scale disasters, catastrophes, or complex humanitarian disasters. Complex humanitarian disasters are relatively acute situations affecting large populations, caused by a combination of factors, often including civil strife, food shortages and population displacement and typically result in significant mortality (Noji and Toole, 1997, Burkholder and Toole, 1995). In addition, incidents may become accidents, which may progress to crises and ultimately disasters (Shaluf, Ahmadun and Said, 2003).

Definitions are dependent upon the discipline using the terms; however, generally large-scale disasters possess unique characteristics as outlined by the Federal Emergency Management Agency (FEMA). Large-scale disasters create demands that exceed the normal capacities of any one organization or government. Consequently, the number and structure of responding organizations may result in the creation of new organizations or of new tasks that engage participants who are not ordinarily disaster responders. Furthermore, the participation of multiple and possibly new

organizations greatly increase the complexity of communication, coordination, and standardization of disaster planning, leading to the difficulty of understanding "who does what" in disaster response. In addition, organizations inexperienced in disaster response often respond by continuing their independent roles, failing to see how their function fits into the complex, broader response effort.

Increased Number and Consequences of Disasters

The number and severity of large-scale disasters in the last 100 years has been growing dramatically. Reasons for the increase in nature- and human-initiated large-scale disasters may be attributable directly or due to interaction among a number of factors (Mitchell, 1996, Logue, 1996, Noji, 1997, Mitroff and Alpaslan, 2003). Some of the more important factors include the increase in population, migration of people to urban areas and consequent increase in population density, location of cities in high risk areas, population mobility, erosion of environmental barriers, changes in climate, increase in social unrest, nationalism, fanaticism, tribalism, economic inequity, development of complex and integrated technologies, global interconnectedness, and the increase in old (cholera, yellow fever, diphtheria, malaria, plague) and the emergence of new (HIV, Ebola, Hepatitis C, hantavirus, rotavirus) infectious diseases.

Disaster Life Cycles

Large-scale disasters have a distinct life cycle and over the course of the life cycle often require dozens of agencies and organizations to address community, regional, and sometimes national and international devastation and recovery. A number of disaster life cycles have been proposed (Carr, 1932, Haas, Kates and Bowden, 1977, Stoddard, 1968), however, disaster life cycles generally have three phases of varying length—pre-disaster, response, and recovery.

Disaster phases are, at best, arbitrary and only useful in distinguishing the major functional activities of a period. Emergency activities do not cease suddenly, to be replaced by other types of activities (Haas, Kates and Bowden, 1977). However, the use of

disaster phases has become important in codifying research results (Neal, 1995) and planning disaster network organization and activities. Generally, the pre-disaster phase includes prevention activities, mitigation, and preparedness. Pre-disaster typically includes hazard and vulnerability analysis as well as the establishment of the response network, incident command plans, planning, and a variety of training activities. The response phase includes early warning, emergency, and response. The emphasis in the response phase is on search and rescue, subsistence, shelter, health care, sanitation, infrastructure, and social services. The recovery phase involves clean up, logistics, rehabilitation, reconstruction, and response evaluation.

The agencies and organizations involved in phases one and two of the disaster life cycle will typically remain stable. These agencies and organizations are primarily those involved in emergency response such as hospitals, emergency response units, Federal Emergency Management Agency (FEMA), public health agencies, and local and state police organizations. However, phase three of the disaster life cycle may require new participants. For example, in phase three of the disaster life cycle, first responder organizations such as EMS and fire department roles likely will diminish and clean up and construction organizations will be required.

It is likely that there will continue to be an increase in the number and severity of nature- and human-initiated large-scale disasters. These disasters can be successfully addressed only through the well organized and coordinated interaction of multiple agencies and organizations throughout each phase of the disaster life cycle. Each phase of the disaster life cycle will require a high reliability preparedness network.

An Organization, Management, and Leadership Problem

Preventing, detecting, containing, and responding to a large-scale disaster is not a response agency competency problem but rather an organization, management, and leadership problem of coordinating efforts. Response, relief and recovery agencies usually have highly developed skills in delivering their particular services. For example, fire fighters are highly trained and know what to do when

responding to fires and many have additional expertise in search and rescue and mitigating hazardous chemical spills. Similarly, EMS personnel have also had extensive training and are highly effective in triaging, treating, and transporting the injured or ill. Public health responders have clear roles in monitoring, diagnosing, and investigating outbreaks and health hazards in the community and are capable of supporting individual and community health efforts. The difficulty in large-scale disasters is organizing, managing, and coordinating the many diverse agencies and stakeholders delivering these services. Therefore, effective organization, management, and leadership issues are critical in large-scale disasters.

The United States Government Accountability Office (GAO) February 1, 2006 Statement by Comptroller General David M. Walker on GAO's Preliminary Observations Regarding Preparedness and Response to Hurricanes Katrina and Rita confirmed that organization, management, and leadership issues underpinned many of the challenges encountered in the response to Hurricanes Katrina and Rita. The critical themes cited in the Statement were a lack of: 1) clear and decisive leadership, 2) strong advance planning, training and exercise programs, and 3) capabilities for a catastrophic event.

Clear and Decisive Leadership

The GAO statement indicated that leadership roles, responsibilities, and lines of authority were not clearly delineated prior to the hurricanes. The lack of lines of authority and a single individual responsible for leading the response led to a protracted and disjointed response. The Statement concludes:

> "As a result, the federal posture generally was to wait for the affected states to request assistance. At the same time, some federal responders such as the Coast Guard and DOD did 'lean forward' in proactive efforts anticipating a major disaster".

The result of a lack of clear and decisive leadership was that "… multiple chains of command, a myriad of approaches and process…" emerged to deal with the escalating problems. Clearly, activities of community based disaster management organizations must be coordinated with efforts of state and federal disaster organizations.

Strong Advance Planning, Training, and Exercise Programs

Based on experience of Hurricanes Katrina and Rita, the GAO Statement advocates strong advance planning both within and among community, state and federal responder organizations. In addition, what is needed is consistent and robust training and periodic exercise programs to test the plans, improve communication channels, and predict and identify potential impacts . Such plans and exercises should include multiple agencies at all levels including first responders, the DOD (National Guard), and contractors. The reasons why plans were not adequate are partly due to lack of central leadership and coordination and participation of the leadership in the training and exercises at all levels of response.

Capabilities for a Catastrophic Event

Identification and rapid restoration of response and recovery capabilities such as communications, continuity of essential services, and logistics and distribution systems were inadequate in the Katrina and Rita response. A "big picture" assessment of the scope of the devastation and of how much and what types of assistance were needed were beyond the capabilities of local officials and inadequate at the federal level. When the scope of devastation was finally determined, logistical systems were often overwhelmed with critical resources not available. The GAO Statement indicated that resources and capabilities should be better managed in such areas as evacuation; mass care (sheltering, feeding, and related services); managing, integrating, and deploying volunteers and unsolicited donations; and initiating and sustaining community and economic recovery.

Similar to the responses to Hurricanes Katrina and Rita, a lack of appropriate capabilities was apparent as severe acute respiratory syndrome (SARS) spread rapidly in more than 25 countries in 2003 (Liang and Xue, 2004). Devadoss, Pan, and Singh (2005) note that the health care information system in Singapore was simply insufficient for managing the information flow involved in the outbreak (Devadoss, Pan and Singh, 2005). Fortunately, the problems were recognized quickly and the major issues were resolved in a couple

of weeks. In Toronto, however, the information system problems were not resolved during the outbreak and Canadian officials were required to rely on an antiquated *post-it notes* paper system for managing contact tracing operations.

New organizational arrangements, public and private cooperation, joint planning and sharing of resources, more training and generally more leadership, management and broader thinking in dealing with large-scale disasters were called for as early as 1998 (Rubin, 1998). Yet, communities and regions have not initiated and maintained integrated, reliable disaster response networks because there has been no relevant model to guide their development.

Clear and decisive leadership, strong advance planning, training and exercise programs, coordination of community based assets with state and federal resources, and capabilities for a catastrophic event appear to be the critical missing elements of large-scale disaster response. The themes regarding Hurricanes Katrina and Rita cited in the GAO Statement and the themes derived from the experience of other types of disasters are the same themes focused on by high-reliability organizations (HROs). Much can be learned from organizations that constantly must deal with potential disaster and have been successful in preventing, detecting, containing, and responding to disasters.

High-reliability Organizations

Organizations that operate under very dangerous conditions and yet manage to have fewer than their fair share of accidents are referred to collectively as *high-reliability organizations* (Roberts, 1990a, Roberts and Weick, 1993). These organizations include power grid dispatching centers, air traffic control systems, nuclear aircraft carriers, nuclear power generating plants, fire fighting incident command systems, US Army combat maneuver groups, high density theme parks, commercial petroleum organizations, prison inmate transport operations, and hospital emergency departments. The best of these organizations rarely fail even though they encounter numerous unexpected, non-routine events (Weick and Sutcliffe, 2001). As Weick and Sutcliffe (2001, p. 3) explain it in terms of managing the "unexpected:"

> "They organize themselves in such a way that they are better able to notice the unexpected in the making and halt its development. If they have difficulty halting the development of the unexpected, they focus on containing it. And if some of the unexpected breaks through the containment, they focus on resilience and swift restoration of system functioning." (Weick and Sutcliffe, 2001)

In organizations that continuously operate in high-risk, high-velocity environments, small problems can cascade into accidents if they are not stopped by pre-planned organizational, technical, or procedural defenses (Roberts, Bea and Bartles, 2001). HROs are especially adept at detecting small system failures and fixing them before they escalate into larger disasters. Given the dangerous nature of the work, the complexity of operations, and the significant consequences of failure, these organizations should probably fail often but do not.

Perhaps the best known HRO is the nuclear aircraft carrier. The HRO characteristics of nuclear aircraft carriers have been studied extensively (Roberts and Weick, 1993). Personnel aboard nuclear aircraft carriers understand the inherent dangers of nuclear ships in general and air operations in particular. As Weick and Sutcliffe (2001) explain:

> "People who work on carriers spend much of their time on a flat deck that has been called 'the most dangerous four and one-half acres in the world.' This 'acreage' is filled with up to eighty jet aircraft, some of which at any one time are being fueled with their engines running, or having armed lethal weapons attached to their wings, or being launched off the front of the ship by two million horsepower catapults that accelerate the 65,000 pound plane to 150 miles per hour in three seconds, or are being recovered simultaneously at the back end of the ship by what amounts to a 'controlled crash.' …the deck is often slippery with a mixture of sea water and oil, blasts from jet engines and afterburners leave few safe places to stand, vocal communication is difficult, and the people who run these operations are nineteen and twenty-year old kids…." (Weick and Sutcliffe, 2001: 25-26)

At the same time air operations are being conducted, carriers have 6,000 people working in tight spaces with jet aircraft, jet fuel, nuclear reactors, nuclear weapons, an onboard air traffic control system, refueling and re-supply from adjacent ships while maneuvering through fog, high seas, or unpredictable water (Weick and Sutcliffe, 2001).

Operations aboard nuclear aircraft carriers are incredibly complex and the potential for disasters cannot be over emphasized and yet disasters rarely occur. What can be learned from HROs and can the lessons learned be applied to organizing and managing a network of independent agencies and organizations working to prevent and contain and ultimately recover from a large-scale disaster?

Lessons Learned by High Reliability Organizations

Over the past 20 years there has been considerable research on high-reliability organizations and the strategies they pursue in avoiding accidents and cascading events resulting in disaster (Perrow, 1984, Roberts, 1990a, Roberts, 1990b, Roberts, Stout and Halpern, 1994, Roberts, Bea and Bartles, 2001, La Porte and Consolini, 1998, Klein, Bigley and Roberts, 1995, Bigley and Roberts, 2001, Bierly and Spender, 1995). Roberts and Bea (2001) aggregated these lessons into three major categories: (Roberts, Bea and Bartles, 2001)

1. HROs aggressively seek to know what they do not know. More specifically HROs train people to look for anomalies unusual events, decouple systems when problems are discovered to minimize the harm caused by the initial incident, delegate decision making down to the lowest organizational level possible and empower people to act, create cultures where people feel comfortable reporting failure, design redundancies in systems to ensure multiple ways to detect problems, and accept input from diverse perspectives to cross-train and redesign systems.
2. HROs design their reward and incentive systems to recognize costs of failure as well as benefits of reliability. In doing so, HROs balance rewarding efficiency and reliability and ensure that organizational goals align with public goals.

3. HROs consistently communicate the big picture of what the organization seeks to do, and try to get everyone to communicate with each other about how they fit into the big picture. As a result, HROs develop a culture supportive of open communication, establish a command and control systems that fits all participants and consider the complexities and details of systems.

High-reliability Preparedness Networks

The increase in the number, complexity and consequences of nature- and human-initiated large-scale disasters has created the need for a new type of organization—the high-reliability preparedness network (HRPN). The magnitude of the impact of large-scale disasters requires the management and coordination of many community, state, and federal autonomous agencies and organizations focusing on an emergency situation. This network of dozens of agencies and organizations must be highly organized and flexible, have well defined incident command protocols, engage in extensive training, and be highly reliable without any real assurance that the network will ever be activated. In addition, an acknowledgement of a disaster life cycle and the organization and management of the agencies and institutions that must function successfully throughout the cycle is pre-condition for a reliable network. Disaster response organizations must develop HRPNs by applying the lessons learned through the success of HROs and previous large-scale disasters such as Hurricanes Katrina and Rita. These lessons focus on the network organization, management, and leadership.

Network Organization

Effective responses to community, regional, and national nature- and human-initiated large-scale disasters will require much more in terms of an organization and the creation of a reliability culture than has been established thus far in developing response networks—far beyond a group of loosely coupled autonomous agencies and organizations. High-reliability organizations are *designed* for reliability and have

well-defined and practiced roles for all participants. These roles, supported by extensive training, allow decision making to be pushed to the lowest level possible for accurate and quick decision making, making prevention and response most effective. Further, decision making at the lowest level keeps small problems from cascading to large ones. Network leadership must have confidence that responders in the field have a sense of the big picture, are adequately trained, and have the latest and most relevant information.

System redundancy is another key to a successful HRO design. Critical systems such as communication, rescue, logistics, distribution, shelter, and medical care must have contingency backup plans in place well before the disaster. As demonstrated after the Katrina and Rita Hurricanes, if one or more of these systems fail without a backup, the domino effect ensues and problems escalate rapidly. Such escalation can result in total system failure.

Some observers were surprised that military units (i.e., Coast Guard, National Guard, Army) were among the most prepared to deal with the conditions created by Hurricane Katrina. However, the military has worked hard to build reliability into its units and their performance demonstrates characteristics that must be adopted in organizing and managing a disaster response network.

As the nature of war has evolved from large-scale conventional force confrontations to limited, dispersed, and fluid encounters the military recognized that the greatest obstacle to an integrated command and control (C^2) mechanism for maneuver and strike was the hierarchical organizational structure. Hierarchical C^2 required careful synchronization of multiple command and control structures and required more time than was available on the modern battle field. Increasingly the military has attempted to "harmonize" the C^2 in such a way as to provide a design and process that allows the various levels of command to sense, orient, maneuver, and strike at a pace and with the intensity required of modern warfare (Macgregor, 2003).

As a result, the military has increasingly developed C^2 around concepts more often found in the private sector. Flat organizations in the military as in business corporations are no longer viewed as an option but as required. Everyone has to be able to talk with and work with everyone else to implement the intent of leadership. Data must

be available to everyone not just to a "chosen few" and, conventional rules must be questioned, broken, and sometimes forgotten. The ability to change through perpetual fluidity in response to changing conditions is essential to operational success (Peters, 1992).

Radical recommendations have been made to replace the inherently top-heavy army divisions of 18,000-23,000 troops with combat maneuver groups of approximately 5,000 soldiers. The vertical C^2 of the division encourages tight and centralized operations. Approximately two-thirds of the division's strength is dedicated to support and logistical functions. Combat maneuver groups, on the other hand, are capability based forces designed for dispersed, mobile warfare with a joint command, control, communications, computers, intelligence, surveillance, and reconnaissance (C^4ISR) structure designed to integrate fighting capabilities into larger joint forces (Macgregor, 1997). Clearly, public sector emergency preparedness networks have much to learn from the military's willingness to question the traditional hierarchical organizational and leadership structures.

Network Management

Management concerns the planning, coordination, and budgeting of operations and training of personnel. HRPNs must be managed in all stages of the disaster life cycle. Management in the pre-event phase primarily involves planning and training. Detailed plans and protocols must be developed that establish a command and control system that fits all stakeholders into a common goal with a common reporting structure. As demonstrated by the Katrina and Rita disasters, clear lines of authority are critical and eliminate parallel approaches and working at cross purposes. In addition, in the pre-disaster phase specific operational, logistical, and financial plans are developed.

