

Finding Community Through Information and Communication Technology During Disaster Events

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ABSTRACT

Disasters affect not only the welfare of individuals and family groups, but also the well-being of communities, and can serve as a catalyst for innovative uses of information and communication technology (ICT). In this paper, we present evidence of ICT use for re-orientation toward the community and for the production of public goods in the form of information dissemination during disasters. Results from this study of information seeking practices by members of the public during the October 2007 Southern California wildfires suggest that ICT use provides a means for communicating community-relevant information especially when members become geographically dispersed, leveraging and even building community resources in the process. In the presence of pervasive ICT, people are developing new practices for emergency response by using ICT to address problems that arise from information dearth and geographical dispersion. In doing so, they find community by reconnecting with others who share their concern for the locale threatened by the hazard.

Author Keywords

Community, innovation, crisis informatics, disaster, wildfire, emergency, computer-mediated communication.

ACM Classification Keywords

H.5.3 Groups & Organization Interfaces—collaborative computing, computer-supported cooperative work, organizational design, K.4.1 Public Policy Issues, K.4.2 Social Issues, K.4.3 Organizational Impacts—computer-supported collaborative work

INTRODUCTION

Disasters and crises are uncertain and highly mutable situations often marked by a combination of both information overload and information dearth, depending on

one's relationship to these events. Whereas emergency management personnel are concerned with managing massive amounts of incoming information, affected members of the public often experience a severe absence of timely information needed for personal decision-making and peace of mind. Even when warning and risk information is disseminated through traditional mass media and official sources, members of the public take initiative to verify it and seek further detail, using social connections and resources at hand, often turning to their communities for support [8,10,17,29].

Researchers in human computer interaction (HCI) and computer-supported cooperative work (CSCW) have long been interested in the nature of situated information seeking, and its facilitation by and implications for information and communication technology (ICT)¹. Research on information management in emergency and safety-critical contexts has centered on the activities of professionals, including emergency call center operators [20], medical personnel [22], firefighters [14] and military personnel [26]. Recently, attention has turned to the ad hoc ICT-facilitated activities of members of the public who are directly and indirectly affected by crises [18,19,24,25]. This research extends that work to describe how features of information seeking link to matters of place and community in emergent public-side emergency response practices.

Disasters affect not only the welfare of individuals and family groups, but also the well-being of communities. Research that addresses the role of ICT use in community processes in times of crisis is nascent [10,21]. Here, we consider how community members use ICT for organizing in crisis situations. The ICT-based peer-to-peer information seeking behaviors we observed during the October 2007

¹We define Information and Communications Technology (ICT) to include all digital/computational forms of technology—hardware and software. In that, ICT as a term can refer to overlapping and interrelated technology, including, for example, both mobile phone hardware devices *and* SMS texting; Web-based social networking sites *and* the Internet itself. The “C” updates the previously standard “IT” to account for the growing reach beyond the commercial sector, machine rooms, and desktops; and refers to the communicative abilities and ease of information exchange that this growing class of technology supports.

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Southern California wildfires suggest an emergent practice in public-side emergency response that re-orient concern toward geographical communities. In the face of the persistent problems of information dearth, affected residents used ICT to leverage local knowledge, to arrange themselves around local concerns, and, in so doing, to find community.

Using ICT for Information Seeking in Crisis Events

Crisis situations create extraordinary information needs where people use whatever means available to find information under rapidly changing conditions [17]. In recent disasters and other emergency events, the response to information dearth has been increasingly realized through innovative use of familiar ICT as well as rapid adoption of new ICT [3,24,29]. The attacks in Washington DC and New York City on September 11, 2001 drew the attention of many scholars to the study of ICT use in mass emergencies. After the attacks, the Internet played a notable role in information seeking activities [3], facilitated public action and served as a source of functional and emotional support [24]. In the aftermath of the August/September 2005 Katrina and Rita hurricanes, strangers from across the country worked to unite separated families [23], and used blogs and forums to organize provision of relief [16]. Studies of survivors after Hurricane Katrina showed that text messaging on mobile phones and post-evacuation Internet access were crucial sources of information [21,25]. Moreover, evacuees reconnected with their communities through online neighborhood-based forums that were developed and maintained by the local New Orleans newspaper [21,25]. In the April 16, 2007 Virginia Tech shooting, students who were told to stay inside for much of the day relied on co-presence awareness features in instant messaging and social networking sites to determine the welfare of those they knew, eventually moving to engage in highly distributed and, in some cases, world-wide problem-solving to determine who had been hurt or killed [18].

Instances of community based ICT use have been reported in political and health crises as well. In a Toronto suburb, residents banded together through the use of an email distribution list to combat unfair practices of a housing developer [11]. During the 2001 UK foot-and-mouth farming crisis, those in quarantined farms connected with their local communities through email and websites developed in response, often using this technology for the first time [10].

