An Overview of Oregon Department of Forestry's Riparian Function and Stream Temperature Study

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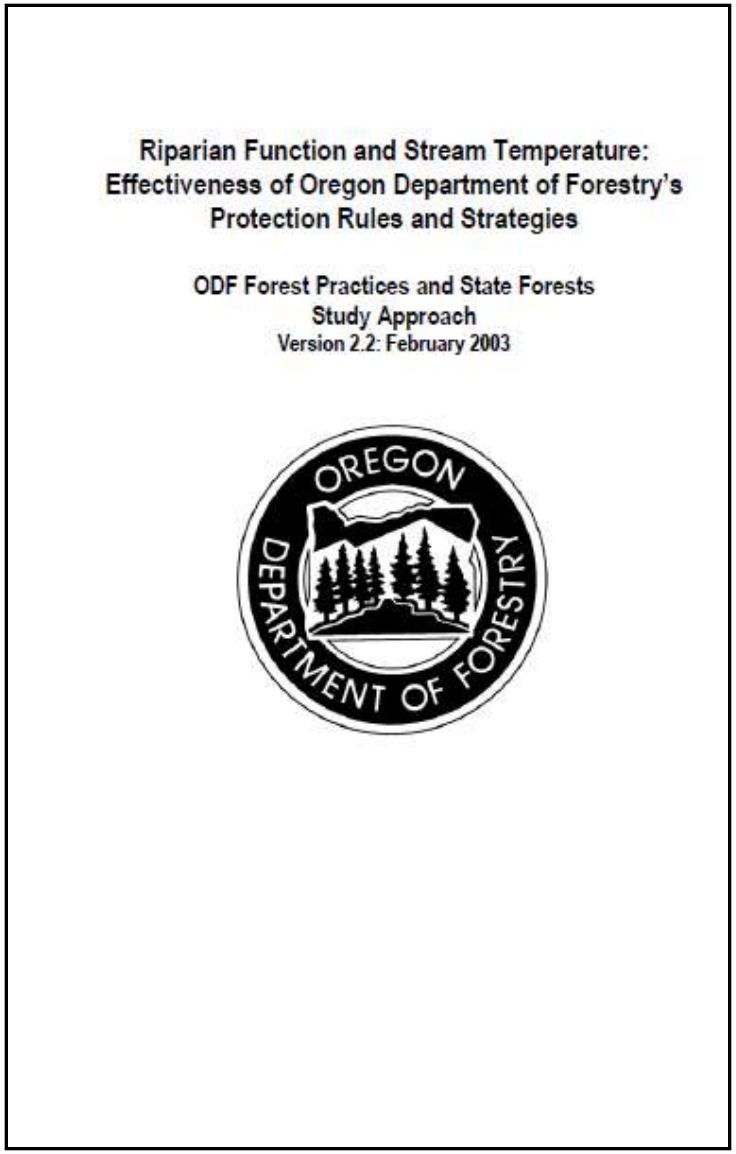
Presentation Overview



- Study background: Why it was initiated
- Study design
- Department of Environmental Quality Standards it addresses
- Results of regulatory analysis
- ODF's approach to address results
- Other Ripstream temperature products (downstream analysis, 5-year post harvest)

RipStream Study History and Objectives

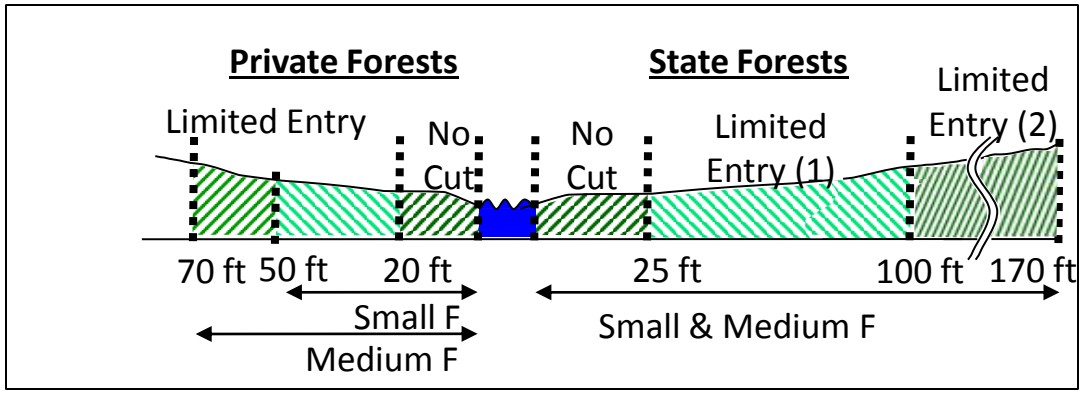
The study name is an abbreviation for “Riparian Function and Stream Temperature” and was a joint effort starting in 2002 between State and Private forests to address the potential for Small and Medium Type F Streams to experience “short-term temperature increases” with the current forest practice rules.