In building and maintaining a HRPN, only multi-agency and multi-organization training and simulations that emphasize reliability, decentralized decision making, and big picture communication will be effective. Current approaches of sporadic discipline-specific training and ill-defined, non-disaster-specific incident command systems can be effective for accidents and isolated incidents; however, such a training focus will not work for large-scale disasters. The HRPN must

engage in continuous multi-agency training and disaster simulations that involve all the network stakeholders including the leadership.

Management in phases two and three of the disaster life cycle involves communication and coordination. Management must focus on executing disaster plans and initiating contingency plans when there are signals of pending system failure.

Walt Disney World Resort provides an example of the benefits of advance planning, training, and exercise programs for emergency preparedness that might be applied to the operations of a response network. In 2004, the resort survived four unprecedented hurricanes that ripped across Florida. Even though the four 2004 Florida hurricanes caused $25 billion in insured losses, Walt Disney World Resort opened immediately after each hurricane passed and did not file a single insurance claim. Disney learned from previous hurricanes and practiced the lessons it learned.

For example, in the midst of preparations for an approaching hurricane, a risk manager observed a life guard moving poolside furniture into an indoor storage area. When asked about her actions she explained that the resort was in "stage three" of its emergency plan and securing poolside furniture was her responsibility. A maintenance worker was also observed tying up chandeliers and a manager was stacking sandbags to protect a low lying area from flooding. Moreover, after Hurricane Andrew in 1995, Disney constructed its Florida roofs to withstand 90 mile per hour winds and presently constructs new facilities to even higher standards. The end result of Disney's preparedness planning and training is thousands of employees who know exactly what to do and what is expected of them. Because of this, the Company "nailed it perfectly" in preparing for Hurricane Frances (Ceniceros, 2005). HRPNs must operate the same way.

Network Leadership

Leadership is about setting direction, building constituencies, and inspiring and motivating. HRPNs will not be established without a champion that pulls together the stakeholders, persuades them that their role in the network is critical, and inspires them to make it work. Once established, HRPN leadership must be clear and leaders

must be quick and decisive.

Network leaders must build constituencies within and outside the network. Leaders must build and reinforce a culture of reliability within the network—reliability of the network to function as designed is the preeminent goal. They must reduce network hierarchy so that channels of authority are as short as possible. Leaders must align participating agencies and organizational goals with public goals and ensure public goals remain at the forefront of network activities. Within the network, leaders must develop a culture of open communication and not let status and hierarchy get in the way. Open communication is the foundation of coordination.

The leadership of the Prisoner Transportation Branch of the Federal Bureau of Prisons has been successful in creating a culture of reliability, something essential to an effective disaster response network. The Bureau transports hundreds of inmates per day and in any year transports more than 50,000 inmates from one prison to another which requires over 1,300 bus trips. In a typical year, approximately 2,000 inmates are transported on medical airlifts and 40,000 inmates are transported for inpatient and outpatient hospital care. Hundreds of thousands of inmates have been transported without a single escape (Babb and Ammons, 1996).

There are a number of reasons for this high reliability of security when prisoners are taken beyond the confines of the razor wire, guard towers and electronic surveillance. Officers are taught to expect the unexpected (traffic jams, medical emergencies, poor weather, etc.) and constantly train through enacting virtually every possible scenario. All scenarios share one thing in common. Unexpected events require quick and decisive action to keep the situation under control and the officers on the scene have to be empowered as leaders to do what is necessary to respond to developing situations.

Dynamic environments require decentralized decision making and in the case of the Prisoner Transport Branch "extraordinary responsibility is assigned to lower level employees."

By providing the proper training and technological backup these officers on the scene become effective leaders that are critical to the accomplishment of the mission of safe and secure transport of some of society's most dangerous inmates. Tightly coupled operations

depend on every step in the process being successfully completed and the safe completion of each step is dependent on the coordinated action of a number of personnel knowledgeable about the big picture and empowered for rapid decision making.

Conclusions and Recommendations

HROs have developed cultures that are effective in avoiding disasters, detecting weak signals and containing them when they do occur, and responding as they occur. If HRPNs are to be developed and be effective, they must create a culture and develop similar protocols that make them effective in avoiding disasters (e.g., preventing terrorists attacks and warning and evacuating populations before natural disasters), detecting and containing disasters (e.g., limiting exposure of epidemics and terrorism and providing vaccines), respond quickly and adequately (e.g., providing health care, food, and shelter) and managing recovery (e.g. coordinating clean up, remediation and reconstruction).

It is clear that different HRPNs may be needed for different types of disasters and that there should be many overlapping networks (any one agency may be a member of a number of response networks) depending upon the type of disaster (the agency's primary function would be the same but the other agencies with which it has to interact may be quite different). In addition, there will be different agencies and organizations in phase three of the disaster life cycle than in stages one and two.

At present, current response efforts have not been *designed* for reliability and no one seems clearly responsible for identifying and organizing the required agencies and organizations for large-scale disasters. As a result training has been fragmented and not inclusive of all likely stakeholders. Rather what is needed is broad regional involvement of relevant agencies and organizations. Further *network* training (how the participating agencies work together) and simulations are needed to exercise the entire network.

The mindset of the 20th century was preventing, detecting, containing, and responding to accidents and crises. The mindset of the 21st century must be preventing, detecting, containing and

responding to large scale nature- and human-initiated large-scale disasters. Preventing, detecting, containing, and responding to large-scale disasters is an enormous organization, management, and leadership problem which extends beyond those faced by single organizations or governmental agencies. The development of HRPNs is essential for dealing with the coordination of the agencies and organizations required to deal with large-scale disasters.

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Improvements in Tornado Warnings and Tornado Casualties

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Doppler radar installation by the National Weather Service (NWS) improved tornado warning performance, raising the probability of detection and mean lead time while reducing the false alarm ratio. Research on tornado casualties has established that a warning reduces tornado injuries while lead times of up to fifteen minutes also reduce tornado fatalities. In this paper we estimate the decrease in tornado casualties attributable to the observed change in the distribution of warning lead times, and thus provide evidence on the benefit to society of weather warning systems. We find that increases in warning lead times accounts for 30-50 percent of the reduction in injuries but no more than 1/4 of the reduction in fatalities which occurred with the installation of Doppler radar by the NWS. Future improvements in warning performance to further reduce tornado fatalities by 18 percent and injuries by 24 percent.

Keywords: Tornadoes, Tornado Warnings, Fatalities, Injuries, Doppler Radar

Introduction

During the 1990s the National Weather Service (NWS) of the United States underwent an extensive modernization (Friday 1994). The modernization included a consolidation of Weather Forecast Offices, an increase in the proportion of professional meteorologists among NWS staff, and the deployment of the Advanced Weather Information Processing System. The most visible component of the modernization perhaps was the installation of new Doppler weather radars (WSR-88D) and the linking of these radars into a genuine national radar network, the NEXRAD network. The deployment of the Doppler radars was expected to improve warnings for severe thunderstorms and tornadoes, with the improved warnings reducing the societal impact of these storms (Crum and Alberty 1993). Doppler radars have indeed delivered on this promise: the percentage of tornadoes warned for increased from 35 percent to 60 percent; mean lead time on warnings increased from 5.3 to 9.5 minutes; and the false alarm ratio fell from .786 to .760. Tornado fatalities and injuries fell by 45 percent and 40 percent after Doppler radar installation (Simmons and Sutter 2005).

Improved warnings are a plausible means by which Doppler radar has reduced casualties, but NWS warnings comprise just one part of the warning process (Lindell and Perry 1987); communication and response also play a role because better weather warnings avert few casualties if people at risk do not receive or ignore the warning. In this paper we explore the relative contributions of improved warnings (specifically longer lead times) and response in the reduction in tornado casualties due to Doppler radar. Doppler radar allows forecasters to issue better tornado warnings but might also improve the public's confidence in and response to warnings.

Quantification of the societal benefits of meteorological services has become an important research and policy priority (Freebairn and Zillman 2002). This paper contributes to a growing number of studies on the benefits of weather hazard warning systems. Craft (1998),

for example, documented a return to society in excess of 60 percent on the Weather Bureau's provision of storm warnings provided to shippers on the Great Lakes in the 1870s. Ebi et al. (2004) found that NWS summer heat advisories in Philadelphia avoided 117 heat related deaths between 1995 and 1998 and yielded a net benefit of $468 million. Carsell, Pingel and Ford (2004) estimated that a flood warning system for the Sacramento River basin could reduce expected annual flood damage by as much as 8 percent. And Escaleras and Register (2005) find that tsunami early warning systems have significantly reduced tsunami fatalities. We also provide a means to distinguish between improvements in warning performance and public response in reducing casualties. Tornado warnings have received relatively little attention in the hazard warning literature (Hammer and Schmidlin 2002), so this study particularly contributes to understanding the societal value of tornado warnings.

We find that the majority of the reduction in tornado casualties attributable to Doppler radar cannot be explained *merely* by the consequent increase in warning lead times. The observed increase in warning lead times accounts for 30-50 percent of the reduction in injuries and no more than one quarter of the reduction in fatalities. Much of the reduction in casualties due to Doppler radar appears attributable to improved public response to warnings, perhaps because Doppler radar images on television lead to greater public confidence in the warnings. The greatest reduction in fatalities and injuries occurs at lead times of 10 to15 minutes, and thus most of the benefit from improved warnings is from warnings for previously unwarned tornadoes. Our results suggest that further increases in the probability of detection and lead time for tornadoes with very short lead times will yield greater reductions in casualties than increasing lead times on currently warned tornadoes beyond 10 to 15 minutes.

Tornado Warning Performance, 1986-2002

We employ a dataset constructed from the Storm Prediction Center's (SPC) tornado archive, augmented by tornado warning records from NOAA. We first examine the improvement in tornado warning performance. The statistics we report are for state tornado

segments, which is the unit of observation in the SPC archive. The tornado warning verification statistics reported by the NWS are for county warnings. Any tornado which tracks through two or more counties in the same state has one entry in the SPC archive and thus is one data point in our calculations. We assign the warning to the first county in the storm path for this tornado in our dataset and disregard the warnings for the subsequent counties; warnings for subsequent counties in the storm's path are included in the NWS calculations. Consequently the warning statistics reported here may differ slightly from official NWS warning performance statistics. Our dataset consists of all state tornado segments in the 48 contiguous United States, 1986-2002.

Figures 1 and 2 graph two important measures of warning performance by year: the percentage of storms warned for and the mean lead time in minutes. Improvement in both measures is readily apparent. The percentage of storms warned for increased from 31.4 in 1986 to 74.8 in 2002, while the mean lead time increased from 5.4 to 11.2 minutes. The improvement was not continuous over the period; for instance, both measures of performance fell in 1987 and 1988 compared to 1986.[1] A pronounced improvement in both measures occurs between 1994 and 1995, with the percentage of storms warned for jumping from just over 40 to just under 60 and the mean lead time increasing from around six to nine minutes. These marked improvements in performance occur when most tornadoes nationally began to be warned for by WFOs operating with Doppler radar. Simmons and Sutter (2005) established this link more formally by categorizing tornadoes by the Doppler radar installation status of the NWS WFO with warning responsibility for the storm. They found a statistically significant increase in both of these measures after Doppler radar installation.

We next consider the distribution of warning lead times. We use the following lead time intervals: zero minutes, 1 to 5 minutes, 6 to 10 minutes, 11 to 15 minutes, 16 to 20 minutes, 21 to 30 minutes, and 31 or more minutes.[2] Table 1 presents the percentage of tornadoes in each lead time interval for each year. The improvement in warning lead times is again apparent and consistent across the positive lead time intervals. The proportion of storms with a zero minute lead time

Figure 1: Percentage of Storms Warned For

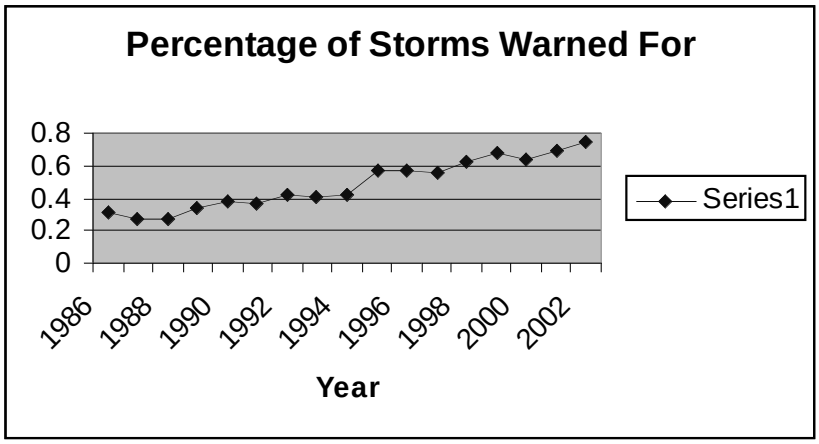
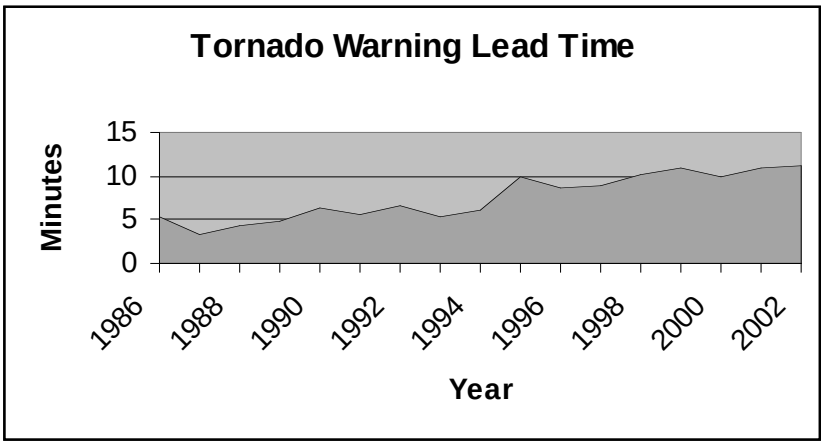


Figure 2: Tornado Warning Lead Time



fell from over three quarters in the first several years to just over one third in 2002. The proportion of tornadoes in the other lead time intervals increased from about 3 to 5 percent in the 1980s to 9 to 12 percent in each category in the last several years. Examination of the individual categories reveals that modest but steady increases in the 1 to 5 minute and 11 to 15 minute lead time categories occurred through 1999, while the other lead time categories experienced a pronounced jump between 1994 and 1995 as Doppler radar was being installed in the majority of NWS WFOs.

Table 1: The Distribution of Tornado Warning Lead Times by Year, 1986-2002

	Lead Time Interval						
Year	0	1 to 5	6 to 10	11 to 15	16 to 20	21 to 30	31+
1986	75.76	3.18	4.24	3.44	2.52	4.77	6.09
1987	81.30	3.55	4.02	3.40	2.01	2.47	3.25
1988	78.25	3.80	3.65	3.94	1.02	4.09	5.26
1989	75.26	3.95	4.65	3.48	3.37	4.41	4.88
1990	68.27	6.04	5.16	4.18	3.29	5.42	7.64
1991	70.61	5.82	4.75	3.67	3.49	5.29	6.36
1992	65.11	6.70	5.84	4.98	3.82	6.70	6.85
1993	67.90	5.59	6.80	4.82	3.70	6.80	4.39
1994	64.06	7.28	5.99	6.27	3.87	7.37	5.16
1995	49.46	7.54	10.23	6.29	5.78	10.23	10.48
1996	51.81	7.49	8.69	7.49	7.49	9.12	7.92
1997	51.82	8.97	8.18	7.48	5.28	8.53	9.67
1998	44.56	9.31	8.74	10.16	8.32	9.38	9.52
1999	40.34	10.10	10.83	10.10	7.15	11.58	10.69
2000	43.30	8.09	9.49	8.83	8.09	11.72	8.47
2001	39.56	9.46	10.77	10.52	5.79	13.54	10.36
2002	33.51	10.74	13.56	10.41	9.87	12.36	9.54
1986-88	78.29	3.50	3.98	3.59	1.87	3.83	4.94
2000-02	39.75	9.38	11.14	9.31	7.72	12.60	9.49

At first glance the lead time categories appear to have experienced roughly equal increases in the proportion of storms as the percentage of warned storms increased over time. To further explore this we calculated the percentage of storms with positive lead times for each interval category in each year. Thus, instead of dividing the annual totals in each category by the total number of tornadoes as in Table 1, we divide by the total minus the number of storms with a zero lead time. Dividing by the number of storms with positive lead times controls for the obvious increase in the percentage of storms warned for. If these percentages remained constant over time then the distribution of warning lead times would not have changed, with only a larger fraction of storms being warned for. To test for a change in warning time distribution, we regressed the percentage of tornadoes with positive lead times for each category on a linear time trend variable and a constant. For the 1 to 5, 6 to 10 and 11 to 15 minute intervals, the coefficient on the time trend was close to zero and not statistically significant, so we cannot reject the null hypothesis

of no change over time in the proportion of warned storms for these categories. The time trend was positive and statistically significant for the 16 to 20 and 21 to 30 minute intervals and negative and significant for the over 30 minute interval, which indicates that fewer warned storms had lead times over half an hour and that 15 to 30 minute lead times have become more common. The distribution of lead times for warned storms has changed somewhat over the period.

