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DISASTER RECOVERY IN AN ON-GOING HAZARD SITUATION ON MONTSERRAT: THE JULY 20, 1999, VOLCANIC DOME COLLAPSE

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ABSTRACT

The Eastern Caribbean Island of Montserrat is entering into the reconstruction stages of its recovery from a catastrophic volcanic disaster. On the southern two-thirds of the island all human settlements have been destroyed by volcanic activity, so complete reconstruction is now taking place on the northern third of the island. However, ongoing volcanic events still have the potential to create a disastrous situation. This quick response fieldwork project focuses on the post-impact period of the July 20, 1999, volcanic dome collapse. Case study methods were applied to investigate if the July 20 volcanic event was considered to be a disaster. Fieldwork suggests that while the volcano is moving toward

inactivity, residual volcanic events can still be disastrous. As Montserrat moves into the reconstruction phase of disaster recovery, the July 20 volcanic event did not interfere with on-going disaster recovery activities. In the eyes of Montserratians, the dome collapse was considered as a volcanic event but not a disastrous event.

INTRODUCTION: MONTSERRAT'S SOUFRIERE HILLS VOLCANO

The Soufriere Hills Volcano on the Eastern Caribbean island of Montserrat began a recent eruptive period on July 18, 1995. The volcanic crisis has been catastrophic for this British Overseas Territory, as human settlements on two-thirds of the 39 square-mile island have been destroyed and approximately 70% of the island's population of 11,000 people has been evacuated under emergency conditions. During the eruptions, all of the island's critical infrastructure elements including the capital city of Plymouth, the main seaport facility, and the international airport were severely damaged and rendered useless. The volcanic crisis has now been ongoing for four years. Due to phased evacuations of hazardous areas in close proximity to the volcano, this disaster has caused less than 25 casualties. Twenty-two settlement areas with a total population of 7,243 people have been evacuated and subsequently damaged or destroyed.

During the past four years, the disaster response and recovery efforts have varied with the intensity of the volcanic crisis. The new Montserrat Physical Development Plan noted, "Under disaster conditions physical planning on the island has been reactive and decisions have been made in response to the urgent needs of the crisis situation" (GoM Physical Planning Unit, 1999). Rapid relocation of infrastructure elements and the shifting of human activity from unsafe to safe zones has been commonplace. In 1999, Montserratian's are starting to attempt to facilitate planning on a proactive basis. This planning is guided by three documents prepared by the government of Montserrat and the United Kingdom government. The *Montserrat Country Policy Plan 1998-2001* focuses on general development and redevelopment of the island outlining both major policy objectives and program implementation targets. The *Sustainable Development Plan: Montserrat Social and Economic Recovery Programme - A Path to Sustainable Development 1998 to 2002* describes the general policy for social and economic recovery during the next five years. The *Physical Development Plan for North Montserrat 1999-2008* is the comprehensive physical plan for redevelopment in the northern portion of the island where volcanic risk is minimal. Montserrat's governing entities have taken an approach to development planning based on the fundamental principle of attracting people back to the island and encouraging population growth (GoM Physical Planning Unit, 1999). While it is not possible to predict the specific rates of population growth and the exact geographic distribution for new population, an overall target of 10,000 persons has been stated and physical plans have been developed for seven new activity centers in northern Montserrat. A population of 10,000 persons roughly equals the island's population prior to the volcanic crisis. Planners have determined that the carrying capacity of northern Montserrat is adequate to support the activity of 10,000 persons.