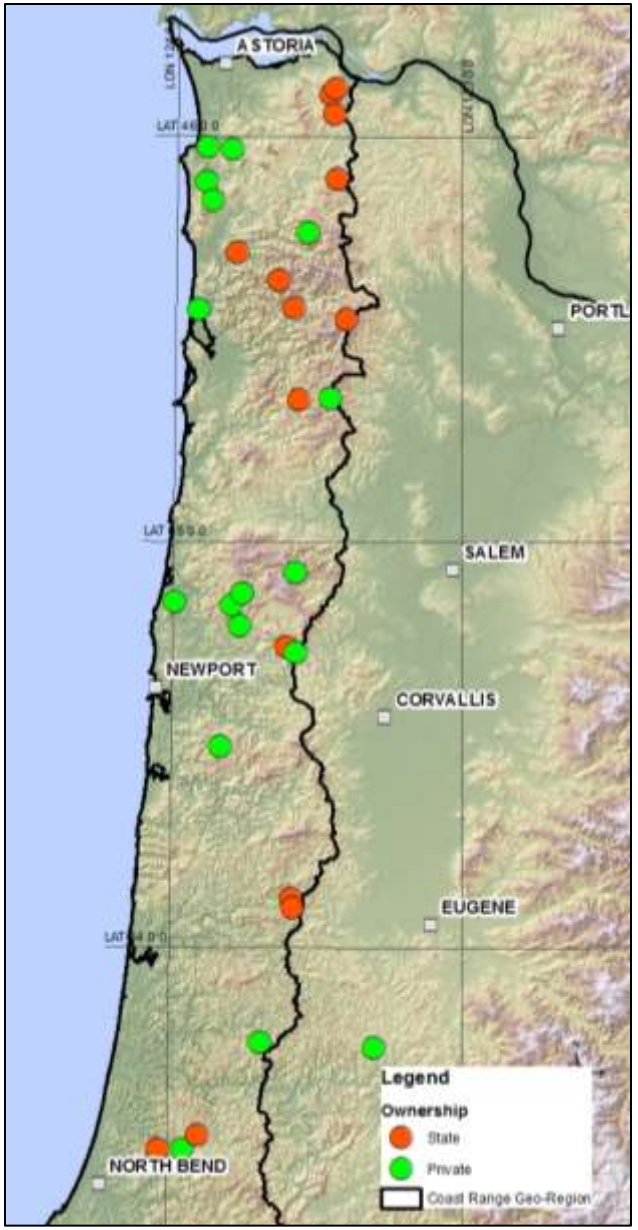
Objectives (from ODF 2003)

- Are the riparian rules and strategies effective in meeting DEQ water quality standards regarding anti-degradation of stream temperature and the water quality standard?
- Are the riparian rules and strategies effective in maintaining large wood recruitment to streams, downed wood in riparian areas, and shade?
- What are the trends in riparian area regeneration?
- What are the trends in overstory and understory riparian characteristics and how do they along with channel and valley characteristics relate to stream temperature and shade?

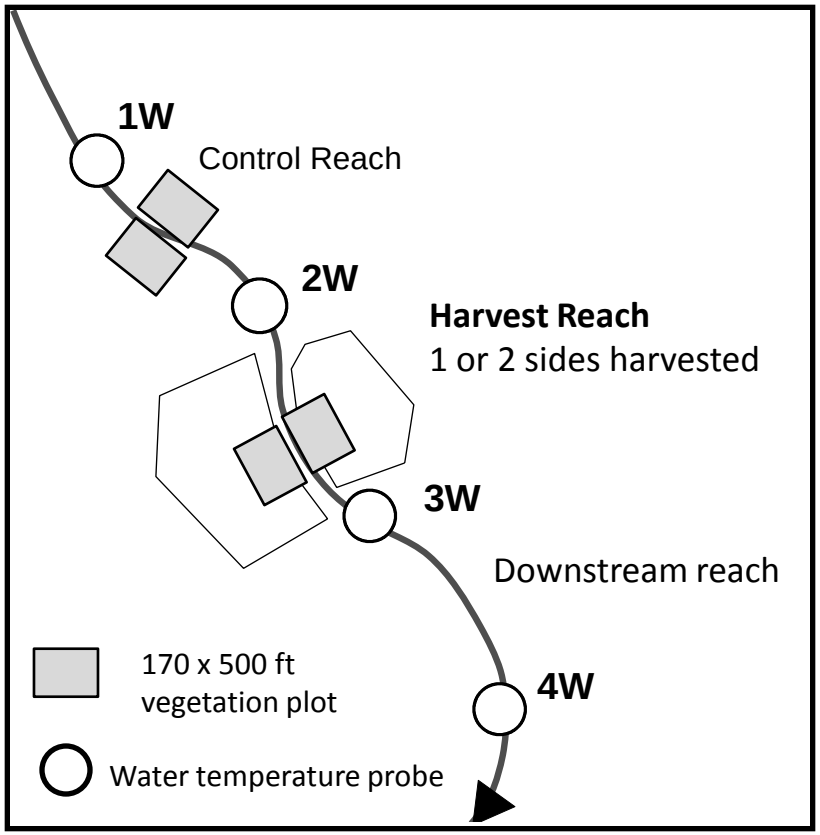
RipStream Study

- State and Private Forests, 2002-2010
- At least 2 years pre-harvest data, an upstream un-harvested reach for the duration of the study
- Small and Medium fish-bearing streams
- Avoid disturbance from beavers and debris torrents
- Result: 33 Sites (18 Private, 15 State)





