5-2007

Risk Perception, Warning Systems and Evacuation Plans for Volcanic Hazards

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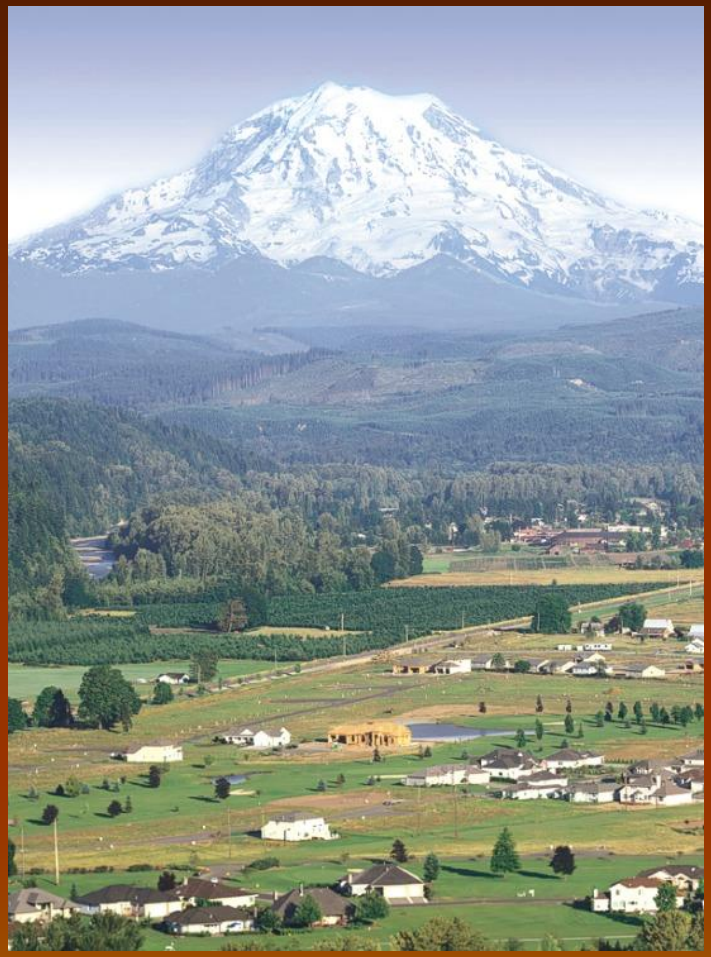
Western Psychological Association, May, 2007,
Vancouver, British Columbia, Canada

Volcanic Hazards & Mt. Rainier

Mt. Rainier is the second most active of the Cascade Volcanoes

It poses several threats to the Puyallup Valley:

- Ashfall
- Pyroclastic Flows
- Lahars (Volcanic mud/debris flows)