Warning Lead Times and Changes in Casualties

We turn now to the impact of the increase in lead times on tornado casualties using the regression model of casualties in Simmons and Sutter (2006). The model uses state tornado segments as units of observation. The lead time for the tornado is the lead time for the warning for the first county in the storm's path. The regression model employs dummy variables for the lead time intervals reported in Table 1. Thus the lead 1 to 5 variable would equal one for tornadoes with lead times in this range and zero otherwise.

A tornado warning is only one factor affecting casualties and bigger storms will kill or injure fewer persons only when other determinants of casualties are controlled for. We will discuss only the impact of lead times on fatalities and injuries here, but the regression models in Simmons and Sutter (2006) contain many other variables which control for storm and storm path characteristics. For instance, the model contains a set of categorical variables to control for the rating of the storm on the Fujita scale of tornado damage, categorical variables for the time of day and the month of the tornado, whether the tornado occurs on a weekend, and the length of the tornado's path. All of these variables are constructed from the SPC archive. The model also contains three storm path characteristic variables from Census data based on the counties in the storm path, population density, mobile homes as a percentage of the housing stock, and median family income. Year dummy variables are also included. The number of persons killed or injured takes on nonnegative integer values, making ordinary least squares an inappropriate regression technique. Instead the models are estimated using a Poisson regression model because the dependent variable is

a count variable. The Poisson model assumes the equivalence of the conditional mean and variance of the dependent variable, and violation of this assumption is known as overdispersion. Tornado injuries are overdispersed, and so the injuries models are estimated using a Negative Binomial regression model.[3]

We consider only the impact of warning lead time here; Simmons and Sutter (2006) present and discuss the full results. Table 2 reports several sets of results on the effect of lead time. In each case we present the proportional effect of the lead times in each interval instead of the regression coefficient. A lead time of zero is normalized to 1.00, so the numbers reported in Table 2 for the other categories represent the effect of an identical storm with a warning

Table 2: The Effect of Lead Time on Casualties

	Lead Time Intervals						
Regression Model	**0**	**1 to 5**	**6 to 10**	**11 to 15**	**16 to 20**	**21 to 30**	**31+**
Full Sample—Point Estimate							
Fatalities	1.000	.806	.590	.809	1.548	1.368	1.007
Injuries	1.000	.579	.739	.527	.761	.806	.586
Full Sample—Lower Bounds							
Fatalities	1.000	1.054	.776	1.110	2.066	1.714	1.315
Injuries	1.000	.750	.950	.692	1.023	1.032	.759
Full Sample—Upper Bounds							
Fatalities	1.000	.616	.448	.590	1.233	1.091	.771
Injuries	1.000	.448	.576	.402	.566	.629	.453
Outliers Omitted							
Fatalities	1.000	.966	.669	.784	.979	.955	.998
Injuries	1.000	.583	.746	.530	.763	.760	.589

Explanatory Note: the full sample is all state tornado segments in the 48 contiguous U.S. states between 1986 and 2002. The second sample omits five tornadoes with lengthy lead times and high fatality tornadoes identified as possible outliers. Fatalities and injuries with no lead time are normalized to 1.0 in each case and the other numbers represent the impact of a warning in the interval relative to a zero lead time.

in that range relative to a zero lead time. A value of .9 then indicates that expected casualties would be reduced by 10 percent relative to no warning. Results are reported for both fatalities and injuries.

The first two rows of Table 2 present our main calculations using the point estimates of the coefficients in Simmons and Sutter's full sample model. Warnings reduce injuries by 20 percent to 47 percent in each interval with the largest reduction in the 11 to 15 minute lead time range. Longer lead times do not produce additional reduction in injuries, because the effect of lead times in the 16 to 20 and 21 to 30 minute ranges is considerably less than the 1 to 5 or 11 to 15 minute ranges. The relationship between fatalities and lead times is not as expected. Warnings up to fifteen minutes reduce expected fatalities, with reductions of about 20 percent for 1 to 5 and 11 to 15 minute intervals and a 41 percent reduction in the 6 to 10 minute range. But lead times over 15 minutes *increase* fatalities relative to no warning, with lead times in the 16 to 20 and 21 to 30 minute ranges increasing expected fatalities by almost 60 percent and 37 percent respectively. A warning over 30 minutes has almost no effect on fatalities relative to no warning. The *positive* relationship between lead times and fatalities for long warnings is puzzling. The marginal value of lead time on a warning may become zero at some point once everyone in the storm's path has received the warning and taken cover, but more fatalities than no warning is difficult to rationalize. Anecdotes suggest that residents can make ill-advised, dangerous decisions with a long lead time on a warning. And some people may conclude after 15 minutes that the warning is a false alarm and leave their shelter too soon. However, such behavior would have to be fairly widespread to offset the people who do take cover to produce more fatalities than with *no* warning.

The next four rows of Table 2 report the effect of lead time with the lower and upper bounds of the 95 percent confidence interval for fatalities and injuries, which indicate the statistical significance of the point estimates of the lead time intervals. Rows 3 and 4 report the lower bounds, or the minimum reduction (or maximum increase) in casualties. Lead times decrease expected injuries in most categories with only the 16 to 20 and 21 to 30 minute intervals yielding slight increases (about 2 percent). The lower bound of the reduction

in injuries is about 25 percent for the 1 to 5, 11 to 15 and over 30 minute intervals. Thus the point estimates of reductions in injuries are statistically significant at the 5 percent level or better except in the 16 to 20 and 21 to 30 minute intervals.[4] On the other hand, an increase in fatalities can be ruled out only in the 6 to 10 minute interval, and the 95 percent confidence interval includes a possible doubling of fatalities in the 16 to 20 minute interval. The upper bound or greatest statistically plausible reductions in fatalities and injuries exceed 50 percent—a 6 to 10 minute warning could reduce fatalities by 55 percent and an 11 to 15 minute warning could decrease injuries by 60 percent compared to a warning with no lead time. The upper bound shows that the increase in fatalities in the 16 to 20 and 21 to 30 minute intervals are statistically significant at the 5 percent level.

The last two rows report the point estimates of regressions which omit five tornadoes—out of more than 18,000 nationally over the period—identified as possible outliers. The five tornadoes all had particularly high death tolls and long warning lead times for their rating on the Fujita scale.[5] Omission of these storms significantly affects the fatalities results, particularly in the 16 to 20 and 21 to 30 minute ranges where warnings increase fatalities significantly with the full sample. With just five tornadoes omitted, fatalities are always lower than with no warning, albeit by less than five percent in some intervals. But the five tornadoes have little effect on injuries, with the change exceeding one percent only in the 21 to 30 minute interval. The implication that longer lead times *increase* fatalities relative to no warning is definitely premature since relatively few tornadoes kill people and a handful of particularly deadly but well warned storms can skew the results. About six times as many tornadoes produce injuries than fatalities, so the results for injuries are much less sensitive to a handful of tornadoes.

We are now ready to calculate the change in casualties attributable to the increase in warning lead times observed between 1986 and 2002. We estimate expected casualties in a year by combining the effect of warnings in each time interval category from Table 2 with the distribution of tornadoes by warning lead time category from Table 1. For example, if the distribution of warning lead times in a given year was .5 with a lead time of zero and .5 with a lead time of 1

to 5 minutes, expected fatalities in the year using the point estimates of the full model would be .903 (=.5*1.0 + .5*.806). The change in casualties due to the change in lead time distributions between two years is calculated using the change in expected casualties with the two distributions. This approach estimates a change in expected fatalities and injuries, since it uses only the proportion of storms with lead times in each category and not the individual storms. The actual change in casualties would depend on exactly which tornadoes had the better warnings. It might be that a violent tornado which would strike a densely populated county with many mobile homes would be warned due to the improvement in the distribution of lead times, with many lives saved. Or the better warned tornadoes might be weak and strike sparsely populated counties. Of course we have no way of knowing which tornadoes in 2002 would have gone unwarned if the distribution of lead times was unchanged from 1986.[6] We also consider a change in only the distribution of lead times and not the number of tornadoes. Thus our percentage change in expected casualties is based on no change in the level of tornado activity as warnings improve. A change in the number of tornadoes relative to the base year would increase the number of casualties avoided.

Table 3 presents the change in casualties for each of the four sets of warning lead time impacts from Table 2. In each case we compare the first and last years of our sample, 1986 and 2002, and for the first and last three years, 1986-88 and 2000-02. Using three year averages for the start and end of our sample smooths out the effect of year-to-year variation in tornado activity and warnings. The improvement in the distribution of lead times reduced expected injuries by 14.8 percent when comparing 1986 to 2002 and 13.7 percent when comparing the three year distributions. The increase in lead times *increased* fatalities slightly, by just under 1 percent when comparing 1986 and 2002 and by 1 percent when comparing the three year totals. The increase in fatalities is due to the relatively larger increases in the percentage of tornadoes with lead times in the 16 to 20 and 21 to 30 minute intervals. Between 1986-88 and 2000-02 the percentage of tornadoes in the 16 to 20 and 21 to 30 minute intervals more than quadrupled and tripled respectively, while the percentages in the 1-5, 6-10 and 11-15 minute less than tripled.

Table 3: The Impact of Longer Warning Lead Times on Casualties

	Percentage Change	
Regression Estimates	**1986 to 2002**	**1986-88 to 2000-2002**
Full Sample—Point Estimates		
Fatalities	+.6 percent	+1.0 percent
Injuries	-14.8 percent	-13.7 percent
Full Sample—Lower Bounds		
Fatalities	+12.5 percent	+12.0 percent
Injuries	-5. percent	-5.1 percent
Full Sample—Upper Bounds		
Fatalities	-9.8 percent	-8.5 percent
Injuries	-22.9 percent	-20.8 percent
Outliers Omitted		
Fatalities	-5.5 percent	-5.1 percent
Injuries	-15.0 percent	-14.0 percent

The upper and lower bounds of the 95 percent confidence interval indicate the limits of the possible effect of the change in lead times. With the lower bounds injuries decrease by about 5 percent over the period, while fatalities increase by about 12 percent, again due to the large positive coefficients on the 16 to 20 and 21 to 30 minute intervals and the larger improvement in lead times in these intervals. The upper bound or maximal effect of improved warning lead times is a 9 to 10 percent reduction in fatalities and a 21 to 23 reduction in injuries.

Finally expected fatalities and injuries fall by about 5 percent and 15 percent respectively with the five outlier tornadoes omitted. Omitting these storms has almost no impact on injuries, while elimination of the increase (relative to no warning) in fatalities in the 16 to 20 and 21 to 30 minute intervals reduces expected fatalities by 6 percent.

Discussion

The installation of Doppler radar by the NWS decreased expected fatalities by 45 percent and expected injuries by 40 percent (Simmons and Sutter 2005). Our analysis here is based on three extra years

of tornado records, and if Simmons and Sutter's regression model is estimated with these extra storms, the effect of Doppler radar is slightly reduced to a 37 percent reduction in fatalities and a 39 percent reduction in injuries.[7] One goal of this paper was to evaluate how much the improvement in warning lead times contributed to the casualty reductions. To do this we have used a regression model of fatalities and injuries with lead time interval dummy variables and then substituted the distribution of lead times in 2002 for the distribution in 1986. We have found, surprisingly, that the increase in lead times has had no discernable impact on fatalities, as the decrease in fatalities due to increased warnings in the 1 to 15 minute intervals is offset by increases in fatalities for the increase in warnings in the 16 to 30 minute intervals. Thus even though the percentage of storms with a warning lead time of zero minutes fell from 75 percent to just over 33 percent between 1986 and 2002, the increase in fatalities for tornadoes with lead times over 15 minutes and the increase in the percentage of warned storms with lead times in this range leads to no reduction in fatalities. The improvement in the distribution of warning lead times reduced injuries by 14-15 percent. The 95 percent confidence interval upper bound of the impact of improved warnings is a 10 percent reduction in fatalities and a 23 percent reduction in injuries. And with just five potential outlier tornadoes omitted, the impact of lead times on fatalities becomes negative, albeit a modest 5 percent reduction in fatalities.

Only 30-50 percent of the reduction in injuries and no more than about 25 percent of the reduction in fatalities are attributable directly to the increase in lead times. If lengthened lead times do not explain the decrease due to Doppler, what does? One obvious candidate would be changes in communications technology over the period—pagers and the Internet as new channels for people to receive warnings, and cell phones and storm chasers to improve the reporting of tornadoes on the ground. But the regression model includes year dummy variables which should control for any changes like new technology that affect the nation as a whole at approximately the same time. Thus the Doppler radar effect cannot plausibly be attributed to these other factors.[8] Regression analysis cannot conclusively demonstrate what is responsible for the Doppler radar casualty impact, but by

process of elimination the most likely remaining factor is improved public response to Doppler radar based warnings. Plausibly, as people see Doppler radar images of thunderstorms on television or the Internet, they might realize that Doppler is a powerful tool that NWS forecasters can use to identify potential tornadoes. Residents consequently might take the warnings more seriously and take cover when they receive a warning. Doppler radar may also contribute by better identifying the area of circulation within the thunderstorm which allows officials to confirm a tornado on the ground and identify the area most at risk.

The reductions in casualties attributable to longer lead times is basically due to providing a warning with some lead time for tornadoes and not increasing the percentage of tornadoes with longer lead times. To see this, the change in the distribution of warning lead times between 1986-88 and 2000-02 is decomposed as follows. Between 1986-88 and 2000-02, the percentage of tornadoes with no lead time decreased from 78.3 to 39.8. These warned storms had lead times throughout each of the intervals. But in the decomposition, assume that all these storms received a warning in the 1 to 5 minute interval. Call this decomposition "improved warnings, short leads." We then calculate the change in casualties between the actual 1986-88 lead times and the "improved warnings, short leads," and then the changes in casualties between the decomposition and the 2000-02 distribution. Providing short warnings for previously unwarned storms reduced expected fatalities by 7.5 percent and expected injuries by 17.5 percent, while lengthening of lead times from the 1-5 minute interval to the actual distribution over 2000-02 increased expected fatalities and injuries by 9 percent and 5 percent respectively.

Improvements in warning times could further reduce tornado casualties. To estimate the magnitude of potential gains from further improvements in warnings, we calculate the change in casualties which would result if all tornadoes with a zero or 1 to 5 minute lead time warning were warned optimally. That is, we compare casualties based on the actual distribution of lead times in 2000-02 to expected casualties when the lowest fatality rate, .590, and lowest injury rate, .527, are applied to tornadoes in the 2000-02 distribution in the 0 and 1 to 5 minute intervals. Technically the lowest fatality rate occurs in the

6 to 10 minute interval and the lowest injury rate in the 11 to 15 minute intervals, but we overlook this here. This hypothetical case shows the effect of providing optimal warnings for currently unwarned or very short lead time tornadoes. Comparison of actual casualties in 2000-02 with this hypothetical show that expected fatalities and injuries could be reduced an additional 18 percent and 24 percent each. Between 2000 and 2005 there were an average of 44 fatalities and 760 injuries from tornadoes per year. Thus improving warnings for the tornadoes with the shortest lead times could save about 8 lives and 180 injuries per year based on recent tornado experience.

Conclusion

The lack of evidence that warning lead times beyond 15 minutes reduce casualties is surprising because as Lindell and Perry (1987) discuss, the warning system is much more than just a warning issued by a government agency. The warning must be transmitted to residents, who may fail to receive or understand the warning, may not know how to respond to the warning, or seek independent confirmation of the threat. Thus a trade-off generally exists between time to disseminate a warning and response. With enough time, they point out that officials can go door-to-door to warn residents, resulting in little chance that residents who are home would fail to receive the warning or not know how to respond. Fifteen minutes seems like a short time to perfectly deliver a warning, so intuition suggests that the marginal value of additional lead time should still be positive. Certainly the recommended response to a tornado warning, namely take cover in a shelter or interior room or closet, takes only seconds. Perhaps informal warning processes, as Lindell and Perry discuss, work well in tornadoes, and residents may not be confused about how to respond to warnings.