Communities in Crisis Events

Dislocations, long-term relocations, property damage and other destruction caused by a disaster event can harm or even destroy geographical communities [7]. In response to disasters, people organize themselves to conduct search and rescue, administer first aid, provide shelter and other necessities and orient toward long-term recovery [30]. Disaster sociologists consider disaster to be a unifying force that creates emotional solidarity and mutual helpfulness

among those affected by it. Researchers describe the emergence of “altruistic communities” in response to disruptions as common, where people routinely assist fellow community members, often going to great lengths to organize and provide help [1,13]. This individual expression of mutual caring and aid to those in need represents an outward expression of community concern. This is captured by Dynes [6], who describes eight socio-temporal stages of disaster showing the shift from an individual’s self-assessment to a concern about the broader impact of the event and its effects on the community (see Figure 1). Once the impact stage of a disaster event has passed, people take stock of the personal effects and then quickly move into an increasingly broadening orientation toward community that can extend through a period of long-term recovery. The “altruistic community,” then, develops soon after the impact of disaster when the extent of damage is uncertain and information is scarce [1,13].

Figure 1. Eight Socio-Temporal Stages of Disaster [6]

Stage 0: PRE-DISASTER State of social system preceding point of impact
Stage 1: WARNING Precautionary activity includes consultation with members of own social network
Stage 2: THREAT Perception of change of conditions that prompts survival action
Stage 3: IMPACT Stage of “holding on” where recognition shifts from individual to community affect and involvement
Stage 4: INVENTORY Individual takes stock, and begins to move into a collective inventory of what happened
Stage 5: RESCUE Spontaneous, local, unorganized extrication and first aid; some preventive measures
Stage 6: REMEDY Organized and professional relief arrive; medical care, preventive and security measures present
Stage 7: RECOVERY Individual rehabilitation and readjustment; community restoration of property; organizational preventive measures against recurrence; community evaluation

Evacuations caused by disaster events can result in geographic dispersal of community members, creating uncertainty about both the fate of the physical location and the well-being of those who lived there. Many argue that in this electronic age, communities are increasingly being defined socially rather than physically [31], but when threatened with destruction or change, the physical place grows in importance [10]. ICT has been used to enable affected residents to find each other in evacuation [23] and to locate information about the fate of the physical place through adoption of new community-oriented ICT, but with varying success [11,21].

In this paper, we discuss ICT use and community response to crisis in two ways: first, we show how computer-mediated communication becomes a means both for disseminating information and for connecting with other local people during times of crisis. Second, we examine two

community-based online environments, one that was developed in response to the October 2007 wildfires and another that has established itself over time in an area repeatedly affected by seasonal wildfires. Together, we examine individual needs and orientation to collective interests and capabilities. We consider that though ICT can facilitate obtaining information during disaster events, it can also serve as a means for helping to reconstitute communities during subsequent recovery, and facilitate future disaster preparedness.

THE STUDY

The October 2007 Southern California wildfires began in Malibu, CA on October 20, 2007. Over the next 19 days, more than 20 blazes ignited from a variety of causes in the region from Santa Barbara County to San Diego County's border with Mexico. Cumulatively, the wildfires destroyed nearly 1500 homes, burned over 500,000 acres of land and caused massive evacuations.

Method

Within days of the start of the fires, we developed a strategy to collect empirical data using qualitative methods of observation, interview, and collection of online texts as a form of "quick response research" to capture perishable data about features of social phenomena that arise in non-routine situations [28]. A standing human subject research approval modified for this event expedited logistics.

In the days following the start of the fires, one researcher mobilized from her home base in Southern California to conduct observations and semi-structured interviews with people affected by the wildfires at sites of "social convergence" such as disaster shelters and family service centers in three Southern California counties. These sites, run by the American Red Cross and the Federal Emergency Management Agency (FEMA), served as locations for collecting, coordinating, and disseminating resources to evacuees as well as providing fire status and recovery information. We visited one large Red Cross disaster shelter and two family service centers in San Diego County, one Red Cross shelter and one family service center in San Bernardino County, and one family service center in Orange County during the first 10 days of the fires. During the visits, we conducted 28 face-to-face, semi-structured interviews, half of which were audio-recorded with participant permission.

As evacuation orders were lifted by day 10, we developed an online questionnaire about ICT use and information gathering and sharing activities to capture a broad base of experiences of those affected by the wildfires. The questions were informed by initial findings from face-to-face interviews as well as earlier research. The questionnaire included both multiple choice questions and free response text fields. We inquired about ICT use for keeping in touch with others during the wildfires;

evacuation experiences; information seeking for fire-related issues; and volunteering of time, goods or services, including online information dissemination activities.

We disseminated the questionnaire to people in our personal and professional networks and posted solicitations on local forums and online newspapers in the affected communities as well as the appropriate discussion groups on Craigslist, Facebook and Flickr. We asked respondents to forward invitations to their contacts. An online deployment of the questionnaire means that our data tell us exclusively about the experiences of people who are already ICT users. Thus we treat the questionnaire as a qualitative means for engaging a greater number of participants than was possible by traditional field-based means, and not one that is a representative sample of the affected population.

From the interviews and questionnaire reports, we learned of two different community websites, one in use by San Bernardino County residents, and another by a community in northern San Diego County. As a result, we contacted and conducted email interviews with the operators of the sites, and observed activity on the site's discussion threads during and after the wildfires.

