Influences of Human Activity on Stream Temperatures and Existence of Cold-Water Fish in Streams with Elevated Temperature: Report of a Workshop

Executive Summary

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Full report available at http://www.fsl.orst.edu/imst

Executive Summary

The Independent Multidisciplinary Science Team (IMST) convened a panel of experts on stream temperature and fish ecology on October 5-6, 2000 for a scientific workshop on human influences on stream temperature and responses by salmonids. The workshop was designed to review and discuss scientifically credible data and publications about 1) factors related to human activity that influence stream temperature and 2) behavioral, physical, and ecological mechanisms of cold water fish species for existing in streams with elevated temperatures. The goal of the workshop was to review empirical evidence and to identify points of agreement, disagreement, and knowledge gaps within the scientific community concerning the factors that influence stream temperature and fish responses to elevated temperatures. This information will assist the IMST in preparing a broader temperature report on Oregon's stream temperature water quality standards and their implementation.

This report is prepared by the IMST. It was reviewed by workshop participants and revised by the IMST accordingly. The report includes abstracts of plenary presentations on factors that influence stream temperatures and fish responses, and the results of group discussions. The workshop participants focused on three main questions and were asked to list statements of agreement and disagreement, and to identify gaps in the scientific knowledge related to each question:

- How and where does riparian vegetation influence stream temperature?
- Do other changes in streams cause increases in stream temperature?
- How can apparently healthy fish populations exist in streams with temperatures higher than laboratory and field studies would indicate as healthy?

The workshop participants provided answers to the questions in the form of bullets. The answers below represent the IMST's summation of the workshop findings and were reviewed by the participants. Several gaps in the scientific basis for specific questions or relationships were identified. The participants found no areas of disagreement for which technical information was available. They noted that any disagreements were not related to scientific interpretation, but were based on concerns or opinions about application, regulation, and management.

How and where does riparian vegetation influence stream temperature?
The influence of riparian vegetation on stream temperature is cumulative and complex, varying by site, over time, and across regions. Riparian vegetation can directly affect stream temperature by intercepting solar radiation and reducing stream heating. The influence of riparian shade in controlling temperature declines as streams widen in downstream reaches, but the role of riparian vegetation in providing water quality and fish habitat benefits continues to be important. Besides providing shade, riparian vegetation can also indirectly affect stream temperature by influencing microclimate, affecting channel morphology, affecting stream flow, influencing wind speed, affecting humidity, affecting soil temperature, using water, influencing air temperature, enhancing infiltration, and influencing thermal radiation. It is critical to know the site potential to understand what vegetation a site can support. There is not a good scientific understanding of how much vegetation shading is required to affect stream temperature. This lack of understanding may be due to the spatial and temporal variability in landscape components, and

the resulting variability in both the direct and indirect influences of vegetation on stream temperature. Therefore, it is difficult to generalize about the effects of vegetation on stream temperature.

Do other changes in streams cause increases in stream temperature?
The answer to this question is yes, other physical changes in the stream system can modify stream temperatures. Stream temperature is a product of complex interactions between geomorphology, soil, hydrology, vegetation, and climate within a watershed. Changes in these factors will result in changes in stream temperature. Human activities influence stream temperature by affecting one or more of four major components: riparian vegetation, channel morphology, hydrology, and surface/subsurface interactions. Stream systems vary substantially across the landscape, and site-specific information is critical to understanding stream temperature responses to human activities.

How can apparently healthy fish populations exist in streams with temperatures higher than laboratory and field studies would indicate as healthy?
Workshop participants identified several mechanisms that might explain the ability of fish populations to exist at higher than expected temperatures. The first mechanism was that the fish may have physiological adaptations to survive exposures to high temperatures. A second possibility was that stream habitats may contain cooler microhabitats that fish can occupy as refuge from higher temperatures. A third consideration is that ecological interactions may be different under differing thermal conditions resulting, for example, in changes in disease virulence or cumulative effects of stressors. Finally, since substantial differences exist between laboratory and field studies, it is difficult to apply results of laboratory studies to fish responses in the field. It is important to note that these proposed mechanisms are speculative and, as the list of gaps indicates, substantial experimental work is required to establish their influences on fish in different stream systems.

Workshop Summary

Workshop participants recognized gaps in the available science. Additional knowledge about human influences on stream temperatures and, consequently, influences on cold-water fish populations, will improve our ability to prevent further degradation of stream habitat and will enhance efforts geared towards the recovery of depressed fish populations. Even with these gaps, there was enough agreement on factors that influence stream temperature to indicate information is available to start developing and implementing management practices that are designed to reduce stream warming. It was suggested that managers should consider riparian vegetation, channel morphology, and hydrology, and should account for site differences.