Study Design



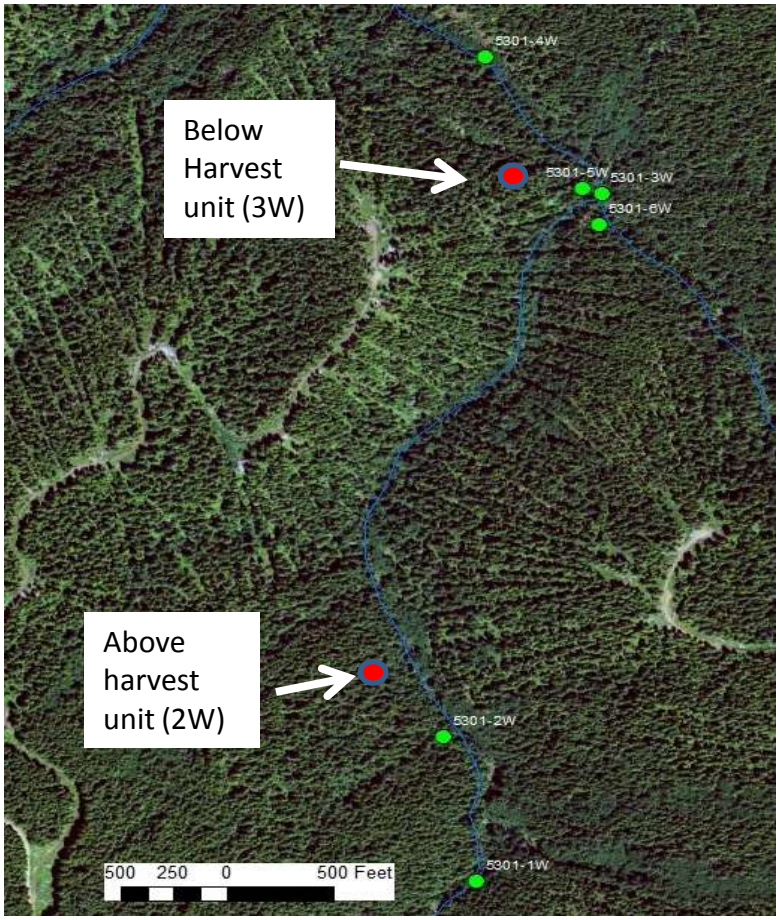
Harvest types:

- State: 7 sites partial-cut (thin), 8 sites clearcut
- Private: All 18 sites clearcut

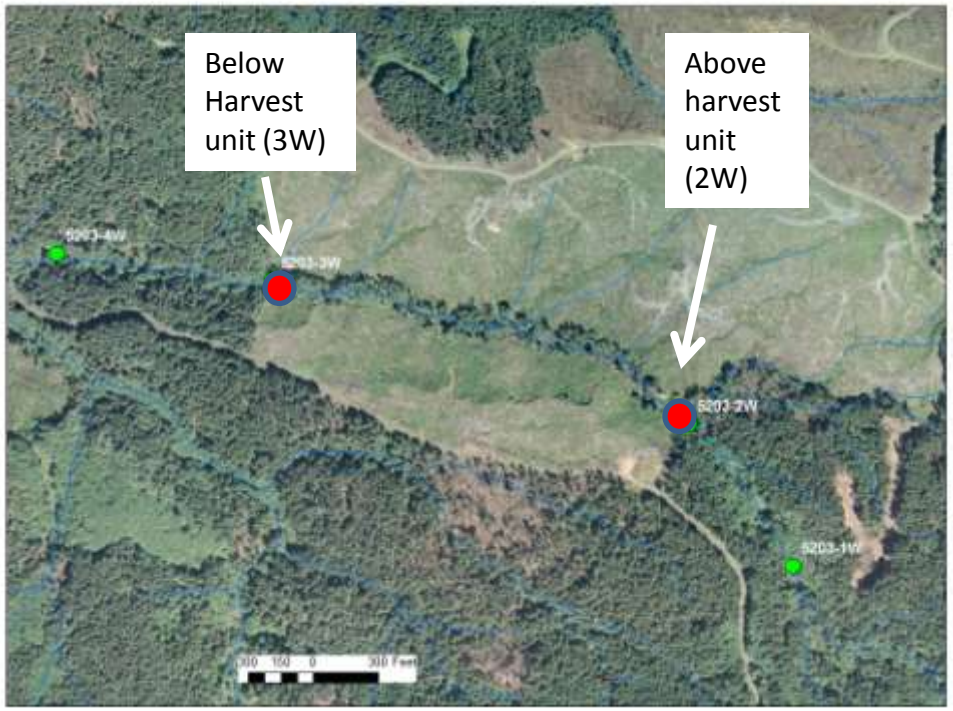
Numbers of sides harvested:

