Over-Summer Habitat Contraction and Water Quality Declines in Intermittent Tributaries of the Russian River

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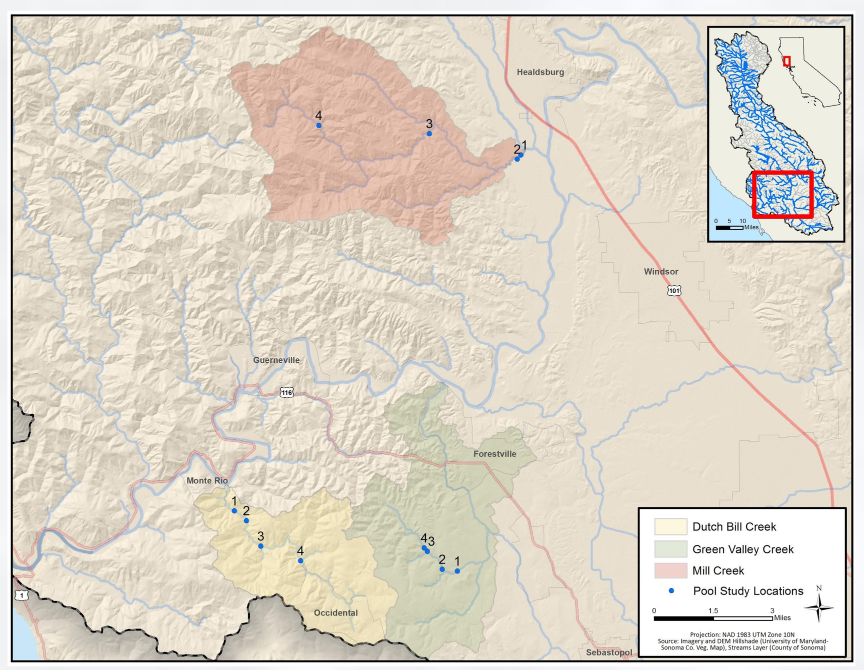
Introduction

In California streams, the summer low-flow period is often associated with decreases in habitat quality and quantity, as well as increases in juvenile coho salmon mortality.[1,2,3,4] CA Sea Grant has identified insufficient summer streamflow as a bottleneck to salmon recovery in tributaries to the lower Russian River. These streams have been observed drying at different times and rates, and evidence suggests that impacts of intermittency vary across reaches.[1] Few studies have examined implications of intermittency and water quality decline at the habitat scale. To examine changes in habitat and water quality in relation to changes in flow-related parameters over the summer, we selected 12 study units on three tributaries and measured a range of biological, physical, and chemical parameters over a five-month period in 2017.



Study Sites

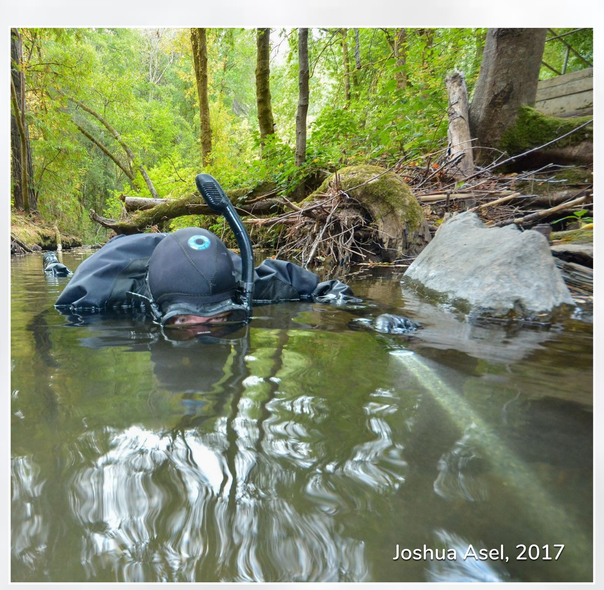
- 3 high priority coho salmon streams
- 4 pool-riffle units per stream
- 12 study units
- Different geomorphic and hydrologic reach types [5]

Methods

Biweekly Survey Measurements
- June-October, low flow period
- Unit wetted area and volume
- Riffle crest thalweg (RCT) depth
- Discharge and connectivity
- Paired snorkel counts

Continuous Measurements
- Dissolved oxygen
- Stage and intermittency
- Water temperature

