Landslide risk assessment for King Range National Conservation Area

By: Ut Huynh, Aidan Williams, Stephen Trivett

December 5, 2014

Introduction

King Range is a mountain range located on the California North Coast in northern California. The entire area is protected by the King Range National Conservation Area (NCA) and managed by the Bureau of Land Management. Due to the rugged terrain of the area, engineers were unable to build State Route 1 near the coast and were inclined to build roads close to the town of Leggett. King Range still remains an inaccessible coastal wilderness that can only been accessed through a few back roads. King Range NCA is inhabited by various diverse populations of animals and plant species; federally endangered species also occur in the range as well. The topography of the area runs steeply to the Pacific Ocean. This assessment will evaluate the potential landslide risks of a given area and how it will affect the main roads and riparian zones in the area.

Methods

GIS data sets were first downloaded from the Humboldt County GIS Data Pool website and the Bureau of Land Management GIS Data website. ArcMap 10.1 by ESRI was used to display and manipulate all data used. The spatial reference used for all data sets was the North American Datum Universal Transverse Mercator Zone 10 North. Multiple digital elevation model (DEM) quadrangles of the general area of the King Range Conservation Area were uploaded into ArcMap and then mosaicked together to form one raster data layer. Next, a vector polygon layer of the King Range was uploaded into ArcMap. Using the “raster clip” tool, the DEM was clipped to the King Range polygon in order to remove excess data that resided outside of the King Range. From the ArcToolbox, the “slope” tool was used to convert the DEM to a slope raster data layer. Next, the “raster calculator” tool was used to calculate all areas with slopes between 45 degrees and 75 degrees. Red was used to differentiate areas with slopes between 45 degrees and 75 degrees from other areas of the King Range.

A hydrography data set of Humboldt County was then uploaded into ArcMap. The hydrography layer was then clipped to the King Range polygon to only display rivers and streams that exist within the King Range. A general topography base map from ESRI was added as the background of the map. Map elements such as a north arrow symbol, scale bar symbol, and map legend were added to complete the site-map of the King Range conservation Area. Following the completion of the site-map, we created a locator map that displayed the outline of Humboldt County and the approximate location of the King Range Conservation Area (see Figure 1).