The themes represented in this paper are based on data analyzed from transcriptions of audio-recorded face-to-face interviews, hand-written field-notes and responses to the online questionnaire. We report here on the major themes using data excerpts to illustrate points, which are reproduced exactly as written or spoken by respondents. Data are denoted by [Q] or [I] for questionnaire and interview sources, respectively.

Respondent Overview

Interviews. During the wildfires, 36 respondents agreed to grant short in-person interviews. Eight interviews were conducted with couples and the rest with single individuals resulting in 28 interviews. All but one of the interviewees had evacuated for an average of 4-5 days. Three of the interviewees reported major damage due to the fire, and an additional three reported minor damage. Seven interviewees did not know the extent of damage to their properties at the time of interview. Five interviewees did not own mobile phones and three did not use computers or the Internet.

Questionnaire. At the time of analysis, 307 respondents had accessed the questionnaire with 279 completing it. Approximately 44% or 122 respondents resided in voluntary or mandatory evacuation areas during the wildfires. More than a third of our respondents (N=93) reported evacuating for an average of 4-5 days. Eleven of our respondents reported major damage due to the fire and an additional eight lost their homes. In total, the fires directly affected 126 respondents (46%). These were people who were forced to evacuate or resided in areas with voluntary or mandatory evacuation orders but did not evacuate. Those who were directly affected by the wildfires

tended to be older, less likely to be students, and more likely to be retired. Overall, 92% of respondents owned mobile phones and 70% owned laptop computers with wireless access, suggesting that this population had access to portable ICT despite potential relocations. Though the evacuee population was somewhat less likely to own mobile technology such as mobile phones or laptops with wireless access, they were, nevertheless, more likely to report sharing information via ICT during the wildfires.

RESULTS

Though disasters are often of broad, newsworthy and historical concern, they are nevertheless profoundly local in terms of impact, need, and consequences. We saw the consequences of the contrast between a broad media focus on the disaster and its very localized impact, when in spite of around-the-clock news coverage, research participants repeatedly told us about problems of information dearth. In response, information seeking activity became a local pursuit, where participants used ICT to locate and leverage the collective knowledge of their local communities.

Getting Locally Relevant Information

In times of disaster, emergency management personnel and local governments rely almost exclusively on mass media to communicate warning, hazard and evacuation information to the public [27]. While official messages are regularly disseminated via private media channels, broadcasters and on-air journalists provide coverage that tends toward human interest and other headline-grabbing stories. Our respondents reported that the 24-hour news coverage of the fires tended toward sensationalism and failed to provide the information they sought:

what you're really trying to listen intently for is what you're concerned about. Is the fire going close to even myself, my neighbors or my friends. You don't care about seeing the same house burning over and over again. [Q]

Participants explained that a central problem in this disaster was the failure to obtain local information from traditional broadcast sources.

Most of the news media ... are utterly clueless about anything in rural areas. They constantly gave out bogus information, like locations and directions that made no sense at all. [Q]

National media outlets gradually lost credibility with local residents because of the apparent lack of familiarity with the areas on which they were reporting:

at first we watched the various news channels. They would report on the fire, but it was obvious they were unfamiliar with the area, because they would report they were standing in one place, and to us who have lived in the area, knew they were standing somewhere else. [Q]

People reported turning to local news outlets as a way to get reliable information, with different degrees of success:

On the most frightening night I depended on the [small local paper]; a ... reporter was on line all night, getting answers to specific questions and posting them on line. [Q]

East County ... had no newspaper to provide what *should* have been made available via traditional media [Q]

In the face of such information dearth, many of our respondents relied on local contacts for information. Often those who resided in areas frequently under threat of fire had personal contacts within the firefighter and emergency response communities and neighbors who “sheltered in place” despite evacuation orders. Most interviewees used mobile phones as a means of contact despite displacement:

My neighbor next door, her son-in-law is part of the [local] Fire Department, so he was calling his wife and his wife was calling his mother-in-law and I was calling his mother-in-law. [I]

we have neighbors who won't leave even if there's fire burning in their—you know—bathroom, so I could call them and fortunately they were always able to keep me updated on how that neighborhood was [I]

Whereas previously fire-tested veteran residents expressed that they were able to function well under the stress of the wildfires, newer mountain community residents who were discovering what it means to live in a fire-prone area reported tremendous confusion and lack of information.

One of our most central concerns was that we did not know how to get the information that we imagined was relevant for us. For example, we were not sure that we would KNOW if we were required to evacuate. [Q]

About a third (8) of our interviewees gave harrowing accounts of having little or no time to pack belongings; of receiving wrong directions from law enforcement and driving towards the fire rather than away from it; of having to find an evacuation location where they could house themselves and their livestock through trial and error; or of being told to evacuate when there was no threat to the area.