- State: 13 1-sided, 2 2-sided
- Private: 4 1-sided, 14 2-sided

Harvest Unit Examples



State Site Example: 2-sided partial cut



Private Site Example: 2-sided clearcut

What Was Measured

Riparian and Channel Characteristics (every 200 ft)

- Shade (use hemispherical photographs)
- Buffer width
- Channel width and depth
- Gradient
- Substrate
- Large Wood
- Aspect

In Plots

- Overstory tree characteristics (species, density, height, etc)
- Blowdown and snags
- Shrubs
- Landform

Applicable Temperature Standards

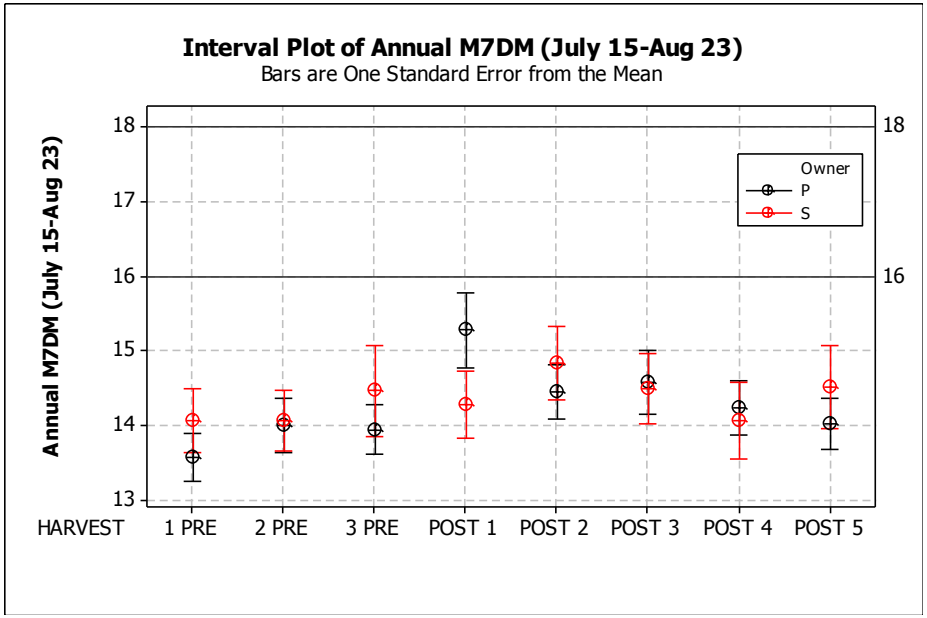
OAR 340-041-0028

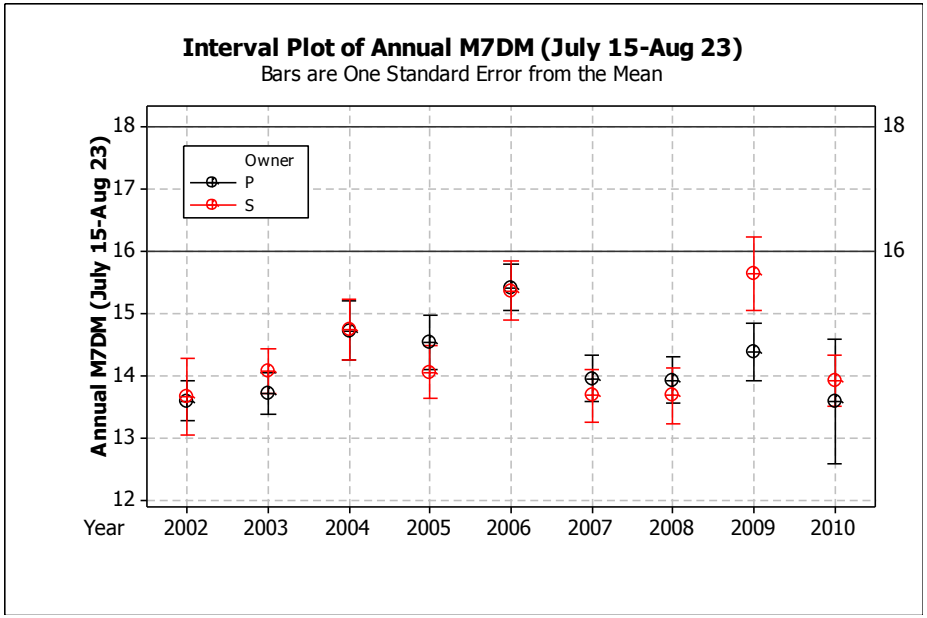
4 (b) The seven-day-average maximum temperature of a stream identified as having core cold water habitat use **may not exceed 16.0 degrees Celsius** (60.8 degrees Fahrenheit);
4 (c) The seven-day-average maximum temperature of a stream identified as having salmon and trout rearing and migration **may not exceed 18.0 degrees Celsius** (64.4 degrees Fahrenheit);

11 (a) …waters of the State that have summer seven-day-average maximum ambient temperatures that are colder than the biologically based criteria in section (4) of this rule, **may not be warmed by more than 0.3 degrees Celsius** (0.5 degrees Fahrenheit) above the colder water ambient temperature. This provision applies to all sources taken together at the point of maximum impact where salmon, steelhead or bull trout are present.