The current state of affairs finds Montserrat's land area divided into three zones. The southern two- thirds of the island is an exclusion zone that remains extremely dangerous for any type of occupation and it is strictly off-limits. In this zone, damage to the infrastructure is complete and a very high risk of injury from volcanic activity exists. All entry into this zone is illegal except for the purposes of scientific monitoring and national security. On the fringe of the exclusion zone, a small area on the central western coast of the island has been opened up as a daytime entry zone. This area is safe for daytime entry only when conditions permit. In the daytime entry zone, many villa-style homes are buried in ash, there are no electric or water services, and damage to the infrastructure is moderate to severe. No persons are allowed to permanently reside in the daytime entry zone. The northern one-third of the island is a safe zone where approximately 4,500 people reside. This zone is rapidly being developed, as all needs of the island's residents must be met in this area. All aspects of livelihood, including the recovery and reconstruction activities are taking place in the northern safe zone. Current discussions on the island indicate that a flexible approach to maintaining zone boundaries should be continued. Ongoing volcanic risk assessments may indicate that at some point in the future it will become safe to reoccupy areas within the daytime exclusion zone or areas on the fringes of the exclusion zone.

When considering disasters on Montserrat, it is important to acknowledge that the Eastern Caribbean island exists in a multiple-hazard environment. During the 1990s, natural hazards of both atmospheric and geologic origin have dealt Montserrat's inhabitants severe blows. Historically, Montserratians have experienced some minor volcanic activity in the 1930s, but otherwise there has not been significant volcano or seismic activity since European settlement in the

1600s. During the twentieth century, Montserrat has dealt with four direct hurricane impacts, most recently in 1989. In September 1989, Hurricane Hugo struck the island for an eight-hour period resulting in severe impacts. Eleven persons were killed, 3,000 people were left homeless, and there was extensive damage to all structures. While Hurricane Hugo was considered as catastrophic, the volcanic crisis has been even more catastrophic in terms of the physical and social dislocation faced by Montserratians. Prior to the current crisis Montserrat historian Howard Fergus wrote, "Disasters make a sorry story, but we can identify positive fallout in the revival of human and community values. Montserrat's disasters are stories of resilience, the strengthening of familial ties across the sea, the challenge of regional solidarity, and a test of the goodwill of the mother country" (Fergus, 1994). This author would be remiss not to acknowledge the high degree of resiliency observed amongst Montserratians. While on island, various recent cultural artifacts related to the volcano were observed. Material culture items included a school based multimedia project describing children's experiences with the disaster, before and after volcano posters, and shirts depicting the new postdisaster housing areas. Non-material cultural items such as personal stories of emergency evacuations and string band musical renditions of volcano stories were also observed. These items and artworks all illustrated the degree to which the volcano disaster was incorporated into human culture, not viewed as a destroyer of human culture. In the last decade of the twentieth entury, few nation-states have endured such multiple catastrophes on such a wide scale. The recent volcanic crisis has ingrained a unique set of characteristics into Montserratian society involving the ability to recover from misfortune and easily adjust to change.

THE DISASTER: THE JULY 20, 1999, VOLCANIC DOME COLLAPSE

On July 20, 1999, a significant volcanic event characterized as a moderate explosion and dome collapse occurred. The event generated a mobile surge cloud of hot gas and ash, produced a pyroclastic flow, launched ballistic rocks, and sent up an ash cloud that reached an altitude of 35,000 feet (Montserrat Volcano Observatory, 1999). The mobile surge cloud was a blast of gas and heat traveling at hurricane velocities away from the dome collapse. In the path of the surge the landscape was scarred. The pyroclastic flow was another type of eruption cloud consisting of volatile fragments of ash, volcanic rock fragments, and gas. Driven by gravity, pyroclastic flows have traveled down ghats at high speeds reaching the coast of the Caribbean Sea. The force of the explosion also launched hot ballistic rocks that resulted in fires being set in vegetation in the proximity of the blast. During the dome collapse a large cloud of fine ash, or dust, was expelled. The entire island of Montserrat was covered in ash.