Response to Need for Information Help

When mass media and local news outlets failed to provide timely information, some residents took matters into their own hands. Several participants expressed a collective orientation to information dissemination and correction at the local level:

the only way we all have to get good information here is for those who have it to share it. We relied on others to give us updates when they had info, and we do the same for others. [Q]

Requests for information and helpful responses seemed to cascade into more expanded forms of assistance that inspired yet more contributions, as one active participant in a community-oriented bulletin board explained:

There was a general outpouring of news and timely information that I joined in with. [Q]

In some cases, community members had a history of using community ICT solutions, and employed them in this event to connect with fellow residents when local officials and local news failed to provide needed evacuation information. One person explained that:

we have a community based email service run by volunteers. Traditional evacuation notices do not account for the transport of large animals like our horses to a new location. Without this email service we would not be safely evacuated [Q]

Three respondents reported using their professional credentials as a means to gain access to the evacuated areas, later distributing information.

I used my press pass to go into fire areas, then blog and send emails to residents. [Q]

When official announcements of fire location and direction of movement were too slow to be useful, people relied on each other to find out any information about the fire. One area resident explained that:

during the initial outbreak, there was almost no mainstream media coverage. We had to rely on word-of-mouth and citizen journalism to figure out where the fire was. [Q]

Once information was known, more technologically savvy residents of this area used a range of social media to redistribute information to community members who might not have had the same access. One resident who was more active on the information dissemination side noted:

I set up a blog to keep others updated when I received information from others; whether that was via text message, cell phone, or instant message. [Q]

These activities are based in a collective concern and orientation to the common good, and are features of a modern-day version of Barton's altruistic community [1]. These community mechanisms, information hubs and repositories of local information were possible through the common concern and joint action of local area residents. Whether residents had enough previous markers of "community" of the sort that scholars have long debated would hardly seem to matter [2,11,31]. In this situation at least, we might say that people "found community" by using ICT to actively seek others with similar needs and concerns about their geographical communities.

Connection to Distributed Others

In instances of large disaster events, evacuations are often required to protect vulnerable members of the public. Affected populations may choose to relocate to temporary shelters, rely on friends and family for short-term accommodations [15], or stay at home by sheltering in place. Those with the means might evacuate to hotels. In

wildfire, whole neighborhoods and communities can be dispersed across large geographical areas. ICT offers a means for those living under such circumstances to reconnect with other residents and solicit and aggregate information that affects them all:

The best, most accurate information that we received about the fires was from local residents who did not evacuate and helped their neighbors and community through the crisis by posting frequently updated information on the internet. [Q]

For some, information about the fires was obtained through a combination of old officially sanctioned stand-bys as well as newer digital technology. For example, one rural community in North County San Diego maintained a Community Emergency Response Team (CERT) for disaster events and integrated their information channels with local residents who were evacuated. One respondent explained how community leaders received information from CERT volunteers and then disseminated it to other community members via mobile phones:

CERT group was monitoring scanners for firefighting information and was a good source of what areas were being impacted [Q]

Community based groups, such as amateur radio operators and CERT regularly participate in disaster rescue and response activities. Though relatively inactive in non-disaster periods, in disaster these groups volunteer time and skills to relay information from firefighters and emergency responders to community leaders [9]. The activation of these volunteer networks not only brings resources to the affected community, but also serves as a basis for building what can be described as community resilience to future hazards [15].

Though most of our respondents used ICT already familiar to them such as mobile phones, email, blogs, bulletin boards or discussion spaces on major news websites, some adopted new ICT as part of their search. For example, nearly 10% of our respondents indicated that they had used Twitter² to obtain or exchange information. For the majority of Twitter users in our sample, their use during the wildfires event was their first experience with the technology. Two respondents who were experienced Twitter users came to fill the function of information clearinghouses. Both reported feeling compelled to collect and disseminate information as a way to alleviate the concerns of those around them:

[I] started twittering the fires a few minutes each hour, but people started contacting me directly to find out if I knew any info on their areas. I then started hearing from people outside our area,

² Twitter is a multiplatform microblogging service that allows users to broadcast text messages, up to 140 characters in length, to whomever is subscribed to their broadcasts.

wondering about their families. That compelled me to write once per minute for hours on end. [Q]

Overall, assistance with finding and providing information about the fire online helped generate a sense of connection with others evacuees. In some cases, the form of participation not only came in the way of information sharing, but also as social support. For example, a respondent explained that he participated in a community website and bulletin board because it provided

just a general sense of community. checking in with other people who were nervous. lightening the situation a bit by chatting about it. [Q]

Throughout this wildfire event, we saw many instances where “regular folks” creatively adapted existing and new ICT to band together in response to the wildfire and the information dearth that such situations cause. As events unfolded, residents of the affected areas experienced Dynes’ socio-temporal stages of disaster. Dynes’ contributions [6], as we discussed earlier, account for the move from individual search and sensemaking to increasingly expanded attention to collective matters at hand. However, Dynes theorized that people would “shift from individual to community affect and involvement,” although presumably only with those who were physically near-by.

