

# Effectiveness Assessment of Best Management Practices for Forestry in the Inland Pacific Northwest

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 Potlatch.



# Motivation

- Forest managers need to balance:
  - Resource extraction
  - Environmental sustainability
- Contemporary BMPs have not been adequately assessed



# Research and Management Needs

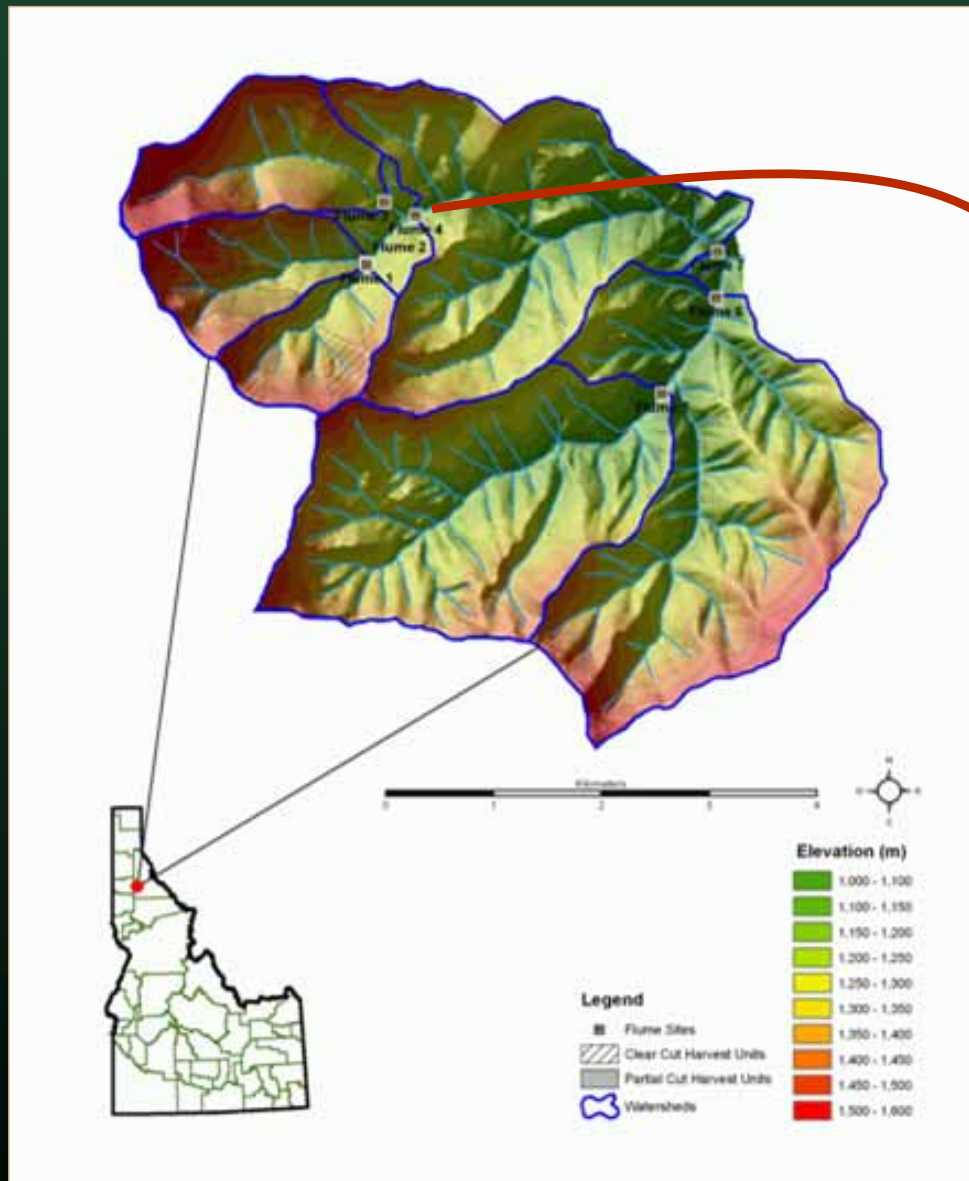
- Data from “typical” managed forestlands
  - Second growth
  - Contemporary management practices
  - Watershed scale
  - Multiple response variables
  - Inland northwest under-represented
- Mechanistic understanding of processes
- Integrated, spatially-explicit management tools

# Objectives:

- Assess effects of contemporary timber harvest practices on:
  - Flow
  - Sediment
  - Temperature
  - Nutrients
  - Macroinvertebrates
  - Fish
- Clear cut, thinning, cumulative effects
- Determine specific mechanisms producing responses



# Mica Creek Experimental Watershed



**Location:**

N. Central Idaho

**Climate:**

Continental/Maritime



# Historical Context

- Extensive logging
  - 1920 - 1930
- Natural regeneration
- Limited disturbance until late 1990s



Mica Creek c. 1932

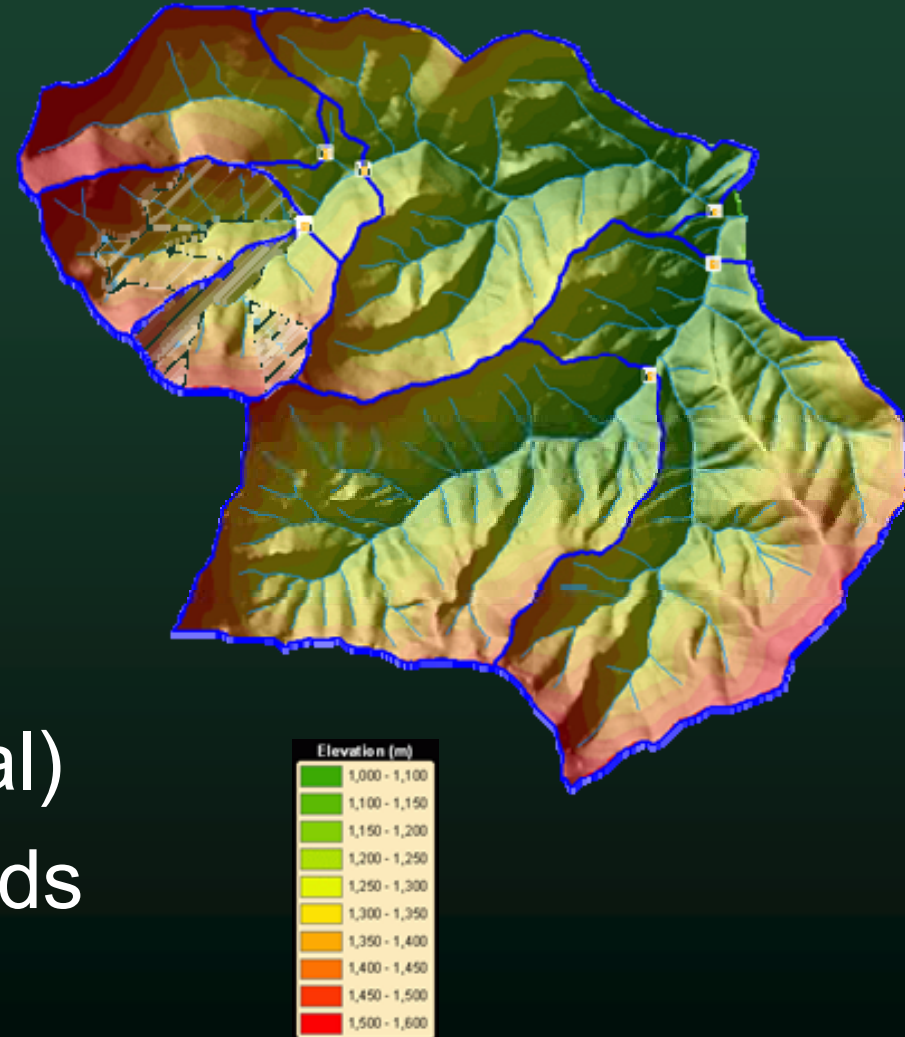
# Site Characteristics

- Size
  - 27 km<sup>2</sup>
  - ~6700 ac
- Elevation
  - 1000-1625 m
  - 3200 – 5240 ft
- Precipitation
  - 1440 mm/yr
  - ~57 in/yr
- Vegetation: Mixed conifers

