Response of Coastal Cutthroat Trout to Timber Harvest in Previously Harvested Headwater Catchments
Objective

• Evaluate the response of coastal cutthroat trout in previously logged catchments to timber harvest under current forest practice regulations
Fish Capture and Tagging

Single pass electrofishing

PIT-tags (23mm half duplex)
Fish Monitoring

Mobile PIT-tag antennas

Stationary (gate) PIT-tag antennas
North Fork Hinkle

South Fork Hinkle

Swim-through PIT tag antenna
Catchment Scale

North Fork Hinkle

South Fork Hinkle

Swim-through PIT tag antenna
Hypotheses On Behavioral Response

North Fork Hinkle

South Fork Hinkle

Swim through antenna
Hinkle Creek First Entry
Experimental Timeline: Hinkle Creek

Calibration Phase

2001

Study Begins

2006

Treatment 1:
(Non-Fish Bearing)

Treatment Phase

2009

Treatment 2:
(Fish Bearing)

Study Ends

2011

South Fork Treatments
Currently streams without fish or a domestic water use do not require the retention of a standing tree buffer.
Results
# Mean Biomass of Age 1+ Cutthroat Trout in Pool Habitats

**North and South Fork Hinkle Creek: Tributary Scale**

<table>
<thead>
<tr>
<th>Year</th>
<th>g/m²</th>
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<tbody>
<tr>
<td>2001</td>
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<td>2002</td>
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<td>2003</td>
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<td>2004</td>
<td>SFT post-treatment</td>
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![Graph showing mean biomass of age 1+ cutthroat trout in pool habitats over years 2001 to 2008.](image-url)

- **NFT pre-treatment**
- **NFT post-treatment**
- **SFT pre-treatment**
- **SFT post-treatment**
<table>
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<tr>
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<tr>
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<tr>
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↑ = detectable treatment effect with relative increase in treated catchment
↓ = detectable treatment effect with relative decline in treated catchment
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NA = not measured for this age class or species
IP = in process
### Summary First Harvest Catchment Scale

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Experimental Timeline: Hinkle Creek Study

- **Calibration Phase**
  - Study Begins: 2001

- **Treatment Phase**
  - Treatment 1: (Non-Fish Bearing) 2001-2006
  - Treatment 2: Log 4 MU (Fish Bearing) 2006-2011

Study Ends: 2011

---

Hinkle Creek

South Fork Treatments
### Summary Second Harvest Tributary Scale

<table>
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Habitat Summary Second Harvest

<table>
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<th>Response</th>
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<td>Fine Sediment</td>
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Alsea First Harvest
Experimental Timeline: Alsea Watershed Study Revised

- **Calibration Phase**
  - 2006: Study Begins

- **1st Harvest**
  - 2009: 1st Harvest Area
  - 2014: Swim Through PIT Tag Antennas

- **2nd Harvest**
  - 2017: Study Ends
  - 2014: 2nd Harvest Area

Map showing the extent of fish within study watersheds and stream gauges.

- **Legend**:
  - Stream Gauges
  - Extent of fish within study watersheds
  - Flynn Creek
  - Needle Branch

- **Scale**:
  - 0 to 1 km
  - 0 to 500 m
Needle Branch and Flynn Creek: Annual Total Biomass and Catch of Age 1+ Cutthroat Trout

Annual Biomass

- Needle Branch
- Flynn Creek

Logging Occurs

P = 0.04

Annual Catch

- Needle Branch
- Flynn Creek

Logging Occurs

P = 0.01

Year

- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012

Number of fish

- 0
- 50
- 100
- 150
- 200
- 250
- 300
- 350
- 400

Grams

- 0
- 500
- 1000
- 1500
- 2000
- 2500
- 3000
- 3500
- 4000
- 4500
- 5000
- 5500
- 6000
### Summary First Harvest

<table>
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<th>Response</th>
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<th>Coho</th>
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Hypothetical Response Curves from Mellina and Hinch (2009)
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Needle Branch: Age 1+ Cutthroat
Abundance 1966-2012
From Gregory et al 2008 and Bateman et al unpublished data
Hypothetical Response Curve from Mellina and Hinch (2009)

Needle Branch: Age 1+ Cutthroat Abundance 1966-2012 From Gregory et al 2008 and Bateman et al unpublished data
Total Large Wood Volume by Year from Flynn Creek and Needle Branch (10cm by 2m)
Large Wood Volume Through Time and by Location for Flynn Creek and Needle Branch (15cm by 2m)


`a` = the portions of the watersheds sampled during AWS and by Veldhuisen

`b` = the portions of the watersheds with fish that were not typically sampled during the AWS and upstream from the areas of large wood removal in Needle Branch
What Do We Know!

Hinkle Creek
• Headwater harvest:
  only increased abundance and biomass of age 1+ cutthroat trout in tributaries

• Downstream harvest:
  Biomass of all trout increased at catchment scale
  Size increased for age 0 trout and 1+cutthroat
growth increased for age 1+ cutthroat

Alsea
• Increased biomass and abundance of age 1+ cutthroat trout
• Decline in length of age 0 cutthroat trout
What Do We Know!

