Southern steelhead, hard woody debris, and temperature: Predicting climate change effects in a California central coast watershed

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Issue
- Steelhead (Oncorhynchus mykiss) and their associated populations of resident rainbow trout, together called steelhead in this poster, are at the southern end of their range in California

- The dominant riparian trees in southern California are hardwoods, rather than conifers

- The role of hardwoods in steelhead habitat is largely unknown

- Climate change is likely to increase stress on steelhead through increases in stream temperatures, reduced summer flows, and effects of increased fire frequency on dry watersheds

Objectives
- Determine the contribution of hardwood tree species to large wood in the upper Salinas River watershed
- Determine how distribution and abundance of steelhead is related to large wood and other habitat factors (mainly temperature) in a hardwood-dominated watershed

Methods
- Surveyed large wood volumes and steelhead and distribution in fifteen 300-m stream reaches
- Sites at elevations of 700-1,470 m
- Surveyed in summer, between 5 July and 10 Aug 2006
- Measured the volume of large wood (length > 1 m, diameter > 10 cm) within the bankfull width
- Identified tree species (if possible) and counted wood jams
- Recorded water flow, temperature, overhead cover, pool number and depth
- Snorkeled to count and identify fish by species and size class
- Spearman rank correlations between steelhead density and habitat characteristics
- Two-dimensional Kolmogorov-Smirnov (2DKS) test to identify potential threshold temperature levels related to steelhead density (Gavney et al. 1998. Ecology 79:442-467)

Upper Salinas River Watershed

Wood Jams Helped Form Pools
- We observed 70 wood jams across the 15 sites, with a mean of 4.7 jams per site
- Large wood jams were important in pool formation and typically had red willow as their key pieces (45%)

Flows Low, Temperatures High
- Stream flow averaged 0.097 m³/s (SD = 0.077)
- One site, Trout 3, was dry throughout the study period
- Temperatures were exceptionally warm during the study period
- Air temperatures at our sites peaked at 49.3°C at Salinas Site 2
- Mean water temperature averaged 20.0°C (SD = 4)
- Maximum water temperature averaged 25°C (SD = 4)

Steelhead & Temperature
- No steelhead were observed at sites where mean water temperature exceeded 21.5°C, or where the maximum water temperature exceeded 26°C
- Steelhead density plotted against mean water temperature and maximum water temperature

Steelhead Distribution & Density
- We observed 7 native and 6 non-native fish species
- We identified 14 tree species contributing to large wood were hardwoods: coast live oak, California sycamore, red willow, and valley oak
- Steelhead were observed at nine out of the fourteen sites with water, and averaged 23 steelhead / 100 m, including young-of-the-year, at these sites

Hardwood Dominated the Large Wood
- We identified 14 tree species contributing to large wood were hardwoods: coast live oak, California sycamore, red willow, and valley oak
- Fallen dead large wood volumes on the central coast were almost 16 times less than conifer-dominated sites in the Pacific Northwest, but similar to volumes on private hardwood-dominated north coast sites

Conclusions
The combined importance of hardwood large wood and high temperatures on southern steelhead distribution and abundance indicates suitable habitat will be greatly reduced if climate change continues on its present course of warming, increasing fire frequency and intensity.

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