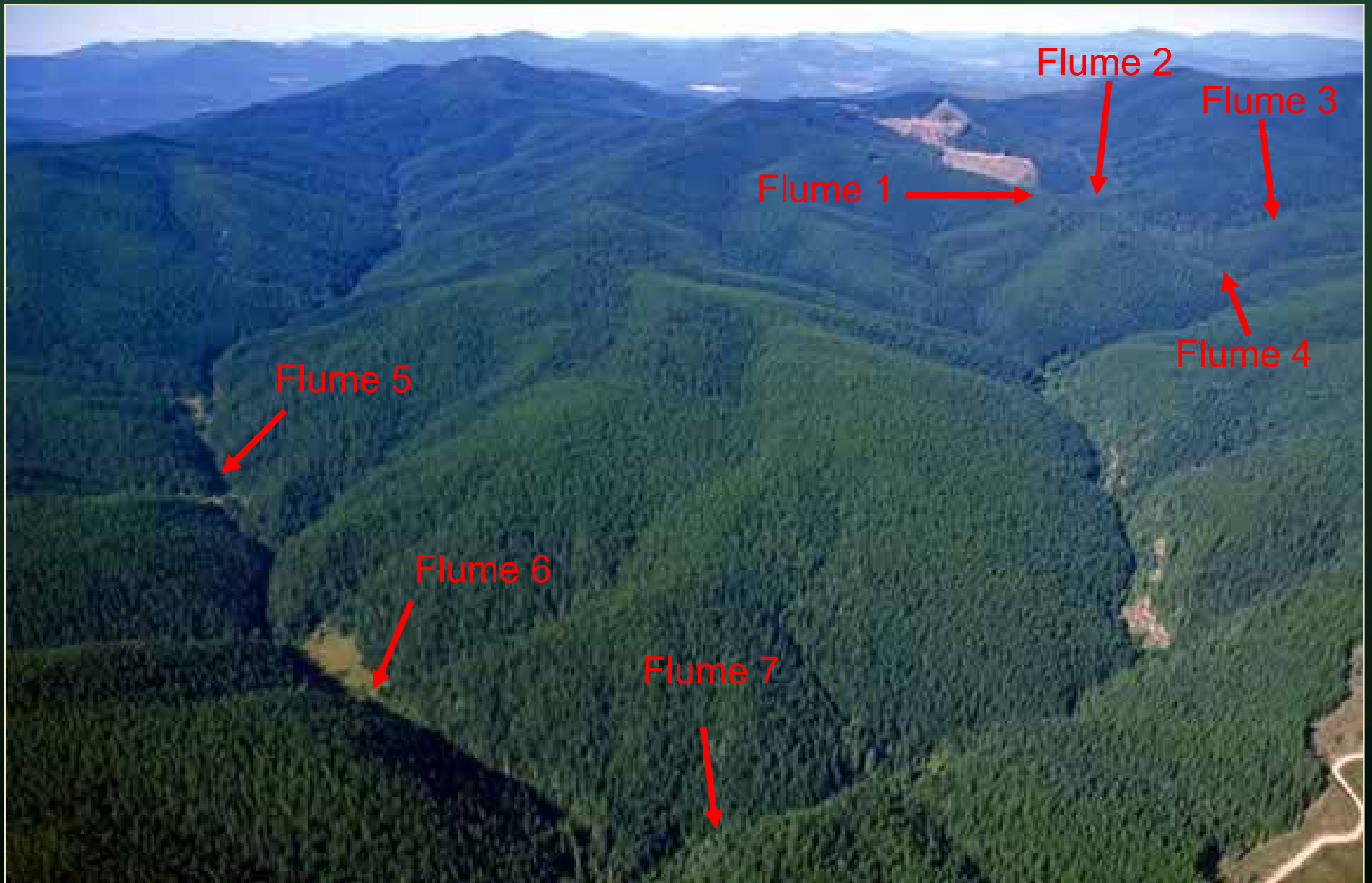


# MCEW Study Design

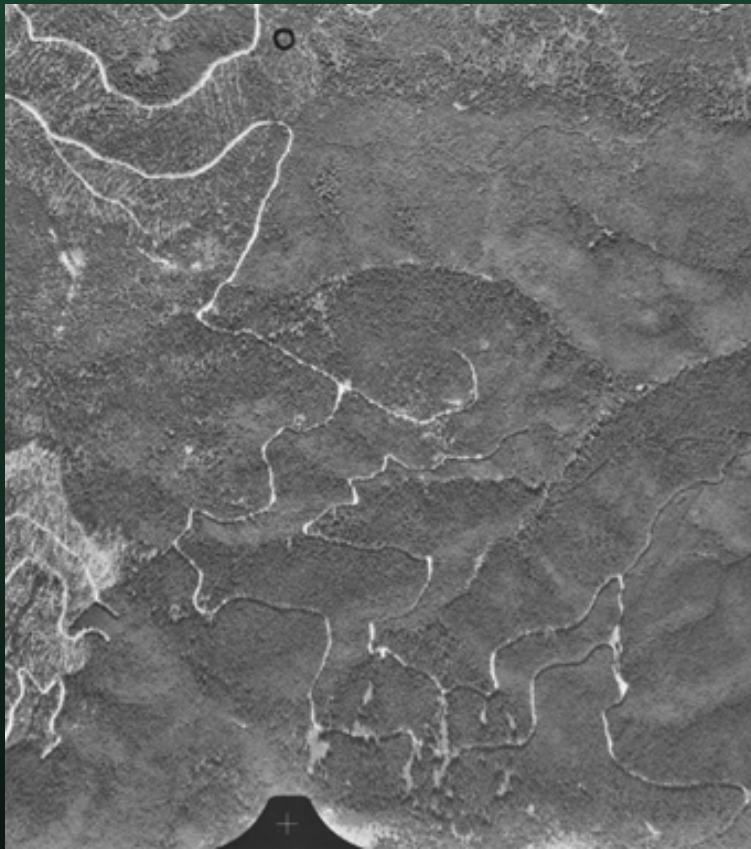
- Initiated 1990
- 6 years calibration period
- 4 years post-roads
- 5+ years post-harvest
  - 50% area impacted
    - Clearcuts
    - Partial Cuts  
(50% canopy removal)
- Paired & nested watersheds



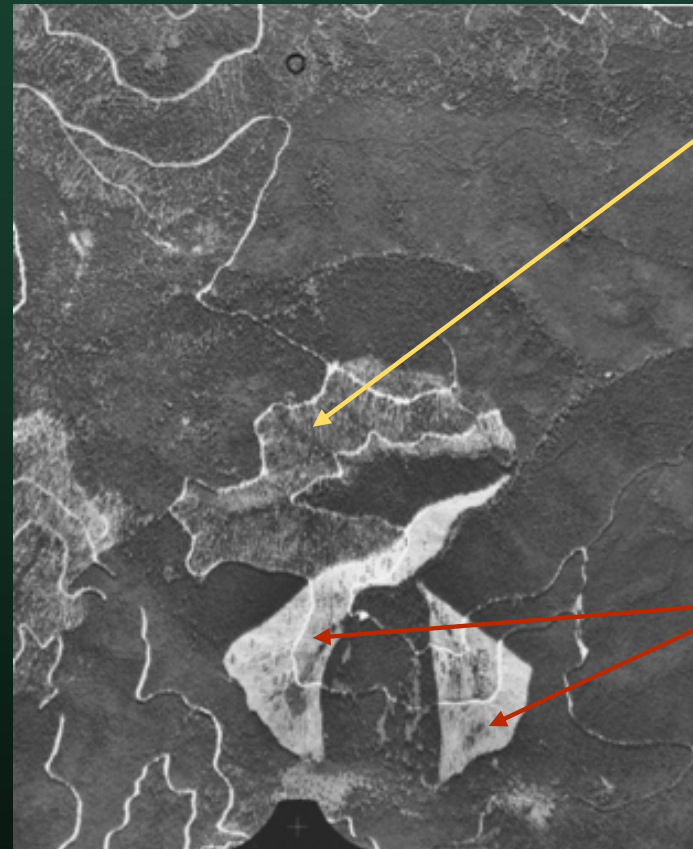
# Mica Creek Experimental Watershed



# Experimental Treatments



Pre harvest 2000



Partial cuts

Clear cuts

Post harvest 2002

# Best Management Practices

- Outsloped Roads
- Spot rocking
- Ditch relief culverts
- Filter windrows
- 30' riparian buffers  
non fish-bearing streams
- 75' riparian buffers  
fish-bearing streams



Class I-II buffer transition

# Results: Streamflow

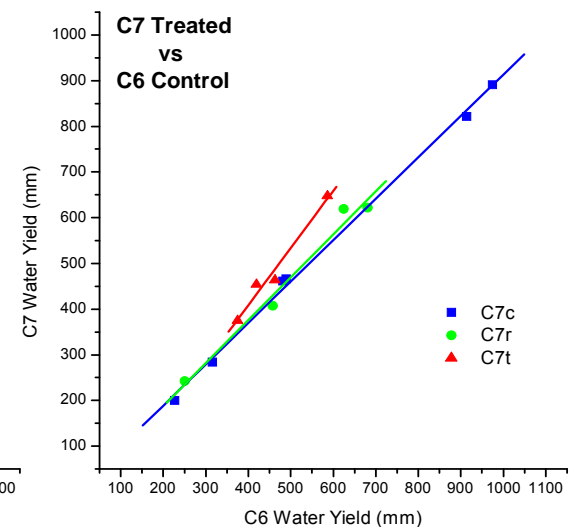
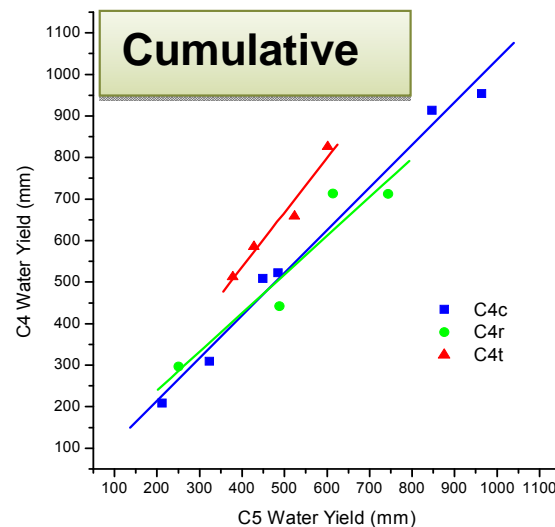
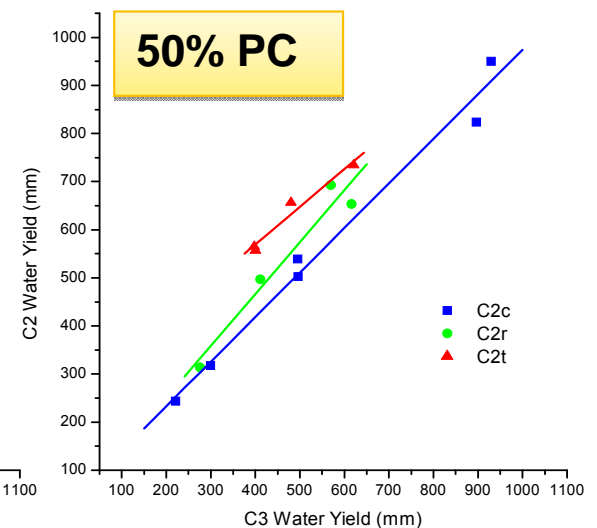
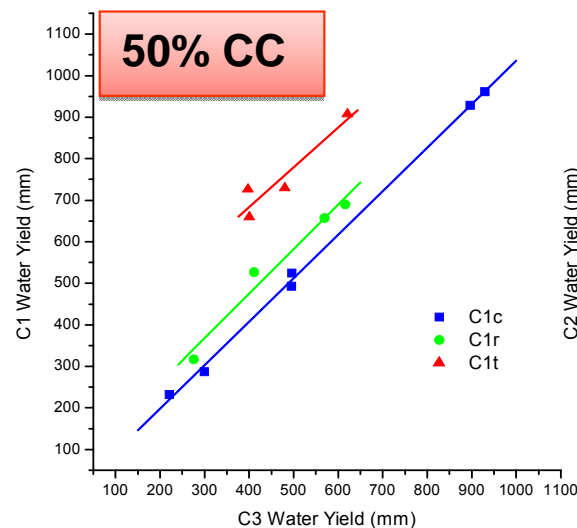
## Post Harvest

