

Use of tributary confluence habitat by westslope cutthroat trout (*Oncorhynchus clarki lewisi*) in a wilderness watershed affected by wildfire

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INTRODUCTION

Tributary confluence areas have received relatively little attention in studies of stream fish distribution and behavior, but may be important because they create local patchiness in factors such as temperature and the availability of drifting prey. In addition, it is at confluences that the effects of disturbances such as wildfire are transferred through stream networks. The effects of wildfire on fish have also received little focused investigation, although wildfires represent an important natural disturbance in watersheds. Here we present the results of a study of adult cutthroat trout use of confluence habitat in a central Idaho wilderness watershed, much of which was burned by wildfire in 2000.

QUESTIONS & OBJECTIVES

Questions

- Do cutthroat trout select confluences, and does this vary with time?
- Does tributary wildfire history influence trout use of confluences?
- What factors may mediate the use of confluence habitat?

Objectives

- Characterize habitat use vs. availability by adult cutthroat trout in mainstem reaches that include junctions with small tributary streams that vary in their history of wildfire
- Survey trout distribution patterns day and night, summer-fall
- Measure characteristics of tributary and confluence habitat, including temperature and the supply of drifting invertebrate prey

STUDY AREA

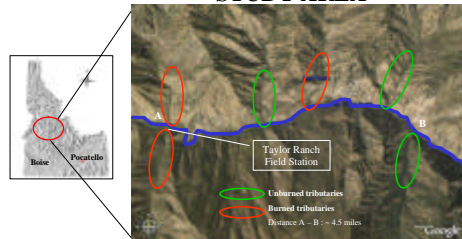


Figure 1. Big Creek watershed (5th order), “River of no Return” Wilderness, Central Idaho, USA

STUDY DESIGN & METHODS

- Selected 6 reaches of Big Cr. that each encompassed a confluence with a small tributary (2nd-3rd order)—three tributary drainages had been burned in 2000 (canopy lost), and three were largely unburned (canopy present). Tributaries were small enough as to not strongly affect the morphology of the mainstem (e.g., they did not create pools).
- Constructed maps of each study reach to characterize habitat availability, confluence habitat delineated by size of mainstem temperature influence
- Conducted a total of 68 underwater surveys (day and night) of adult cutthroat trout from August-October, 2005
- Sampled drifting stream invertebrates (250 μ m drift-net) over 24-hr period in one burned and one unburned tributary, just above confluence
- Estimated trout selection of habitat by calculating Ivlev’s electivity index, then compared burned vs. unburned types via *t*-test



RESULTS



Trout Selection of Confluence Habitat

- Adult cutthroat trout showed positive selection for confluence habitat, relative to its availability in 69% of all observations from the summer period, but only in 24% of all fall observations. In both seasons, the selection of confluence habitat was stronger during night than during day. All the night observations in summer showed positive selection for confluence habitat, whereas this was the case for only 56% of the day observations. In fall, the selection for this habitat changed to 53% for the night observations, and no preference was observed during the day-time surveys.
- In general, trout showed stronger selection for habitat at confluences with burned tributaries vs. those that were unburned (Figure 2). The difference in trout selection between the two classes was stronger in summer than in fall ($P < 0.01$ and $P > 0.05$, for summer and fall respectively, by *t*-test). In addition, in summer, the difference in selection among burn types was stronger during day than at night ($P < 0.01$ and $P > 0.20$ for day and night respectively).

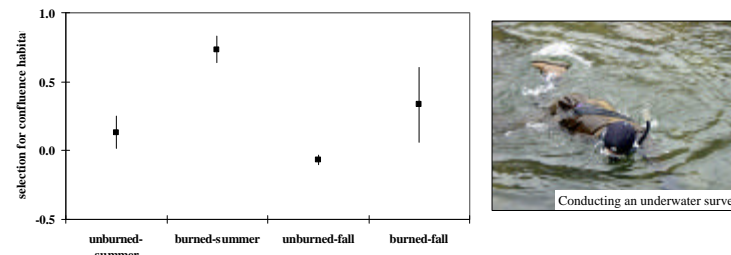


Figure 2. Selection (use vs. availability) of confluence habitat by adult cutthroat trout for junctions with unburned vs. burned tributaries in summer and fall (mean Ivlev’s electivity values \pm 1 SE).

Confluence Habitat Characters & Prey Delivery

- Burned and unburned tributaries had similar discharge, temperature, and thermal effects on the mainstem ($P > 0.4$, by *t*-test)
- Local cooling effects of tributaries on the mainstem were greater in summer than in fall
- Confluences differed in physiognomy (Fig. 3), and habitat arrangement created variability in distance and pathways to safety for trout (evaluated by observing trout “escapes” underwater)
- During a 24 hour period in summer, the burned tributary that was sampled supplied more than twice as many drifting invertebrate prey than did the unburned tributary.

Trade-offs? Thermoregulation, Feeding & Predation Risk

Examining confluences and their use by trout “case by case,” it appeared selection for confluence habitat occurred:

- when main-stem temperature = 18°C
- or
- when main-stem temperatures were $< 18^\circ\text{C}$, and presumably when the supply of drifting prey, along with the cool water influence were enough to warrant the predation risk associated with the physiognomy of the confluence

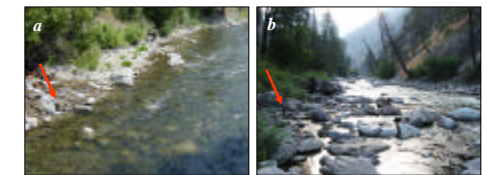


Figure 3. Confluences differed in their shape, which could affect the predation risk for trout. At confluence a, trout could hold in deep water and had a quick escape route, whereas at b trout had to negotiate a path to reach a shallow, exposed patch of cool water at the confluence.

CONCLUSIONS

This study showed that:

- tributary confluences (even those with relatively small streams) may be important in determining adult westslope cutthroat trout distribution
- wildfire may influence trout distribution and behavior in main-stem habitats by altering tributary confluence characteristics, possibly through increasing the local supply of drifting invertebrate prey
- a trade-off involving thermoregulation, foraging opportunity, and predation risk may mediate the use of confluence habitat by trout

Though further studies are needed to better understand the interactive effects of tributaries and fire regimes on fish distribution and behavior, this investigation in a wilderness watershed has yielded results that may have consequences for the way trout habitat is assessed, as well as how the effects of fire on fish may be perceived by scientists and land managers.

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