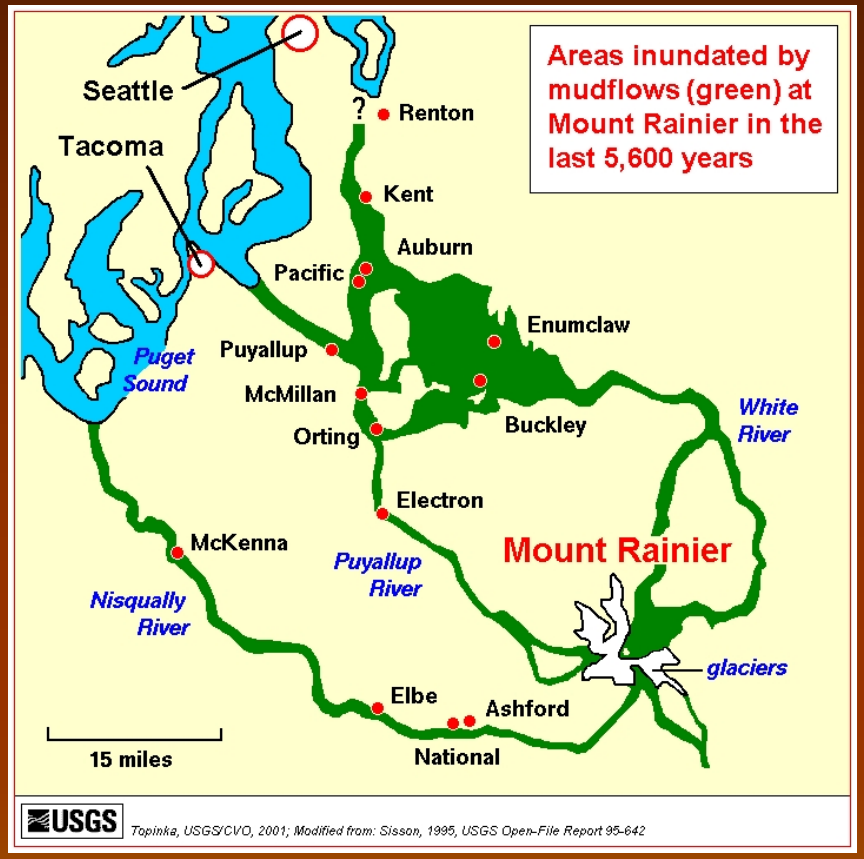
What is a Lahar?

* Lahars consist of water, mud, rocks and debris that flow rapidly down streams and rivers
* Eruptions, quakes or even a spring thaw can trigger lahars
* Can reach Puyallup Valley communities within 30 - 40 minutes

Prior Examples of Deadly Lahars

- 1980 Mt. St. Helens eruption sent lahars 50 miles, destroying 27 bridges and nearly 200 homes
- 1985 Nevado del Ruiz eruption in Colombia killed 20,000 people in the town of Armero

A Population At-Risk



- >150,000 residents now live on top of old lahar deposits
- Residents will need to evacuate to higher ground if a lahar warning is issued
- Increasing population and limited access roads present a risk

More Residents, Greater Risk

Detection, Warning, and Evacuation Plan

- USGS & Pierce County, WA set up first fully automated detection & warning system in 1998
- Sensors record ground vibration and trigger alerts to emergency agencies
- If warning is issued, residents evacuate to high ground along prescribed routes
- Success depends on public understanding of risk and responding appropriately and promptly to warnings

What determines the success of such emergency plans?

- Do people feel the risk is real?
- Are they aware of details of the warning system & evacuation plan?
- Do they believe the plan will work?
- How will they react when a warning is actually issued?

Prior Research & Educational Campaigns at Mt. Rainier

- Johnston et al. (2001) conducted several assessments of risk perception among school children in Orting, Washington
- Since 2001, USGS, local educators, and emergency management personnel have been increasing their efforts to educate the public about lahar hazards and the evacuation plan, but there has been no assessment of the effectiveness of these efforts

Purpose of the Present Study

- This study was a first attempt to assess risk perception, awareness of and confidence in the warning and evacuation plan among at-risk, adult residents living close to Mt. Rainier
- We also saw this as an opportunity to build upon our own prior work on perceptions of risk and confidence in evacuation plans regarding:
  - Volcanic eruptions at Etna and Vesuvius in Italy (Davis et al., 2005)
  - Tsunami hazards in Washington State (Johnston et al., 2002) and in northern California (Davis, 2006).

Method

Participant Recruitment Procedure

* A total of 712 surveys were distributed by trained volunteers from May - August, 2006
* Canvassing of neighborhoods, distribution at safety fairs and farmers markets in Orting, Puyallup and nearby communities
* Surveys were returned by mail in business-reply envelopes.