50% Clear-cut:  
↑28% (254 mm)

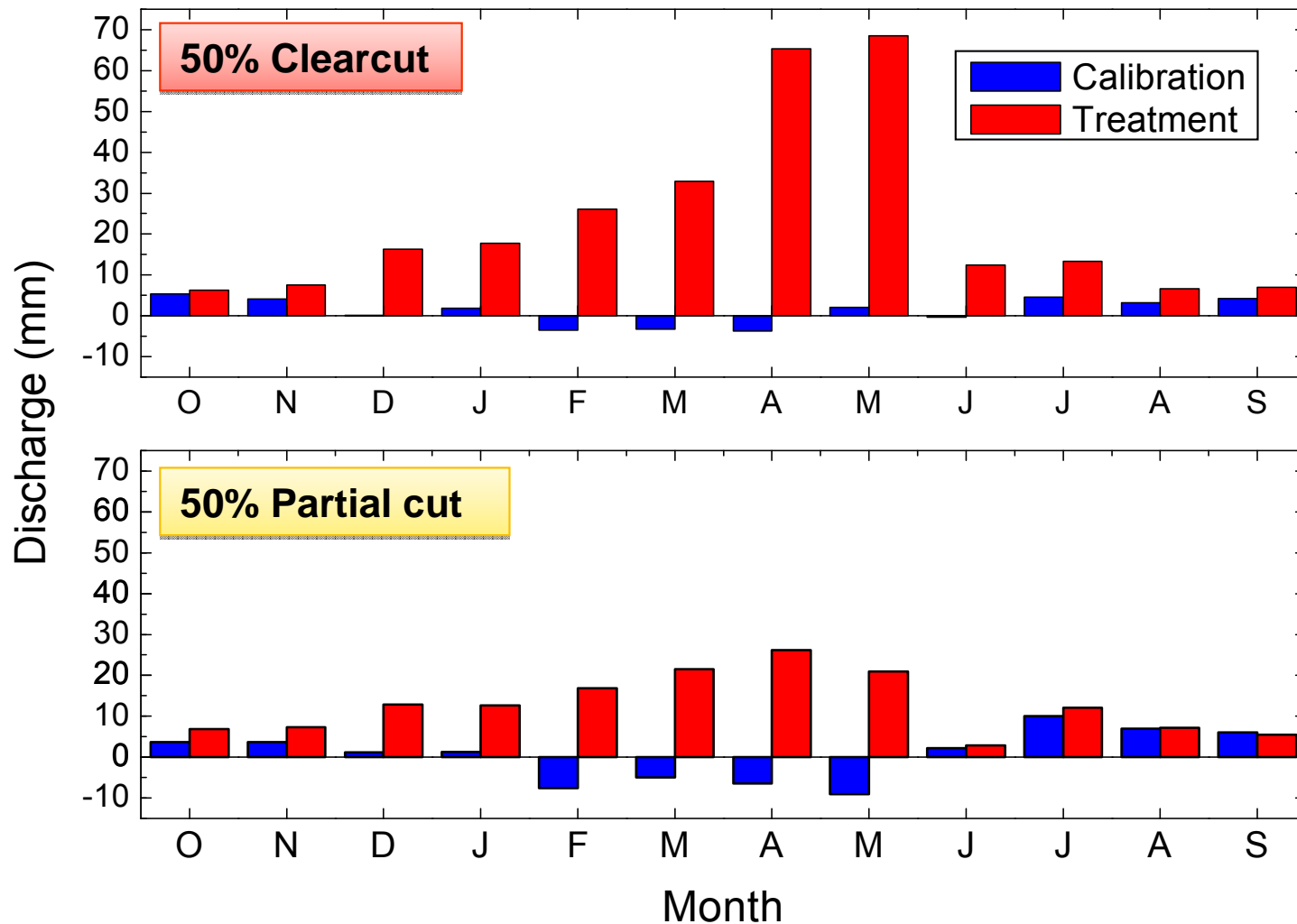
50% Partial cut:  
↑20% (135 mm)\*

Cumulative WS:  
↑20% (130 mm)\*

\*= marginal statistical  
significance ( $p \leq 0.05$ )