New radar technologies, particularly phased array radar, offer the potential for significant improvements in average lead times in the future (NSSL 2003, p.2). Our analysis shows that the reductions in casualties due to longer lead times that we can document result from warning for tornadoes which otherwise would be unwarned. Also, increasing the lead times for tornadoes with less than a five minute

warning yields benefits. Warning optimally for currently unwarned or underwarned tornadoes could reduce fatalities by about 18 percent and injuries by 24 percent. We have been unable to document that increasing lead times beyond 15 minutes yields additional casualty reductions. Thus in the development of new technology and efforts to improve warnings, meteorologists would benefit society by focusing on increasing the probability of detection and lengthening short warnings.

Would an investment to increase the warning lead time for tornadoes beyond fifteen minutes produce benefits to society? Analysis to date provides no evidence of this. Nonetheless, three factors suggest that longer lead times may yield benefits. First, the inability to document a casualty reduction for lead times over 15 minutes may be due to data limitations. Violent tornadoes (rated F4 or F5) are rare; and those tracking through highly populated areas even rarer; violent tornadoes are also better warned than average. We do not observe the number of casualties that might have occurred in the Jarrell, Texas or Moore, Oklahoma F5 tornadoes if these storms had occurred without warning. With additional data, a life saving impact of long lead times may yet be documented. Second, long lead times on tornado warnings have been quite infrequent in the past, so residents may not have taken long lead times seriously. Between 1986 and 1988, only about 10 percent of tornadoes occurred with warnings of 16 minutes or more, and nearly half of these warnings had lead times of 31 minutes or more. Given that over 75 percent of tornado warnings are false alarms, residents might reasonably have dismissed warnings not followed promptly by a tornado as likely false alarms. As longer lead time warnings become more common, residents might have greater confidence in warnings and respond better. Finally, recommended warning response has always been for residents to shelter in their homes. Provided that this is how people respond, an increase in lead times merely gives residents more time to do what they have always done for a tornado warning. An extra ten minutes provides little benefit (and only increases sheltering time) for residents who quickly receive and responded to the warning. At some point longer lead times coupled perhaps with a lower false alarm ratio or greater specificity about the exact location of the tornado might make different response options feasible. Residents

might be willing and able to take other actions besides going to the safest place in their home. It may become possible for residents to go to a neighbor's or relative's shelter or flee the tornado path. Casualties from past tornadoes are a function of residents responding as they always have to tornadoes. If residents eventually respond to longer lead times with better response options, longer tornado warnings might yield casualty reductions impossible to extrapolate from the historical record.

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Notes

1. Brooks (2004) similarly finds several apparently discontinuous improvements in tornado warning performance.

2. The verification statistics report a lead time of zero minutes when a warning is issued for a tornado at or after the time of touchdown. Hence the percentage of tornadoes with zero lead time in the first column of Table 1 does not equal one minus the percentage of storms warned for in Figure 1.

3. For details on the Poisson and Negative Binomial regression models and overdispersion see Greene (2000, pp.861-868).

4. The reductions for 16 to 20 and 21 to 30 minutes are significant at the 10 percent level.

5. The omitted tornadoes (with deaths and lead times in parentheses) were: Moore, Oklahoma, 5/3/99 (36, 19); Reaves County, Texas, 5/22/87 (30, 22); Ocala, Florida, 2/22/98 (25, 18);

Seminole County, Florida, 2/22/98 (13, 14); and Mitchell County, Georgia, 2/13/00 (11, 24).

6. As Scanlon (1988) notes, both disasters and public policy toward disasters are likely to produce winners and losers, and improvement in tornado warnings is no exception. Areas of the country which experienced greater tornado activity in the latter years of our sample were the winners in experiencing less tornado impact.

7. The Simmons and Sutter model did not include the weekend variable, which takes away a portion of the fatality impact previously attributed to Doppler.

8. New technologies not introduced evenly throughout the nation would tend to be used first in wealthier communities but Simmons and Sutter (2005, 2006) find that income increases fatalities and injuries, which provides further evidence that new technologies do not explain the Doppler radar casualties effect.

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OCCASIONAL SERIES ON THE FUTURE OF DISASTERS RESEARCH

Transforming the Field of Disaster Research Through Training the Next Generation*

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Given the importance of nurturing the next generation of hazards and disaster researchers and exposing them to the breadth, depth, and vitality of the field, surprisingly little has been written that explicitly addresses this topic. In this article, I examine the role of research centers in transforming the field of disaster research and specifically focus on the responsibility of research centers in educating and mentoring new scholars, who in turn will influence the future directions of the field. I

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discuss five aspects of training new researchers that I consider essential: a) fostering commitment to the field; b) maintaining academic and professional integrity; c) examining root causes of disasters; d) developing and improving research agendas; and e) disseminating research findings. The role of research centers is critical in the training process, given that there is probably no better venue for educating new scholars and ultimately encouraging innovative perspectives, generating new knowledge, advancing science, and strengthening the field.

As expanding populations increasingly inhabit high-risk locations and as subsequent human and economic losses from natural, technological, and human-initiated disasters continue to escalate, the world is arguably more vulnerable to extreme events than ever before (Blaikie et al. 1994; Hewitt 1997; Perrow 1999). Given the growing exposure of the world's people to various chronic and acute risks, the hazards and disaster research community, which has systematically investigated the causes and consequences of disasters for over five decades, is poised to make significant contributions toward reducing the pain, suffering, and loss inflicted by catastrophic events. Moreover, given the recent occurrence of several large-scale catastrophes, such as the September 11, 2001, terrorist attacks, the 2003 Bam, Iran earthquake, the 2004 Indian Ocean earthquake and tsunami, the Gulf Coast hurricanes of 2005 (especially Katrina and Rita), and the 2005 Kashmir earthquake in Northern Pakistan, the efforts of disaster researchers and practitioners are receiving increased attention, and in some cases, additional government and private-sector funding for particular research and mitigation programs. Thus, despite the historically low prominence of hazards research in most social science disciplines (Anderson 1990), the work of scholars who study hazards and disasters is currently highly salient, and opportunities for conducting research have expanded greatly (Tierney 2002).

Considering these recent events and developments, this is an opportune time to recruit, train, and ultimately retain new hazards and disaster researchers. However, despite the critical importance of nurturing the next generation of scholars, little has been written

specifically about how such scholars should be educated or supported in their work, although notable exceptions exist. For example, in a chapter on data-gathering techniques and fieldwork immediately following disaster impact, Quarantelli (2002, p. 101) emphasizes the importance of thoroughly training graduate students and notes that all new graduate research assistants at the Disaster Research Center (DRC) at the University of Delaware are provided with: 1) a general introduction to the history of disaster research and the DRC; 2) a review of procedures and problems in qualitative field research; and 3) a detailed introduction to the specific research project(s) in which they are to be involved. In short, Quarantelli identifies and demonstrates the importance of systematic instruction for novice researchers, while also providing a framework for how that instruction may occur.

Based on his recognition of the potential future shortage of new hazards scholars, Anderson (1990) has challenged faculty members to make their work more attractive and exciting to both undergraduate and graduate students by involving them in field research and data analysis and allowing them to co-author reports and articles. In the same article, Anderson discusses the substantial lack of minority student involvement in the field and offers potential solutions to this problem (also see Tierney 2002). Wilson (1999) has proposed a tentative research agenda for the next generation of disaster researchers, focusing on questions with particular relevance to emergency management practitioners. At a 2004 conference on disaster research and the social sciences, an entire panel discussion was dedicated to the role of research centers in training the next generation of hazards and disaster scholars (see Rodríguez, Wachtendorf, and Russell 2004).

In this article, I further the discussion regarding fostering the next generation of hazards scholars by examining the role of research centers in shaping the field of disaster research. Specifically, I focus on the responsibility of research centers to train and mentor new hazards and disaster social science researchers at the graduate level, who in turn will influence the future directions of the field. As opposed to the 1960s and 1970s, when the Disaster Research Center, then at the Ohio State University, and the Natural Hazards Center at the

University of Colorado-Boulder were the two principal institutions in the United States dedicated to training new academic disaster researchers (Anderson 1990; Drabek 1996), today there are numerous educational institutions in the United States and other countries that are actively involved in either conducting or sponsoring disaster data-collection efforts and educating undergraduate and graduate students (Tierney 2002). Indeed, the Natural Hazards Center (2006) web site lists over 40 such academic centers and institutes in the United States alone. In addition, Blanchard (2006) recently compiled a list of 120 emergency management higher education programs, 56 homeland security/defense and terrorism higher education programs, 9 international disaster relief/humanitarian assistance programs, and over 30 additional related programs in areas such as fire administration, public health and safety, and environmental science. These centers, institutes, and academic programs investigate all forms of extreme environmental, technological, and human-initiated events, as well as examine specific types of risk, such as earthquakes, hurricanes, drought, floods, and terrorism.

I acknowledge the fundamental importance of many of these programs in training future practitioners and emergency management specialists (for a discussion of educational needs and employment opportunities for hazards managers, see Britton 1999, 2003; Thomas and Mileti 2003). In this article, however, I limit my remarks to graduate social science academic programs affiliated with hazards and disaster research centers, which are aimed at educating and training doctoral level students. I have chosen to focus my discussion somewhat out of necessity given space constraints, but also in recognition of the fact that it will likely be the individuals with doctorates who lead future research efforts in the field and guide subsequent cohorts of students through the academic education and training process. Moreover, if current trends continue, there will be a dearth of scholars to replace the professors who are soon to retire (for more information regarding the need for new faculty members in the field, also see Neal 2000). Thus, the role of these centers is critical, given that there is probably no better venue for training new scholars in the field of disaster research and ultimately encouraging innovative perspectives, generating new knowledge, advancing science, and strengthening the field.

Nurturing the Next Generation of Hazards and Disaster Researchers

Today in the United States, new researchers are being trained at several of the leading social science hazards and disaster research centers, including the Center for Public Health and Disasters at the University of California-Los Angeles, the Disaster Research Center at the University of Delaware, the Hazard Reduction and Recovery Center at Texas A&M University, the Hazards Research Laboratory at the University of South Carolina, the Institute for Crisis, Disaster, and Risk Management at the George Washington University, and the Natural Hazards Center at the University of Colorado-Boulder. These centers provide many different kinds of support for young researchers, including logistical support, financial support, library resources, new social networks, research and collaborative opportunities, and perhaps most importantly, mentoring for the next generation. Below, I focus on five aspects of training the next generation of hazards and disaster researchers that I consider essential: a) fostering commitment to the field; b) maintaining academic and professional integrity; c) examining root causes of disasters; d) developing and improving research agendas; and e) disseminating research findings.

Fostering Commitment to the Hazards and Disaster Research Field

The commitment and professionalism necessarily involved in conducting disaster research can perhaps best be instilled at hazards and disaster research centers. Indeed, doing so may be the first obligation of any graduate training program. It is often through the research centers that new graduate students are introduced to the field of disaster research. Although these students may have been interested in pursuing this type of research because of their fascination with disasters or because of a personal desire to reduce the negative impacts of catastrophic events, students are certainly not innately devoted to the field. The specific commitment to disaster research must be fostered by staff at those centers who

demonstrate the importance of hazards research and how such work can contribute to the broader mission of minimizing damage and loss resulting from disasters. In particular, leaders at the centers must be thoughtful, committed, and enthusiastic mentors. As Phillips (2002) argues, advisors should support students' research interests while also promoting high academic standards. Students need to understand the place of disaster research within broader theoretical, methodological, and disciplinary perspectives. In addition, students and young professionals must be taught, encouraged, and reminded that one of the primary goals of this field is to reduce risks from hazards and to produce knowledge that will contribute to that goal (see Anderson and Mattingly 1991; Myers 1993). Related to this, scholars and practitioners also want to foster effective disaster response and recovery operations, and thus students should be educated in these important areas as well.

One of the best ways to instill these values and teach students about the field is to involve them in various aspects of a research center's mission, as well as in the larger hazards and disaster community. Students should actively contribute to all phases of the research process: including formulating new research questions, designing studies, gathering and analyzing data, and writing up and disseminating research results. They also need to participate in the day-to-day activities of the research center, as well as attend and present their work at scholarly conferences and workshops. These experiences will help students better understand the field as they become more informed, connected, and committed.

In support of the training missions of academic hazards and disaster research centers, the National Science Foundation (NSF) has funded several initiatives expressly designed to foster the next generation of hazards and disaster scholars. For example, with support from NSF, the Disaster Research Center has established a Research Experience for Undergraduates' (REU) program that allows undergraduate students to engage in training and hands-on research to improve their understanding of the social science aspects of disasters.

Similarly, with a grant from NSF, the Public Entity Risk Institute, the Natural Hazards Center, and Swiss Re have established a program

that awards dissertation fellowships to graduate students in all disciplines studying risk, hazards, and disasters. The purpose of the PERIShip dissertation fellowship program is threefold: 1) to advance knowledge in the hazards field; 2) to ensure that the next generation of interdisciplinary hazards professionals has a source of financial aid to foster their academic development; and 3) to solidify students' interest in and commitment to hazards and disaster research. This program is a particularly important resource for graduate students who are not affiliated with one of the major hazards or disaster research centers in the nation. These students often do not have the same level of institutional support for their research, and thus the dissertation fellowship program is vital in fostering their commitment to the field, while also connecting the students to the broader hazards and disaster research and practitioner communities.

"Enabling the Next Generation of Hazards Researchers," another program funded by NSF, supports mentoring of junior faculty members who are interested in conducting social science research addressing hazards and extreme events. The junior faculty fellows participate in workshops, tutorials, and discussions with senior researchers and receive practical advice about research design and grant proposal development. A similar program, "Research Education in Disaster Mental Health," which is funded by the National Institute of Mental Health, strives to improve the quality and utility of disaster mental health research by matching scholars at the beginning stages of their career with well-established disaster mental health researchers.

Continued financial and institutional support for the academic missions of hazards and disaster research centers, as well as for the programs mentioned above, is essential to the continuity and growth of the field. The mentoring that occurs within the centers as well as through the aforementioned programs helps inform new researchers about the state of knowledge in the field, while also fostering commitment by encouraging the development of long-term academic research agendas.

Maintaining Academic and Professional Integrity

A second goal in training the next generation is to promote continued academic and professional integrity. Obviously, the field of disaster research is highly event-driven. Research and funding are subject to the events and politics of the moment. Regardless of the type of disaster, if the scale and scope of a catastrophe are sufficient to capture national and international attention, the event inevitably becomes the focus of not only the media, but of government officials, funding agencies, and researchers as well. It is not inherently bad to follow the hazard or disaster of the moment. However, it *is* a serious issue if researchers undertake studies just because funding is available, at the cost of ignoring very real problems that are equally worthy of their time, attention, and efforts.

In the post-September 11 era, where new "terrorism experts," centers for homeland security, and parallel degree programs are appearing frequently, and many calls for disaster funding seems to be linked to terrorism, the need for integrity in research and the disaster field generally is perhaps greater than ever. We must step back and assess how we are going to maintain appropriate scholarly agendas and ask how terrorism fits into definitions, typologies, and theories of disaster, how what we already know from the field can be applied, and what new questions must now be considered (see Peek and Sutton 2003; Quarantelli 1993). Perhaps most importantly, we must be circumspect, critical, and even wary regarding what sort of support we accept and what kinds of research we undertake. As scholars, we must take the broadest view and be willing to battle for the study of what we believe are the most important long-range research and policy questions, and we must pass these values onto our students.

Examining Root Causes of Disasters

Related to the event-driven nature of the disaster research field is the continued overemphasis of research and policy on response to emergencies and disasters versus the societal/structural forces that put populations at risk and may be considered, in many cases, the *root* causes of disaster (Blaikie et al. 1994; Mileti 1999; White,

Kates, and Burton 2001). Of course studying disaster response is an important aspect of the field that must continue, as we have learned many important lessons from this type of research (see Tierney, Lindell, and Perry 2001). However, if they are to contribute to the long-term improvement of society, hazards and disaster research centers, and the scholars they produce, should not only attempt to understand and improve disaster response, but also must train scholars and produce research that examines fundamental causes of catastrophic events. We must question *why* an event occurred – not only in physical science or engineering terms, but in social science terms as well. The socio-political ecology perspective, most clearly used by Peacock, Morrow, and Gladwin (1997) in their edited book on Hurricane Andrew, integrates this type of broad ecological and political approach to disasters and focuses on interactions – not solely the interaction of human systems and the physical environment, but of all social systems.

Currently in the United States there is much discussion regarding what the next terrorist event will be. It is important to consider these questions, given the possibility of a future terrorist strike that could potentially harm thousands, or even millions, of people. At the same time, there has been very little dialogue or research regarding *why* another terrorist attack might occur (or, indeed, why past attacks occurred). Simplistic political statements about "attacks on freedom," "pure evil," and "hatred of the American way" beg the question. Clearly the causes of terrorism run deeper and lie in the ways that cultures meet, or fail to meet, and accommodate one another, especially cultures with markedly different histories, social structures, values, and economies. Again, it is taken for granted that another terrorist attack *will* happen, but this short-sighted acceptance of "reality" has hindered critical analysis and dialogue about *why* another event could take place, *what* the causes for that attack might be, and *how* we could possibly prevent it – in the sense of ameliorating the deeper, systemic causes of these conflicts (Butler 2004). The most sophisticated airport security systems, the most hardened buildings, will not stop terrorism. We must examine the root causes of these destructive actions and events and engage in serious dialogue regarding preventive measures.