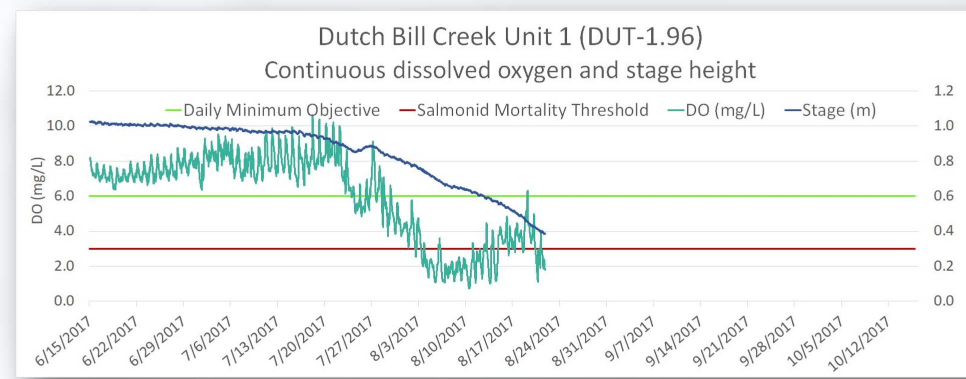
Initial Analysis
- Classification trees to identify relevant parameters using package rpart for R
- DO thresholds applied
  - Juvenile salmonid mortality threshold of 3 mg/L[6]
  - Regional objective of 6 mg/L daily minimum [7]

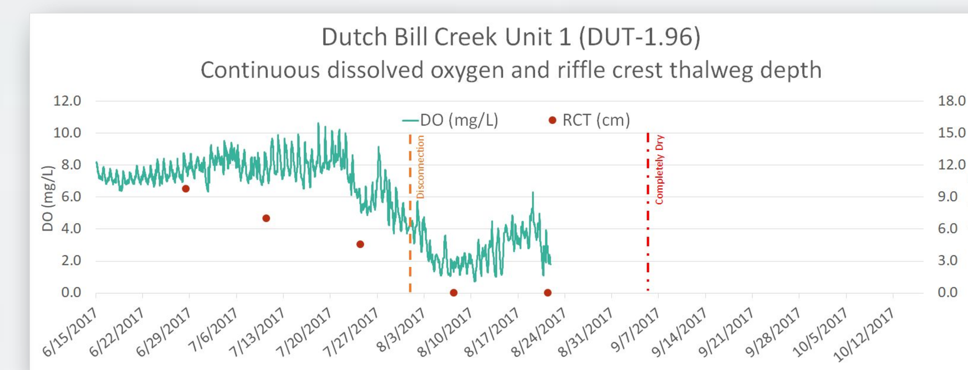


Results

Dutch Bill Creek Unit 1

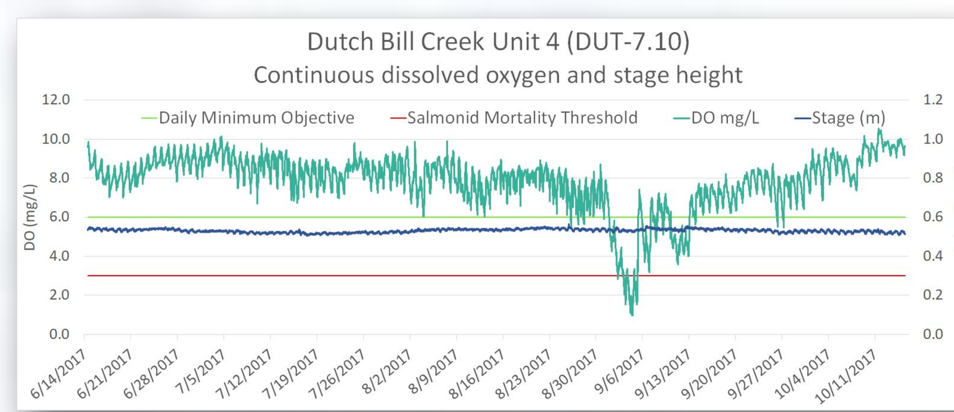
Geomorphic reach type	Alluvial
Percent change in pool volume	-100%
Percent change in salmonid count	-100%
This unit was one of the two pools to completely dry. Loggers were pulled on 8/22 when they became exposed to air.	