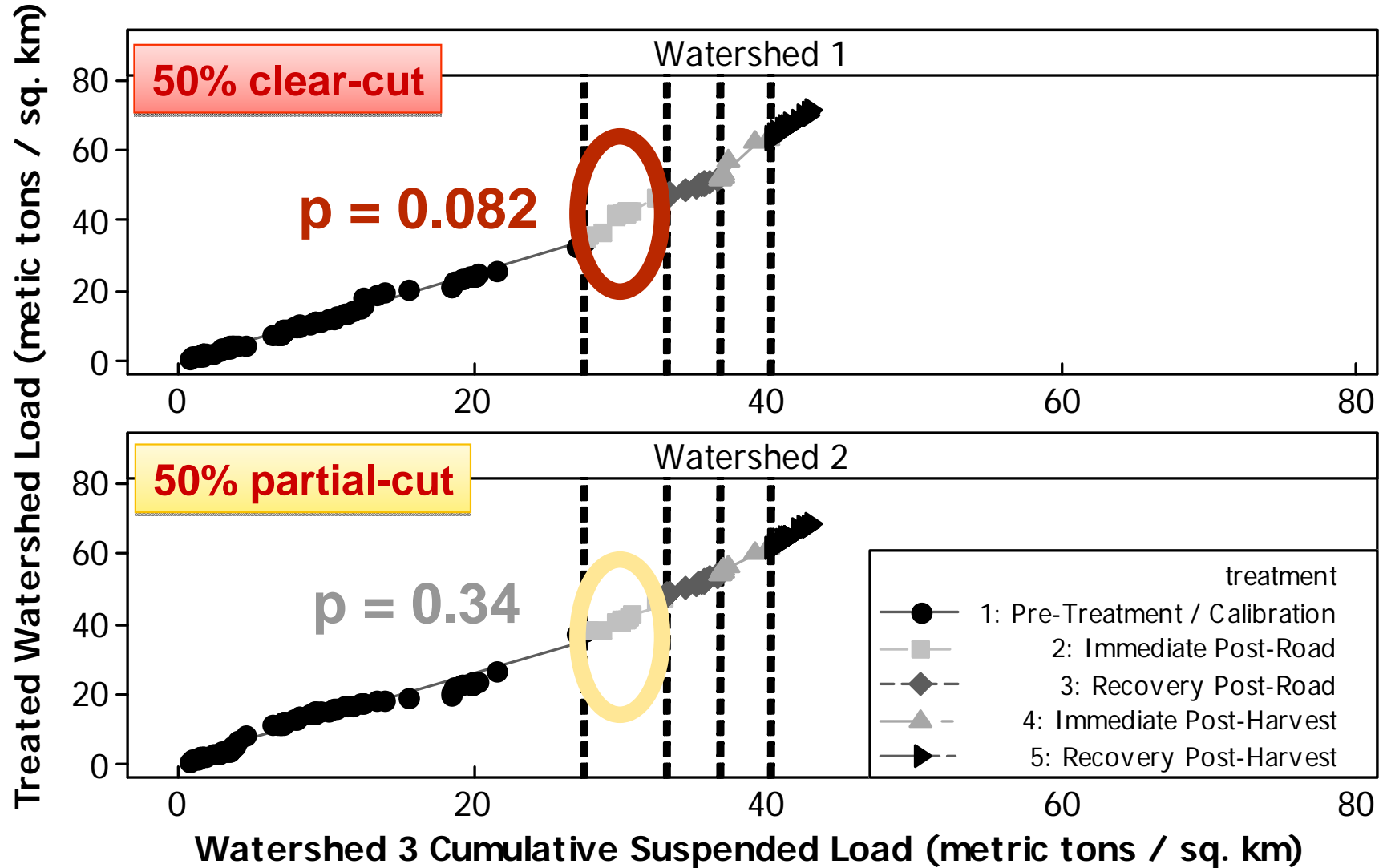


# Seasonal Flow Changes

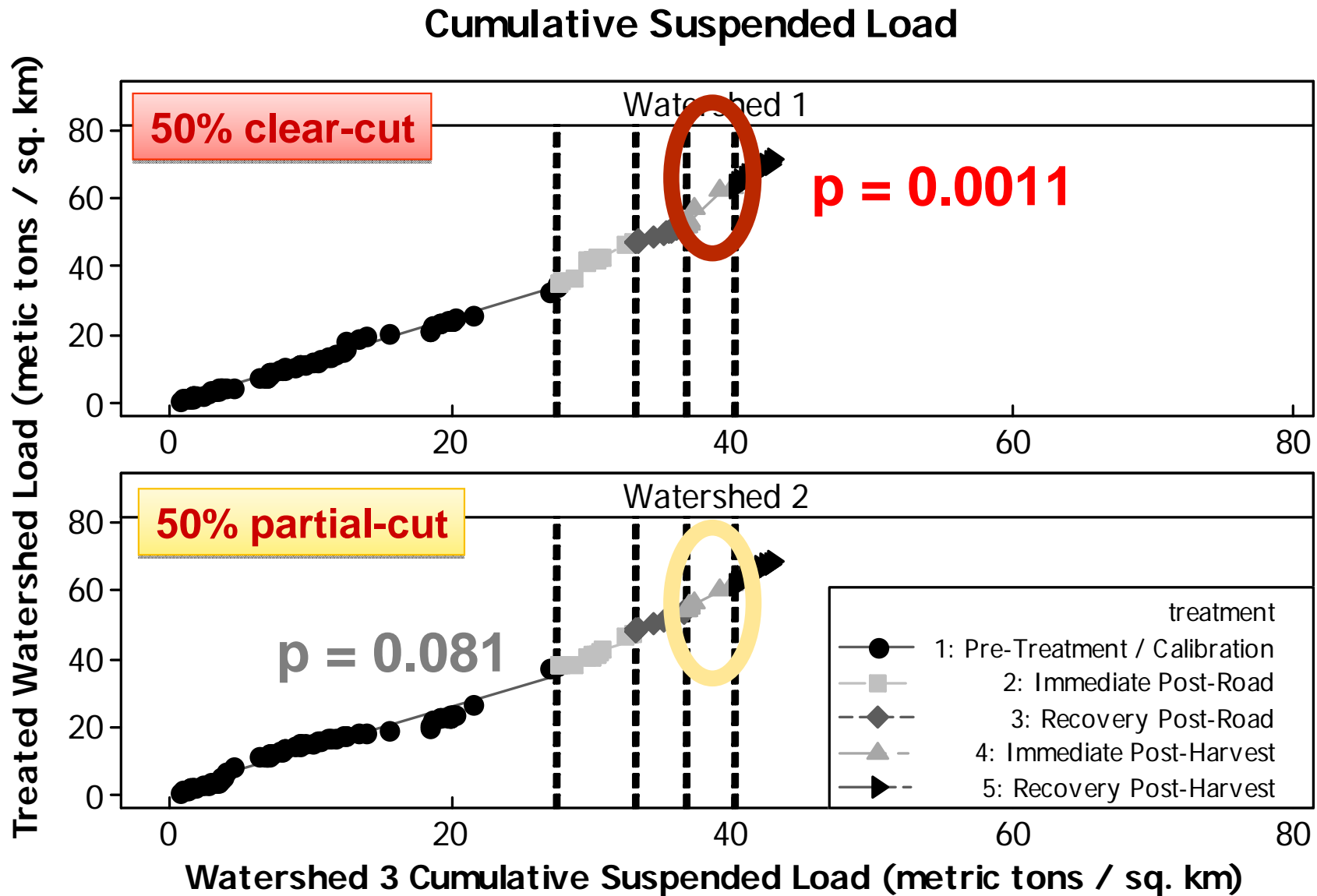


# Results: Suspended Load Post-roads

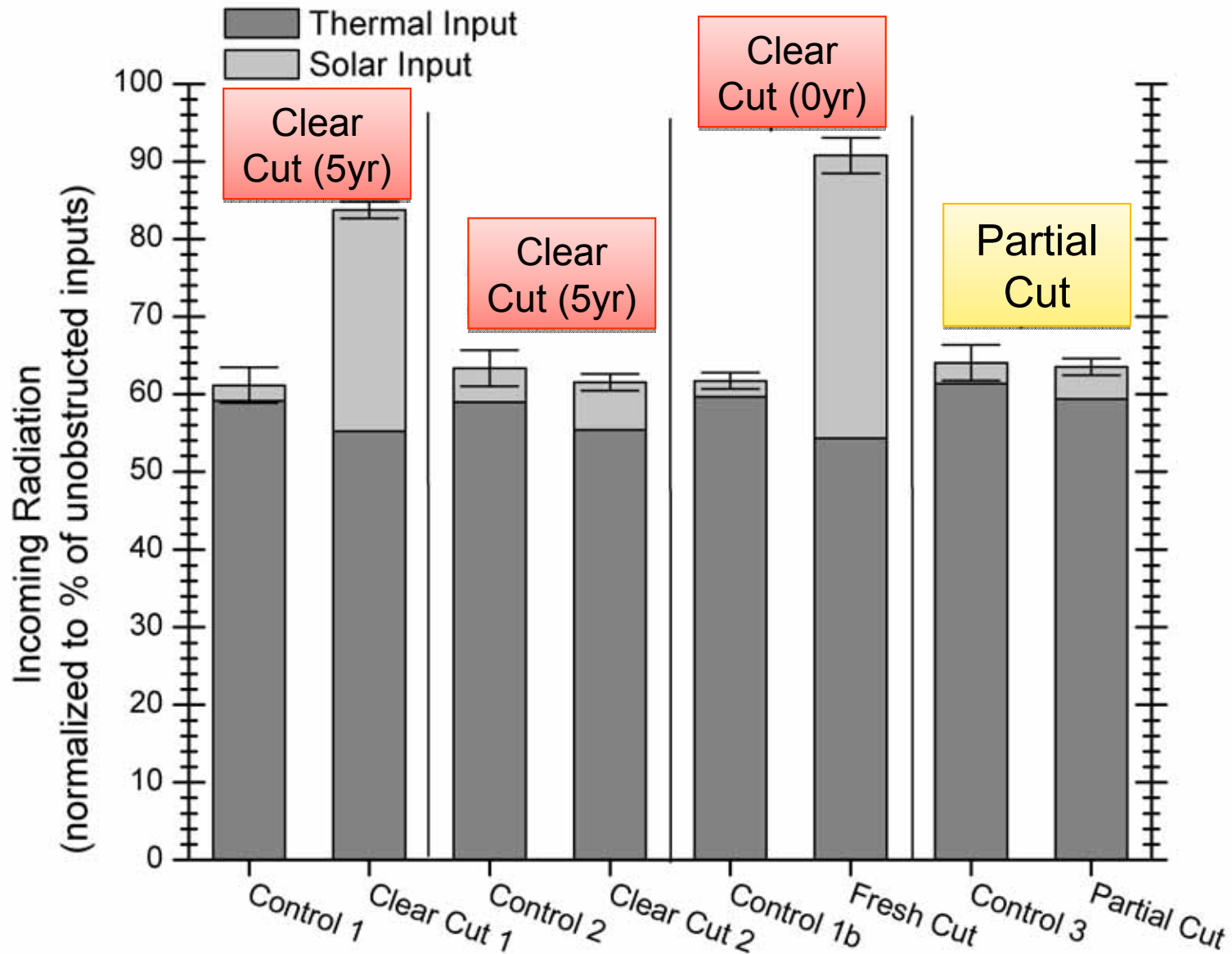
## Cumulative Suspended Load



# Results: Suspended Load Post-Harvest



# Results: Stream Radiation



# Results: Stream Radiation

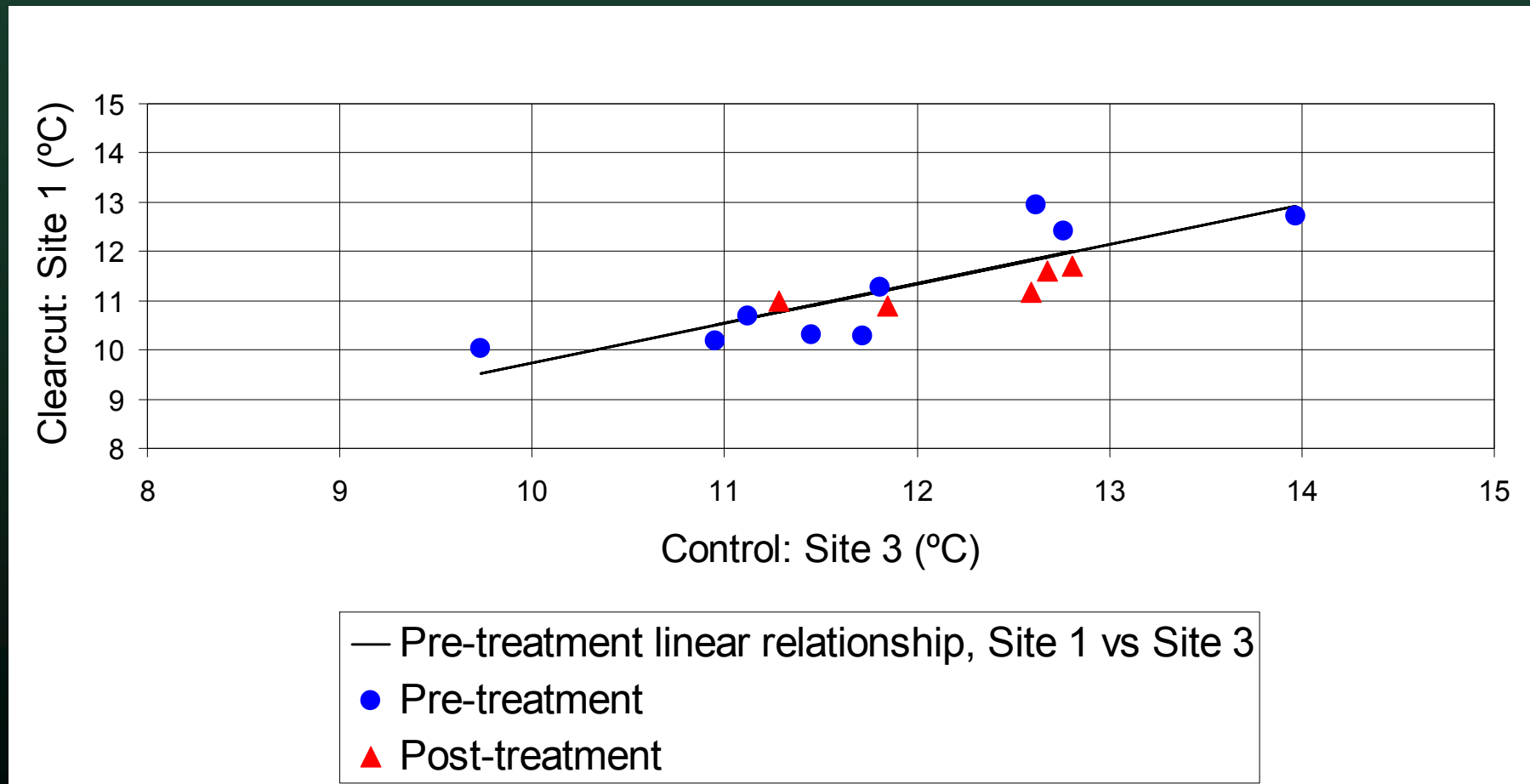
