Salish Sea Ecosystem Conference

May 1st, 3:30 PM - 5:00 PM

Changes in Kelp and Other Seaweeds Following Elwha Dam Removal

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Speaker
Stephen P. Rubin, Helen Berry, Nancy Elder, Ian Miller, Jeff Duda, Melissa M. Foley, Jonathan A. Warrick, Matt Beirne, Mike McHenry, and Rob Pedersen

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Changes in Kelp and Other Seaweeds Following Elwha Dam Removal

Steve Rubin\(^1\), Helen Berry\(^2\), Nancy Elder\(^3\), Ian Miller\(^4\), Jeff Duda\(^1\), Melissa Foley\(^5\), Jon Warrick\(^5\), Matt Beirne\(^6\), Mike McHenry\(^6\), Rob Pedersen\(^7\)

\(^1\)USGS Western Fisheries Research Center
\(^2\)WA Department of Natural Resources
\(^3\)USGS WFRC Marrowstone Marine Station
\(^4\)WA Sea Grant, Port Angeles WA
\(^5\)USGS Pacific Coastal and Marine Science Center
\(^6\)Lower Elwha Klallam Tribe
\(^7\)USEPA Region 10 Environmental Cleanup Office
Nearshore Vegetation

- Diverse algae and seagrasses
- 3-D structure
- Important food source to local and distant ecosystems
Expected Changes

- **Long-term**
  - Shift toward soft sediment species

- **Short-term**
  - Turbidity
  - Scour
  - Burial
Floating Kelp Monitoring Methods (Since 1989)

Near-vertical aerial photography collected from small plane during a late summer low tide (7500’ MSL) with Nikon D200 digital 35mm DSLR camera. Hand delineated onto 1:12K basemaps.
Floating Kelp Canopy Area Changes Following Elwha Dam Removal

-53% (2011-2013)

Crescent Bay -54%
Tongue Pt - Observatory Pt -42%
Freshwater Bay -74%
Angeles Point - Elwha Bluffs -100%
Ediz Hook +14%
Dungeness Bluffs -7%
Dungeness Spit -42%

<table>
<thead>
<tr>
<th>Location</th>
<th>1989-2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
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<tbody>
<tr>
<td>Crescent Bay</td>
<td></td>
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<td></td>
<td>-54%</td>
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<td></td>
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<td>-42%</td>
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Canopy Area (ha)

0 10 20 30 40 50 60 70

2011 2012 2013
Underwater Transects Surveyed in 2010*, 2012 & 2013 from shallow to -15 m

* Thanks to Clallam County (Cathy Lear) and MRC (Jim Norris) for 2010 imagery.
Underwater Video Classification

• Vegetation Types
  – All macrovegetation
    • All kelp
      – Stipitate kelp
      – Prostrate kelp
      – Floating kelp
    • Non-kelp red/brown algae
    • Green algae
    • Seagrass

• Cover classes
  – Really Low <15%
  – Low 15-33%
  – Medium 33-66%
  – High 66-85%
  – Really High >85%

Mapping Unit ~ 1 m²
Directly east of the Elwha River mouth, -8 m (MLLW).
Major Decrease in Area with Vegetation Present, 2010-2013

Area (ha)

-20% **
-57% **
-73%**
-54%*

Weighted Linear regression
* p < 0.2
** p < 0.05
Dive surveys

- Identify and count plants in 30 m x 1 m swaths
- Transect endpoint markers on seafloor:
  - End pyramid
  - Center post
- Two transects per site
- Seasonal window: Late July-early September
- Surveys conducted annually at 17 sites:
  - 1 site: 2009-2013
  - 4 sites: 2010-2013
  - 9 sites: 2011-2013
  - 3 sites: 2009 (GPS only, no endpoint markers), 2012-2013
All kelp

- Density before dam removal
All kelp

• Percent change in density after dam removal
Kelp species

- Density before dam removal and in 2012 and 2013
Kelp species

- Density before dam removal and in 2012 and 2013

![Graph showing kelp species density](image)

- **Nereocystis luetkeana** (bull kelp)

<table>
<thead>
<tr>
<th>Species</th>
<th>Before</th>
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<th>2013</th>
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<tbody>
<tr>
<td>Agarum fimbriatum</td>
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<tr>
<td>Alaria marginata</td>
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<td>Costaria costata</td>
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<td>Cymathere triplicata</td>
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<tr>
<td>Laminaria setchellii</td>
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<tr>
<td>Pterygophora californica</td>
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Kelp species

- Density before dam removal and in 2012 and 2013

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<tr>
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Kelp species

- Density before dam removal and in 2012 and 2013
Other seaweeds

• Also decreased after dam removal

• Acid kelp (*Desmarestia* spp):

• Red algae (*Rhodophyta*):

• Kelp + acid kelp + red algae = total vegetation
Unseasonal recruitment

- Juveniles appeared in late August 2013

Not present August 16

Present August 30
Unseasonal recruitment

• Species that typically recruit in spring:

  - Alaria marginata
  - Cymathere triplicata
  - Nereocystis luetkeana
  - Laminaria ephemera
  - Desmarestia “bushy”
  - Desmarestia “flat-bladded”

• Present at three sites:
Physical drivers

- Not “permanent” burial

Not buried

2012: 15 sites
2013: 11 sites

Buried

2012: 0 sites
2013: 4 sites
Physical drivers

- Not “permanent” burial

Gelfenbaum et al. in prep.
Physical drivers

- Ephemeral deposition
- Scour ("sandblasting")
- Light reduction

Photos from Jonathon Warrick
Chance to learn

- How does sedimentation affect kelp and other seaweeds?