Method

Participants

* 257 residents returned and completed surveys (Response rate of 36%)
* 65% Female, 35 % Male
* Age: 18 – 87 years (M = 51.8, SD = 15.2)
* 92% Home Owners, 7% Renters
* 35% were high school graduates, 46% had a college degree, 14% an advanced degree

Method

Survey Measure (adapted from Johnston et al., 2001)

* 37 Items (Rating Scales and Open-Ended)
  - perceived risk regarding lahar hazard
  - knowledge of lahar warning system
  - awareness of appropriate response
  - confidence in evacuation routes
  - self-efficacy and information-seeking

Results: Perceived Risk

- Large proportion of residents see lahars as a potential threat:
  - 57% "Lahars threaten my personal safety."
  - 67% "Lahars threaten my home or property."
- Few residents are in denial of risk:
  - 14% "Lahar risk has been exaggerated."
  - 10% "There may be a lahar but it won't be that bad"

Results: Warning System & Response

- 82% of residents were aware of the warning system for their community
  - Of these, significant numbers were able to describe important elements of the system:
    - sensors will relay data (n = 43)
    - sirens will indicate approaching lahar (n = 177)
    - Media will broadcast alerts (n = 19)
- 70% know that they are to evacuate to higher ground or use official evacuation routes in response to warnings

Results: Evacuation Plan

* Over 50% said they have actually followed the official evacuation route for their town
* Only 31% of respondents believe that the official evacuation routes are adequate
* Most commonly voiced concerns were:
  - Too many people/too few routes, traffic jams, panic (82%)
  - It is too far to evacuate on foot (5%)
  - Poorly marked evacuation routes (3%)

