A Distributed Approach to Sheltering: Response to the 2024 Noto Earthquake in Japan

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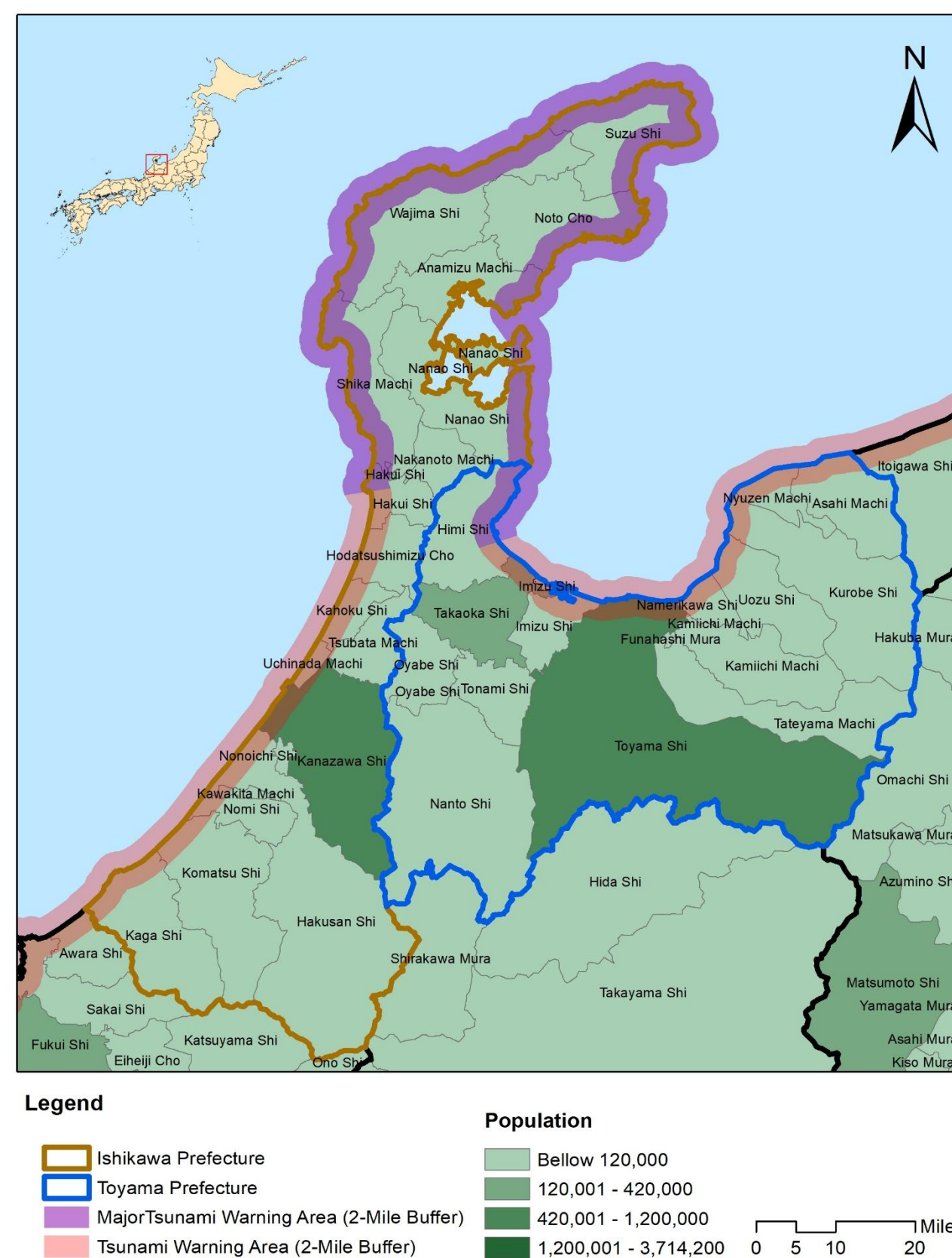
BACKGROUND

This NSF-funded RAPID study examines the evacuation and sheltering operations in response to the Noto Earthquake. This event provided the opportunity to study evacuation in a nighttime context and an innovative, emergent approach to sheltering operations. Studies of nighttime disasters, while scant, have shown that people respond differently at night, and limited studies have examined distributed sheltering operations. We use a convergent mixed method design to build on the updated Protective Action Decision Model (PADM) and enhance the model by investigating the impact of the social and environmental contexts on individuals' risk perceptions and their evacuation decisions.

