Apr 5th, 10:00 AM - 11:30 AM

Seven years of development and change within 200' of the shore in Puget Sound

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Pierce, Kenneth; Quinn, Timothy; Folkerts, Keith; Miller, Jeanne; Samson, Kevin; and Muller, Matt, "Seven years of development and change within 200' of the shore in Puget Sound" (2018). Salish Sea Ecosystem Conference. 119.


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Speaker
Kenneth Pierce, Timothy Quinn, Keith Folkerts, Jeanne Miller, Kevin Samson, and Matt Muller

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A New View of Shoreline Terrestrial Change:
Mapping shoreline urbanization and forestry activities from 2006-2013 using high-resolution (1-m) imagery data

Kenneth B. Pierce Jr., Timothy Quinn, Keith Folkerts, Jeanne Miller, Kevin Samson
WDFW Habitat Science Division
Apr 5, 2018
WA Dept. of Fish & Wildlife’s High Resolution Change Detection Program

• Land cover change measured from 1m NAIP data
• Use aerial imagery as source and truth
• Focuses on mapping urbanization and canopy loss
• Completed/funded time-periods
  – 2006-2009
  – 2009-2011
  – 2011-2013
  – 2015-2017 (fall 2019)
Shoreline Monitoring Methods

• Satellite/Aerial Remote sensing
  – Shoreline itself (aggrading, eroding, slope, etc.)
  – Upland urbanization
  – Shoreline vegetation
  – Restoration success

• Beach surveys / Field sampling / Boat surveys
  – Shoreline itself (aggrading, eroding, slope, etc.)
  – Shoreline vegetation
  – Restoration success
  – Biological response
  – Water quality
  – Shoreline armoring
Two views of the shore

Landsat 30-m pixel
139-ft diagonal

NAIP 1-m pixel
4.6-ft diagonal
2006-2013 Puget Sound Change Map

- 142,548 Change events
- 218,770 Change acres
- 57,834 Acres Canopy removal
- 155,656 Acres Timber harvest
- 12,500 Acres New Impervious

Scale: ~219,000 acres

Event size is exaggerated for visibility.
Mixed to Developed Example

Cover: Mixed Non-built
Area: 0.68 acres

Change Type: Development
Changed area: 50%
Tree decrease: 25%
Impervious increase: 25%
Semi-pervious increase: 25%
Analysis procedure

1. Clipped all change polygons along the 4,000 km shoreline to the
   1. 0-200’
   2. 200’-400’
   3. 400’-600’
2. Reassessed change within just 0-200’ buffer area.
3. Added second change descriptor
   1. Verified change
   2. Landslide
   3. Error: positional
   4. Error: human
4. Clipped CCAP change polygons and reassessed change within the 0-200’ buffer
HRCD Positional Error

Change location, 32 acres
HRCD Positional Error

Change location, 32 acres
75% Canopy loss

HRCD assumes change is evenly distributed
HRCD Positional Error

Change location, 32 acres
75% Canopy loss

Change polygon 0-200’
Area 2.8 acres

HRCD assumes change is evenly distributed
HRCD Positional Error

HRCD assumes change is evenly distributed
HRCD Positional Error

HRCD assumes change is evenly distributed

2009
HRCD Positional Error

Change polygon 0-200’
Area 0.7 acres

HRCD assumes change is evenly distributed
HRCD 2006-2013

• 19 WRIAs per time period
• Change locations
  – 0-200’ : 2,951
  – 0-400’ : 4,733
  – 0-600’ : 6,194
2006 Naip imagery
200’ – yellow
400’ – purple
600’ – blue
Changes - orange
2013 Naip imagery
200’ – yellow
400’ – purple
600’ – blue
Changes - orange
Change by agent
CCAP error example

Palustrine Aquatic Bed to Developed

Pasture/Hay to Developed

Unconsolidated Shore to Developed

Grassland to Developed

Wetland to Developed
## HRCD-CCAP Comparison

<table>
<thead>
<tr>
<th></th>
<th>CCAP 2006-2011</th>
<th>HRCD 2006-2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intersecting Polygons 0-200’</td>
<td>928</td>
<td>2128</td>
</tr>
<tr>
<td>Area 0-200’</td>
<td>335 ac</td>
<td>369 ac</td>
</tr>
<tr>
<td>Reported change</td>
<td>335 ac</td>
<td>234 ac</td>
</tr>
<tr>
<td>Verified mapped change</td>
<td>11 ac</td>
<td>207 ac</td>
</tr>
<tr>
<td>Verified change locations</td>
<td>103</td>
<td>1857</td>
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</tbody>
</table>
HRCD changes split at CCAP
minimum mapping unit of 1.33 acres

HRCD counts include 2011-2013 locations. This time period not yet mapped by CCAP
Largest of 226 Landslides
Largest change location (6 acres)
Largest change location (6 acres)
Largest change location (6 acres)
Largest change location (6 acres)
Largest change location (6 acres)
Summary

• Land-cover change along the shoreline management zone primarily occurs as events that are smaller than the minimum detection threshold for Landsat analyses.

• HRCD provides a fully verified database of land-cover change locations specifically focusing on canopy loss and urbanization with a minimum mapping unit of 1/20 acre.

• HRCD mapped 303 acres of change in 2,399 change locations within the 2500-mile by 200-foot strip of land along the Puget Sound shoreline during 2006-2013.
Thanks!

Data: www.PSHRCD.com

• Funding provided by:
  – EPA Lead Organization Grants administered by Dept. of Ecology and Dept. of Commerce
  – Recreation and Conservation Office
  – Dept. of Ecology Wetlands Grant
  – Salmon Recovery Funding Board

"This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement PC-01J22301 through the Washington Department of Fish and Wildlife. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency or the Washington Department of Fish and Wildlife, nor does mention of trade names or commercial products constitute endorsement or recommendation for use."
### Reanalysis of HRCD shoreline change polygons (acres)

<table>
<thead>
<tr>
<th></th>
<th>HRCD</th>
<th>HRCD Reanalysis</th>
<th>Difference</th>
<th>Locations</th>
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</thead>
<tbody>
<tr>
<td>Anthropogenic</td>
<td>250</td>
<td>268</td>
<td>18</td>
<td>2179</td>
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<tr>
<td>Natural</td>
<td>33</td>
<td>35</td>
<td>2</td>
<td>243</td>
</tr>
<tr>
<td>Positional Error</td>
<td>36</td>
<td>0</td>
<td>-36</td>
<td>384</td>
</tr>
<tr>
<td>Human Error</td>
<td>20</td>
<td>0</td>
<td>-20*</td>
<td>132</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>339</td>
<td>303</td>
<td>-36</td>
<td>2938</td>
</tr>
</tbody>
</table>

*16 acres of human error was during the initial 2006-2009 analysis*