Here, in an ICT-enabled world, we see historical patterns repeat anew, enabling information exchange, community concern and affective connections despite the physical distance between our respondents. In fact in areas that are frequently affected by seasonal wildfires, the experience of using ICT during one disaster can become a “lesson learned” in subsequent disaster experiences:

What we learned in [an earlier wildfire] is that there is no "they". "They" won't tell us if there is danger, "they" aren't coming to help, and "they" won't correct bad information. We (regular folks) have to do that amongst ourselves. [Q]

The above quote also demonstrates the expressed need to go local, that is, to seek out similarly affected others, express concern for the same locale, and find accurate information about immediate issues at hand. Thus going local in this urgent, necessary search is a mechanism for finding community. Affected residents regarded much of media activity as “outsiders looking in” as they, as one of our respondents aptly put: “got the subtleties of the area wrong.” In response, many concentrated their information search on personal contacts and specifically local sources.

In our investigation, we observed different geographical areas affected by the same disaster event. In the rural and mountain communities that are frequently subject to wildfire threat, we noted, as we discuss next, what appeared to be more sophisticated but different instances of community, web-based resources.

Community Computing

Though some communities in the affected multi-county region received substantial media coverage, others—and especially those that were more remote—received far less. It was from information provided by research participants residing in these remote areas that we see focused and sometimes socio-technically mature organization around community-based computing enterprises.

Emergent Community-Based Volunteer Site. “RuralSite” was created by a technology developer from a small rural community, who was unable to find relevant information about his area while evacuated during the 2007 wildfires. Through personal correspondence he wrote:

Our community is located 20 minutes from the nearest freeway which is why I feel the media was unable to cover our community sufficiently

Having the technical skill and means, he created a simple community discussion board just three days after the wildfires began and publicized it among his friends and neighbors. The explicit goal of RuralSite was to facilitate reconnection among community members, and to support exchange of information about situation status and humanitarian relief efforts in the area. The site quickly became known among other area evacuees, and within days grew to a size and level of participation well beyond its creator’s expectations. Community members used RuralSite to locate friends and acquaintances, seek information and receive assistance and emotional support from each other.

As the fires subsided, the site creator continued to operate RuralSite as active discussions turned from issues of disaster response to dealing with damage and recovery. The rate of participation declined substantially from its earlier levels at the height of the fire threat, but stabilized through the next month. Yet over the next three months, as community members turned their attention to recovery, participation on RuralSite declined. The site creator posted several messages to seek input from community members about whether to continue operation and received a tepid, uncertain response from users who seemed to have shifted their attentions elsewhere. Three months after the creation of the site, RuralSite was taken down.

Continuing Growth of a Mature Community Site. In a different part of the region, a pre-existing, mature community site was widely used for similar purposes. In interviews and questionnaire responses, residents of an affected mountain area referred to a community website, “MountainSite,” as a major source of information that arose out of the experience of earlier fires. Specifically, several respondents referred to the wildfires of 2003 as catalysts for adoption of ICT used in the October 2007 wildfires:

During the Old Fire we were panicked by network news and the news media in general. By listening to the scanner feeds and reading local news, we were able to regain some sanity. [Q]

MountainSite was originally created as a general information resource for the area in 2001, and gained popularity when area residents discovered it during the 2003 wildfires. For example:

I learned the value of our community's internet information source during the fires of 2003. That site ultimately evolved into the current [MountainSite]. [Q]

Others used it in times of non-disaster and then discovered its full range of services in the face of the hazard:

I first started going to that site to get the best info regarding snow/road conditions in my area for my daily commute. I soon learned that they were an invaluable source of local, accurate information for fires, mudslides, and extreme weather events [Q]

The content and participation on MountainSite is extensive, and now includes area news articles written by site operators or submitted by residents, discussion forums, photo galleries, area maps, and links to other local and government information websites. Most respondents from the mountain communities served by the site mentioned it as an important and often vital information source. For instance, one respondent told us that she “would have been lost” without it. Another respondent, who lost his home to the fire, explained:

[MountainSite] kept me informed and helped me save what little I was able to recover before evacuating not to mention being able to get my animals out. I knew about the fire within five minutes of it starting. [Q]

In our interviews with mountain residents, MountainSite was mentioned as a major source of information nearly every time. Its importance to daily life was most evident when one of the residents—who was a new arrival to the area—explained that when she moved in, the first thing her neighbors had told her was that MountainSite was the most important source of local information.

The founder of MountainSite created the site because of his frustration with the lack of emergency-related information local to their community. He originally developed the site with the hope of remedying this problem. It grew to be widely known and valued, and is now supported by many volunteers from the communities it serves. Some of our respondents reported getting involved with the site because its goal matched theirs, as this questionnaire participant explained in a follow-up exchange:

[I got involved because of] the need for accurate, timely information for our mountain communities. I have done this since [a 2003 fire], tracking major to minor incidents and false alarms. The site owner did everything himself at first - I felt a need to help him so his original vision could become a reality and it has gone beyond that original concept.