Many directly observable effects of this volcanic activity were present. On the southern portion of the island massive impacts were apparent in areas of the mobile surge clouds and pyroclastic flows. However, these areas have already been evacuated, and 100% of the infrastructure in those areas was already severely damaged and subsequently scrapped. The surge cloud swept over Roaches Mountain (a mountain not previously overcome) and set fires in an unaffected valley; however these areas of new damage were well within the existing exclusion zone. On the fringe of the exclusion zone, in the daytime entry zone, ash fallout ranging from feet to inches was present. The daytime entry zone was declared off limits during the period of increased volcanic activity. While more ash was deposited in this daytime entry zone, it was far away from the immediate area of the dome collapse so that no further damage was added. In the northern safe zone, the primary effects were that of ash fallout ranging from a trace to a fraction of inches. After the dome collapse, the ash cloud reached an altitude of 35,000 feet and part of it drifted northward at 10,000 to 15,000 feet directly over the northern safe zone.

RESEARCH PROBLEM

While Montserrat is recovering from the effects of the four years of volcanic eruptions, are volcanic dome collapses such as the July 20, 1999, event considered as disasters? As further dome collapses are likely, what can be the expected responses to such events and what effects will they have on the ongoing recovery and reconstruction efforts? Study of the July 20, 1999, volcanic event provides information on how Montserratians cope with an ongoing series of disasters and information on the actual workings of the disaster recovery process in a complex situation.

RESEARCH METHODS

Quick response fieldwork took place from August 6, 1999, to August 15, 1999. As international transport facilities on Montserrat were destroyed by volcanic activity, it was necessary to fly from Miami, Florida, USA, to the island of Antigua. Then, a ferry was taken from Heritage Quay, Antigua, to a temporary port facility at Little Bay, Montserrat. While on Montserrat, accommodations were made available at a privately operated guesthouse in Woodlands. Once on Montserrat, conditions did not impede the research process.

The methods of case study research were applied for this quick response fieldwork. Social scientist Robert Yin describes case studies as, "The preferred method when how or why questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within a real-life context" (Yin, 1994). This fieldwork can be classified as a single-case exploratory study. A single-case study design was deemed appropriate since the disaster events on Montserrat are extreme and unique. The phenomenon or theme that was analyzed was the postdisaster circumstances of the July 20, 1999, volcanic event. Case study methods allowed for an unfolding process of realization in order to attempt to interpret events in the context of the greater whole of Montserrat's volcanic crisis. Field procedures included gaining access to key organizations, seeking guidance from local knowledge sources, interviews, reconnaissance surveys, and acquisition of spatial, ephemeral, and archival data. Data collected included documentation, archival records, interviews, direct observations, participant observations, and collection of physical artifacts. Analysis took place by attempting to discern converging lines of inquiry from multiple sources of evidence. This author notes that in the postdisaster environment field methods had to remain fluid to allow for unanticipated events to inform the case, changes in the availability of interviewees, and changes in the mood and motivation of the case study investigator or research subjects. The development of this case study was also informed by pre-dissertation research on Montserrat in October/November 1998.

As this fieldwork was performed outside the cultural context of United States society, attempts were made to be cognizant of the relevant cultural context in which the fieldwork was taking place. During fieldwork, Montserratian, British, expatriate (North American and European), Afro-Caribbean, and Caribbean Islander were amongst the cultural contexts this researcher encountered.