Additionally, the focus on terrorism response might well be reflected in other disaster research where response issues will take further precedence over research into more fundamental causes and hence will usurp mitigation efforts. Moreover, the focus on terrorism may overshadow the importance of examining the root causes of other, potentially more devastating hazards such as large-scale natural disasters, pollution, water shortage, and global warming. Over the past few years, the world has witnessed the horrors inflicted by massive earthquakes, a devastating tsunami, and the worst natural disaster in U.S. history. The death and destruction caused by these "natural" catastrophes should serve as a reminder of the fundamental importance of examining the root causes that lead to these types of events. As Mileti (1999, p. 3) argues, disaster losses – rather than stemming from unexpected events – are the predictable result of interactions among three major systems: the physical environment, which includes hazardous events; the social and demographic characteristics of the communities that experience them; and the buildings, roads, bridges, and other components of the constructed environment. Again, we must ensure that the next generation of disaster scholars is able to discern the fundamentally important issues and long-term problems as distinct from the crises of the moment.

Developing and Improving Research Agendas

Developing innovative, interesting, and important research agendas is critical to the scientific progress and survival of any field. Indeed, disciplines can only remain viable if they identify and study new problems, or, at a minimum, old problems from new perspectives, and systematically accumulate new knowledge. Because some disaster research is opportunistic and driven by a sense of urgency, researchers often dedicate too little effort to reviewing existing literature and building upon previous findings (Dynes 2000). Hence, earlier mistakes are repeated, and different researchers ask and explore similar questions time and time again. Replicating pre-existing research or studying the same phenomena is not always problematic, of course. For example, Kendra and Wachtendorf

(2001), in their examination of the response to the September 11 attacks, identify a new form of convergence not discussed by other researchers. In addition, many disaster researchers have argued that looting is essentially non-existent in natural disasters (see Fischer 1998). Yet the widespread media reporting of looting after Hurricane Katrina challenged disaster researchers to re-think their assumptions regarding looting behavior, and some embarked on new studies to explore this phenomena (Barsky, Trainor, and Torres 2006). These examples illustrate the importance of studying social and behavioral phenomena across a variety of contexts, and also remind us that important lessons can be learned by re-evaluating previously studied cases. At the same time, it remains imperative that hazards and disaster research centers continue to teach students to ask new and important questions, while also reminding them to evaluate the state of knowledge before embarking on new projects.

Asking New and Important Questions. As the members of the academic hazards community develop research agendas, we must challenge ourselves and our students to look deep and ask the questions that have not yet been asked but are central to improving the human condition. Where are the gaps in our knowledge – theoretically, empirically, practically, locally, and globally?

Responding to this challenge is difficult for a new scholar to the field, someone who does not yet know what knowledge has already been produced and who may not even know how to formulate a research question. Clearly, a key role for research centers, and specifically, individual mentors within those centers, is to both define those questions and teach new scholars how to identify them. Again, we must train scholars to ask larger questions, to break new ground, and to consider new empirical and theoretical issues. In this regard, it would be beneficial for directors of the various research centers, as well as other faculty who advise graduate students, to meet regularly (perhaps once a year) to discuss the state of the field and to present overviews of ongoing and upcoming projects. Such a meeting would allow researchers to understand and complement one another's work, foster collaboration, and establish unified, integrated research agendas. A meeting of the director's of hazards and disaster research centers currently takes place each July at the Hazards Research

and Applications Workshop in Boulder, Colorado. Perhaps such a meeting could be expanded to include all faculty members who advise graduate student researchers. Another possibility is to create an electronic mail list that faculty could use to communicate with one another about ongoing projects, new research opportunities, and so forth.

In addition to relying on faculty mentors to help formulate new research questions, research agendas should be developed *in conjunction with practitioners* – with the planners, public officials, emergency managers, law enforcement officials, and others – working in communities. These practitioners are keenly aware of what needs to be studied and what questions need to be answered, and they are looking for concrete, feasible recommendations regarding what they should or should not do to lessen disaster losses in their communities (Myers 1993). Additionally, because these individuals are often the people responsible for the day-to-day activities associated with disaster preparedness, response, and recovery, they can often shed the most light on important practical needs or policy options that should be considered in research reports.

Another recommendation is to encourage graduate students to gain practical experience through internships at organizations such as the American Red Cross, the Environmental Protection Agency, or the National Oceanic and Atmospheric Administration, for example. The type of experience that is gained through actually working closely with practitioners can provide important insights that may help future researchers ask new questions and better understand the links between research, practice, and policy. Moreover, internships and other fieldwork experiences may equip students with the theoretical, methodological, and applied knowledge and skills necessary to understand a range of increasingly complex and serious emergency situations (also see Moseley 2004).

At the same time, because disasters involve all dimensions of society, from the personal to the collective, cross-disciplinary and interdisciplinary collaboration is vital. Although there have been calls for higher education to move away from traditional disciplines toward interdisciplinary education that solves the real-world problems entailed in linking hazards risk and sustainability (see

Mileti 1999), most graduate students continue to be educated in the theories and methods of a particular discipline, such as anthropology, geography, political science, or sociology. However, graduate students who study hazards and disasters often have the opportunity to become involved with more interdisciplinary research efforts through a hazards or disaster research center. Particularly in the current funding environment, where cross-disciplinary collaboration is not just recommended but often required, it is extremely important that researchers and young scholars from one discipline work with others involved with the same problems. Research questions, and the answers to these questions, can no longer be developed in isolation; they will span all social science disciplines and also integrate knowledge from the natural and physical sciences and engineering.

In the March 2004 *Natural Hazards Observer*, Russell Dynes offered an invited comment that challenged scholars to think more broadly, more globally, and he asked us to recognize the different types and fundamentally different nature of disasters that are occurring in our world, particularly in less-developed countries. Dynes posed a set of questions and issues regarding various hazards agents and their consequences that he feels must be addressed if disaster research is to remain viable. Specifically, he argues that we must expand our research horizons to examine conflict and slow-onset disaster events in developing countries, which often result in enormous human costs. New students of hazards and disaster research should be challenged to develop innovative theories of disaster that may help us to understand these new and understudied types of disaster.

Assessing the State of the Field. To ask new questions and to develop new research agendas, current scholars and their students must first comprehensively assess what is already known and then take a serious look at the gaps in research and practice. *The Second Assessment on Natural Hazards,* which Dennis Mileti (1999) and a host of contributing authors concluded seven years ago, was a recent attempt to do just that (also see Drabek 1986; Hewitt 1997; Quarantelli 1998; Tierney et al. 2001). However, one lesson of this millennium is certainly that such an assessment cannot be conducted only every 25 years. The world changes too quickly.

What, then, are we to do? First, of course, new students to the field must be encouraged to carefully review the disaster research literature to ensure the examination of key questions and to adequately conceptualize research projects. At the same time, the assessment of hazards research and practice must become an ongoing project, with a collective appraisal of significant changes and possible research implications occurring much more frequently. This is one of the goals of the Natural Hazards Center's Annual Hazards Research and Applications Workshop, but the evaluation could and should be more explicit.

Disseminating Research Findings

A person may conduct stellar research and arrive at brilliant conclusions, but if he or she cannot clearly articulate and communicate those findings – both to colleagues, and perhaps more importantly, to practitioners – the labor has been pointless. We must take what we have learned through disaster research and make it useful, and we must demonstrate this goal to our students. This may seem a simple point, but defining what is useful, based on the audience, can be very difficult. What is useful to sociologists could be defined as something that contributes to the empirical literature and says something new theoretically. What is useful to practitioners might well be a clear, jargon free, summary of research findings that offers realistic recommendations for policy and practice (Myers 1993). Research centers must train young scholars regarding these different notions of "useful," teach them how to write for and present to various audiences, and impress on them that they must *do* just that: communicate to all audiences that might benefit from their knowledge.

One effective way to discover what is useful, and to train young scholars regarding how to write and present, is to have both researchers and practitioners actively involved, not only in the design of research, but more integrally in the ongoing work of hazards and disaster research centers (see Drabek 1986, p. 416). Research centers cannot work in isolation. Practitioners should be included in a center's operations – whether it be as a paid staff member, a

member of an advisory committee, or as a visiting fellow. In a field that relies on the connections between researchers and practitioners, such interchange between various stakeholders is vital.

Although some great research is currently being conducted within various hazards and disaster research centers and independently within universities, that information is slow to reach policy makers and practitioners. The main goal of the Natural Hazards Center at the University of Colorado-Boulder is to strengthen communication among researchers, and the individuals, organizations, and agencies concerned with individual and public actions to reduce damages from disasters (see Myers 1993). Through its information dissemination program, the Hazards Center produces both print (*Natural Hazards Observer)* and electronic (*Disaster Research*) newsletters. These publications provide briefings on current research, and reach approximately 30,000 individuals in the national and international hazards community. The Hazards Center also convenes a workshop each summer in Boulder to strengthen the link between the research and applications communities. The Hazards Center and the Disaster Research Center at the University of Delaware house large libraries that contain thousands of books, articles, reports, journals, and other documents. In short, there are many resources available to help researchers disseminate their research findings; however, academics must seek out and utilize these resources, while encouraging their graduate student mentees to do the same.

Conclusion

During the first years of the twenty-first century, catastrophic, and in some cases unprecedented, disasters have occurred across the globe, resulting in the death and displacement of hundreds of thousands of people and costing billions of dollars (Munich Re 2004). Soaring urban populations, environmental degradation, and poverty are exacerbating seasonal hazards such as droughts and floods to create chronic adversity for many of the world's people (International Red Cross 2004, p. 8). Over the past several decades, hazards and disaster research has played a vital role in documenting and explicating the causes and consequences of extreme events for

human society (White et al. 2001). However, as more individuals and communities are exposed to new and multiple forms of risk and as disasters continue to grow in frequency, scope, magnitude, and complexity, researchers must adapt their agendas to consider these new issues, while also preparing future generations to study, understand, and, ideally, minimize these threats.

If the field of disaster research is to change with the times, the hazards and disaster centers are where that transformation will begin. But such transformation requires reflection and planning, and then action. We must examine what is working within our research centers and be honest about what needs to change. We must look at the trends in the field and decide which to embrace and which lead down dead-end paths. We must distinguish the most critical problems from those highlighted by the media. By engaging the students who will become the next generation of disaster scholars in this process, the present leaders and mentors at the various centers will ensure that the field remains not just relevant but a contributor to the betterment of humankind.

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FEEDBACK FROM THE FIELD

Estimation of Financial Losses to Alabama's Seafood Industry Due to Hurricane Katrina*

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Hurricane Katrina impacted the coastal areas in the states of Alabama, Mississippi and Louisiana, U.S.A. on 29 August 2005. This study estimated economic loss to Alabama's seafood industry from Katrina's devastation. For loss estimation, the Alabama seafood industry was divided into four categories: dealers and processors, shrimp fishermen, other fishermen, and charter boat owners and/or operators. Estimated losses were calculated separately for damages to boats and facilities (excluding insurance coverage), beached vessels, lost inventories, wages and invoices unpaid, and lost revenues from past and future lost sales. Loss estimation was based on broad guidelines suggested by the U.S. National Academy of Sciences for impact estimation from natural disasters and the U.S. OMB Circular A-94. Losses to Alabama's seafood industry were estimated at $122.25 million with a possible additional loss of $61.1 million due to defaulted loans.

Hurricane Katrina made landfall in the states of Louisiana and Mississippi, U.S.A 29

August 2005. In addition to damages from wind, high storm surges literally wiped out many communities from Louisiana to Alabama. Due to its geographic proximity and concentration on the coastline, the Gulf Coast seafood industry was severely impacted. The damage inflicted on the seafood industry in Alabama, Mississippi and Louisiana caught the attention of the national media (Stoller and Woodyard 2005; Copeland 2005). Damages and losses were experienced by all coastal areas in Alabama with significant concentrations in Bayou La Batre and the surrounding areas where storm surge reached 18 feet flooding/destroying shoreline buildings and businesses. Bayou La Batre, according to 2000 U.S. Census data, had a population of 2,313 with a poverty rate nearly twice the national rate at 22.9 percent. The 1999 median household income in this area was $24,539. Research indicates that natural disasters create winners and losers (Scanlon 1988; Chang 1984). At least in the short run, however, small areas like Bayou La Batre appear to be more losers than winners.

The primary objective of this study was to estimate economic damages and losses to Alabama's seafood industry, including the charter boat industry, caused by Hurricane Katrina and, to a lesser extent, Hurricane Rita. Chang et al. (2006) estimated economic losses for Alabama's fishery sectors. This paper is the summary of a report prepared for the Alabama Marine Resources Division (Chang et al. 2006) and presented to the U.S. Congress by the National Marine Fisheries Service as part of the damage assessment of the Gulf Coast seafood industry. This paper provides a methodological framework for assessing initial damages to fishing communities due to a major hurricane.

The Model

Damages from natural disasters are difficult to identify; Handmer (2002) describes many of these difficulties. For this study the authors chose to follow broad guidelines for estimating damages resulting from natural disasters as outlined by the National Academy of Sciences (NAS 1999). In these guidelines, the NAS determined loss caused by a disaster is a broader concept than the cost, a term referring to the losses typically reimbursed by insurance companies and governments. The NAS further defines losses from disasters as the combination of 1) direct losses resulting from the destruction of physical items such as buildings and natural resources and 2) indirect losses representing outcomes of the destruction such as job loss and suspension of business activities. As in the NAS guidelines, this report included any affected entity regardless of whether or not those who received losses were insured or qualified for government financial aid (NAS 1999).

Typically the "multiplier effect" is included in economic impact valuations. However, the NAS does not require the inclusion or exclusion of the multiplier effect for estimating losses from natural disasters (NAS 1999). Being such a small area, the multiplier effect in the study area is likely very small. Considering the assumptions of the multiplier effect within the affected area, in conjunction with the Office of Budget and Management's Circular A-94 prohibiting the inclusion of the multiplier effect for impact estimation (Chang 1997), the multiplier effect was not included in this study.

For the purposes of impact estimation, the Alabama seafood industry was divided into the following four categories: dealers and processors (D), shrimp fishermen (M), other fishermen (N), and charter boat owners and/or operators (C). Losses (L) were calculated from damages to vessels and facilities (F) excluding insurance coverage (S), beached vessels (V), lost inventories (I), wages and invoices unpaid (U), and revenues from past and future lost sales (R).

Losses to the Alabama seafood industry (L) can be described as the sum of these components as illustrated below:

$$L = (F\text{-}S)^{D+M+N+C} + V^{D+M+N+C} + I^{D+M+N+C} + U^{D+M+N+C} + R^{D+M+N+C}$$

Damages to public infrastructure included losses to fishing habitat, ship channel dredging, debris on fishing grounds, and public access to the waterfront. These were not included in this study for two reasons. First, Hurricane Katrina followed closely Hurricane Ivan (September 2004) and projects such as habitat enhancement and channel dredging were underway, and second, damages to access roads to the waterfront were relatively minor in the study area. Loan estimates were included in this study.

Sources of Data

The contract for this study was signed on 28 October 2005; the study was scheduled for completion by the end of November 2005. Personal interviews were conducted during October 14 and 15. More than 50 seafood dealers and processors were visited by investigators from the University of South Alabama and the Alabama Marine Resources Division asking them to complete a questionnaire designed by the authors. The questionnaire was also distributed by mail to all licensed Alabama resident commercial fishermen, charter boat owners/operators, and the area's seafood dealers not initially interviewed. A copy of the questionnaire used to survey fishermen, seafood dealers, and seafood processors has been placed in Appendix 1. The number of questionnaires mailed and returned is indicated in Table 1. The number of dealers and processors mailed the questionnaire does not include those who were interviewed personally:

Because the survey period was so close to the aftermath of the hurricane, many questionnaires were returned unopened, possibly

Table 1: Number of Mailed and Returned Questionnaires

Category	Mailed (Received)
Dealers & processors	189 (69)
Charter boat operators	154 (37)
Shrimp fishermen reporting landings	210 (52)
Other fishermen reporting landings	496 (66)

due to delivery problems. Time constraints prevented the mailing of a follow-up questionnaire possibly reducing the response rate. Licensed commercial fishermen with no landings (harvested seafoods sold to a licensed seafood dealer) reported to the Alabama Marine Resources Division were not included in the survey.