Earthquake and subsequent fire damage in Wajima, Japan (7/30/2024 Photo Credit: Alex Greer)

NOTO EARTHQUAKE

Legend
- Ishikawa Prefecture
- Toyama Prefecture
- MajorTsunami Warning Area (2-Mile Buffer)
- Tsunami Warning Area (2-Mile Buffer)

Population
- Bellow 120,000
- 120,001 - 420,000
- 420,001 - 1,200,000
- 1,200,001 - 3,714,200

0 5 10 20 Miles

- On January 1st, 2024, a M7.6 earthquake (referred to as the 2024 Noto Peninsula Earthquake) struck Ishikawa and Toyama Prefectures in Japan at 4:10PM (sunset time 4:49PM).
- Resulted in at least 500 deaths and a major evacuation of coastal residents.
- As Noto is a mountainous area with an aging population, many displaced individuals were relocated further inland, sometimes multiple times, to receive adequate medical care.
- This confluence of a major earthquake and tsunami warning, a nighttime evacuation scenario, and an aging, remote population led to a complex response operation. Evacuees often moved from an initial, open space tsunami evacuation space to a primary shelter close to home. Evacuees were then moved to a 1.5 shelter and later placed as far as 200km in a secondary shelter.

RESEARCH QUESTIONS

- How do the social and environmental contexts, risk perceptions, personal characteristics, and situational factors relate to one another and shape disaster response during a nighttime tsunami event?
- How do survey results from the 2024 Noto tsunami compare to survey results from the 2011 Tōhoku tsunami?
- How do survey results from the 2024 Noto tsunami compare to survey results from other hazard events employing similar survey instruments?
- How did experiences during the 2011 Tōhoku Earthquake and Tsunami shape tsunami preparedness and response efforts for the 2024 Noto Tsunami among emergency managers?
- How did COVID-19 affect tsunami planning and response efforts for the 2024 Noto Tsunami?

Earthquake damage in Wajima, Japan (7/30/2024 Photo Credit: Alex Greer)

METHODOLOGY

Designated primary shelter in Suzu, Japan (7/26/2024 Photo Credit: Alex Greer)

1.5 shelter in Kanazawa, Japan (7/31/2024 Photo Credit: Alex Greer)

Data Collection:
- Qualitative
  - 16 semi-structured interviews
    - Central, prefecture, and local government representatives
    - Shelter operators
    - NGO representatives
- Quantitative
  - Surveys were distributed across cities/towns with differing levels of major house damage in the tsunami-affected Ishikawa Prefecture
  - A total of 3,600 surveys were distributed