DEQ Numeric Standard

State and Private Sites were not raised above 16 or 18 deg. C biologically-based numeric criteria. Figures show results by harvest status (top) and by year (bottom).

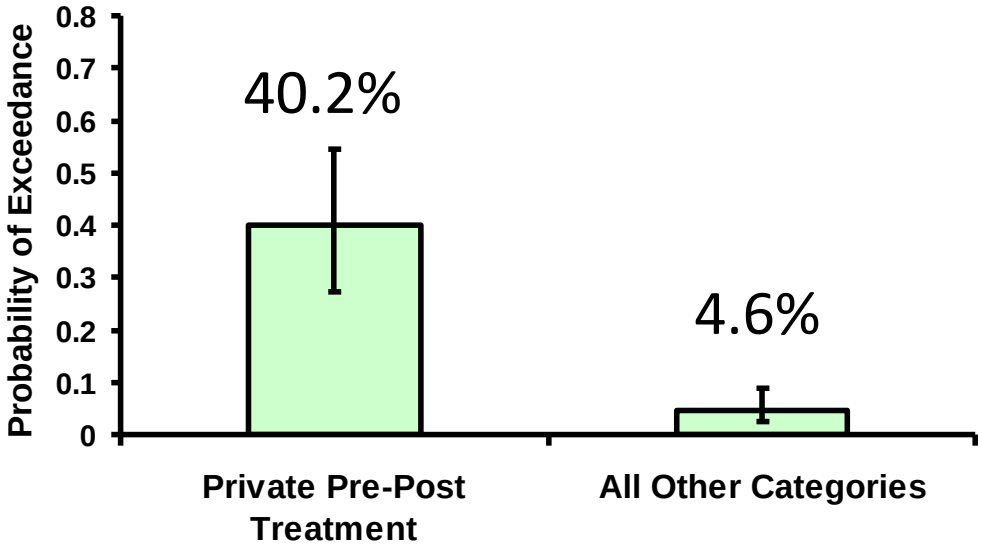




DEQ Protecting Cold Water Standard

1. Were streams warmed by more than 0.3 C?

- Yes, on private (not State) streams
- The analysis was complex due to the way the standard was written and DEQ not sure how to apply it.



Groom et al., 2011, Water Resources Research 2011

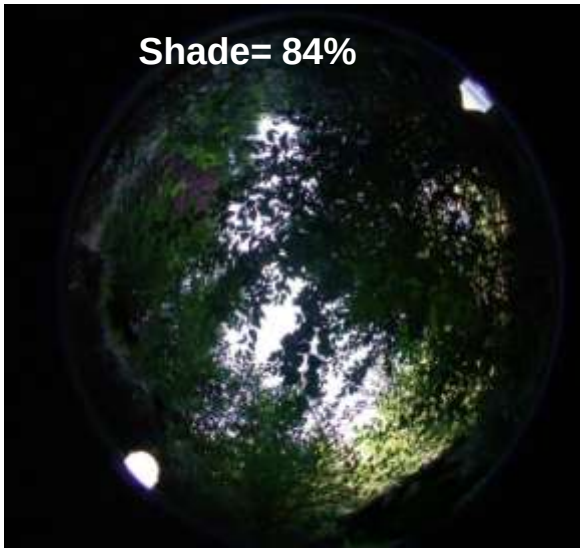
2. To what degree did temperatures change? And why?

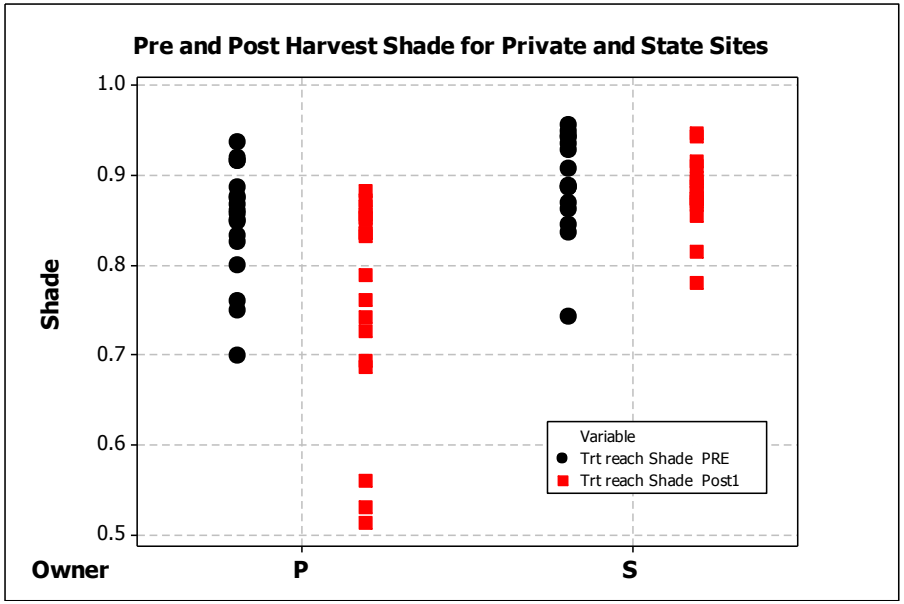
- Private sites: temperature increased + 0.7 °C (2.5, -0.9)
- State sites: + 0.0 °C (1.0, -0.9)
- Temperature increases related to declines in shade
- Shade related to riparian basal area (+), tree height (-)