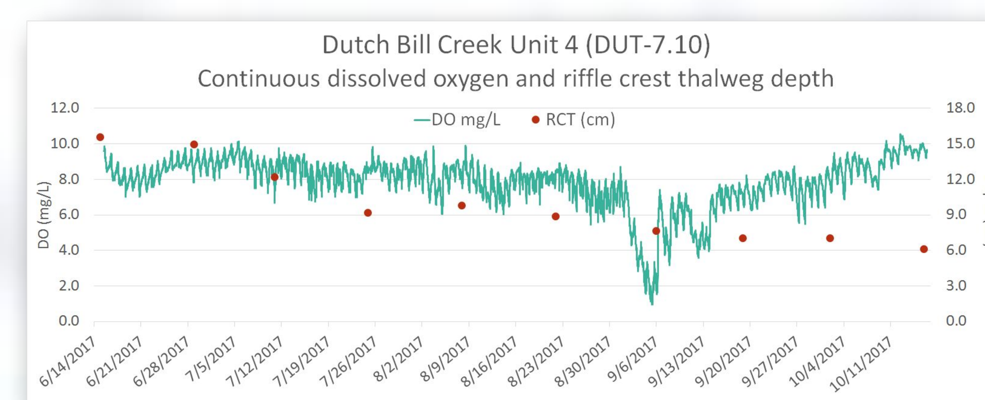




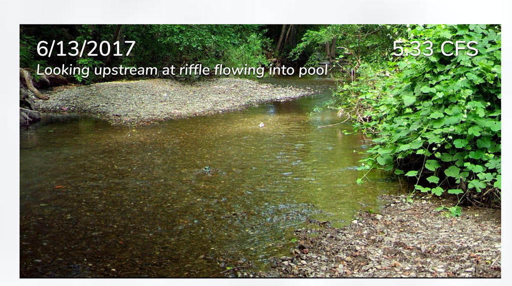
Dutch Bill Creek Unit 4

Geomorphic reach type	Bedrock
Percent change in pool volume	-16%
Percent change in salmonid count	-18%
The riffle upstream of this unit remained wet. DO levels dropped below the mortality threshold in early September.	

