The Effects of Climate Change on Beaver Habitat Suitability in Northwest rivers

By Aaron Tam, Benjamin Dittbrenner, and Joshua Lawler

School of Environmental and Forest Sciences, University of Washington

Introduction

Through wetland creation, beavers create habitats for many animals, increase biodiversity, and provide vital ecosystem services.

Climate models project a shift to higher summer air temperatures, decreased snowpack and glaciers, earlier peak stream flows, increase in flooding frequency, and decline in summer stream flows in the Pacific Northwest region.

Changes in stream-flow timing and magnitude could reduce beaver habitat by blowing out beaver dams during peak flow and dry out previous habitable areas during low flow.

Objectives:
- Model suitable beaver habitat based on stream flows and how that will change from now to 2040 and 2080
- Determine accuracy of the model

Methods

- Calculated and modeled historical (<2000), 2040, and 2080 stream powers in Pacific Northwest streams using the Western US Stream Flow Metric Dataset and bankfull discharge estimates, joined with the National Hydrography Dataset.
- Predicted suitable beaver habitat in historical, 2040, 2080 models where stream power at bankfull discharge was less than 2000 \( \frac{m^3}{s} \), and the drainage area is greater than 0.2km\(^2\).
- Analyzed completeness and accuracy of model by comparing to Beaver Intrinsic Potential model

Change Table

<table>
<thead>
<tr>
<th>Change</th>
<th>Historic to 2040</th>
<th>2040 to 2080</th>
<th>Historical to 2080</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis area (km(^2))</td>
<td>622,514</td>
<td>22,491.947</td>
<td></td>
</tr>
<tr>
<td>Total stream length (km)</td>
<td>460,875</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total suitable habitat (km)</td>
<td>396,730</td>
<td>391,261</td>
<td>375,091.18</td>
</tr>
<tr>
<td>Total suitable habitat (%)</td>
<td>86.2</td>
<td>84.9</td>
<td>81.4</td>
</tr>
</tbody>
</table>

Change to unsuitable habitat
- km: 6,491.32 to 16,883.06 to 22,491.947
- %: 1.64% to 4.32% to 5.67%

Change to suitable habitat
- km: 1,022,083 to 712,951 to 852,605
- %: 0.26% to 0.18% to 0.21%

Results

Historical Suitable Habitat

Δ Habitat (Historic to 2040)

Δ Habitat (Historic to 2080)

Analysis of Accuracy

Confidence: Extremely High (0-25m)
- BIP model suitability prediction
  - Unsuitable: 27,620
  - Suitable: 2,003

WUSSFMD model suitability predictions
- Unsuitable: 9,598
- Suitable: 13,532

Sensitivity: 0.7421
Specificity: 0.8711
Accuracy: 0.7801, 95% CI (0.7765, 0.7836)

McNemar’s test: p-value < 2.2e-16

Discussion

Loss of 22,491.947 km of potential suitable beaver habitat by 2080 could mean species, such as salmon and frogs, that rely upon beaver-driven wetlands and riparian habitat could decrease in population size and range. Loss of beaver dams may also negatively impact agriculture and similar land uses due to these hydrologic alterations.

This is a conservative estimate as the NHD flowlines, which this model is based on, only capture larger streams. Furthermore, many of the small streams that are omitted may provide high quality beaver habitat.

Recommendations for further research:
- How do beavers respond to changing hydrologic conditions due to climate change?

Acknowledgements

This research would not be possible without the help of Ben Dittbrenner and Joshua Lawler and the work of Michael Pollock and the Rocky Mountain Research Station.