CONCLUSIONS AND DISCUSSION, PART I: CHARACTERIZATION OF THE EVENT IN CONTEXT OF VOLCANIC CRISIS

The first conclusion concerns the characterization of the July 20 volcanic event, and the context of that event in the recent case history of the Soufriere Hills Volcano. Montserrat's volcano can now be considered in a state of residual activity moving towards repose. In March of 1999, new magma ceased to be intruded into the lava dome. At that time, volcanologists considered the volcano to be entering into a stage of inactivity. However, residual events can still occur. At Montserrat's volcano, a dome-shaped structure formed. Viscous magma filled the upper part of the pipe-like volcanic conduit, and then this solid to semi-solid magma pushed up like a cork from the neck of a bottle. The dome grows when magma does not flow far from the vent and starts piling up. As the dome grows in volume, it becomes steep-sided and a spine sometimes emerges as viscous magma squeezes through ruptures in the semi-solid skin of the dome (Chester,1993). When the dome becomes unstable it collapses in a violent eruption. Technically, the volcano is not considered to be active since such dome collapses are considered as residual activity resulting from the past build-up of the dome. However, with a large lava dome still present, this residual activity can still take the form of significant volcanic events. In the case of the July 20 dome collapse, magma reached the surface of the vent and cooled, adding to the volume of the dome. As the magma cooled it crystallized, releasing gas in the process. This gas pressurized the dome leading to an explosion. The Montserrat Volcano Observatory reported seismic signals indicating a moderate explosion immediately before the dome collapse. Such an explosion likely destabilized the lava dome which was already fragile due to its steep and unstable sides, natural degradation, and weathering. Consequently, the dome gravitationally collapsed upon itself and the explosive force of this collapse expelled three to five million cubic

meters of volcanic material upwards and outwards in the direction of the north facing side of the south wall of the volcano.

The July 20 dome collapse was a significant event in the case history of the recent volcanic episodes. It was both large in magnitude and it also provided an alert to Montserratians indicating that significant volcanic events are still possible. The July 20 volcanic event was the largest event since the December 26, 1997, Boxing Day eruption. The dome collapse was estimated to rank sixth or seventh in terms of magnitude of the eruptive events since 1995. Regarding future volcanic events, the limiting factor is the amount of material remaining in the dome. It is now estimated that 65 to 70 million cubic meters of volcanic material remains in the dome. It is likely that further dome collapses will occur having overall consequences similar in scope to the July 20 event. Scientists at the Montserrat Volcano Observatory estimate that the dome will remain unstable until its volume is reduced to 30 to 40 million cubic meters of material. When the dome reaches that volume the volcano will go into a state of repose becoming considerably less active than the present. With the present level of knowledge about the complex dynamics of the volcano, it is not possible to estimate an exact time frame for future dome collapses, however it is certain that one or more will occur. The July 20 event is important to consider in the context of the recent eruptive sequence since it can be considered as typical of the type of volcanic activity Montserratians will have to face in the coming years if not decades.

CONCLUSIONS AND DISCUSSION, PART II: EFFECTS OF THE DISASTER ON THE DISASTER RECOVERY PROCESS

The second conclusion of this quick response research was that Montserrat is now in the restoration stage of its volcanic disaster recovery and that the July 20 volcanic event did not interfere with the postdisaster restoration efforts. While it was difficult to apply existing models of disaster recovery to the situation on Montserrat, it was clear that volcanic activity of the magnitude of the July 20 event would not cause Montserrat to backtrack from the restoration phase to the emergency phase of disaster recovery.

In the cycle of natural disaster events, a model suggested by hazards researchers Haas, Kates, and Bowden divided the post-disaster recovery period into four distinct phases. (Haas, et al., 1977) In the first phase, or the emergency phase, normal activities are ceased or changed. Search and rescue operations are completed and the need for emergency shelters ends. In the second phase, or the restoration phase, there is a return to normalcy and major services are restored. In the third phase, the reconstruction phase, normal activities return at pre-disaster levels or greater, and pre-disaster levels of capital stock and activities are attained. In the fourth phase, the development phase, normal activities are improved and developed, as this phase is an opportunity for long-term community betterment and postdisaster sustainable development. Each interval lasts approximately 10 times longer than the previous one; however evidence to support the time frame is sketchy (Tobin and Montz, 1997). This model is based on the occurrence of a singular disaster event, which is easily defined. After Hurricane Hugo, hazard researchers Berke and Beaty applied this model of postdisaster recovery to Montserrat. They concluded the emergency phase came to an end about two weeks after Hugo's landfall. Restoration activities ended approximately four to ten months after impact, while the reconstruction and development phases continued beyond a year from the initial impact (Berke and Beatley, 1997).