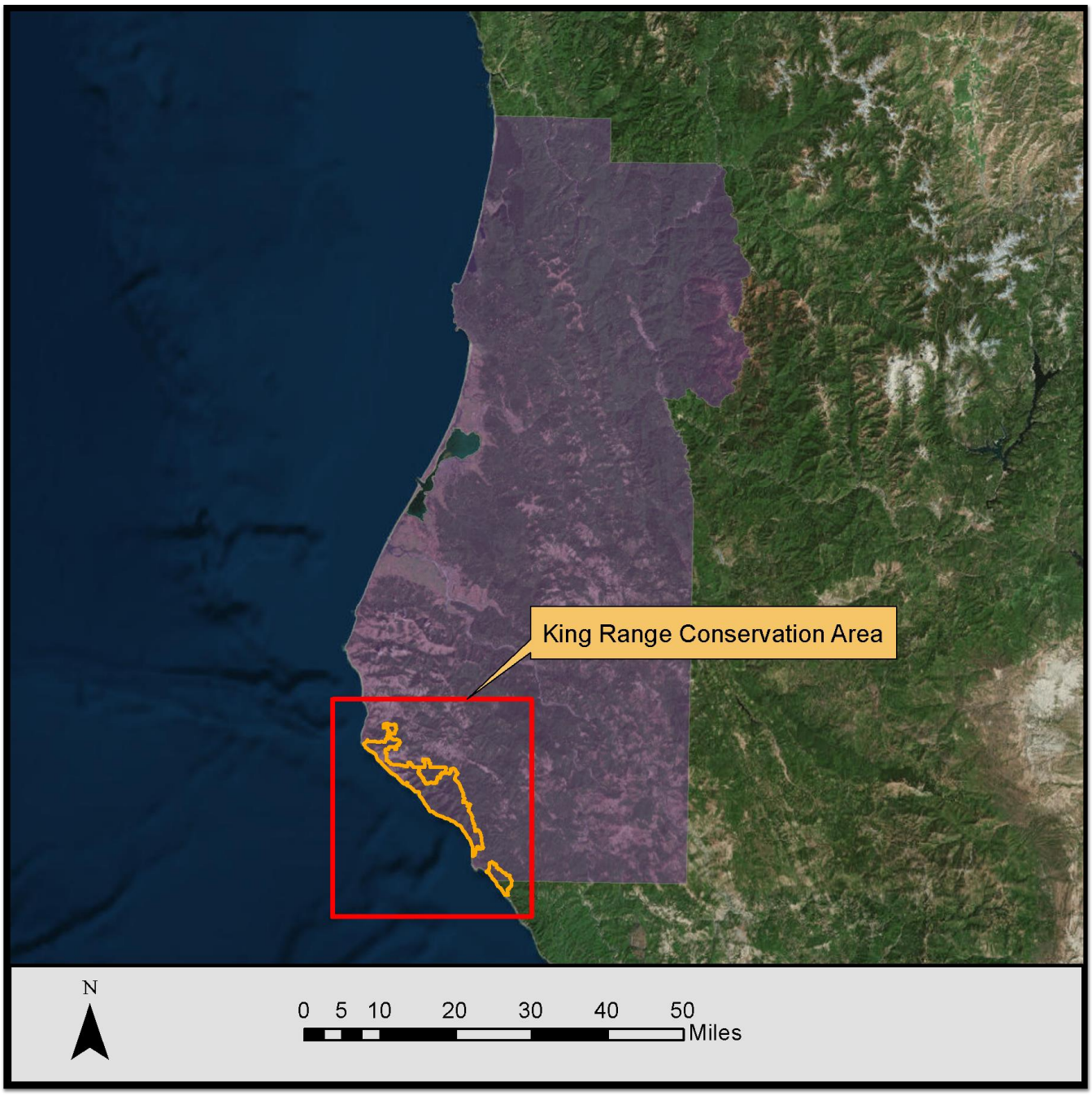

Figure 1. King Range National Conservation Area.

Results

This assessment depicts the landslide risk near riparian zones within the King Range National Conversation Area. It is apparent that slopes between 45%-75% in steepness have a moderate to high landslide risk in this area. Humboldt County is generally known for its high seismic activity due to the location of the triple junction in close proximity to the county line. With the high accumulation rates of organic-rich sediment and local steeping of slopes by tectonic uplifts, areas with a 55% slope are highly susceptible to land slide risks (Gardener 1999; Geertsema 598). Figure 2. illustrates the moderate to high landslide risk in King Range.