Not only do community members support MountainSite through their contributions and readership, the site has also gained legitimacy by local officials, and regularly includes updates from them in times of wildfire threat. During the most recent October 2007 wildfires, MountainSite operators collaborated with local officials and firefighters to provide accurate local information in a timely manner, and this information was then reposted to a number of other local forums and discussion boards. Furthermore, as the fires subsided, MountainSite operators and volunteers conducted photo tours of the affected areas street by street, posting pictures of each affected property in a public gallery. Respondents from the mountain communities served by MountainSite reported relying on it for information sometimes even in lieu of traditional media:

Traditional news was not reliable, [MountainSite] was [Q]

Others participated in the site's discussion groups and in return gave their time to it because of the high emotional and practical value the site had for them:

after I drew so much useful information out of those boards I felt like "giving back" [Q]

One of the main reasons why MountainSite became so important to the mountain communities was its geographical allegiance. Site contributors are themselves community residents who bring detailed geographical and local knowledge to the news and articles posted on the site. As one of our respondents mentioned:

[MountainSite] was and is the best source of information for those of us on the mountain since they are based on the mountain and are current with info. [Q]

Recent events have only seemed to accelerate its growth. During the 2007 fires, MountainSite became a conduit for information obtained from both official channels and private community members. Site operators reported via an email interview that the number of page views MountainSite received during the 2007 wildfires over the course of two weeks was ten times the normal monthly page view rate. Furthermore, the number of unique visitors to the site doubled from pre-wildfire numbers and remained at that level even three months after the wildfires subsided. MountainSite operators also reported that they had experienced similar increases in site activity during prior wildfires and expected the number of site-users to remain twice as high simply because “more people had found out about [MountainSite].” As MountainSite continues to demonstrate value and reliability during disaster events, more mountain community residents seem to adopt it as a source of information about some of the hazardous features of the natural world in which they live.

DISCUSSION

In disaster, it is simply not possible to provide enough help to all those who need it fast enough, no matter how well

executed the formal response. In such situations, human resiliency and resourcefulness come to the fore. People mobilize to help themselves and each other, often turning to their communities for assistance. In the face of threat and evacuation, victims can feel disconnected from the previous realities of their lives [12]. In disaster, attachment to the physical place of belonging is often strengthened, which can in turn motivate action to reconnect with others in a similar situation [4]. Information seeking under these conditions happens, then, in part because people have the need to re-arrange and re-explain their understanding of an altered world [4,12]. Media coverage as well as exchanges of information via ICT may provide some sense of connection with the outside world [10,27].

In complement to this external connection, we also observed that ICT use can enable reliance upon one's own local community, even in circumstances where people become geographically dispersed. ICT use can help people not only to connect to the outside world but also to reconnect to the affected community during disruption. Not only does ICT provide a means for communicating with others who are in similar circumstances, it helps to leverage and even build community resources. As people generate information and correct misinformation peer-to-peer in the midst and aftermath of disaster, new relationships—and perhaps new community-based information practices—are forged.

Individual Information-Seeking in a Community Context

Leveraging local expertise to respond to information dearth is made increasingly possible with ICT, and is the basis for an emergent practice in public-side emergency response. To go local to find information is to make use of local knowledge about people and places through social connections and resources. Local knowledge is necessary for assessing the true state of affairs of the physical community—both its people and geographical area—with more accuracy, detail, and understanding of implications than broadcast media can possibly allow [10]. This need to go local can be particularly acute in protracted and expansive disasters where the threat of damage and danger is extended over time, such as the wildfires that we investigate here.

This research reflects findings from prior work to show that locally oriented information systems can be beneficial for generating cohesion in community response to wildfires [5]. Our data suggest that in this modern networked world, ICT supports exchanges of local knowledge and enables dissemination of fast-changing information to a population that might be evacuated and widely dispersed. Respondents described how use of ICT facilitated the orientation towards the physical places of their communities by enabling them to find up-to-date information about continuing threat and the extent of damage. Search for information employed both friends and strangers who shared their concern for the locale. Thus we argue that going local for information is a

way of finding community – seeking out others who share similar concerns for the physical place in danger, making use of their local knowledge, and reconnecting to these community members to begin action towards recovery.

Digital Community Resources in Emergency Response

In some community cases, an evolution from individual practice toward shared, designated digital community information resources is apparent. As we described, RuralSite was a short-lived but well-used simple bulletin board created for a small rural community directly in response to the wildfires. MountainSite is a mature community resource developed as a place where mountain residents could get area information. Residents used this site during an earlier wildfire as well. Both sites were squarely organized as spaces for community residents to exchange information and to reconnect, though their different goals illustrate the different ways communities might organize around digital resources. From the outset, RuralSite was created directly in response to the October 2007 wildfires to provide “disaster relief” by addressing the lack of timely information for the community with content provided by community members. MountainSite was an enduring source of information for all things local, and was built by mountain residents who shared a feeling of personal responsibility for living in a fire-prone area. Its function during the October 2007 wildfires was an extension of its everyday function: relying on community volunteers and collaboration with local institutions and authorities.

The differences between the two sites and their longevity can be ascribed to geographical distribution of the population, alternatives for other news sources, and even the population composition (with a regular influx of weekenders and vacationers in the area covered by MountainSite). These factors are familiar issues for those thinking about why community-based computing takes hold in one form in one location and in a different form in another. Yet the lessons here lie not in the account of technology adoption, but instead in how communities fulfill unmet needs through adaptation and innovative uses of ICT.