In order to conceptualize the July 20 event in relation to the volcanic crisis, this author considered how the disaster recovery model could be applied to the current situation. From discussions with government of Montserrat officials and Montserrat Volcano Observatory scientists, it was determined that the first phase of disaster recovery, the emergency phase ended in March 1999. At that point volcanic monitoring indicated that no new magma was being added to the volcanic dome. Therefore after March 1999, no new eruptions of new volcanic material will take place. However, continued dome collapses are likely and these dome collapses can have similar consequences as eruptions. When characterizing the state of the recovery process in terms of the volcano, Montserrat has ended the emergency phase of its recovery. However during field observations, it was clear that activities such as the construction and occupation of new housing estates in the areas of Lookout and Davy Hill could be considered as part of the restoration or reconstruction phases. The situation of recovery from Montserrat's volcanic disaster is difficult to break into distinct

recovery periods since the volcanic eruptions have been an ongoing series of disasters for four years, not a single event. It is also difficult to characterize the stages of recovery for Montserrat since different areas of the island were are in different stages of the recovery process.

The effects of the July 20 volcanic event had little if any physical effect on the progress of the disaster recovery in northern Montserrat. It is also likely that as the volume of volcanic material in the dome decreases with future dome collapses, the redevelopment projects in the northern safe zone will face little if any impact from future volcanic events. This quick response research indicated an area of future research is the investigation of how additional disasters will influence progress of the disaster recovery process. As Montserrat as a whole can be considered to be moving from the emergency stage of recovery into the restoration and reconstruction phases, it is an open question whether any existing models of disaster recovery can be used to predict a time frame for Montserrat's recovery. Perhaps, new models for disaster recovery must be developed for this unique situation.

CONCLUSIONS AND DISCUSSION, PART III: A VOLCANIC EVENT BUT NOT A DISASTROUS EVENT

The third conclusion concerns distinguishing between a volcanic event and a disastrous event. Clearly, the July 20 dome collapse was a volcanic event, but many people on Montserrat did not consider it a disastrous event. However, the potential for a disastrous event did exist. Government officials indicated that, if people were illegally in the exclusion zone putting themselves in the path of the surge cloud or if the pyroclastic flows went in a different direction, the consequences would have been very serious. As the post-impact situation turned out, no people were in the hazardous areas that they were not supposed to be in, so there were no injuries. Also, the areas near Roaches Mountain that were scarred by the 700- to 800-foot surge cloud of hot gas and heat were well within the established exclusion zone. What the July 20 volcanic event did do was cause further damage to areas that were already in the severely damaged southern exclusion zone. In the northern safe zone, the population is well advised concerning the procedure for mopping-up ash, so although the ash cloud deposited airborne ash fallout in the north, the consequences were not disastrous. The ash falls in populated areas were for the most part seen as an inconvenience. The potential for respiratory problems caused by the long-term exposure to ash is present, but such problems are seen as minimal for Northern Montserrat and air monitoring continues.

A more intangible, but none-the-less important, consequence of the July 20 volcanic event is the psychological impact. The population of Montserrat has been dealing with the recovery for four years, and the 35,000 foot ash cloud was a stark reminder of the forces that influenced their predicament. While the July 20 volcanic event was not considered as a disaster that would divert resources from the ongoing recovery and reconstruction efforts, it is an open question how the continued volcanic events will effect an individual's personal coping with the events of the past four years.

Also, as the volcano was relatively quiet prior to July 20, complacency set in concerning the dangers present. With no significant disaster events in the short-term, there seemed to be a tendency for Montserratians to believe that the volcanic risks were lessening. While that belief is true in some ways, the volcano still remains very dangerous. The government of Montserrat used the July 20 volcanic event as an opportunity to reinforce the message about the dangers of entering the exclusion zone. On occasion people would venture into the exclusion zone for a variety of reasons including photographing the destruction, adventure tourism, and visiting abandoned homes/businesses to reclaim material possessions. While volcanic activity was at a low level, no immediate physical reminders of the high risks of entering into the exclusion zone were apparent. However, when the July 20 dome collapse resulted in surges devastating areas that had not been previously affected, all Montserratians were reminded that the volcano is still very dangerous.