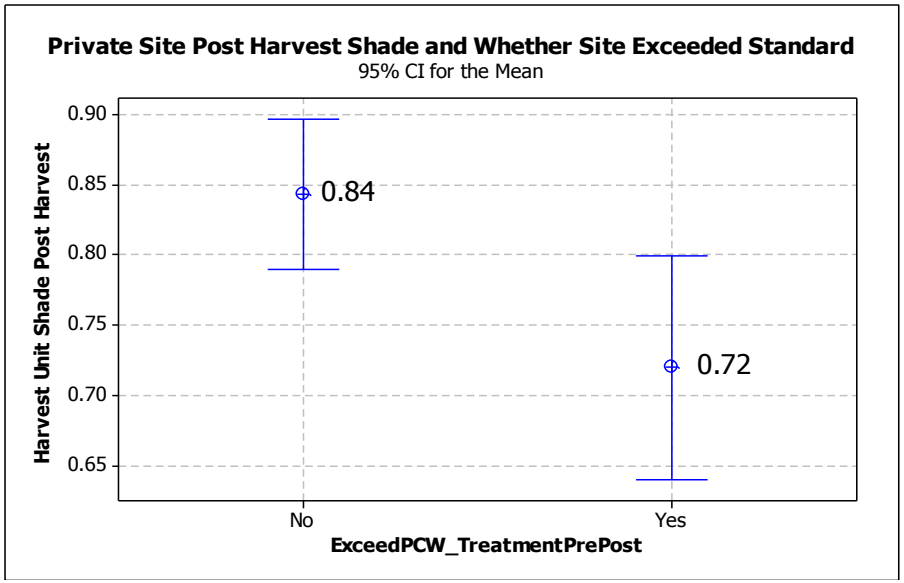
Groom et al., 2011 Forest Ecology and Management

RipStream Results

Change in Shade = Change in Temperature





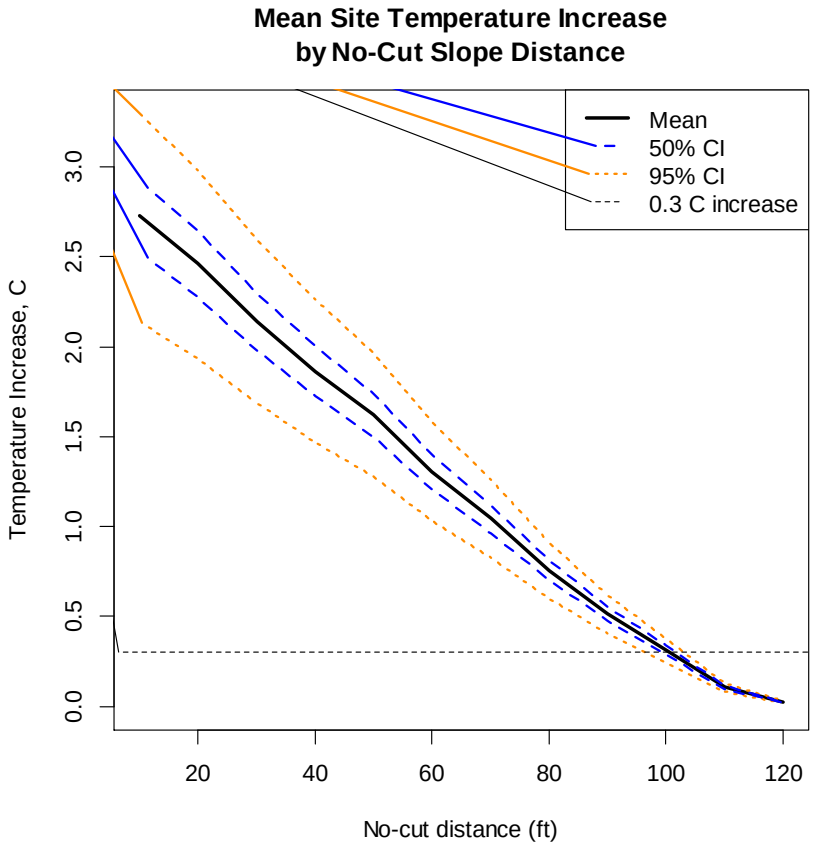


Temperature Increase on Private Forests

Because Ripstream found a 0.7 deg C increase, ODF indicated a change to the Forest Practice Rules was needed. One approach ODF is using is a statistical model to determine buffer width or basal area based on plot data collected at each study location.