- Net incoming radiation
- 24 hr clear period
- Fresh clear cut  
Small reduction
- 5-yr clear cut  
highly variable
- Partial cut  
negligible effect



# Results: Stream Temperature

Maximum Weekly Maximum Temperature (MWMT)

Clear cut catchment

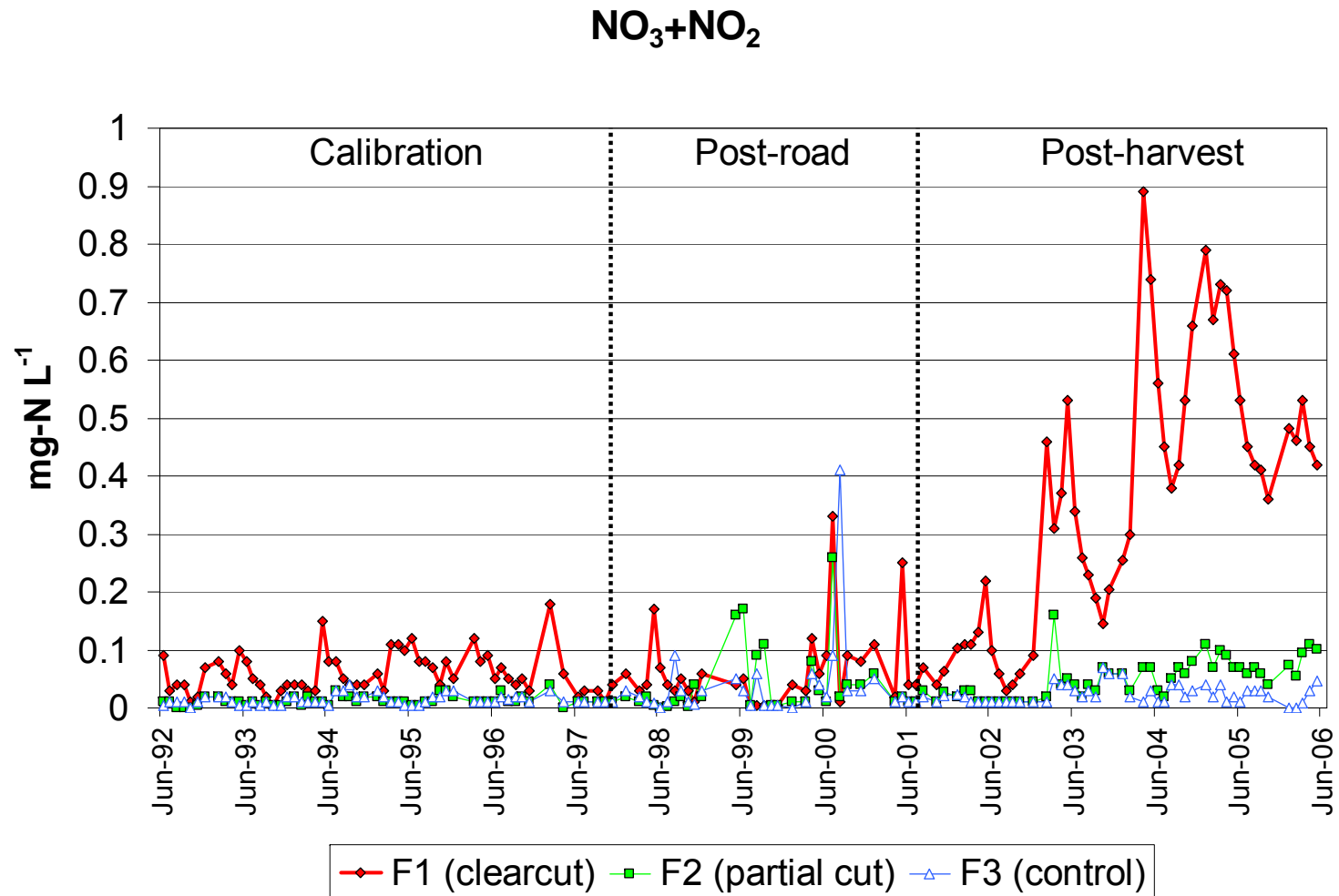


\*Partial cut catchment very similar...