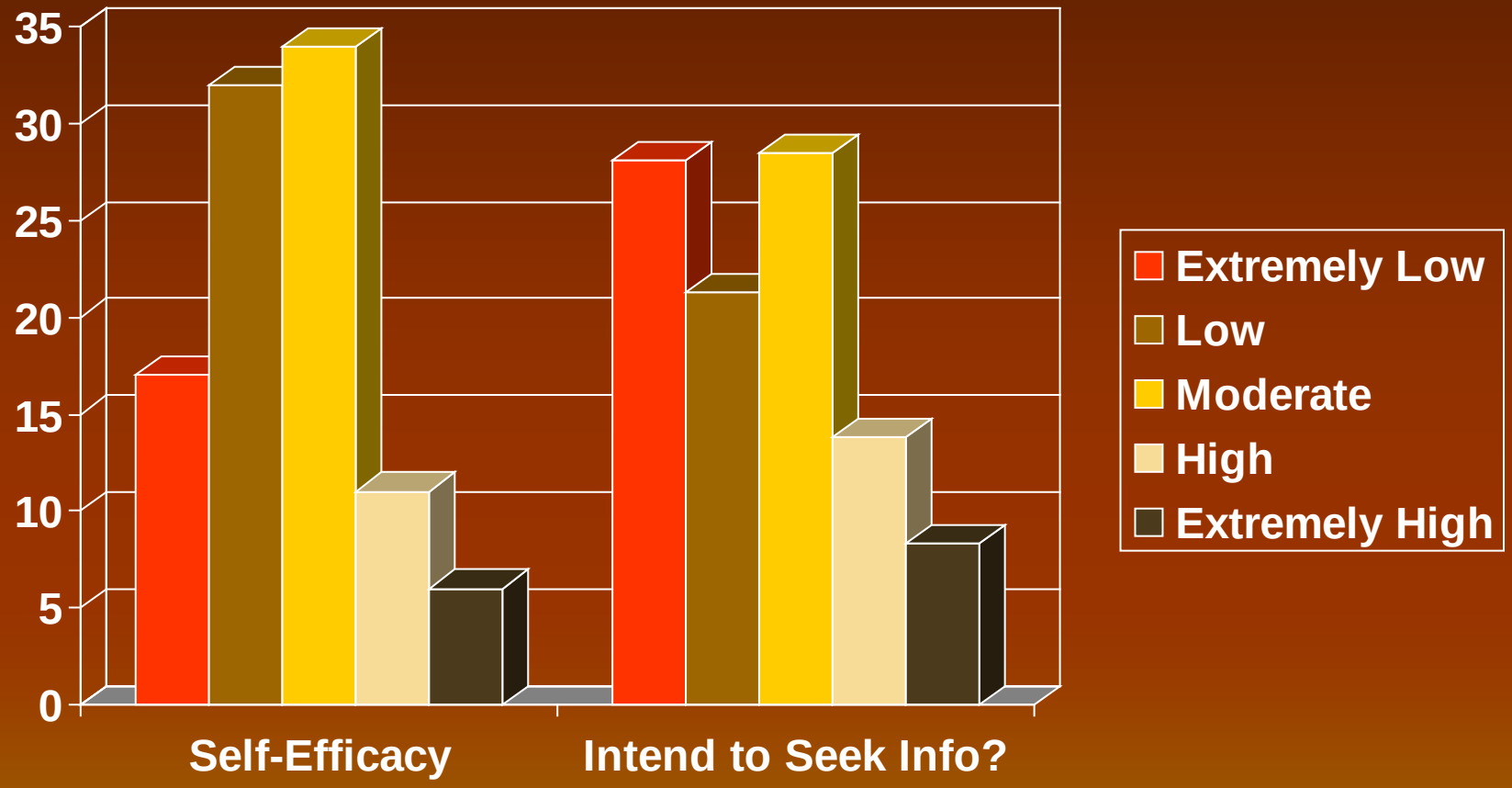
Results: Evacuation Plan

- 45% of the sample admitted that they have considered using an evacuation route that is different from the official route
  - **Official routes will be too congested (n = 60)**
  - **Know a faster/closer/easier route (n = 26)**
  - **Desire for other alternatives (n = 13)**
- Relatively few respondents (4%) said they will require help to evacuate: disabilities, transportation issues, small children.

Results: Concerns of Parents

- 30% (n = 76) of those sampled have children in grades K – 12
- Of these, 73% are aware that their child's school has a lahar evacuation plan
- 31% do not trust the school's evacuation plan to protect their children from a lahar
- 39% plan to go to the school to get their children if a warning is issued

Results: Self Efficacy and Information-Seeking



Conclusions/Implications

- Consistent with findings from our work in Italy (volcanic risk), and in Washington & California (tsunami), most residents close to Mt. Rainier:
  - see lahars as a threat to their safety and property
  - demonstrate no real evidence of denial
  - demonstrate moderate to low levels of self-efficacy regarding their ability ro protect themselves
  - believe that evacuation plans are inadequate and have little faith in the success of these plans
  - feel that local government officials as not well-prepared to deal with a crisis
  - plan to use their own evacuation routes or to ignore aspects of the official plan (i.e. going to schools)

Conclusions/Implications

- Public's lack of faith in evacuation plans and the often slow process of educating the public may stem from not bringing residents into the discussion; there is a need for community-based educational campaigns
- Emergency management officials often plan evacuations and develop educational campaigns without consulting with social scientists, who can shed light on how the public might respond

What would you do?

- Will residents follow official recommendations that are counter-intuitive or which are unrealistic?
- Does leaving citizens out of the planning and decision-making process contribute to feelings of low self-efficacy?

A plea for greater involvement by social scientists...

- The vast majority of past studies on response to natural hazards have been done without input by social scientists
- When social scientists do conduct research on this topic, they tend to focus on after-effects like PTSD, rather than on pre-disaster preparedness
- A recent international conference (Cities on Volcanoes 4) in 2006 called for greater inter-disciplinary research among geologists, social scientists, and emergency management officials

Special thanks to...

- The Department of Emergency Management, Pierce County, Washington for providing the funding for this project
- Students volunteers Samantha Mitchell, Kate Wilson, Nick Schuur, and Kim Batayola of Dominican University of California for their help with survey preparation, mailing and coding