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

Changes in Kelp and Other Seaweeds Following Elwha Dam Removal

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

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Steve Rubin¹, Helen Berry², Nancy Elder³, Ian Miller⁴, Jeff Duda¹, Melissa Foley⁵, Jon Warrick⁵, Matt Beirne⁶, Mike McHenry⁶, Rob Pedersen⁷

¹USGS Western Fisheries Research Center
²WA Department of Natural Resources
³USGS WFRC Marrowstone Marine Station
⁴WA Sea Grant, Port Angeles WA
⁵USGS Pacific Coastal and Marine Science Center
⁶Lower Elwha Klallam Tribe
⁷USEPA 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%

Floating Kelp
1989 - 2010
2011
2012
2013

Canopy Area (ha) -42% -74% -100% +14% -7% -42%

Tongue Pt - Observatory Pt
Freshwater Bay
Angeles Point – Elwha Bluffs
Ediz Hook
Dungeness Bluffs
Dungeness Spit

0 10 20 30 40 50 60 70
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

- All Vegetation
- Red/brown (non-kelp)
- Kelp - all
- Kelp - prostrate
- Kelp - stipitate
- Seagrass

Weighted Linear regression
* p < 0.2
** p < 0.05
Strong Gradient

2010 Median Cover Kelp All
- Absent
- Trace
- < 15%
- 15 - 32%
- 33 - 65%
- 66 - 85%
- > 85%

2012 Median Cover Kelp All
- Absent
- Trace
- < 15%
- 15 - 32%
- 33 - 65%
- 66 - 85%
- > 85%

2013 Median Cover Kelp All
- Absent
- Trace
- < 15%
- 15 - 32%
- 33 - 65%
- 66 - 85%
- > 85%
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

[Graph showing density of different kelp species before and after dam removal in 2012 and 2013]
Kelp species

- Density before dam removal and in 2012 and 2013

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<th>Species</th>
<th>Before</th>
<th>2012</th>
<th>2013</th>
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<td>Saccharina spp</td>
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Kelp species

- Density before dam removal and in 2012 and 2013

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**Cymathere triplicata**
Kelp species

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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-bladed”

• 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?