Gravelle & Link, 2007, *For. Sci.*

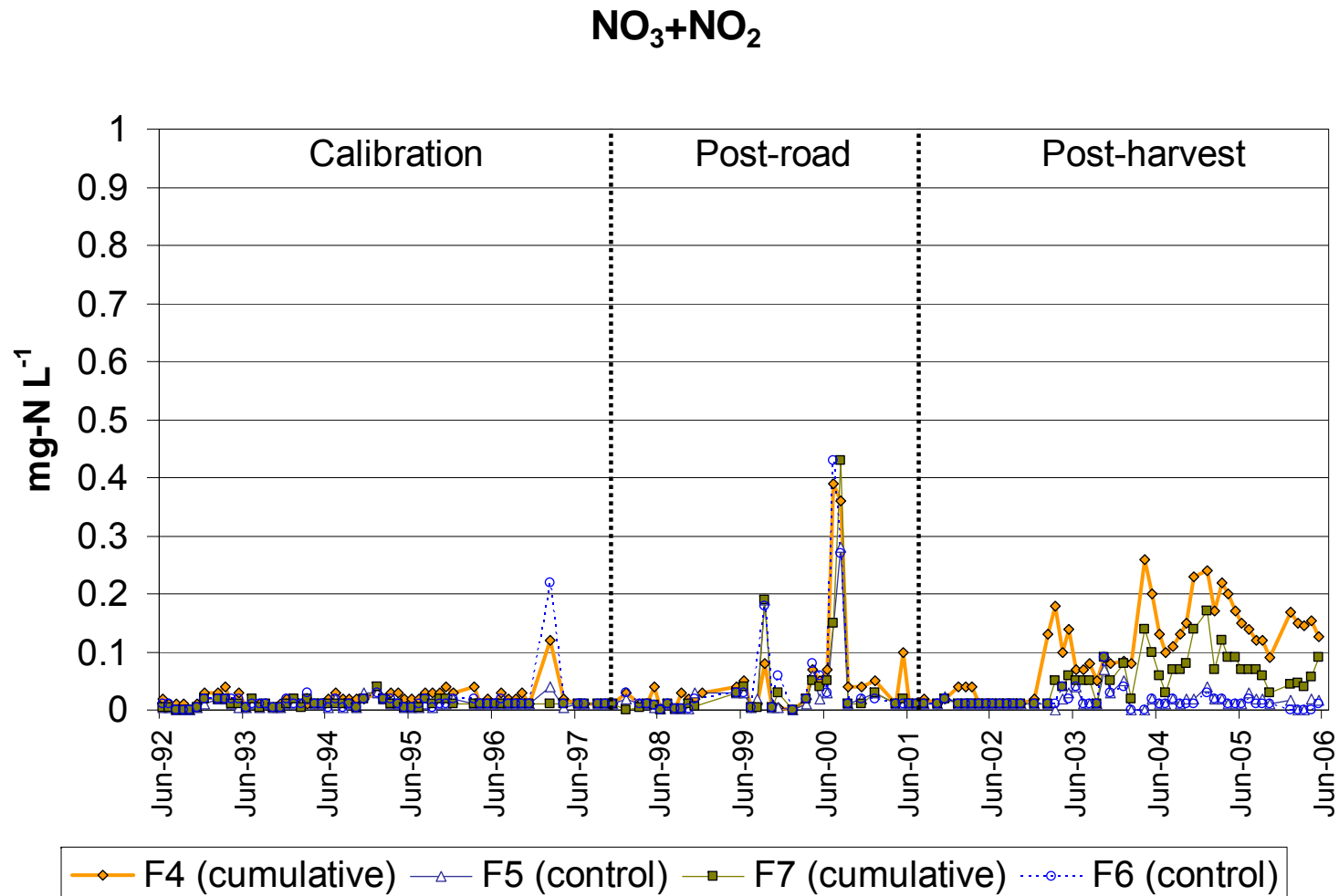
# Results: Nutrients

## Headwater Sites



# Results: Nutrients

## Downstream Sites

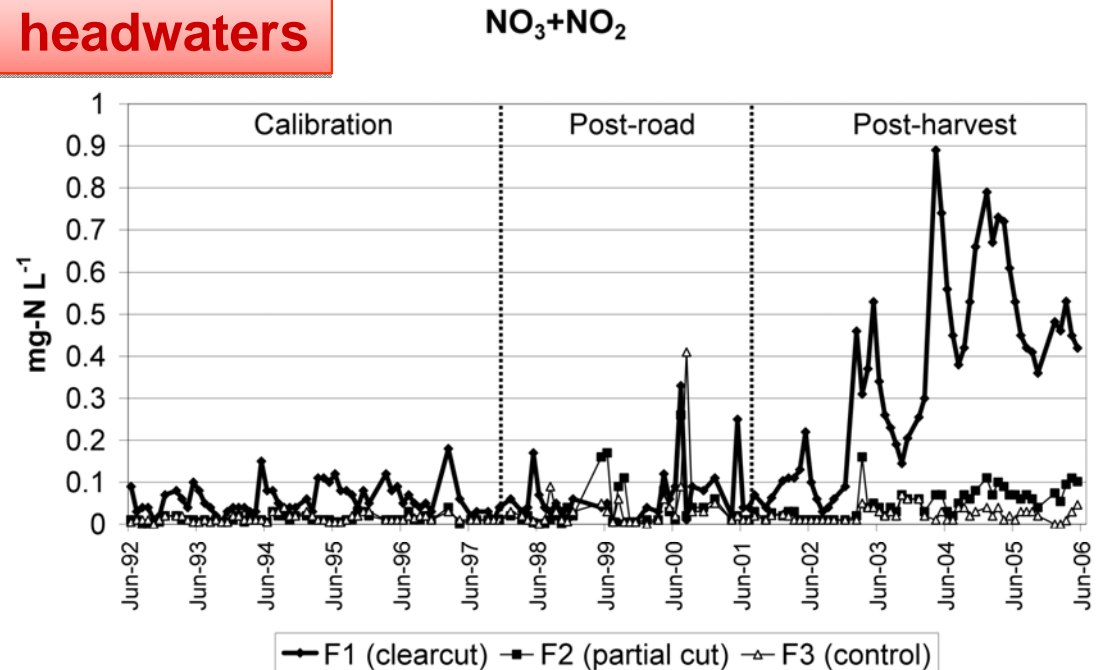


# Summary: Nutrients

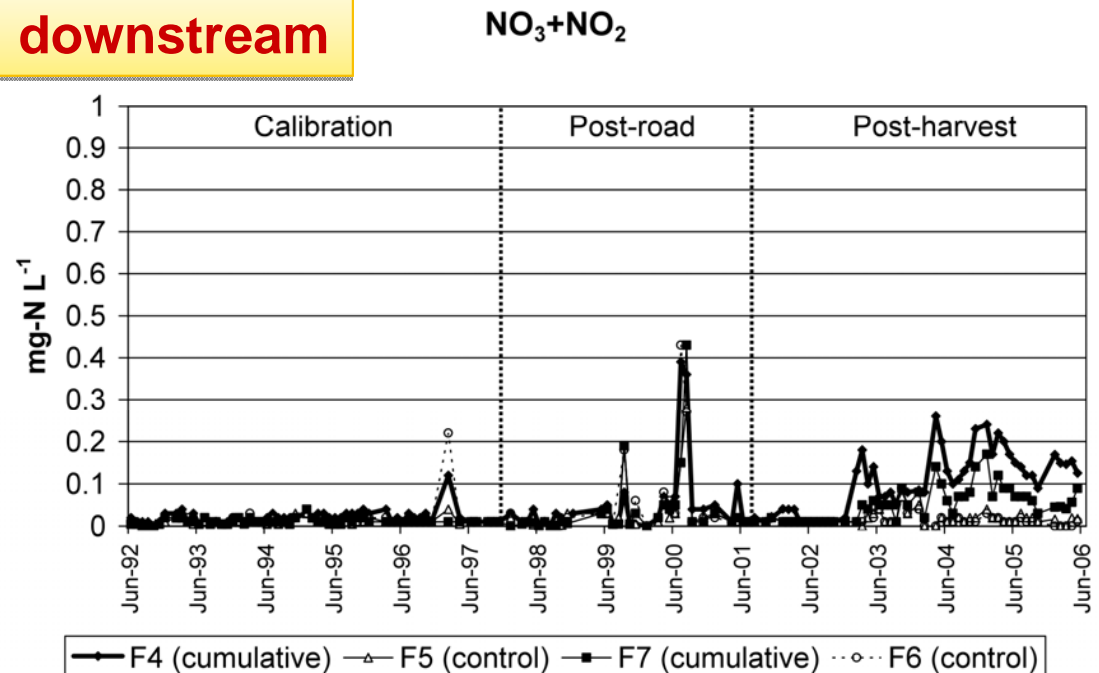
- NO<sub>3</sub> + NO<sub>2</sub>
    - +0.29 mg L<sup>-1</sup> (CC)
    - +0.03 mg L<sup>-1</sup> (PC)
    - + downstream
  - TKN (no change)
  - TP (no change)
  - OP (no change)
    - +0.01 mg L<sup>-1</sup>
- Cumulative site