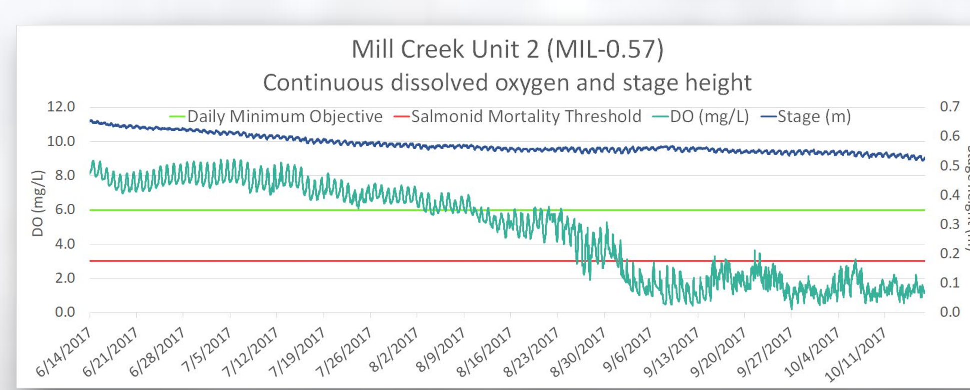


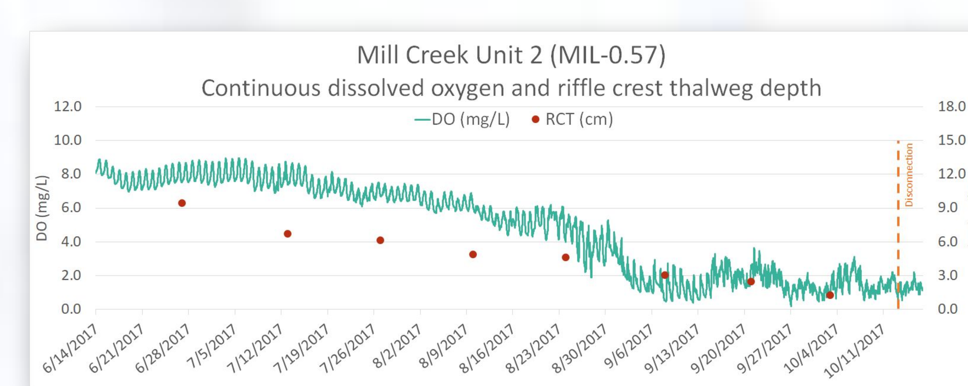


Mill Creek Unit 2

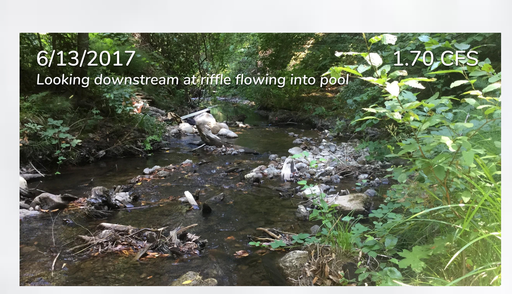


Geomorphic reach type	Alluvial
Percent change in pool volume	-42%
Percent change in salmonid count	-100%
This unit remained connected for most of the season, but DO dropped below the mortality threshold in early August and remained low.	