People used these sites to find community when the rest of their world was undergoing change, threatened by the possibility of substantial loss. Interviewees explained that they were concerned not only about their own properties, but also about their neighbors' and whether the hillsides that surround their communities had been blackened by the blazes. They wanted to know which houses were damaged and whether the public spaces remained. It is these details that our respondents actively sought through ICT use, because these details were an important part of reconstituting their understanding of their world. The success of both RuralSite and MountainSite then, is not just in enabling information exchange, although that is important, but also in providing a virtual space for

community members to congregate and offer emotional support by expressing commonly held fears and concerns.

Community Computing—Looking to the Future

There are several interesting and viable ways that people rely on and support their communities that get realized—and perhaps catalyzed—in times of disaster. In some cases, individual and community needs result in actions, moving toward the establishment of tangible resources like websites and newsgroups that perhaps even endure over time. In other cases, ICT use might be ad hoc and temporary, resulting in the establishment of something less tangible: *practices* that prove useful to the community and can henceforward be invoked. Community computing then might best be understood not just as examples of digital sites that endure, but also as collections of developed practices of ICT use in specific contexts that community members share.

Disruptions, such as wildfires, are external events that recast individual and community needs and perceptions – making information access a premium. ICT-supported peer-to-peer information seeking is emerging as a new practice in crisis activity by creating opportunity to engage in rapid, expansive peer-to-peer contact to query a vast audience for information [19]. Because such activity is based upon a pre-existing behavioral tendency [18], it will likely continue to expand as a basis for collective response and community-focused action. Communities adapt available means of obtaining information, though at the same time, the social structure of these communities can both enable and constrain this adoption as is evident in the RuralSite and MountainSite examples. In this research, ICT use emerged as an important mechanism of connection and a way to locate information during a time when many respondents had explicitly interpreted traditional media as unable to provide necessary information.

In times of disaster, spontaneous helping behavior has been commonly observed and explained as the foundation of an “altruistic community.” The nature of ICT-supported information-seeking and community emergency response examined here helps elaborate that phenomena and anticipate possibilities for a future of community computing. We argue that while though information-seeking in a disaster context may start out as an individual pursuit, it frequently transforms into a process of finding community—both by leveraging local knowledge and returning investment into places where others are also invested and attached—an explanation that helps elaborate motivation for this helping phenomena.

CONCLUSIONS

Disaster researchers have long observed that hazardous events motivate outpourings of help and support both from affected communities and from unaffected witnesses. We observe that ICT use can facilitate a broader audience for calls for and provisions of help. At the same time, ICT use can help communities stay connected despite geographical

dispersal due to evacuation. Affected residents regarded much of media activity as “outsiders looking in” and many concentrated their search for information on the personal contacts and local sources. Individual accounts of ICT use as well as the considerations of RuralSite and MountainSite illustrate ways people improvise in disaster. They do so by going local, extending ICT to address information needs and geographical dispersion, and to find community by reconnecting with those who share concern for the threatened locale.

Many theorists argue that communities are best defined socially rather than spatially because advances in transportation and communication technologies have broadened our choice of social connections, no longer tying that social choice to a physical locale [31]. However, when the physical place is threatened, it comes to the fore as an important aspect of the community that is situated within it. In disaster, finding community by discovering others who care for the locale and who are willing to share information and provide support in times of need, gives new reason for forging social connections. Thus use of ICT to find community can help facilitate social cohesion in geographical communities post-disaster, which is crucial for progress in recovery [5].

Rapid expansion of ICT in the last decade has fueled concern that broad adoption of ICT in private life is potentially associated with a decline of the public sphere and local community. In this paper, we present evidence of ICT use specifically for re-orienting toward one’s community, for going local and for the production of public goods in the form of information dissemination during disasters. We theorize that in these interactions via ICT, members of communities not only derive immediate benefits, but also establish emergent practices that prepare for the future.

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REFERENCES

1. Barton, A.H. (1970) *Communities in Disasters: A Sociological Analysis of Collective Stress Situations*. Doubleday, Anchor Books., Garden City, N.Y.
2. Bell, C. & Newby, H. (1972) *Community studies: An introduction to the sociology of the local community*. Praeger Publishers, New York.