Their current model

$$\Delta\hat{T}_{3-2ij} = \alpha_0 + \alpha_j + (\beta_1 \Delta TControl_{2-1} + \beta_i \Delta TControl_{2-1j}) + \beta_2 TreatmentReachLength + \beta_3 (inverse\ logit\ of: \alpha_{Shade} + \beta_{1Shade} PctDifferenceBA + \beta_{2Shade} PctHwd_{100} + \beta_{3Shade} TreeHeightPre_{100}) + \beta_4 GradientQuartile$$



Model Limitations and Next Steps

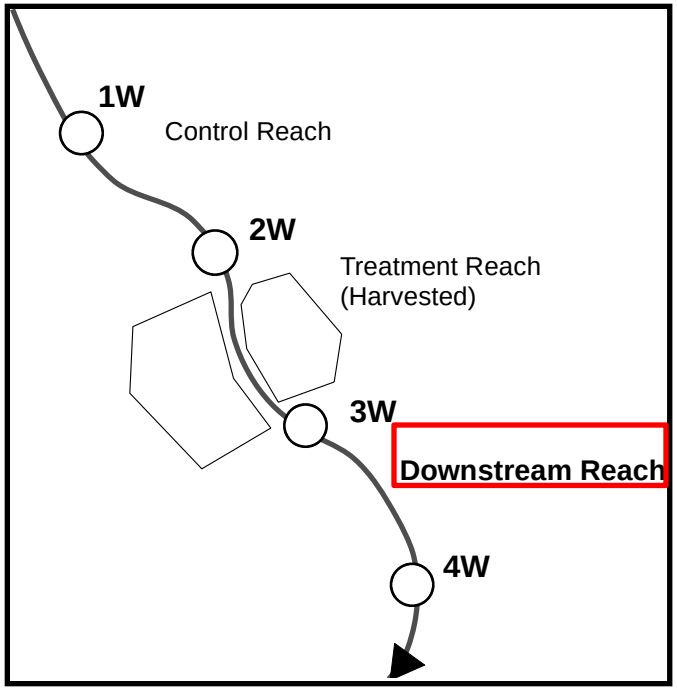
The Ripstream data were not collected for designing stream buffers. Had the study also had the objective of designing buffers for meeting the PCW, there would have been more of an effort to control for varying factors such as treatment reach length, the number of sides harvested and the management strategy. Also could have added more temperature probes as different distances in harvest unit.

Implications of basing results on a single shade model, when several competing models that perform just as well may be available. A related concern is the terms used in the model, some of the terms are not something we change through management or are hard to interpret.

Don't know how well these models will predict stream temperature change on stands not used to fit the models. "The model is designed to describe the temperature and shade behavior of 33 sites within this study. Applying the results outside of the RipStream sites requires extrapolation". ODF April, 2014

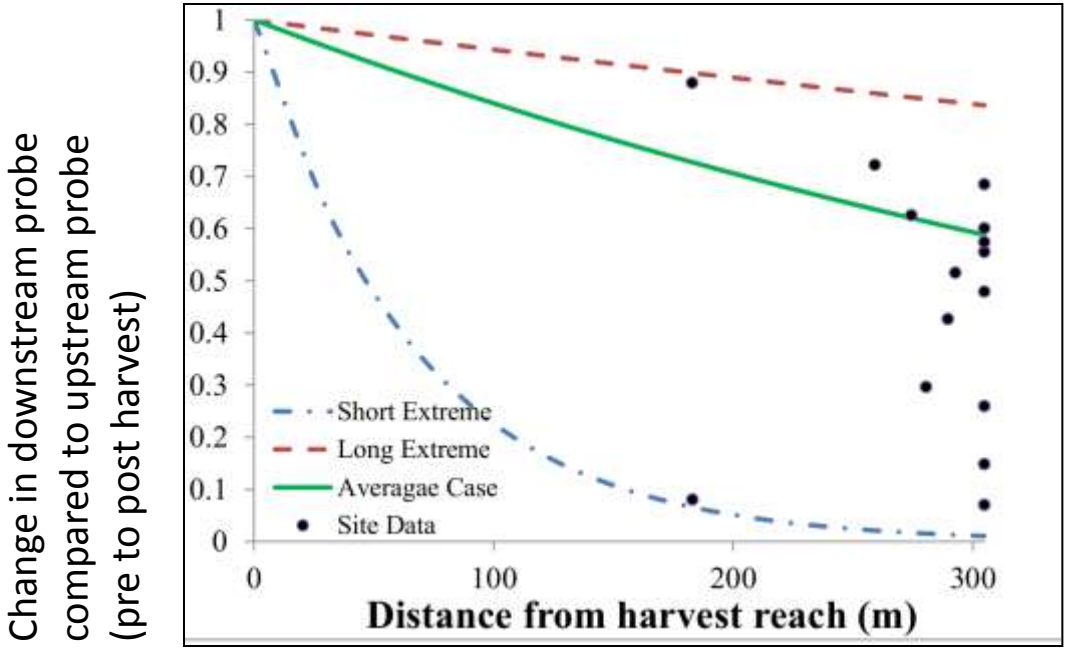
Model Next Steps: ODF working with WY statisticians to address some of the model concerns.