In conjunction with the mailed questionnaire and personal interviews, two additional surveys, each tailored to their respective seafood category, were incorporated in this study. The first survey was conducted by Alabama Marine Resources Division personnel who contacted Alabama charter boat owners/operators via telephone to survey damages immediately following Katrina. The second survey was conducted by the Organized Seafood Association of Alabama to evaluate damages through direct survey of its member dealers and processors.

Summary of Loss Estimates

Estimated losses based on survey responses are summarized in Table 2. Seafood dealer/processors also holding commercial fishing licenses were counted only once and placed in the dealers and processors category. Figures in Table 2 were obtained by multiplying the average of returned samples, including those obtained through personal interviews, to the total number of addresses in each group.

Some loss items required data collection beyond the questionnaire survey. The first item pertained to vessel removal. The removal of stranded/beached vessels continued to be a controversy several months after the hurricane hit. About 48 fishing boats were beached in Bayou La Batre alone (Henderson 2005). By early November, 12 boats had been removed either by boat owners' insurance companies

Table 2: Total Losses from Katrina to the Alabama Seafood Industry

Loss Items	Loss Amount	Sub-category
(F-S) Net value of damages on boats & facilities	$24,610,251.21	
(F) Damages on boats & facilities		
Dealers & processors		$19,741,679.63
Shrimp fishermen		$ 7,889,891.10
Other fishermen		$ 5,613,534.56
Charter boats		$ 4,096,752.66
subtotal		$37,341,857.95
(S) Insurance coverage		$12,731,606.74
(F-S) Net value excluding insurance coverage		$24,610,251.21
(V) Vessel removal	$ 3,840,000.00	
(I) Lost inventories	$20,519,138.06	
Dealers & processors		$ 3,408,895.24
Shrimp fishermen		$ 9,837,660.00
Other fishermen		$ 3,968,000.00
Charter boats		$ 3,304,582.82
subtotal		$20,519,138.06
(U) Wages & invoices unpaid	$ 5,846,943.82	
Dealers & processors		$ 3,934,179.00
Shrimp fishermen		$ 398,611.50
Other fishermen		$ 819,228.32
Charter boats		$ 694,925.00
subtotal		$ 5,846,943.82
(R) Lost revenues & future lost sales	$57,433,526.40	
Dealers & processors		$29,392,936.00
Fishermen		$18,885,107.00
Charter boat operators		$ 9,155,483.40
subtotal		$57,433,526.40
Grand Total	$112,249,859.49	
Potential Loss from Loans		
Loans from SBA		$ 5,809,000
Loans from Other Sources		$ 55,326,000
total loans		$ 61,135,000

or by the Federal Emergency Management Agency (FEMA). The remaining 32 uninsured vessels, however, remained beached and tied together by dock ropes. The problem was that FEMA removed boats that threatened public health, but refused to remove boats

unless boat owners agreed to pay a fee of up to $60,000 for removing their boat (Henderson 2005). The Organized Seafood Association, however, estimated that about 80 boats were stranded on the shore and estimated the cost of removing and repairing beached boats to be $100,000 per boat. As a compromise, boat removal and repair costs in Table 2 were adjusted as follows:

(80 + 48)/2 x $60,000 = $3,840,000 for vessel removal (see V in Table 2)

(80 + 48)/2 x $40,000 = $2,560,000 for vessel repair (included in F-S in Table 2)

The cost of vessel removal changed almost on a daily basis. It took more than a year before all beached boats were floated again.

The second item relates to the amount of lost sales caused by Hurricane Katrina. Based on personal interviews and questionnaire responses, the following assumptions were made regarding loss by month following the hurricane. Assumed losses for 2006 depended heavily on if and how quickly recovery assistance was received:

September 2005	100% loss
October 2005	75% loss
November 2005	50% loss
December 2005	25% loss
2006	25% loss

To calculate losses suffered by dealers and processors by month for 2005, it was necessary to know annual total sales of processed seafood and their breakdown into monthly sales. The amount of total sales of processed seafood for 2004 was $135,696,235 of which $83,317,538 was for shrimp, according to the Alabama Marine Resources Division. Monthly breakdown of total processed sales was not available. However, one of the largest and highly respected seafood processors in Alabama made their monthly data for 1993 through 2004 available for this study. According to the data, the monthly minimum share of annual total seafood processed was 5.822 percent (0.05822) in April and the monthly maximum share of annual total seafood processed was 11.186 percent (0.11186) in June with the average being 8.3333 percent (0.083333) and standard deviation of 1.6569 percent (0.016569). Monthly average shares for ten out of 12 months fall within one standard deviation from the mean (0.06676 to 0.09990), while all 12 monthly

averages fall within two standard deviations from the mean (0.05019 to 0.11647). Since there was no convincing evidence indicating a clear monthly fluctuation of all processed seafoods combined, it was assumed in this study that the total value of seafood processed remains equal each month at 1/12 (i.e., 8.3333 percent) of the annual total. Actual calculations of lost sales and lost future sales by type of seafood industry were made using the formula below:

Fishery Loss = [(Total Value of Fishery/12 months) x 100% loss for September] + [(Total Value of Fishery/12 months) x 75% loss for October] + [(Total Value of Fishery/12 months) x 50% loss for November] + [(Total Value of Fishery/12 months) x 25% loss for December] + [(Total Value of Fishery/12 months) x 25% loss for 2006]

The total amount of lost sales thus calculated for dealers and processors is $62,194,108. The total figure, however, included wholesale prices that processors paid to suppliers. According to the U.S. Census Bureau, the share of the cost of materials ($144,778,000) relative to total value of shipment ($247,034,000) for fresh and frozen seafood in Alabama was 58.6 percent. This adjustment was needed because the loss estimation in this section pertains to dealers and processors, who usually purchase their raw seafood for processing. Based on personal interviews, however, it was found that many dealers and processors also own their own boats to fish. To account for this observation, 10 percent of the total loss was assumed unaffected by the 58.6 percent share of the cost of materials. Net loss in sales for dealers and processors was calculated:

Net Loss = $62,194,108 x 0.10 + $62,194,108 x 0.90 x (1 - 0.586)
= $6,219,411 + $23,173,525
= $29,392,936

For estimation of loss in sales suffered by fishermen, it should be noted that Alabama has a trip ticket program which requires seafood dealers to report the seafood landings of each commercial fisherman by filling out a form (ticket) detailing the primary area of harvest, harvest gear, fishing and trip times, the quantity of each species harvested per condition and count size, and the dockside value of each. Seafood landed in Alabama by resident and non-resident fishermen may have

been caught anywhere inside or outside of Alabama's state waters. The amount of landings in Alabama, therefore, is not equal to the amount of catch in Alabama. Unlike data on processed seafood, Alabama seafood landings data are available monthly. The total dockside value of annual landings for fishermen for 2004 was $37,396,250 of which $29,540,012 was for shrimp, according to the Alabama Marine Resources Division. Lost sales to fishermen were calculated by applying the following formula separately to shrimp, crabs, fish, oyster, and other, and then obtaining the total at $18,885,107:

Fishery Loss = [(Total Value of Fishery/12 months) x Monthly Share x 100% loss for September] + [(Total Value of Fishery/12 months) x Monthly Share x 75% loss for October] + [(Total Value of Fishery/12 months) x Monthly Share x 50% loss for November] + [(Total Value of Fishery/12 months) x Monthly Share x 25% loss for December] + [(Total Value of Fishery/12 months) x 25% loss for 2006]

It is interesting to observe in Table 2 that the amount of loans from SBA comprises only a small portion (less than 9.5%) of total loans outstanding in Alabama's seafood industry. It is also noted that the amount of losses calculated in Table 2 may overestimate actual losses if a greater number of returned questionnaires were submitted by groups experiencing damages more than those of the general population, while the amount may underestimate actual losses to the extent that respondents' perception of future losses are more accurate than the percentages assumed in this study. Percentage losses in the future indicated in the returned survey questionnaires are significantly greater than those assumed in this study.

Conclusions

Hurricane Katrina delivered a severe blow to Alabama's seafood industry. Based on the findings of this paper in conjunction with data from various sources, Alabama's seafood industry, which is comprised of seafood dealers, commercial fishermen, and charter

captains, should be expected to incur losses of up to $112 million in the months following Hurricane Katrina. These losses stem from facility and vessel damages, inventory and sales losses, and loss wages to the workforce. Seafood dealers stand to lose valuable market share and processors struggle to locate seafood for processing. Additionally, potential losses of over $61.1 million due to forfeit or delinquency of encumbered loans could occur.

Financial losses incurred by Alabama's seafood industry were substantial. These losses severely impacted these businesses and to a lesser extent support industries at a local, state and national level. Alabama's seafood harvesting and processing sectors began limited operation within months after the hurricane hit while these sectors in Mississippi and Louisiana are expected to take a longer time to recover. Birkland (1996) suggests hurricane disasters often solicit short-term relief efforts and mitigation discussions; however, policies reflecting long-term mitigation for future hurricanes do not materialize. Hurricane Katrina was an atypical storm which may have provided the appropriate social impetus for changing the hurricane relief and mitigation policies in the USA. Hopefully, information contained within this paper and the report on which it is based will help policy makers identify and prioritize relief and mitigation efforts in coastal areas in order to reduce future financial distress associated with hurricanes.

Shown below are three of many comments that respondents to our questionnaire wrote to us. Note that names are excluded in the following quotations and comments are printed exactly as they are written:

> "I lost a 40 ft. shrimp boat due to hurricane Katrina. I've not gotten no help my boat was a total loss. I'm currently trying to get the coast-guard to help get my boat it's on the dock of a business. I don't have the money to make repairs to salvage the boat any help would be much appreciated fishing and shrimping is all I've ever done suffering a total loss is tragic to any commercial fishermen."

> "Since many crab suppliers on the gulf coast were wiped out, every crab processing plant in this area with east coast and Texas suppliers may be hanging on, but there's not enough

crab from those areas to supply all of us. We have therefore, closed our business since we no longer have anything for our employees to do."

"Our boat is sitting on the beach a total loss. We just don't know what to do with it. Been asking Coast Guard for help or anyone and still haven't received anything. It's sitting on private property and the people are asking for us to remove it. But where it's located we can hardly get to it by foot. It's sitting propped up between two pine trees so what can we do. Please help us. God Bless You. Thank you"

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FEEDBACK FROM THE FIELD

Promotion of Disaster Education in Nepal: The Role of Teachers as Change Agents

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Disaster education allows community members to initiate pre-disaster measures at the individual level. The National Society for Earthquake Technology (NSET) has initiated a school safety program in selected government schools in Nepal, one of the most disaster prone countries.

This study outlines the current condition of disaster education in Nepal, identifies teachers' levels of awareness and evaluates the effect of NSET's work. A survey of 130 teachers was conducted in over 40 schools in which it was found that while a level of disaster education in Nepal is widespread, it has not been implemented systematically but depends on the awareness of individual teachers. More teachers in NSET project schools provided disaster education than in the typical government and private schools that were observed. However, the quality of education provided was found to be the same. The teaching focused particularly on the effects of disasters in which the teachers had personal experience. These topics were often covered even if they were not included in the textbooks.

The majority of teachers surveyed reported a need for curriculum development in this area. However, considering the results listed above, it can be considered that teacher training is the most important step to improve disaster education in Nepal.

Introduction

Recently, many catastrophic disasters have occurred across the world. These include the Kobe Earthquake of 1995 in Japan, the Indian Ocean Tsunami of 2004, the Pakistan Earthquake of 2005, Hurricane Katrina of 2005 in the USA, and various other water-induced disasters. Central and local governments play a significant role in preventing or reducing damage caused by natural disasters. However, it is the local communities who suffer the most severe damages. This suggests that disaster management should be the role not just of governments but also of communities.

Although local people need to take measures at the individual level, they often do not do so for various reasons; some may not

recognize the importance of taking measures and others may not take action to prevent or reduce damages even when they know the importance. The gap between intention and action is one of the crucial issues of disaster management. Disaster education is one way (albeit not the only way) in which this problem can be addressed. Schools can provide education to all students equally.

In addressing disaster management in schools, many researchers and workers in NGOs, UN agencies and other organizations have pointed out that both building type and disaster education are significant factors in developing school safety, especially in the case of earthquake disasters (see Izadkhan 2004; Dixit 2004; Wisner et al. 2004; COGSS 2006a, COGSS 2006b). Building safety is valuable for disaster reduction in the shorter term and education can play a significant role in developing a culture of disaster reduction from a long term perspective. Disaster education can be delivered in different ways by schools, NGOs or other organizations. In addition, training can be offered (mock drills, evacuation training, rescue training, etc.) and disaster topics included within the curriculum and as extra curricula activities. Much training focuses on response, and this kind of training is not sufficient for promoting pre-disaster measures and preparedness. Moreover, while disaster education delivered by organizations external to schools can be useful, it is difficult for schools to make disaster education sustainable after such an activity or project. In this study, education by schools is the focus.

The importance of disaster education at school level is recognized by the works of Radu (1993), Kuroiwa (1993), Arya (1993), Andrews et al. (1998), Frew (2002) and Shaw et al. (2004). Shaw and Kobayashi (2001) stress that schools play an important role in raising awareness among students, teachers, and parents. However, Douglas and David (2001) emphasize the role of researchers, planners and emergency managers in facilitating preparedness. In addition, UNESCO and Kyoto University, Japan have collected and published case studies of disaster reduction from all over the world. The case studies include research, projects and other activities of NGOs, researchers, governments and other disaster related institutions. Few of the case studies focus on schools and especially teachers for disaster reduction (Shaw and Rouhban 2005). This paper attempts to

fill this gap in the existing body of work.

Nepal is extremely vulnerable to natural disasters due to its fragile geology (Paudel et al. 2003). In Nepal, environmental degradation, growth of population and unregulated development cause frequent floods and landslides. In addition, Nepal is an earthquake prone country that is becoming increasingly vulnerable to earthquake risk with each passing year due, in addition to those factors already mentioned, to a construction practice that has actually deteriorated over the last century. The National Society for Earthquake Technology-Nepal (NSET-Nepal), an NGO conducting projects for earthquake disaster reduction, is conducting a School Earthquake Safety Program (SESP) in government (public) schools in Nepal. SESP consists of three parts; retrofitting or rebuilding of schools; training masons; and training and awareness raising for students, parents, and communities.

Recent work conducted by the Graduate School of Global Environmental Studies of Kyoto University has monitored and evaluated NSET-Nepal's program. The goal was to promote disaster education in school and its objectives were 1) to understand the current condition of implementing disaster education in schools; 2) to identify teachers' awareness of disaster education and needs for promoting disaster education in schools; and 3) to identify the effect of SESP on teachers. This paper details the results of this work, drawing upon the collected information from the first author's visit to NSET-Nepal and also upon the document written by Khadka (2005), from the Ministry of Home Affairs in Nepal.

The School Earthquake Safety Program (SESP)

As previously mentioned, Nepal is an earthquake prone country. The last large earthquakes occurred in 1986 and 1934. The earthquake of 1934 caused the loss of over 11,000 people. Earthquakes of this size occur approximately every 75 years (NSET-Nepal and GHI 2005). The next large earthquake could occur at any time and thus the people of Nepal need to focus on risk reduction and to take mitigation measures.

Schools are at the center of their communities and also become evacuation centers after a disaster occurs. After the Kobe Earthquake

which occurred on 17th January, 1995 in Japan, more than 300,000 affected people were evacuated to schools or public institutions at the peak period. The local government closed these evacuation centers in August 1995 but even at that late stage, more than 6,672 people were staying in 194 schools or other places (Asahi Simbun 1996).

However, school buildings are themselves vulnerable to earthquake damage, especially those in government schools in Nepal. Unlike private schools, government schools do not have the resources to recover by themselves. Therefore, NSET-Nepal's work focuses on government schools.

The SESP conducted by NSET-Nepal consists of three parts; the first is retrofitting or rebuilding the school building, the second consists of training for masons and teachers, and the final part is an awareness program for students, teachers, and the community. One of the aims of this project is community based disaster management through these three activities. The masons involved learn to use and understand suitable technologies for earthquake safety through the instruction given by NSET-Nepal. After the project, they can build safe houses or buildings. Teachers, students and the community are given information related to disaster management in the SESP. The following topics are explored in lectures:

- Disaster risks in Nepal.
- Earthquake risk in Nepal and Nepalese schools.
- Damages caused by past earthquakes.
- The importance of structural measures.
- Technology for earthquake safety.

The teacher training consists of six parts which are explicated below:

1. Overview of disaster risk management.
    - Overview of disasters in Nepal.
    - Past disaster history, loss and damage.
    - Existing disaster risk management system in Nepal.
    - Sensitizing video show/discussion.
2. Earthquake hazards and risks.
    - Earthquake hazards and risks in Nepal and the Kathmandu valley.
    - The earthquake vulnerability of schools in Nepal.

- Sources of earthquake risk in schools.