Gravelle et al., in press,  
*For. Ecol. & Mgmt.*

## headwaters

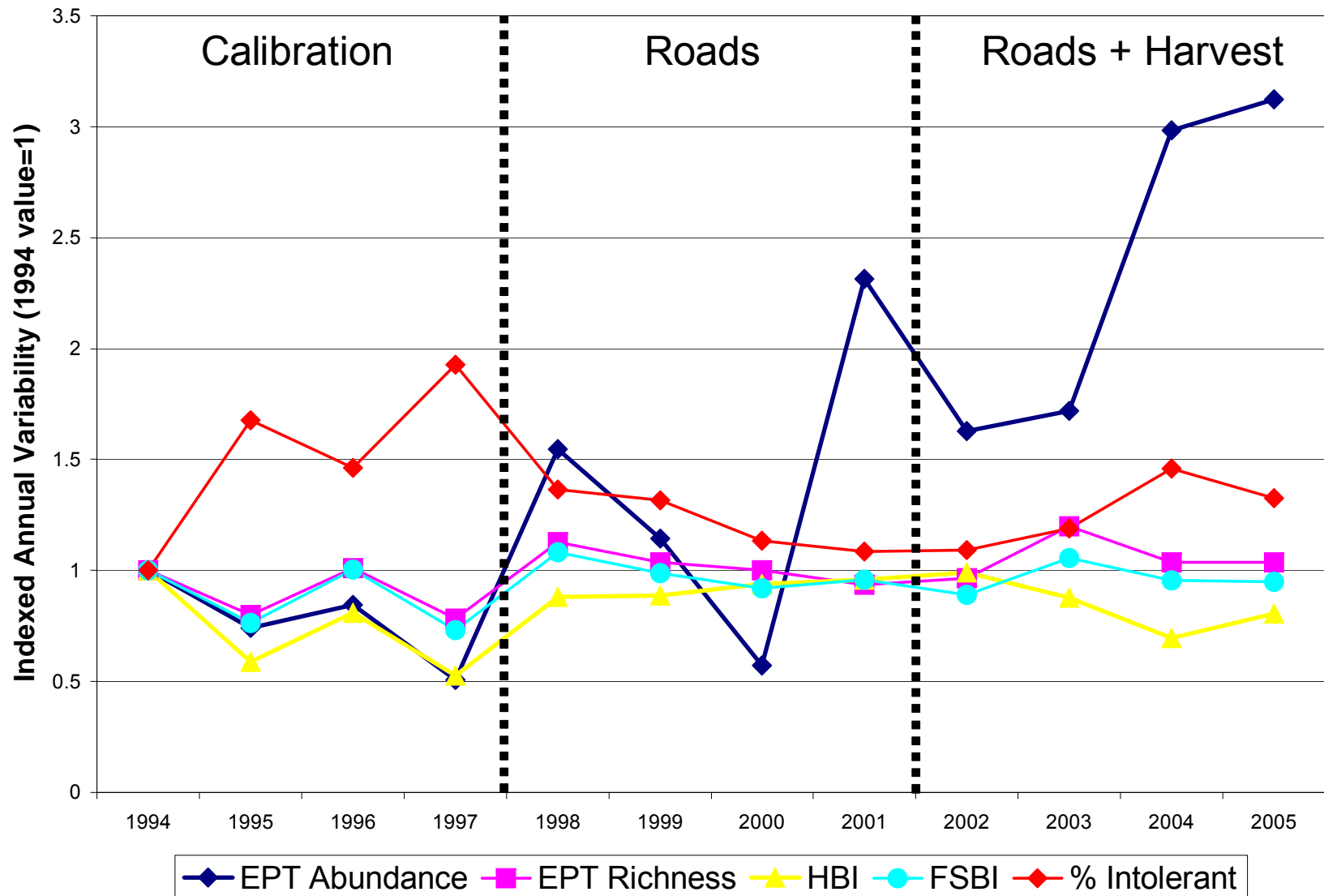


## downstream

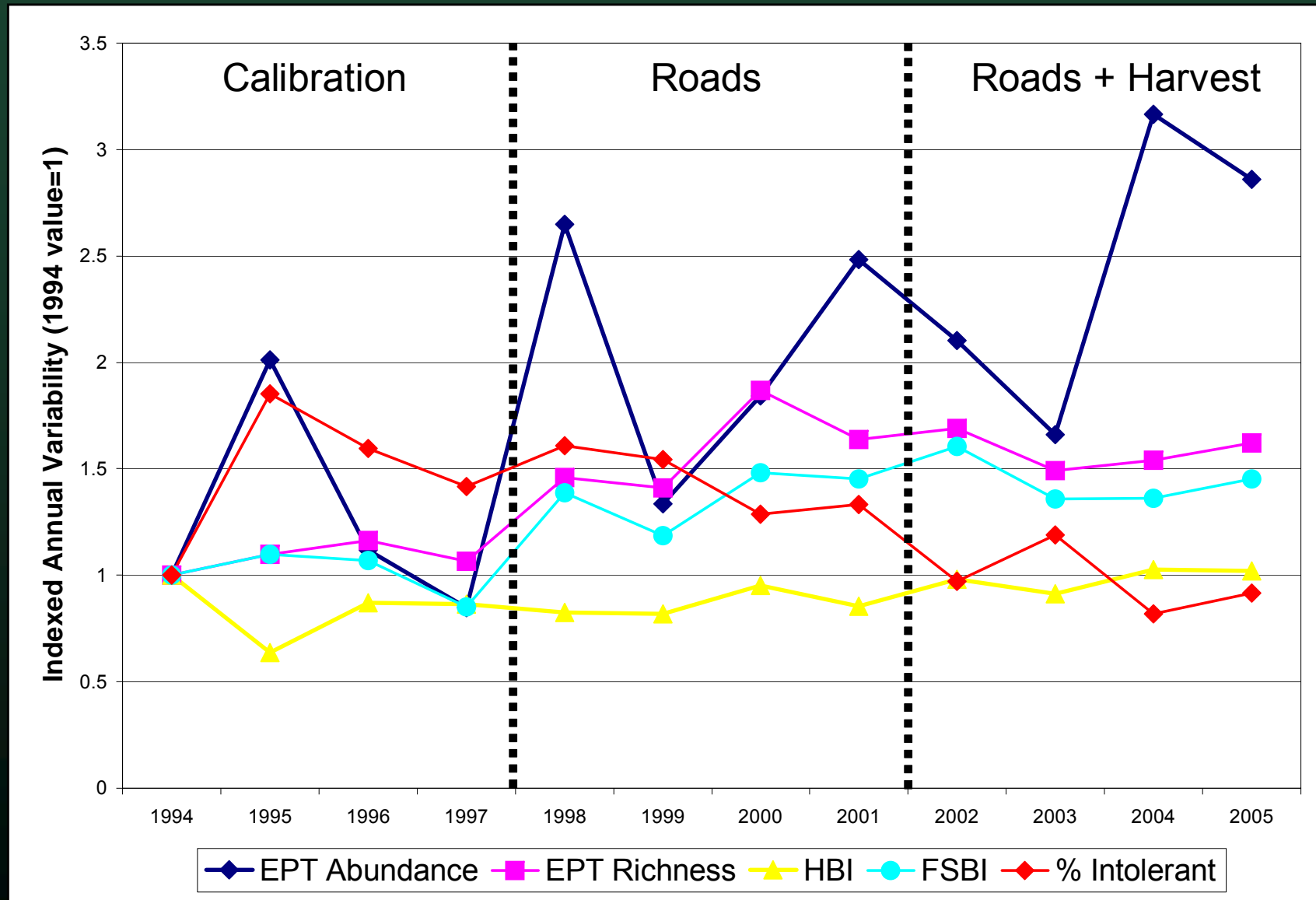


# Results: Macroinvertebrates

## Clearcut Catchment



# Results: Macroinvertebrates Control Catchment



# Results: Macroinvertebrate Summary

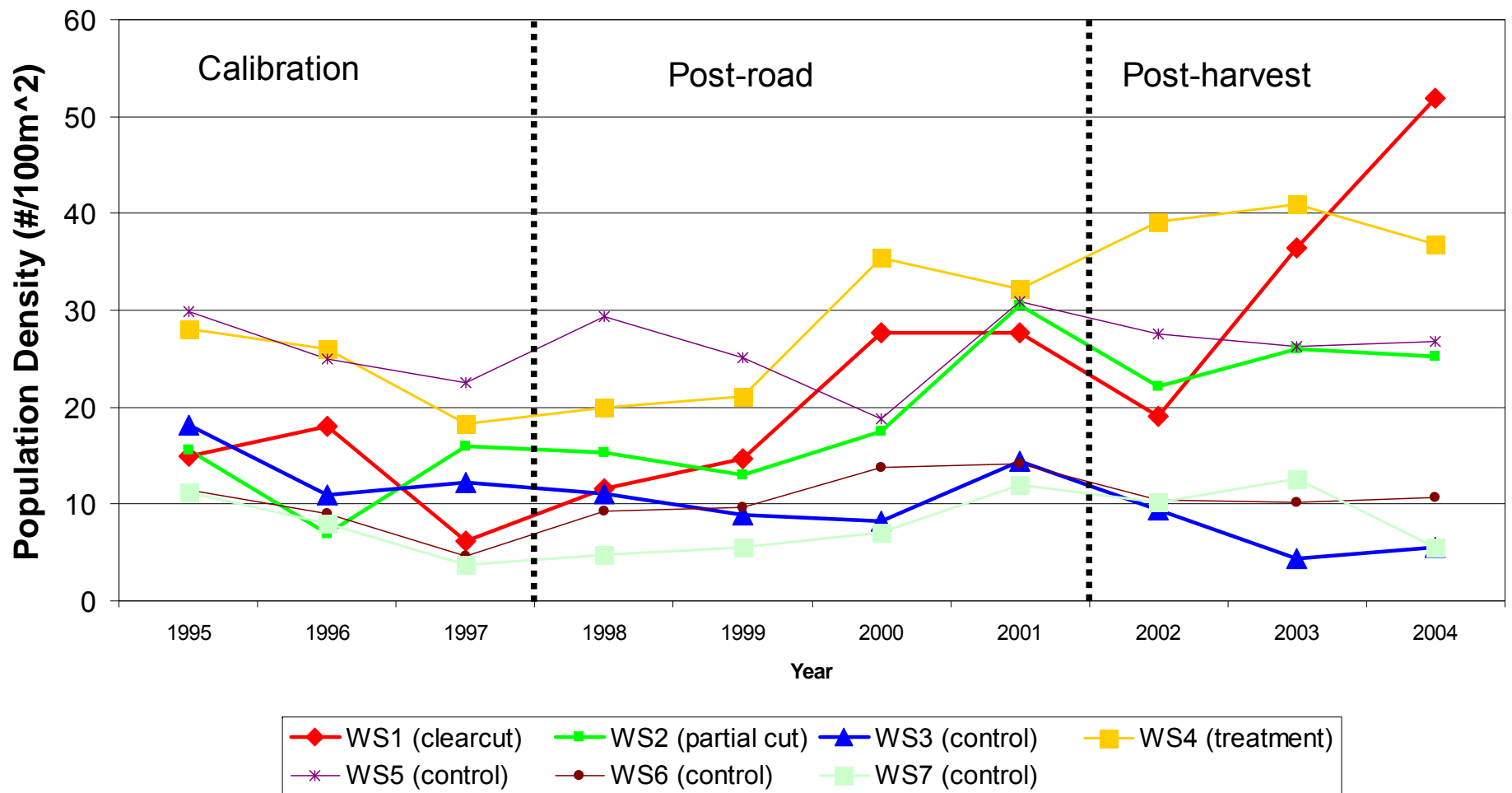
- Repeat measures ANOVA  
(calibration, post-roads, post-harvest)
- Metrics:
  - Abundance
  - EPT Abundance
  - EPT Richness
  - Scraper Richness (cumulative, post-road)
  - Predator Richness
  - Sediment Intolerant Taxa Richness
  - Shannon-Weiner H' Diversity
  - Hilsenhoff Biotic Index (HBI) (partial cut, post-harvest)
  - Fine Sediment Biotic Index (FSBI)
  - % Intolerant (partial cut, post-harvest)