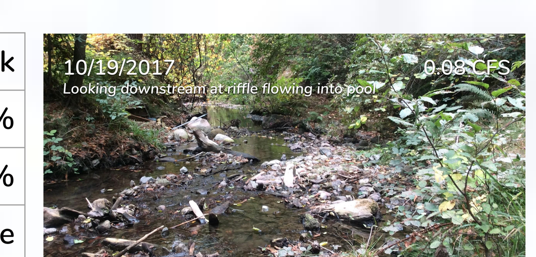


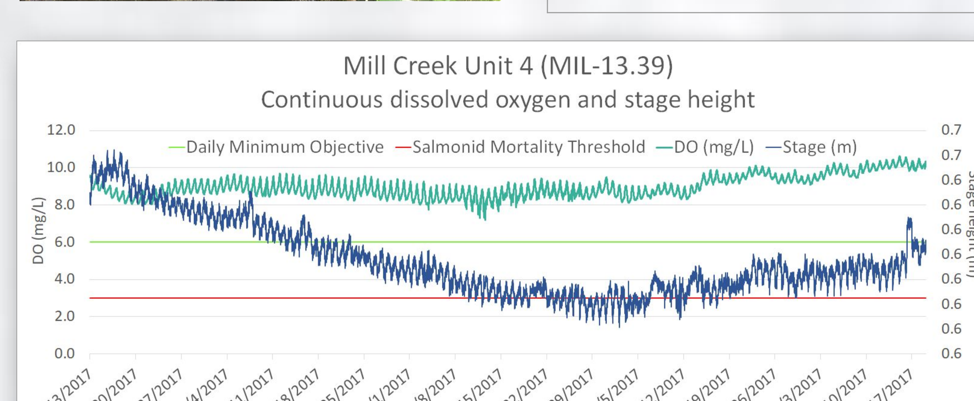


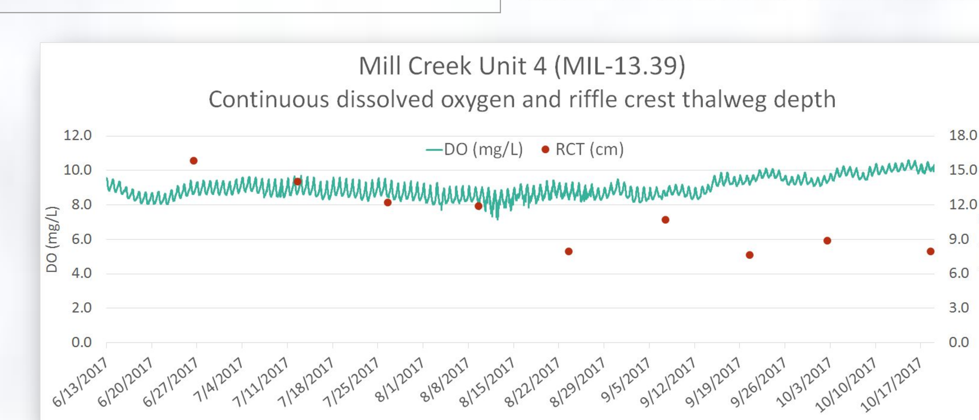
Mill Creek Unit 4



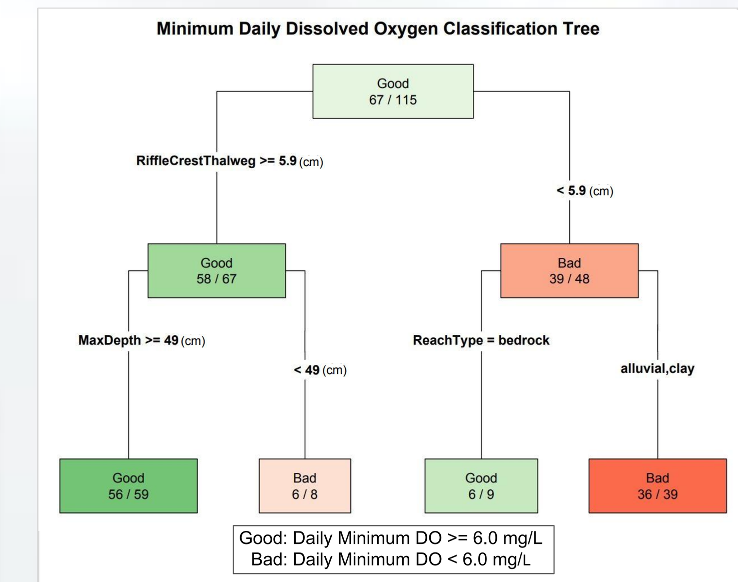
Geomorphic reach type	Bedrock
Percent change in pool volume	-2%
Percent change in salmonid count	24%
This unit was one of five to remain completely connected all season. The RCT never dropped below 6.0 cm and DO stayed above both thresholds.	

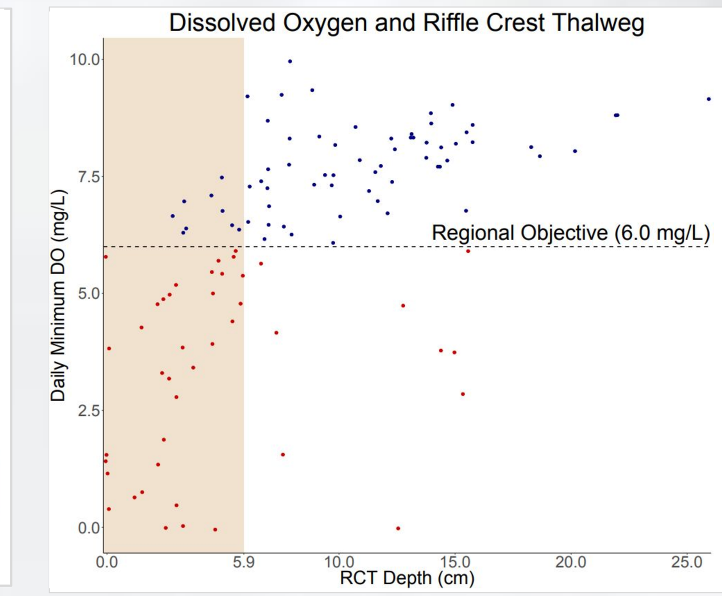






Discussion





- Variables included in the classification tree model were RCT depth, date, reach type, water temperature, upstream riffle area and maximum pool depth.
- RCT depth was the most effective variable at predicting whether minimum DO on the measurement date was "Good" or "Bad".
- Among units with a RCT ≥ 5.9 cm, maximum depth was the most effective variable at predicting whether DO was "Good" or "Bad"
  - Pools with a maximum depth < 49 cm were more likely to have "Bad" DO.
- For units with RCT depth < 5.9 cm the reach type was the most important predictor of DO quality
  - Generally, bedrock units had "Good" DO while alluvial and clay units had "Bad" DO.
- The scatter plot, above right, shows the distribution of the 115 data points used in the classification analysis.

Conclusions

- Riffle crest thalweg depth is a strong indicator of declines in dissolved oxygen concentrations in these study units.
- There is variation in water quality and rate of change between creeks, geomorphic reaches, and between units.
- Additional research is needed for a range of water year conditions.
- Planned next steps include generating rating curves and continuing the examination of different predictive parameters.

Acknowledgements

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