3. Earthquake risk mitigation/reduction measures.
    - Structural mitigation measures—retrofit/reconstruct the building.
    - Non-structural mitigation measures—fix, fasten, anchor, replace, relocate, rectify, manage, restore, reinsure.
4. Earthquake preparedness in schools.
    - Emergency preparedness for individual safety.
    - Emergency preparedness for collective safety.
    - Preparedness planning—before earthquake.
    - Preparedness planning—during and after earthquake.
    - Do's and don'ts during and after earthquakes.
5. Strategies for earthquake risk reduction.
    - Overview of School Earthquake Safety Program.
    - Video clip regarding school safety.
    - Roles of school teachers in earthquake awareness in the community.
    - Possibilities for disaster safety in school curriculum.
    - Case study visit to field—sharing experiences.
6. Exercise on emergency preparedness planning.
    - Introduction of emergency preparedness in schools.
    - Group work on model preparedness planning.
    - Presentation of group work.
    - Discussion and finalization of a model of preparedness planning prepared by the groups.
    - Next steps for teachers after training.

Disaster Education in Schools in Nepal

Teachers can play an important role in providing disaster education to students. Therefore, a survey of teachers was conducted to understand the current condition of disaster education in schools and the needs of teachers to further this provision. Using a questionnaire, 130 teachers of 8th, 9th and 10th grades (14-17 age group students) were interviewed. Teachers of science and environment-related subjects were specifically selected. Environment-related topics are termed H.P.E. ('Health, Population, and Environment') in the figures or tables shown here.

Table 1: Teacher Information

Subject	SESP	Government	Private	Total
Science	3	18	17	38
Environment	4	13	26	43
Social Studies	2	15	23	40
Others	1	5	3	9
Total	10	51	69	130

Explanatory note:
'SESP' refers to government schools where SESP was conducted.
'Government' refers to government schools where SESP has not been conducted.
'Private' refers to private schools.
'Others' refers to where the teacher's subject was not one of the above three subjects or where they are in charge of several subjects.

Figure 1: Current Status of Implementation of Disaster Education in Each School Type

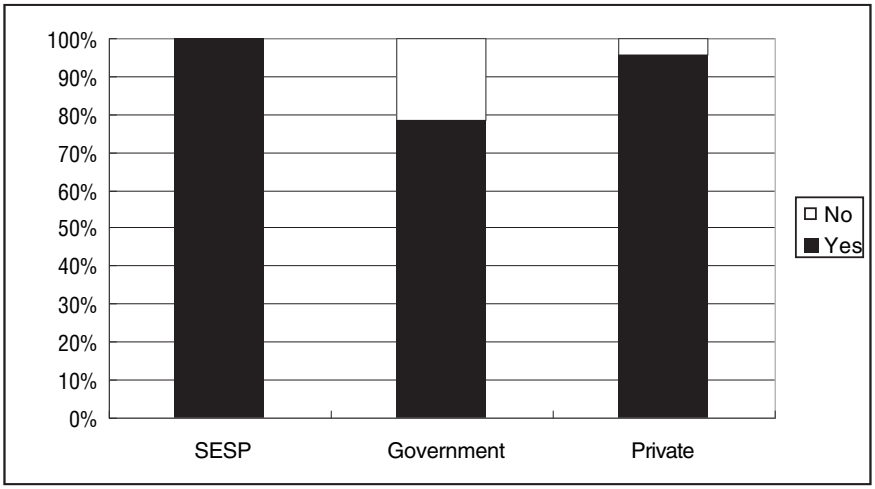
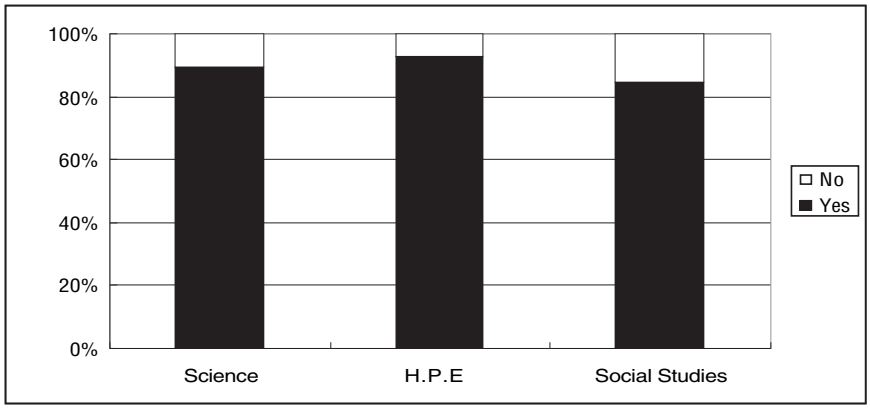


Table 1 gives details of the teachers involved in the study: the types of schools and the subject areas in which they work.

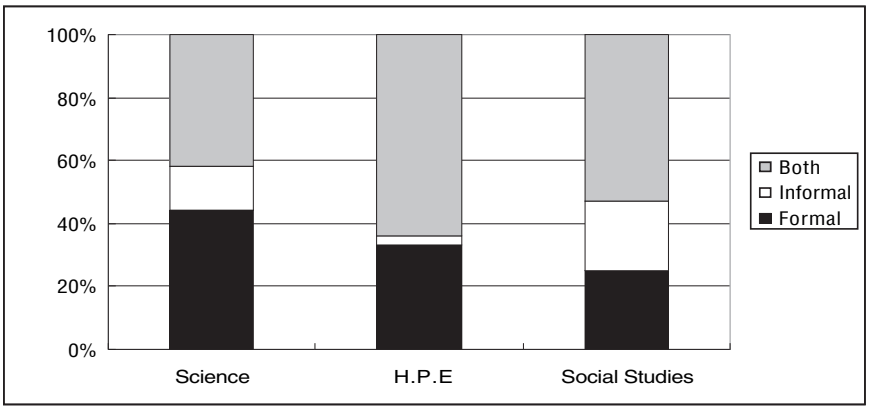
Figures 1, 2 and 3 show the current status of implementing disaster education in schools. The research demonstrated that most teachers in Nepal are implementing some form of disaster education (Figure 1). All teachers in the SESP schools and the vast majority of teachers in private (95%) and government (80%) schools are implementing disaster education. Private schools in Nepal are able to pass on more information to students than government schools as they have more

Figure 2: Current Status of Implementation of School Disaster Education Across Subject Areas.



Explanatory note:
Yes: implemented.
No: not implemented.
H.P.E. refers to the subject "Health, Population, and Environment".

Figure 3: Style of School Disaster Education.



Explanatory note:
H.P.E. refers to the subject "Health, Population, and Environment".

time for disaster education. This is hypothesized to be the cause of the difference between government schools and private schools. That more SESP school teachers are providing disaster education than other government school teachers can be regarded as a positive impact of the SESP of NSET-Nepal.

Figure 3 shows the style of disaster education in school hours. Most teachers are implementing disaster education formally or are adopting a mixture of formal and informal measures.

In this study, curriculum education is focused upon to understand the current status of disaster education. In Nepal, curriculum education is that which is implemented based on textbooks. The areas highlighted in grey in Table 2 indicate those disasters that are covered by the textbooks.

Table 2: Disasters in Curriculum Education (percentage of teachers who have taught a corresponding disaster in a corresponding subject).

Subject	Grade	Flood	Landslide	Earthquake	Epidemic	Wind Storm	Environment and Environment Degradation
Science	8	31	31	27	4	23	31
	9	91	94	94	3	6	29
	10	26	29	35	16	0	39
H.P.E.	8	87	87	48	52	39	78
	9	82	79	45	68	47	87
	10	59	59	30	41	30	76
Social Studies	8	67	71	71	21	38	63
	9	58	53	32	26	71	76
	10	44	41	18	21	33	67

Explanatory note:
The grey zone indicates that the corresponding disaster is in the textbook of the corresponding subject and grade.
H.P.E. refers to the subject "Health, Population, and Environment".

From the grey zone marked in Table 2, it is evident that the education in Nepal focuses on flood, landslide and environment. Earthquake, epidemic and windstorm are not focused upon to the same extent. It is hypothesized that this gap is caused primarily by the relative frequencies of occurrence of disasters in Nepal. Flood, landslide and environmental degradation are disasters which occur

often and which are closely related to livelihoods. Earthquake and windstorm are disasters whose cycle of occurrence is much longer than that of flood or landslide. The anomaly here is epidemic which has a high frequency of occurrence but a low frequency of being part of disaster study, possibly due to it being perceived to be more closely related to health and sanitation issues rather than disasters per se.

The questionnaire explored which components of disasters were focused upon by teachers in their disaster education (see Table 3). "Cause and nature of disasters" and "Effects of disasters" for flood and landslide are covered in all three subject groups but other elements of the disaster cycle were not covered fully. It can be argued that disaster education in Nepal functions primarily to teach the causes and effects of floods and landslides.

Table 3: Disaster Related Topics in Curriculum Education

Subject	Topics	Flood	Landslide	Earthquake	Epidemic	Wind Storm
Science	Cause and nature of disasters	92	92	87	11	13
	Effects of disasters	87	87	82	8	13
	Lessons from past disasters	29	26	45	3	8
	Disaster risk reduction/mitigation	68	71	61	11	8
	Preparedness	24	26	26	0	0
	Response-rescue and relief	11	11	8	0	0
	Reconstruction and Rehabilitation	3	3	3	0	0
	Role of community/institution	8	8	5	3	0
H.P.E	Cause and nature of disasters	79	77	33	49	21
	Effects of disasters	67	65	35	44	21
	Lessons from past disasters	35	30	28	21	12
	Disaster risk reduction/mitigation	51	49	23	37	16
	Preparedness	21	21	21	9	7
	Response-rescue and relief	19	21	19	14	12
	Reconstruction and Rehabilitation	7	14	9	7	7
	Role of community/institution	37	40	21	28	14
Social Studies	Cause and nature of disasters	73	73	48	23	55
	Effects of disasters	58	60	38	28	50
	Lessons from past disasters	45	35	40	18	38
	Disaster risk reduction/mitigation	45	50	33	23	33
	Preparedness	25	23	18	13	23
	Response-rescue and relief	38	40	28	18	23
	Reconstruction and Rehabilitation	28	28	28	13	18
	Role of community/institution	53	48	40	25	33

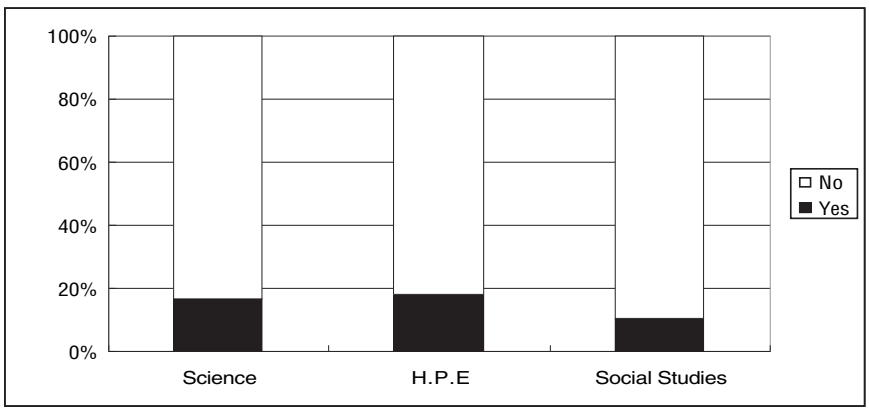
Explanatory note:
The grey zone indicates that the corresponding disaster is in the textbook of the corresponding subject and grade.
H.P.E. refers to the subject "Health, Population, and Environment".

Overall, topics covered in the textbooks are taught by more teachers than those without textbook support. However, clearly, some teachers do teach disaster education without the use of textbooks.

In Table 3, disaster reduction for flood, landslide and earthquake are mentioned in textbooks. When they are compared with causes and effects of the above mentioned disasters, the percentage of teachers is not high. In addition, reconstruction and rehabilitation for many disasters are not covered by textbooks. When these topics are compared to other non-covered topics such as response, rescue, and relief, fewer teachers teach them as a part of disaster education.

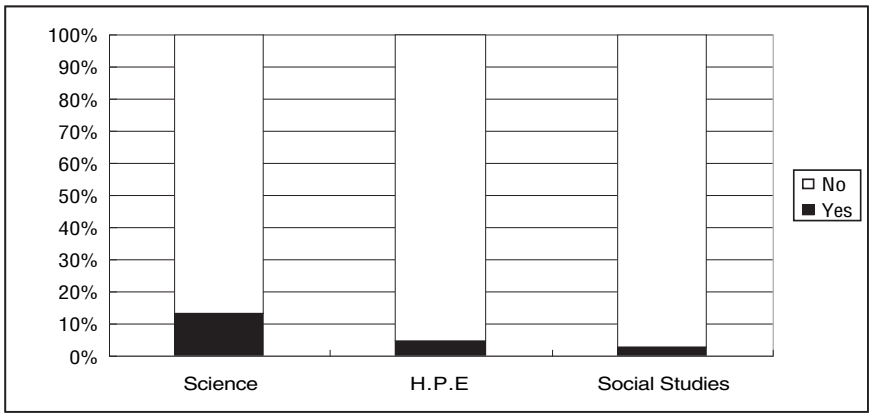
In the survey, teachers were asked about their level of satisfaction with disaster education. Figure 4 shows responses to a question asking whether the disaster related topics of Table 3 are systematically covered in disaster education; the data reveal a high degree of dissatisfaction.

Figure 4: Satisfaction of Teachers with Degree of Systematic Delivery of Disaster Related Topics. (Teachers were asked if the disaster related topics of Table 3 are systematically covered in disaster education).



Explanatory note:
H.P.E. refers to the subject “Health, Population, and Environment”.

Figure 5: Satisfaction of Teachers About the Current Formal Education System for Disasters.



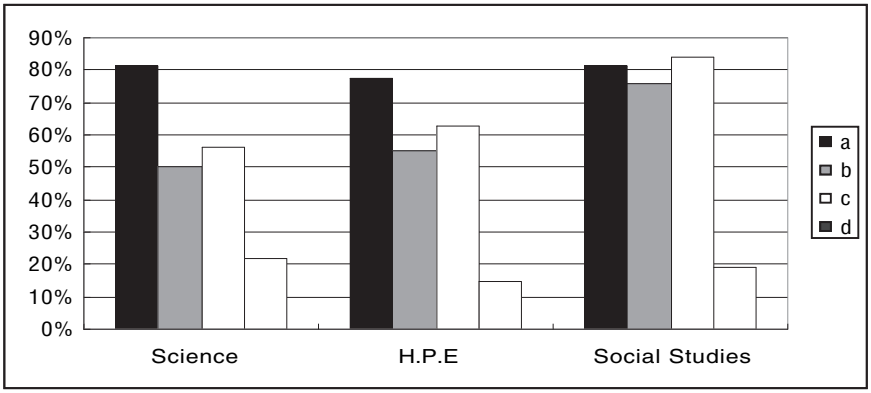
Explanatory note:
H.P.E. refers to the subject "Health, Population, and Environment".

Figure 5 shows teachers' satisfaction with the current formal education system for disaster education generally. Science teachers reported slightly higher levels of satisfaction (at just over 10%) than other subject teachers but there are very low levels of satisfaction reported by teachers of all types.

Figure 6 shows the needs expressed by teachers in order for them to better promote disaster education in schools. Teachers were given several options and chose multiple options. Around 80% of teachers highlighted the need for curriculum development. The majority of social studies teachers, more than in the other study areas, report a need for teacher training.

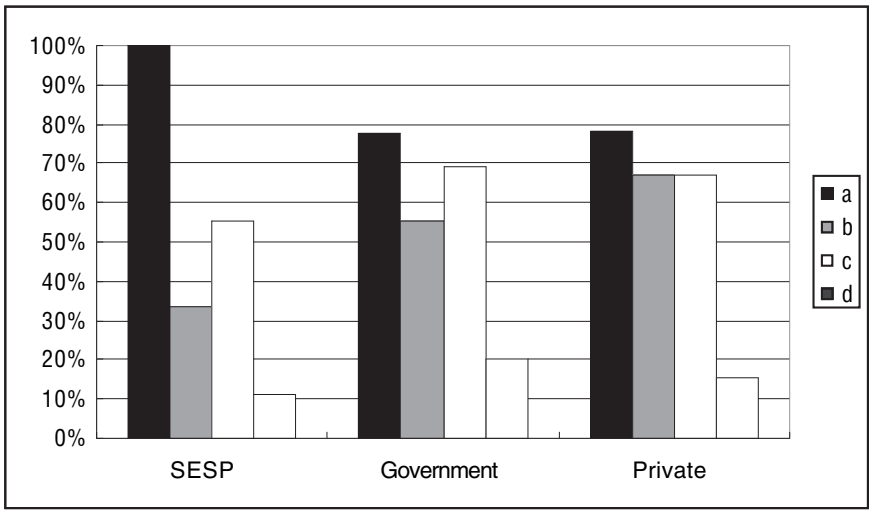
The majority of teachers in all types of school think the current curriculum is not sufficient for adequate disaster education. To promote disaster education in school, teachers particularly reported the need for curriculum development and teacher training. In SESP schools the request rate for teacher training is lower than in other schools, which is perhaps indicative of the greater level of training they received. However, the responses for SESP schools do highlight a greater need for curriculum development (see Figure 7).

