



## A41 Locational Analysis of the Camp Fire Fatalities in Communities and Residences

*Casey A. Hegel, BA\*, California State University, Chico, Chico, CA 95929; Samuel A. Mijal, BS, Chico, CA 95926*

**Learning Overview:** After attending this presentation, attendees will understand the application of Geographic Information Systems (GIS) to forensic anthropology for the spatial analysis of fatalities in a mass disaster.

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by demonstrating the use of geospatial analysis to examine mass fatality events to assist communities in identifying vulnerability in a population and to aid in recovery efforts.

On Thursday, November 8, 2018, a brush fire in Pulga, CA, started early in the morning. Fueled by high winds and overall dry climate from significant droughts, the fire swept through the towns of Concow, Paradise, and Magalia. These towns are all foothill communities, with Magalia and Paradise having one arterial road, named the Skyway, to get in and out of the town. The Camp Fire is currently the deadliest and most destructive fire in California's history. The fire burned more than 150,000 acres, more than 18,000 structures were destroyed, and it resulted in 85 fatalities. With the increase of fire events, it is important to examine disasters to identify vulnerable individuals in communities in order to help prevent fatalities in future mass disaster events.

This analysis utilizes ArcMap® 10.7 to spatially examine the locations of the fatalities from the Camp Fire. Data on fire victims and the locations where these individuals were recovered was provided by Butte County Sheriff's Office. Information concerning the victims' disabilities came from local newspaper accounts that consisted primarily of personal recollections from family members and friends. The fire perimeter used for this analysis was obtained from the California Department of Forestry and Fire Protection (CAL FIRE) website. Shapefiles for roads and counties were downloaded from United States census data. Landsat 8 satellite imagery was also utilized.

GIS analysis allows for assessment of factors that could have contributed to the deaths of individuals in the Camp Fire. This includes the location of fatalities in relation to the spread of the fire across the communities. The victims' ages, sex, and any mobility-inhibiting disabilities are also assessed. Furthermore, the distance from home addresses to where victims were found in vehicles on arterial and secondary thoroughfares is evaluated to assess the relationship between the human response to the fire spreading and to evaluate how traffic congestion in the early hours of the fire contributed to the high fatality rate for this fire.

Results from spatial analysis led to several conclusions. Primarily, it is concluded from this study that proximity to arterial thoroughfares did not influence the Camp Fire victim demographics. In addition, this study identified a lack of relationship between age and distance of remains from the origin of the fire, contrary to expectations. This suggests victim age and disability played a significant role in victim demographics, while distance from the fire's origin and the warning time it afforded was less of a factor. Finally, sex of the individual and distance from the origin of the fire were found to have no relationship, supporting the conclusion that sex was not a strong factor in the response to the fire and subsequent evacuation of the Camp Fire communities. A spatial autocorrelation, using Moran's I to examine fatalities and the variable of age, shows a significant positive relationship for a clustered pattern in the distribution of fatalities. This supports victim age as playing a role in victim demographics and indicates that individuals are likely not randomly dispersed throughout the towns of Concow, Paradise, and Magalia.

Geospatial examination of fire fatalities, as applied in this study, can allow for identifying preventative measures for communities that are particularly at risk and vulnerable in mass disaster events. Also, the examination of location patterns in fatalities could aid in future mass disaster recovery efforts of human remains.

### Mass Fatality Incident, Spatial Analysis, Camp Fire