Overall

- Three years post-harvest: results for cutthroat trout are similar to those predicted from other studies

- The response of steelhead and coho differed from that of cutthroat trout

- No evidence of acute negative effects on habitat
What We Think!

• Increases in abundance/biomass will eventually peak and then decline
What We Hope to Learn!

• How will fish respond through time in these watersheds

• What the important changes in associated habitat will be
Proportion Harvested from 40 Randomly Selected 500-1000 ha Headwater Catchments in Western Oregon and the North and South Forks of Hinkle Creek (Torgersen et al unpublished data)
Cumulative Catch in Grams of Age 1+ Cutthroat Trout from Mainstems of Needle Branch and Flynn Creek

**Needle Branch**
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012

**Flynn Creek**

Distance (m)

Gams
Caveats

• Study sites not randomly selected
• Treatments within study sites not randomly assigned
Therefore scope of inference of results is limited to the study sites and the duration of the studies

• Hinkle reference site was a previously harvest catchment
• To date post-treatment periods are short i.e. one generation
• No extreme events like 50-100 year flood events?
South Fork Hinkle Pre-treatment Average Fish Distribution

Steelhead

Cutthroat Trout
Age 1+ Steelhead: Total Biomass by Year for the North and South Forks of Hinkle Creek

Year
Grams
0
2000
4000
6000
8000
10000
12000

NF Hinkle
SF Hinkle

Year
Grams
0
2000
4000
6000
8000
10000
12000

NF Hinkle
SF Hinkle
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<th>Stream</th>
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</table>
Positives!

- Hinkle Creek spatially very large relative to previous studies
- North and South Fork Hinkle are an excellent pair and as close to a treatment/control as is likely possible in non-laboratory environment
- There is replication at the tributary scale within Hinkle Creek
- Hinkle Creek and the Alsea streams have very different geologies and are located in different ecoregions
- Alsea has a long history for both fish and water quality parameters
- Flynn Creek is as an unharvested reference site and represents one of a very few catchments devoid of anthropogenic disturbance in the Coast Range or Oregon
- Analysis is at the catchment rather than at the reach scale
- Data are collected in a spatially explicit manner allowing analysis at multiple spatial scales
Distance from Downstream End of Flynn Creek and Needle Branch Mainstems to Point Where 50% of Age 1+ Cutthroat Biomass was Captured

Logging occurs

P=0.04
Cumulative Catch Age 0 Trout from Mainstems of Needle Branch and Flynn Creek

Needle Branch

- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012

Flynn Creek

Distance (m)

Cumulative catch
Summary

• Cutthroat Trout
  – increased biomass and abundance post harvest driven by increased number of age 1+ individuals
  – distribution of biomass shifted upstream post-treatment suggesting effects from harvest are localized
  – no detectable change in behavior

• Age 0 Trout
  – no evidence of treatment effect on abundance or biomass but some decline in mean fork length post-treatment in Needle Branch
Summary

• Coho
  – no evidence for a treatment effect on abundance, biomass, mean or 90th percentile of fork length, distribution, or condition

• Habitat
  – Overall few detectable changes
Comparing Flynn Creek and Needle Branch to ODFW Aquatic Inventory Project Habitat Benchmarks

<table>
<thead>
<tr>
<th>Stream</th>
<th>Pieces/100 m</th>
<th>% Pieces Conifer</th>
<th>M3/100 m</th>
<th>Key Pieces/100 m</th>
<th>Riffle Width/Depth</th>
<th>% Gravel</th>
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<td>Flynn</td>
<td>12.5</td>
<td>55</td>
<td>49.7</td>
<td>2.5</td>
<td>16*</td>
<td>44*</td>
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<td>Needle</td>
<td>15.8</td>
<td>58</td>
<td>36</td>
<td>2.3</td>
<td>15*</td>
<td>46*</td>
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*Averaged over all years

- 🙁 poor
- 🙂 intermediate
- 😊 good
Proportion of Outmigranting Cutthroat Trout by Month

1960-63*

Flynn Creek

Needle Branch

2006-08

Average proportion out

1960-63*

* From Lowry 1965
Alsea Watershed Study: Cutthroat Trout Biomass

Flynn Creek

Cutthroat trout g/m²

1962-65 Pre-treatment AWS
1966-74 Post-treatment AWS
1988-96*
2007-09 Pre-treatment NAWS
2010-12 Post-treatment NAWS

Needle Branch

* No sampling occurred in Needle Branch during 1988 due to low flows
Mean Wetted Channel Width by Sampling Period in Flynn Creek and Needle Branch

Sampling period
Mean wetted channel width (m)

Percent Pool Based on Stream Length in Flynn Creek and Needle Branch by Sampling Period

Sampling periods

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<thead>
<tr>
<th></th>
<th>Flynn Creek</th>
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<td>Pre-logging</td>
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<td>2010-12</td>
<td>NAWS</td>
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% Pool...