Analyses:
- Qualitative
  - First-cycle open coding followed by second-cycle focused coding
- Quantitative
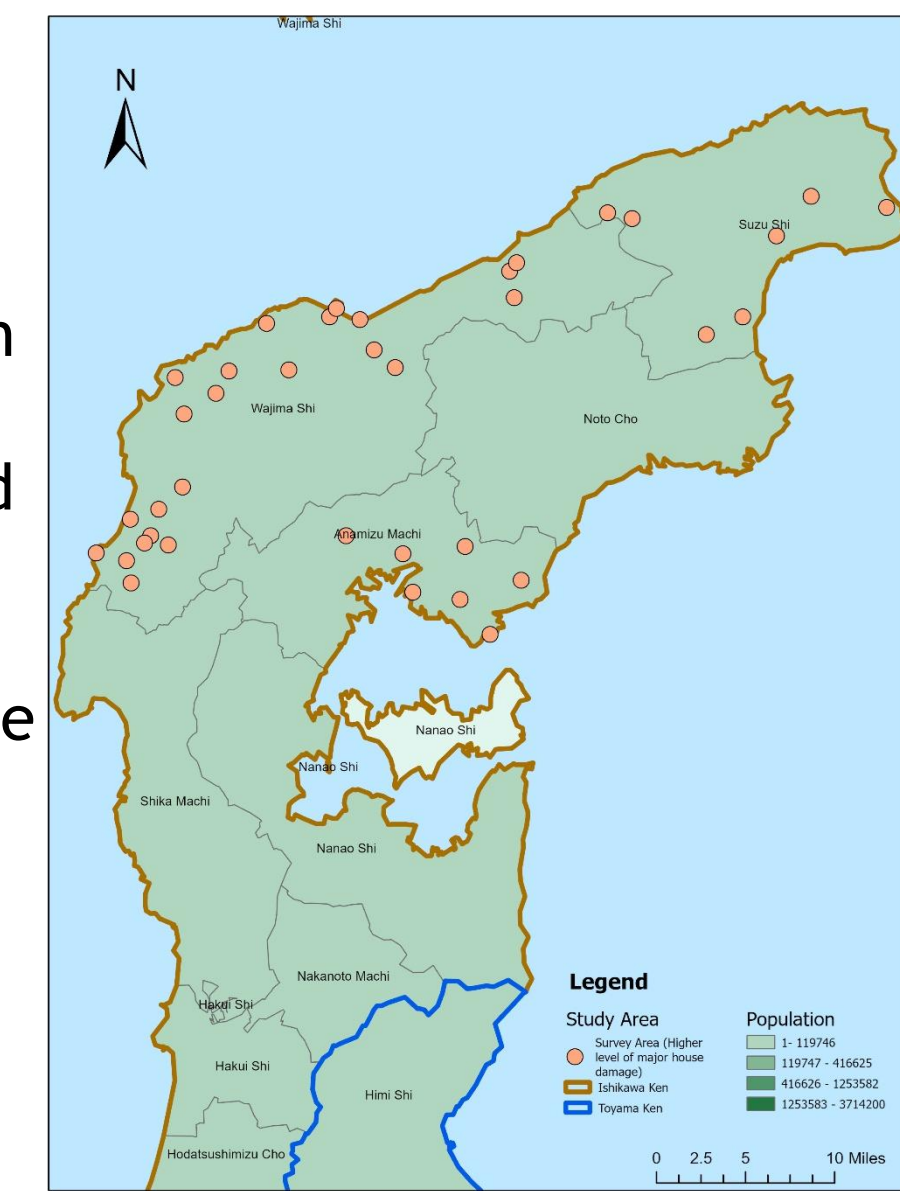 - Structural Equation Modeling

FINDINGS

Qualitative findings
- Shift to a step-wise model for sheltering improvised to address the geographical challenges along with acute and long-term medical needs
- Narratives reflected a reactionary response approach heavily influenced by lessons learned in response to the COVID-19 pandemic and the 2011 Tōhoku Earthquake and Tsunami
- Perceptions were mixed regarding who made decisions during the evacuation and sheltering operation, reflecting a disconnect between local- and prefecture-level decision-making
- Beyond impacts of the earthquake itself, the distributed evacuation threatens the sustainability of towns in the Noto region

Shelter in Noto, Japan (7/24/2024 Photo Credit: Alex Greer)

Quantitative data collection is ongoing
- The household survey measures risk perceptions, sources of risk information, social and environmental contexts, immediate responses, tsunami evacuation behavior, evacuation destinations, past tsunami and earthquake experiences, and demographic information.
- The survey was distributed between January and March 2025. To date, we have received 1,900 responses, resulting in a 52% response rate.
- Road damage data was collected from reports by the Japanese national government and the Ishikawa Prefecture government.

Legend
Study Area
- Survey Area (Higher level of major house damage)
- level of major house damage
- Ishikawa Ken
- Toyama Ken

Population
- 0 - 11976
- 11977 - 43625
- 43626 - 125062
- 125063 - 371435

0 2.5 5 10 Miles

IMPLICATIONS & NEXT STEPS

- The survey results will be compared with other evacuation events—such as wildfires, tsunamis, and hurricanes—that used similar survey instruments.
- Insights from this study will help validate tools used by emergency managers to respond to complex disasters and guide the development of effective policies along the U.S. West Coast and globally.
- The findings and collaborations established through this project will also support future research into the recovery process of the Noto Peninsula, which has been impacted by multiple disasters, including floods and earthquakes, in the months following the 2024 Noto earthquake and tsunami.