Mapping Current and Future Landslide Susceptibility with GIS for the Tualatin Mountains, Oregon, USA

INTRODUCTION

*Landslides are bad... but good*

**Avg. Annual Cost**
- $2 billion and 20 – 50 fatalities nationally
- > $10 million in Oregon

**Benefits**
- Introduce essential components of salmonid habitat (e.g. sediment and LWD)
- Component of beneficial disturbance regimes—optimizing biodiversity
INTRODUCTION CONT’D

Estimated increases in precipitation due to climate change, and the inevitable pressures of urban growth, further emphasize the need for spatially explicit susceptibility indices.

STATEMENT OF PURPOSE

This study intended to create a landslide susceptibility index for the Tualatin Mountains west of Portland, Oregon, that synthesized geospatially variable data from historic landslide records, soil types, elevation, slope, land cover, and precipitation values.

1 map,

4 LSIs !!!

But wait, there’s more...
HYPOTHESIS

We expected to see considerable increases in landslide susceptibility for future projections caused by climate change induced increases in precipitation.

METHODS

-Study Area and Datasets
**Study Area and Datasets Cont’d**

<table>
<thead>
<tr>
<th>Layer</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Elevation Model (DEM)</td>
<td>Portland State University. Retrieved from: I:\Students\Data\GIS\Oregon\DEM\Oregon10mDEMs\nw</td>
</tr>
<tr>
<td>Slope</td>
<td>Created from DEM</td>
</tr>
</tbody>
</table>

**METHODS**

**-Dataset Preparation**

1. Create polygon feature to define extent of all future raster analysis.

2. Convert historic landslide points from vector to raster using *Point to Raster* tool.

![Study Area and Analysis Polygon](image)
3. The quantification of qualitative values

**Land cover**

<table>
<thead>
<tr>
<th>IF</th>
<th>Open water</th>
<th>Developed land</th>
<th>Forested or shrub</th>
<th>Grass/crop land</th>
<th>Barren land</th>
</tr>
</thead>
<tbody>
<tr>
<td>THEN</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

**Soils**

<table>
<thead>
<tr>
<th>IF</th>
<th>Clay</th>
<th>Loam</th>
<th>Silt</th>
<th>Sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>THEN</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
4. Reclassification of quantitative values

Precipitation  
Slope  
Land Cover  
Soil Type  
Historic Landslide Points

\[(cell\_value) \div (Max\_cell\_value) = new\_value,\]

where

\[0 \leq (new\_value) \leq 1\]

5. Re-sampling to achieve consistent cell size

Dataset Preparation Cont’d
Creating a Landslide Susceptibility Index (LSI)

Historic Landslide Points
- Precipitation
- Land Cover
- Soil Type
- Slope

LSI

Creating Future Landslide Susceptibility Indices

Raster Calculator

<table>
<thead>
<tr>
<th>Percent Change</th>
<th>Multiplier Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020s +1.3</td>
<td>1.013</td>
</tr>
<tr>
<td>2040s +2.3</td>
<td>1.023</td>
</tr>
<tr>
<td>2080s +3.8</td>
<td>1.038</td>
</tr>
</tbody>
</table>

Estimated changes in precipitation are based on estimates from Mote and Salathe (2010), and Littell et al. (2011).
RESULTS CONT’D

[Bar chart showing index values for different time periods: Current, 2020s, 2040s, 2080s.

DISCUSSION

Hypothesis: Increased precipitation will cause considerable increase in landslide susceptibility

[Red cross symbol and red text over the hypothesis]

Hypothesis: Increased precipitation will not cause considerable increase in landslide susceptibility
DISCUSSION CONT’D

Improvements:
• Include other dynamic causative factors
  – E.g. land use change as a function of population growth.
• Optimize accuracy by researching the best weighting techniques.

THANK YOU!

QUESTIONS?
REFERENCES