Figure 6: Needs of Teachers to Promote Disaster Education



Explanatory note:
a: Curriculum development; b: Teaching materials; c: Teacher training; and d: Other (including field/exposure visits, and seminar/workshops).
H.P.E. refers to the subject "Health, Population, and Environment".

Figure 7: Needs of Teachers to Promote Disaster Education in Each School Type.



Explanatory note:
a: Curriculum development; b: Teaching materials; c: Teacher training; and d: Other (including field/exposure visits, and seminar/workshops).
H.P.E. refers to the subject "Health, Population, and Environment".

Conclusion

This small survey points to several issues concerning the current position of disaster education in Nepal.

- While some form of disaster education is quite widespread, more teachers teach those disasters mentioned in textbooks and this suggests a need to generate more textbook or other support materials to enable more of them to engage with disaster education in its widest sense.
- For topics such as reconstruction and risk reduction, fewer teachers teach them as disaster education even though some of them are mentioned in the textbooks.

Possible reasons for these findings include: a lack of information or teacher knowledge and therefore a lack of teacher confidence in delivering disaster related material; that disasters and disaster related topics are not covered systematically in either the curriculum or textbooks; and that it is sometimes difficult for teachers to understand the links between some of the topics and disasters.

Teachers are clearly dissatisfied with the current curriculum for delivering disaster education (Figure 4 and 5). Action is called for across all subjects (Figure 5) but two key needs have been identified by teachers: curriculum development and teacher training (Figures 6 and 7).

Wisner (2006) also identified these two factors as concrete examples of what nations can do to increase school safety. However, while a standardized curriculum for disaster education may be effective for giving uniform and basic disaster knowledge, it must be adapted to the specific conditions of each local area. This paper concludes that teacher training is the most important factor for promoting disaster education in schools even if curriculum development (in Nepal, curriculum development is equivalent to prescribing the text books for specific grades in the schools) is the first need identified by teachers themselves because the survey showed some disaster topics are not covered even if textbooks are available. To promote disaster education, teacher training can be conducted by either or both the NGO sector and the education ministry.

SESP provides training to teachers for school safety. All teachers in SESP schools are giving disaster education and this suggests SESP is

particularly effective in motivating teachers' awareness for promoting disaster education. In the training program of SESP, NSET-Nepal focuses on school safety which means that the main objective of the training is to save students' and teachers' lives. While teachers can understand the risks, relevant mitigation measures or preparedness through the training, teachers do not make the link with livelihoods and this suggests more training needs to be focused here.

A related questionnaire survey was conducted in Japan in 2003 (Shiwaku et al. 2004) which targeted high school students in Japan to identify the effective factors for promoting students' action for disaster reduction. Disaster education in many schools in Japan is focused on evacuation or rescue, clearly a part of school safety, but in some schools they also teach the importance of mitigation or preparedness. Maiko High School in Kobe (in one of the most affected areas of the Kobe Earthquake of 1995) is one school with a special course on disaster management. Maiko makes a major focus on the relationship between disaster and the natural and human environment through experiences of the Kobe Earthquake of 1995 (Shiwaku et al. 2004) and while students in schools across Japan understand the importance of mitigation or preparedness, students at Maiko more often take action for disaster reduction. Making connections and taking action are key to disaster risk reduction (Koshimura et al 2006) and these must be transferred to disaster education more widely. To better promote disaster education in schools, NSET-Nepal should develop a program to help teachers understand the links between disaster, the natural and the human/social environments.

Disaster education is relevant to many parts of the school curriculum and disaster related topics can be identified within any subject (Suwa 2006). An argument can be advanced that to fully benefit risk reduction and to capitalize on the links between usually discrete educational sectors, disaster education should be mainstreamed throughout general subjects and not isolated and covered in special classes. However, we do not have hard evidence for this conclusion.

Without understanding and knowledge, disaster education cannot be communicated adequately in a classroom. Schools play an important role in transferring knowledge of tradition and culture in communities (Kenneth, 2000) and teachers can play a role in

developing a culture of risk reduction through disaster education. To this end, this paper has identified teacher training as the most important area for any future focus.

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BOOK REVIEW

Displacement Risks in Africa: Refugees, Resettlers and their Host Population. Ohta, I. and Gebre, Y.S. (eds.). 2005. Kyoto: Kyoto University Press and Trans Pacific Press. 394 pp. ISBN: 1-92090-108-6 Hardback. 1-92090-109-4 Paperback.

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Displacement Risks in Africa is a useful compendium of displacement issues and a significant contribution to the resource base of a fairly well established academic fraternity engaging with Africa oriented refugee studies. As suggested in the title, displacement in this text is primarily concerned with refugees or displaced populations who physically relocate, rather than non-relocation displacement. A focus on the overall nature of the refugee and displacement predicament in Africa in terms of reintegration and resettlement is addressed as Part One. Jeff Crisp provides a comprehensive review of the nature of protracted refugee situations. The message is that there is no reason to believe there will be an end to it, but that vital lessons are waiting to be learnt in dealing with the inevitability of long-term refugeedom. Furthermore, building risk into displacement analyses highlights how prevention of displacement impacts could avoid grappling with often-ineffective cures. The editors point out that 'discourse and instruments focus on the treatment of effects rather than causes of human uprooting' (p.6), a sentiment that is supported by several of the contributions

that follow. It is also made clear from the opening introduction that institutional refugee rights and conventions abound. The problem is the failure to uphold them.

The heterogeneous and complex nature of refugee resettlement is apparent throughout most of the contributions. Effective solutions in addressing refugees' needs are dependent on understanding particular circumstances of externally induced relocation or self-settlement. This varies for urban, rural and camp environments; during conflict, development or otherwise; and for different parts of society. Refugee groups are generally made up of social networks, key to survival during displacement, in particular when no formalized emergency relief if provided. The importance of social capital and how it varies pre- and post-displacement is addressed by Roos Willems (Chapter 2) for the case of refugees to urban contexts in Tanzania. However, it is not indicated here that what complicates matters is the nature of replacement of pre-existing civil society with alternatives during and after displacement (which is sometimes an extreme change). The survival networks of conflict replace any more obvious social capital restoration opening up the possibilities of a complex of less desirable coerced networks influenced by fear. This is exemplified by the example provided by Art Hanson in the following chapter (Chapter 3), which focuses on child soldiers. This case raises questions about the need for specialist policies for reintegration of ex-fighters. Hanson provides a unique attempt at identifying more precisely what might be needed, not least community education and a community development component. Although very useful advice is provided, it is also one of the most honest of the contributions in acknowledging that more questions may be raised than can be answered in dealing with social learning with this type of displacement.

Gaim Kibreab provides a fascinating contribution (Chapter 4) addressing a core theme of belonging and displacement. Although based on his observations of the particular experiences of Eritrean returnees, this chapter has much wider application in terms of how we might better assess displacement. Nationalism, territorial belonging, together with the debate on the relationship between people, places and identity lie behind understanding relative risks and outcomes. Based on the Eritrean case, Kibreab leaves the reader

with a closer understanding of just what it is that policy makers may fall short of understanding about displacement identity. By way of contrast but equally convincing is the following chapter by Takeuchi and Marara (Chapter 5) who demonstrate the Rwanda displacement crisis to be largely a function of people's tie to specific areas of land. Rapid shifts in population density, due to return migrations were part of a long history of ethnic tension exacerbated by colonialism. Here we see that failure to recognize the cause of tension, leading to conflict, and then displacement, means that the resettlement process provoked yet further tension, fear and mistrust. The issue of reconciliation in terms of land is alarmingly complex to address and an issue ongoing in Rwanda to date. I found the argument for the case of land and Rwanda convincing in being the opposite outcome to that of Mozambique where I have considered this previously. Land availability for returnees post conflict was generally plentiful there and a remarkably sound peace has remained intact since the first half of the 1990s. Arguably, the complexity of ethnicity, kinship and state imposed identity existed in that case too, but land availability has prevented any more elevated an issue that might lead to community hostilities such as still ongoing in Rwanda.

Part Two opens with an analysis of the process of impoverishment, revealingly combined with a chapter on displacement through dam developments, and another on conservation projects. First we are presented with the Impoverishment, Risks and Reconstruction (IRR) model (Chapter 6) attributed to the author of this contribution, Michael Cernea. The model is well acknowledged by scholars several of whom refer to it systematically in their contributions to this book. It is however important to note here that the items that make up the IRR model were by no means new even at the time this framework was first released. It is perhaps a list of what the lay reader or practitioner of development or relief work would expect to see, a basic criteria list of well-known displacement impacts. This perhaps explains its applied value. There are parallels in this approach with well established basic and extended needs analysis and with notions of primary subsistence and the poverty frameworks. The chapter is the longest of the book, seeking to document where the model has been used in scholarly work since its publication.

It is here that, in a research sense the model may be of additional use, to show how basic indicators show up in the varying contexts in which other authors have applied it. A more critical view of this contribution however, might be that it tends towards somewhat extensive promotion of 'the author's model' in terms of adoption by the scholarly process rather than impact on refugee policy. Arguably, what is needed in this field is less of a prescribed model checklist, and more the skill of listening, empathizing and recording refugee and displaced people's issues inductively. The contributors to this book have in most instances demonstrated that as possible. However, to its credit there is acknowledgment of the need for flexibility in the model and acceptance of the possibility of other ingredients. Two of these, less apparent in the original list, politics and education, are acknowledged during the course of this book.

The case of dam-induced resettlement is outlined by Chris to Wet (Chapter 7). Whilst the overall figures of people displaced by dams in Africa is actually not high in comparison to other forms of displacement (less than 0.5 million), it has devastated a good number of communities. It exemplifies a failing of development in that in no instance of this type of development have all stakeholders been satisfied with the outcome. It is also clear that many more than those immediately resettled have been affected. The story of dam developments is one of a lack of consultation and participation, which is the precursor to impoverishment. The case of conservation-induced displacement by Kai Schmidt-Soltau (Chapter 8) is interesting in that only 54,000 people are in this instance indicated as having actually been relocated for the whole of Central Africa. If hosting area population impacts are taking into account figures are significantly higher, but this still clearly contrasts significantly with the magnitude of conflict related displacements dealt with elsewhere in the book. Sometimes more than half a population of a country is displaced. For example, if a fuller list of categories of internally displaced people is taken into account, as well as refugees who crossed international borders, it is estimated that over half of Mozambique's 14 million population were displaced during the war there (Green 1992). Similar magnitudes apply to Angola and other African nations, not directly dealt with by this book. Nonetheless,

displacement through conservation programs is clearly critical for this very much smaller group. Also, the point that conservation is for global gain, but at local cost, is a poignant and fair one highlighted in this chapter, and one that demands a rethink in terms of wider resonance beyond conservation areas. For example, further contributions with this logic would need to extend the argument to the potential impacts on African displacements of climate change should this be increased further by combinations of industrialized nations' pollutants and loss of vegetation. This middle section of the book is useful in that it alerts us that displacement risks are also through economic and nationalistic development, and through conservation in the name of nature. Also, some dam and conservation projects have included a measure of participation and some benefits, which is rarely the case for other forms of displacement.

Part Three addresses the implications of displacement induced inwards migration for host populations based on a case study from northern Kenya and two from Ethiopia. Whilst much of the book has understandably focused on vulnerability and negative displacement impacts we start to get a better glimpse here of refugee and host community adaptation and resilience. Itaru Ohta's case study of the Turkana and Sudanese refugees in northern Kenya is the clearest example (Chapter 9). The explanation of there being a relatively successful relationship between refugee and host, despite some notable impacts and incidents, is convincingly explained in term of the self-assuredness of the Turkana. Individual characteristics of hosting groups are therefore seen as one of the keys to possible reduced problems with hosting communities. A further example would be the case of rural displaced populations in areas of Mozambique's cities in the 1990s (Collins 1998). Little conflict between the displaced and hosting group and little difference in vulnerability could be explained in terms of both communities subsisting at a common level below that of absolute poverty. Each community experienced common risks to health and wellbeing largely determined by their immediate environmental and economic context. But, these examples contrast dramatically with the very different situation described by Eisei Kurimoto (Chapter 10). Here a story of uneven opportunity and imposed resettlement categories lies behind a detailed account

of the complex emergency of Gambela, Ethiopia. This demonstrates how human adaptability and tolerances can break down with tragic consequences when overridden by overpowering structural or political forces, including in the management of humanitarian aid. At this point the role of the international 'contribution' is also brought under the spotlight. Yntiso Gebre's recounting the suffering caused by imposed settlement in Ethiopia provides a further example of how politics and aid can be destructive of human coping in adversity (Chapter 11).

Surprisingly, there is no concluding chapter, although some of the summing up is provided in the introduction. In my view it would have been possible to summarize further some of what is presented here in terms of the key displacement risks across this work. The opportunity is modestly seized upon here, and is certainly in one way or the other indicated within the various contributions. In my view the message is that displacement risks in Africa are about a lack of security, reconciliation of conflicting groups, accountability of governments and humanitarian assistance, and of a sense of justice more widely. Where issues are continuously left unresolved it leads to further perpetuation of displacement risks and outcomes. To some extent the continent is facing the scenario of ongoing inter-ethnic alliances and feuds in a context of changing local and regional structures and political economies, including that presented by aid. This is in part the scenario referred to in this book by Gebre as 'resettlement-induced deterioration of livelihood' (p.375). However, refugee situations are highly diverse, such that homogenizations of displacement conditions or the refugee process of survival might not be helpful, although refugeedom tends to cause that. Furthermore, refugees aspire to much more than just survival and coping.

For such an extensive book, it is perhaps unfair to flag what might be missing here. However, by way of constructive comment I would point out that it is generally short in examining displacement also as a state of underlying development trends. The book concentrated on the more quantifiable physical examples missing the opportunity to comment on underlying creeping displacements of development of underdevelopment and contemporary globalization processes (of economies and cultures) that impact on the continent. It seems incomplete not to include analysis of displacement of life and

livelihood through for example free trade and structural adjustment programs. Whilst the book does mildly imply that displacement occurs *in situ* and through misguided development action, it neither ventures far into the issue of displacement as cultural rape. The full meaning of location and ancestry, of nature, culture and spirit in relation to land, kin and origin, would perhaps be beyond the scope of this text. However, there is some hint in this direction in the work of Kibreab. To assess meaning in people's sense of belonging and security, and the impact and recovery from displacement, we would probably need to enter beyond the domains of exogenous written word. Furthermore it could be argued that to capture the essence of displacement more thoroughly it would require contributions from a wider group of African scholars and non-formalized thinkers from communities experiencing displacement. The contributors are most likely sensitized to the participant voice in their various fields of expertise, but the written contributions often lack evidence of this in constructing this book. There is also surprisingly little on health despite the fact that HIV/AIDS as with other previous diseases is displacing and impoverishing on a far greater scale than most of the other displacement examples used in this text. A more gendered view of displacement is also conspicuously absent although some contributors provide brief comment. It is perhaps also fair to point out that 11 of the 12 contributors are male. Beyond these observations as part of my critique, I found the book on the whole highly engaging and informative. Perhaps it is best classified as a contribution to a subject area for which there is clearly plenty of room for further exploration, understanding, and influencing of change.

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Expanding the Horizons of Disaster Research

an invited comment

How we define the world defines us. Definitions affect what we see, what we look at, what we are concerned about, what we study, and how we make policy. Disaster is one of those definitions—those images—that both informs and distorts. Ever since Noah (or perhaps Gilbert White), humankind has experienced disasters associated with floods and other natural hazards. More recently, we have associated disaster with dangerous technologies that create risk in societies. And even more recently we have discovered new disasters, such as terrorism, that have multiple agents and impact areas that cannot be identified before the event.

In light of current concerns regarding technology and terrorism, it is useful to recall the post-World War II emphasis on the importance of disaster for economic development. For example, Fred Cuny talked about how disaster assistance could be used as an investment in the development process. This appealing idea provided a rationale for donor governments policy during much of the last half of the 20th century.

But that is the past. The peak year for development funding among all donor countries was 1992, and the subsequent decline has been due no doubt about the effectiveness of aid as well as changes in political and economic ideology. The social and economic criteria used to measure development have now been replaced by an assessment of a developing country's threat to peace and security.

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