In the context of living in close proximity to an active volcano for four years and the massive destruction of the 1996-1997 eruptions, most Montserratians this author interacted with were of the opinion that the July 20 dome collapse was a volcanic event, but not a disastrous event. During the Mount St. Helens ashfall event of May 18, 1980, a research team led by Warrick studied the effects of the ashfall in four northwestern USA communities. In three of the four communities studied, respondents were willing to admit that the volcanic ash was a major inconvenience, but not a

disastrous event. The gray area where inconvenience turns to disaster was somewhere between ash depths of 7 mm to 17 mm (Warrick, et al., 1981). Similarly on Montserrat, people are making decisions concerning at what depth of volcanic ash fallout does the situation turns from an inconvenience to a disaster.

This quick response research indicated that the question of "What is meant by a disaster?" is relevant to consider on Montserrat. When disaster researcher Enrico Quarentelli considered the question of "What is a disaster?" he suggested that such concern with definition is not a pointless academic exercise. "It is instead to focus in a fundamental way on what should be considered important and significant in what we find to be the characteristics of the phenomenon, the conditions that lead to them, and the consequences that result" (Quarentelli, 1998).

Factors influencing Montserrat's future reconstruction will be dependent not only on whether those people on Montserrat think they are in a disaster, but on the definitions of disaster that others cast upon them. For example, the event that this research was based on was described by the headline "Montserrat Volcano Hurls Ash, Avalanche of Superheated Rock" on the Cable News Network (Cable News Network Interactive, 1999) and "Montserrat Volcano Hurls Ash" by the Associated Press (Hawley, 1999). Disaster researcher Rosenthall suggests that future disasters will follow the media-instigated lead of the Thomas Theorem (i.e., if men define a situation as a crisis it will be a crisis in its own consequences). "If the media define a situation as a disaster or crisis, be sure that it will be a disaster or a crisis in all its consequences" (Rosenthall, 1998). Such abstract conceptualization of disaster has real-life consequences for Montserrat. Montserrat's postdisaster economy will be to a large extent externally orientated with tourism being a major income generator. While Montserrat's commercial interests are attempting to rebuild the island's tourism sector, international media reports describing another Montserrat crisis in the most recent series of Central American and Caribbean disasters will lead the North American or European tourist to avoid the island, even as normalcy is being restored. Unfortunately, the restoration of normalcy will not attract the same amount of international media attention as the volcanic eruptions.

In conclusion, the following statement from a Montserrat innkeeper eloquently describes how people on Montserrat coped with the impacts of the July 20 volcanic event. The quotation was written by an innkeeper as she looked outside her window from a vantage point in Montserrat's northern safe zone.

> Each and every morning, after a last (loving) glance at my sleeping husband, next thing I do is peep through the louvres at the car's windscreen. If there is no ash, my eyes go further to the flowers, the lawn, the sea and the sky. And that's when my heart opens up with a flood of love for my God and my fellow man. And I notice every blade of new grass, and every new bud on every tree.
>
> Then there's the day when I wake up to thunder (not too often, now), lightening, and that heavy metallic smell of an overhanging ash cloud. The windscreen is white with ash, dirty snow. The sea and sky, flowers and lawn have all disappeared in clouds of grey. But I hear rain, real, sweet rain coming down the sides of the Centre Hills towards us, and know that the ash will be washed away. And that's when, with a quick (impatient) glance at my still sleeping husband, I say a silent prayer of thanks for being alive. I thank Him for each drop of rain that falls on each blade of grass. And for being a part of this new beginning! (Spycalla, 1999)

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Notes

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