3. Boyle, M., Schmierbach, M., Armstrong, C. & McLeod, D. (2004) Information seeking and emotional reactions to the September 11 terrorist attacks. *Journalism and Mass Communication Quarterly*, 81(1). 155-167.
4. Brown, B.B. & Perkins, D.D. (1992) Disruptions in place attachment. in Altman, I. & Low, S.M. eds. *Place attachment*, Plenum Press, New York, 279-304.
5. Carroll, M., Cohn, P., Seesholtz, D. & Higgins, L. (2005) Fire as a Galvanizing and Fragmenting Influence on Communities: The Case of the RodeoChediski Fire. *Society and Natural Resources*, 18. 301-320.
6. Dynes, R.R. (1970) *Organized Behavior in Disaster*. Heath.
7. Erikson, K.T. (1976) Disaster at Buffalo Creek. Loss of communality at Buffalo Creek. *Am J Psychiatry*, 133(3). 302-305.
8. Fitzpatrick, C. & Mileti, D.S. (1994) Public risk communication. in Dynes, R.R. & Tierney, K.J. eds. *Disasters, collective behavior, and social organization*, University of Delaware Press, Newark, NJ, 71-84.
9. Flint, C. & Brennan, M. (2006) Community Emergency Response Teams: From Disaster Responders to Community Builders. *Rural Realities*, 1(3).
10. Hagar, C. (2009) The information and social needs of Cumbrian farmers during the UK 2001 foot and mouth disease outbreak and the role of information and communication technologies. in Döring, M. & Nerlich, B. eds. *The Socio-Cultural Impact of Foot and Mouth Disease in the UK in 2001: Experiences and Analyses.*, Manchester University Press.
11. Hampton, K. (2003) Grieving for a Lost Network: Collective Action in a Wired Suburb. *The Information Society*, 19. 417-428.
12. Janoff-Bulman, R. (1992) *Shattered assumptions: towards a new psychology of trauma*. Free Press, New York.
13. Kaniasty, K. & Norris, F. (1995) In search of altruistic community: Patterns of social support mobilization following Hurricane Hugo. *American Journal of Community Psychology*, 23(4). 447-477.
14. Landgren, J. (2006) Making action visible in time-critical work. in *Proceedings of the SIGCHI conference on Human Factors in computing systems*, ACM.
15. Maguire, B. & Hagan, P. (2007) Disasters and communities: Understanding social resilience. *Australian J. of Emergency Management*, 22(2). 16-20.
16. Majchrzak, A., Jarvenpaa, S. & Hollingshead, A. (2007) Coordinating Expertise Among Emergent Groups Responding to Disasters. *Org. Science*, 18(1). 147-161.
17. Mileti, D.S. & Darlington, J.D. (1997) The Role of Searching in Shaping Reactions to Earthquake Risk Information. *Social Problems*, 44(1). 89-103.
18. Palen, L. & Liu, S.B. (2007) Citizen communications in crisis: anticipating a future of ICT-supported public participation *Proceedings of the SIGCHI conference on Human factors in computing systems*, ACM Press
19. Palen, L., Vieweg, S., Sutton, J., Liu, S.B. & Hughes, A. (2007) Crisis Informatics: Studying Crisis in a Networked World. in *Proceedings of the Third International Conference on E-Social Science*. Ann Arbor, MI, Oct 7-9, 2007.
20. Pettersson, M., Randall, D. & Helgeson, B. (2002) Ambiguities, awareness and economy: a study of emergency service work *Proceedings of the 2002 ACM conference on Computer supported cooperative work*, ACM, New Orleans, Louisiana, USA, 2002.
21. Procopio, C.H. & Procopio, S.T. (2007) Do You Know What It Means to Miss New Orleans? Internet Communication, Geographic Community, and Social Capital in Crisis. *Journal of Applied Communication Research*, 35(1). 67 - 87.
22. Reddy, M. & Dourish, P. (2002) A finger on the pulse: temporal rhythms and information seeking in medical work. in *Proceedings of the 2002 ACM conference on Computer Supported Cooperative Work*, (New Orleans, Louisiana, USA), ACM.
23. Scaffidi, C., Myers, B. & Shaw, M. (2007) Trial By Water: Creating Hurricane Katrina "Person Locator" Web Sites. in Weisband, S. ed. *Leadership at a Distance: Research in Technologically-Supported Work*, Lawrence Erlbaum, Mahwah, NJ, 209-222.
24. Schneider, S.M. & Foot, K. (2002) The Web After September 11. in Rainie, L., Schneider, S.M. & Foot, K. eds. *One Year Later, September 11 and the Internet*, Pew Internet & American Life Project Report.
25. Shklovski, I., Burke, M., Kiesler, S. & Kraut, R. (2008) Use of communication technologies in Hurricane Katrina aftermath. Position paper for the HCI for Emergencies workshop *Conference on Human Factors in Computing (CHI 2008)*, Florence, Italy, 2008.
26. Sonnenwald, D.H. & Pierce, L.G. (2000) Information behavior in dynamic group work contexts: Interwoven situational awareness, dense social networks and contested collaboration in command and control. *Information Processing & Management*, 36(3). 461-479.
27. Sood, R., Stockdale, G. & Rogers, E.M. (1987) How the News Media Operate in Natural Disasters. *Journal of Communication*, 37(3). 27-41.
28. Stallings, R.A. (ed.), *Methods of Disaster Research*. International Research Committee on Disasters: Xlibris Corporation, 2002.
29. Sutton, J., Palen, L. & Shklovski, I. (2008) Backchannels on the front lines: Emergent use of social media in the 2007 Southern California fire. *proceedings of Information Systems for Crisis Response and Management Conference (ISCRAM)*, Washington DC.
30. Tierney, K.J., Lindell, M.K. & Perry, R.W. (2001) *Facing the unexpected: Disaster preparedness and response in the United States*. Joseph Henry Press, Washington, D.C.
31. Wellman, B., Boase, J. & Chen, W. (2002) The Networked Nature of Community Online and Offline. *IT & Society*, 1(1). 151-165.