Downstream Analysis



We used basic laws of physics to develop a model for downstream temperature response. The result was that we could predict downstream response using the upstream temperature, width, depth and gradient of the downstream reach. Longer downstream reaches with less gradient and less water experienced the most cooling.

For average values the across harvest-year change in downstream temperature drops to ~50-60% of that change occurring in the harvest reach after 300m.



Calculated ratio of harvest reach and downstream temperature changes. Modified from Davis et al., WRR in review.

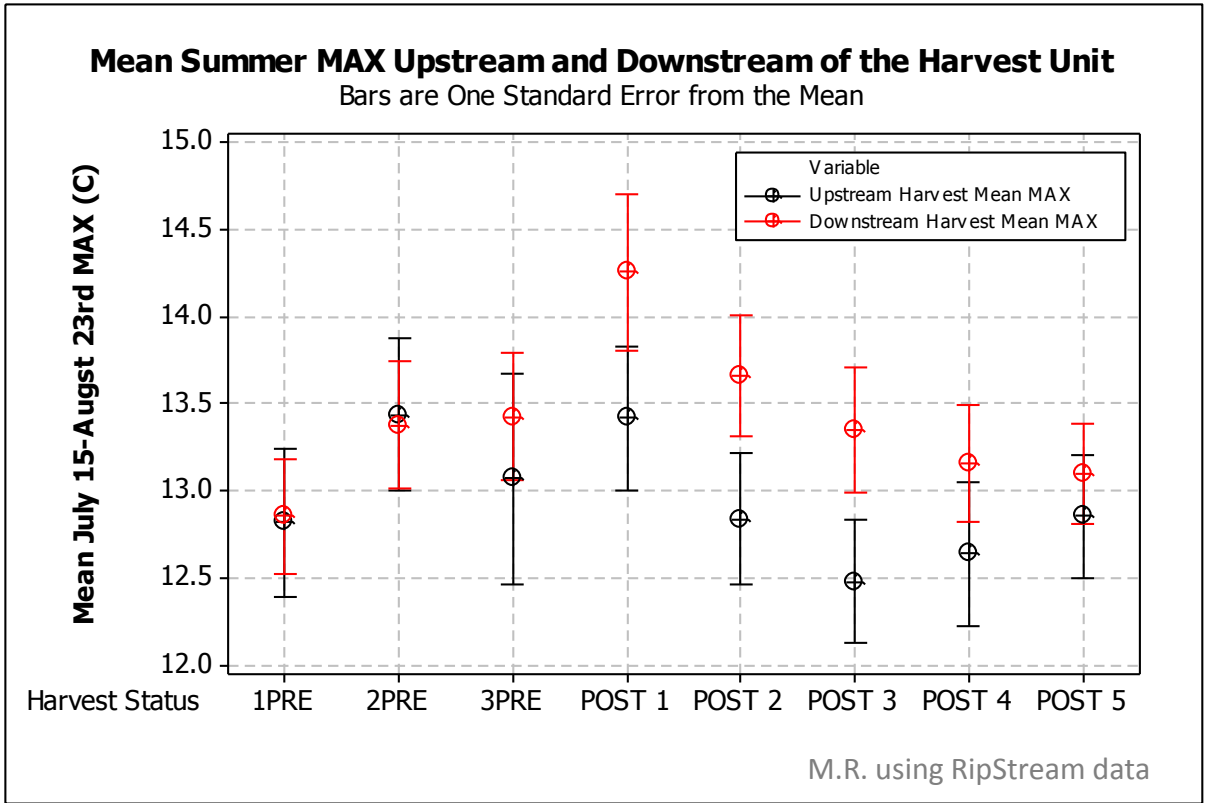
Five Years Postharvest: Private Sites

Recovery

Temperature: greater the initial increase, greater the subsequent decrease

Shade: Greater the initial decrease, greater the subsequent increase

All sites are not necessarily back to pre-harvest temperatures within 5 years



The average of all private sites very close to recovered within 5 years

From Groom 2012

Summary

•RipStream was a very intensive and extensive study examining whether current forest practices on State and Private lands were effective in meeting DEQ water temperature standards.

•The results show that current forest practices meet the numeric standards for fish but that we are slightly above the protecting cold water standard

•The downstream analysis indicated that within 300 m that the temperature change before and after harvest is 50-60% of the harvest unit temperature change.

•The results also show that for the most part stream temperatures have recovered over 5 years.