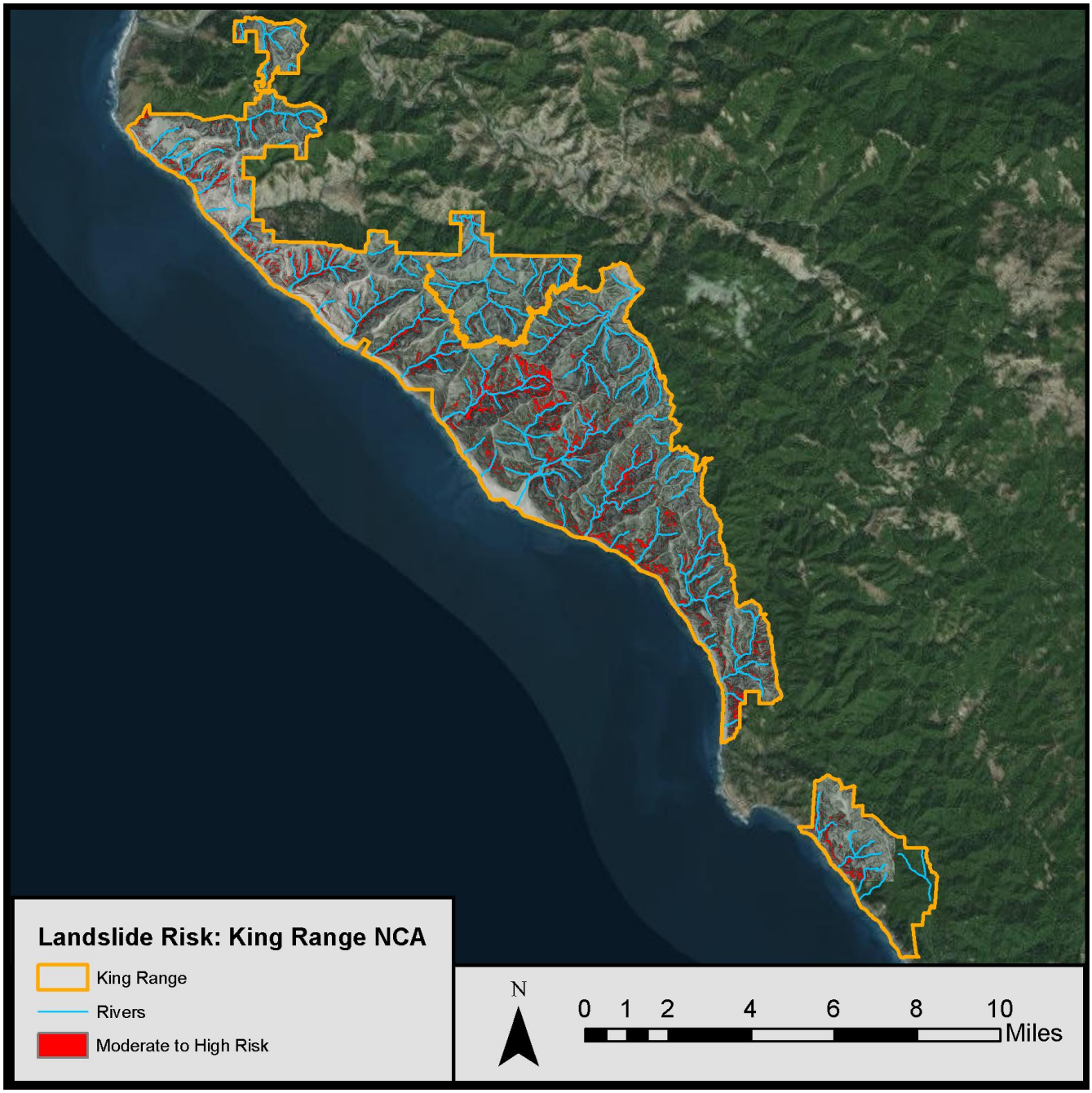

Figure 2. Landslide Risk in King Range National Conservation Area.

Landslides will also affect the water quality of the area and cause moderate damage to the habitat in the area. Landslides cause large woody debris and sediment to enter the stream and flood the area—destroying vegetation and aquatic habitats—changing the dynamics of the area. Woody debris "jams control channels and provide refugia against flood scour for vegetation development lasting decades or even centuries" (Naiman). This disturbance causes a change in the ecosystem by allowing the succession of newer vegetation and contributes to species richness in the area by creating a habitat of various physical conditions that allow a large number of species to

coexist. Increased sediment levels in freshwater streams can also impact steelhead trout populations that reside in a majority of creeks in King Range. (Armantrout 1973). High levels of sediment can inhibit the spawning of juvenile steelhead by entrapping newly hatched trout and decreasing the amount of dissolved oxygen available to them. (Suttle. 2004).

Conclusion

Most of the moderate to high landslide risk areas of King Range National Conservation Area are found along the river corridors of various streams that reside within the conservation area. Potential landslides will mostly have an impact on the surrounding ecological systems as well as the water quality of the rivers. Further data such as recreation and trail information is required in order to fully analyze the impacts that the potential landslide risk areas will have to the surrounding land. Further data is also needed in order to further analyze the potential risk of landslides occurring in the areas that were already identified as having a moderate to high risk based on slope. Precise and accurate soil data would be needed to determine if the soils found on these sites are more susceptible to erosion and runoff. Vegetative information is also needed in order to further evaluate the susceptibility of the sites to erosion.

Acknowledgements

Funding, computer access, IT assistance, faculty members, and facilities were provided by Humboldt State University.

Bibliography

Armantrout, Niel B. 1973. King Range National Conservation Area Aquatic Inventory. California – Nevada Wildlife. Bureau of Land Management.

Bureau of Land Management[computer file].2013. NLCS Wilderness Areas, Humboldt County/CA: U.S. Department of the Interior. Available FTP: www.blm.gov/ca/gis/nclswilderness v10 [November 3,2014]

Gardner, J.V., D.B. Prior, and M.E. Field. 1999. Humboldt Slide—a large-sher-dominated retrograssive slope failure. Marine Geology. 154:323-338

Geertsema.M., L. Highland, and L. Vaugeouis. 2009. Environmental Impacts of Landslides. Landslides—Disaster Risk Reduction. pp.: 589

Humboldt County GIS[computer files] Eureka, Humboldt County/CA: Humboldt County California's Redwood Coast. Available FTP: www.humboldtgov.org/276/GIS-Data-Down-load [November 3, 2014]

"King Range National Conservation Area and The Lost Coast, Arcata Field Office, Bureau of Land Management California." *King Range National Conservation Area and*

The Lost Coast, Arcata Field Office, Bureau of Land Management California., n.d. Web 3 Nov. 2014.

Naiman. R.J., R.E. Bilby, and P.A. Bisson. 2000. Riparian Ecology and Management in the Pacific Coastal Rain Forest. BioScience. 50:996-1011

Suttle, K. B., Power, M. E., Levine, J. M., & McNeely, C. (2004). How fine sediment in riverbeds impairs growth and survival of juvenile salmonids. *Ecological Applications*, *14*(4), 969-974. Retrieved November 17, 2014 from http://www.jstor.org/stable/4493596