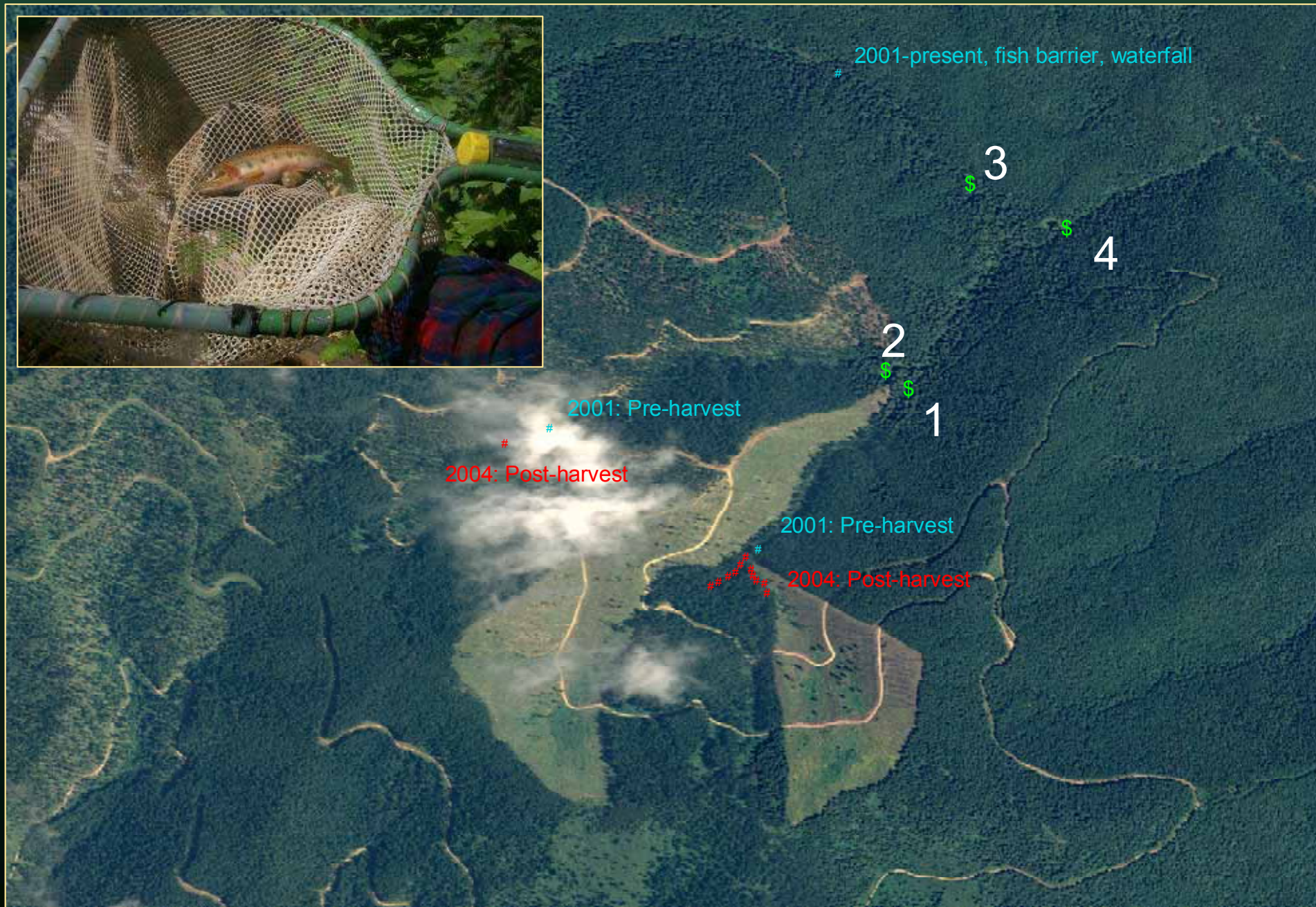
(indicates treatment and phase where significant changes were observed)

# Mica Creek Fish Population Densities

## Brook Trout



# Upstream Extent of Fish Presence

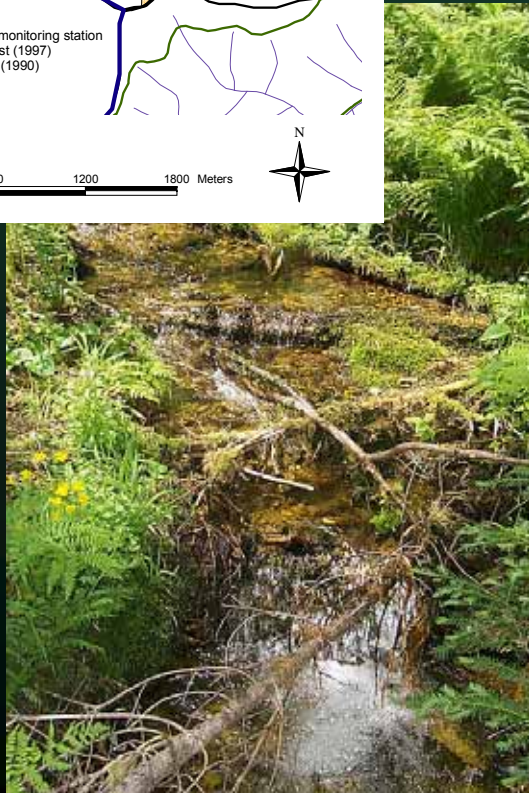
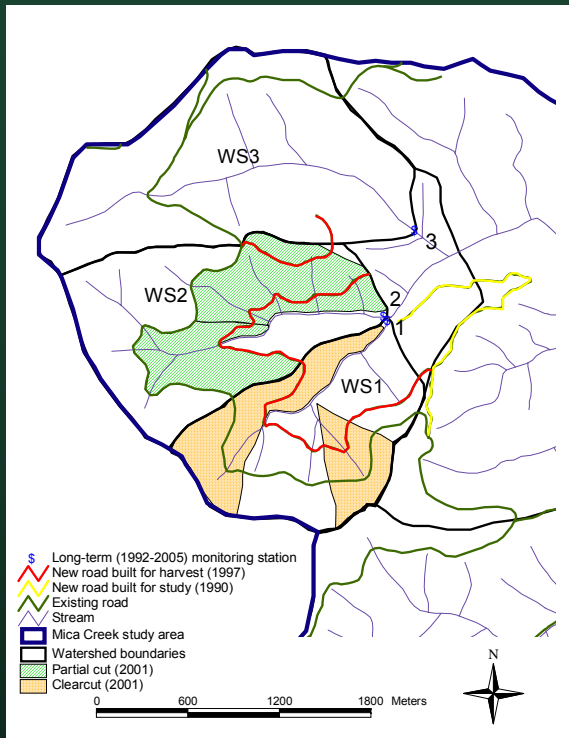


# Harvest Effects Summary

- Roads: Minimal effects
- Flows: 20-30% ↑
- Suspended sediment: 3x ↑ (1-yr)
- Stream radiation: rapid recovery, variable
- Temperature: slight ↓
- Nutrients: 10x ↑ ( $\text{NO}_3 + \text{NO}_2$ )
- Macroinvertebrates: Minimal impacts
- Fish: increase?

# Implications and...

## A word of caution...



- Systems are resilient
- BMPs greatly reduce the impact to water quality
  - Riparian buffers
  - Road design
  - Stream crossings
- Current FPA regulations can sustain water quality and riparian ecosystems
  - Monitoring will still be required.
- Mica Creek is a case study!
- Different results may occur..
  - Extensive disturbance
  - Land-use conversion
- To be continued...

# Citations

Gravelle J. A., T. E. Link, J. Broglio, and J. Braatne, Effects of timber harvest on aquatic macroinvertebrate community composition in a northern Idaho watershed, *Forest Science*, *in press*.

Gravelle J. A., G. Ice, T. E. Link, and D. Cook, Nutrient concentration dynamics in an inland Pacific Northwest watershed before and after timber harvest, *Forest Ecology and Management*, *in press*.

Gravelle J. A., and T. E. Link, Influence of timber harvesting on headwater peak stream temperatures in a northern Idaho watershed, *Forest Science*, *53*, 189–205, 2007.

Hubbart J. A., T. E. Link, J. A. Gravelle, and W. J. Elliot, Timber harvest impacts on water yield in the continental/maritime hydroclimatic region of the United States, *Forest Science*, *53*, 169–180, 2007.

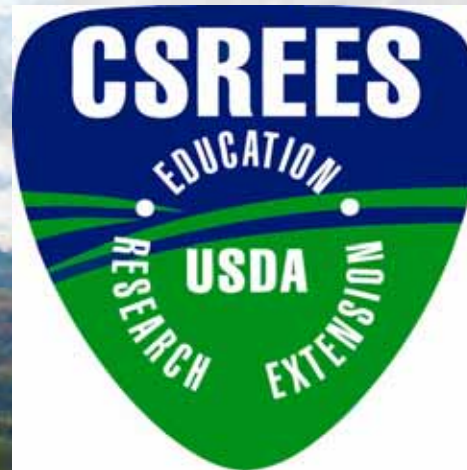
Karwan D., J. Gravelle, and J. Hubbart, Effects of Timber Harvest on Suspended Sediment Loads in Mica Creek, Idaho, *Forest Science*, *53*, 181–188, 2007.

Klos P. Z., and T. E. Link, Quantifying incoming shortwave and longwave radiation to headwater streams beneath different canopy structures, *in preparation for: Agricultural and Forest Meteorology*.

Koeniger P., J. A. Hubbart, T. Link, and J. D. Marshall, Isotopic variation of snow cover and streamflow in response to changes in canopy structure in a snow-dominated mountain catchment, *Hydrological Processes*, *22*, 557–566, 2008.

[www.cnr.uidaho.edu/micacreek](http://www.cnr.uidaho.edu/micacreek)

# Thank You!



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