The Sound of Science: What Can Songbirds Tell Us About Forest Ecosystems on the Olympic Peninsula?

Background
Intensely managed forests can degrade wildlife habitat quality
Washington Department of Natural Resources integrates ecosystem health & timber production
Traditional monitoring methods can be resource intensive, especially in rough terrain and large spatial and temporal scales
Acoustic monitoring offers an efficient way to collect data and inform integrative forest management strategies

Are songbirds occupying areas of the Olympic Peninsula according to known habitat associations? What factors influence occupancy and detection?

Internship & Methods
Interned with DNR processing acoustic surveys to detect presence of 10 songbird species across 4 forest stages (fig. 8)
Examined spectrograms (fig. 3) for bird vocalizations, aircraft, & rain events
Literature review of habitat associations for Pacific-slope Flycatcher and Orange-crowned Warbler
Modeled occupancy using variables of forest stage, aircraft, rain, and Julian day (DNR data from 86 stations, 4 repeat surveys per station)

Results
Orange-crowned Warbler Observations by Forest Stage

<table>
<thead>
<tr>
<th>Forest Stage</th>
<th>Stand Initiation Exclusion</th>
<th>Stem Thinned</th>
<th>Mature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>37</td>
<td>0</td>
<td>1</td>
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</tbody>
</table>

Known to Inhabit
- Mature mixed forest, deep shade and humidity
- Canopy gaps
- Snags
- Riparian areas

Figure 3. Spectrogram view of survey in Audacity showing 3-syllable song of Pacific-slope Flycatcher

Pacific-slope Flycatcher Observations by Forest Stage

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</thead>
<tbody>
<tr>
<td>Observations</td>
<td>10</td>
<td>48</td>
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Figure 4. Pacific-slope Flycatcher

Figure 5. Bar graph illustrating species detection at each forest stage

Forest Stage strong predictor of occupancy
Rain had negative effect on detection
Aircraft & Julian day had slight positive effect on detection probability

Forest stage strong predictor of occupancy

Aircraft had positive effect on detection
Julian day & rain had negative effect

Figure 6. Orange-crowned Warbler

Takeaways
Forest stage strong predictor of habitat use, and both species found to use expected habitat areas
Acoustic Monitoring is effective method for tracking forest songbirds
Rain & aircraft events impact detection probability

Significance
Acoustic monitoring allows efficient study of environmental soundscape in difficult terrain at large spatiotemporal scales
Ecologically informed forest management is an opportunity to enhance and protect ecosystem health AND provide forest resources for humans
Biodiversity loss and pressure on resources requires deeper ecological understanding in a changing climate

Acknowledgements
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