FACT SHEET No. 27

Rangeland Watershed Program

U.C. Cooperative Extension and USDA Natural Resources Conservation Service

Fishery Habitat:
2) Temperature Requirements

Royce E. Larsen, Department of Agronomy and Range Science, University of California, Davis, CA 95616-8515.

Fish are cold-blooded (poikilothermic) animals; therefore, their body temperature is controlled by the environment in which they live. Because water temperature controls the body temperature of fish, it can regulate activity and physiological processes. However, fish will move into more favorable areas of a stream to regulate their body temperature. Fish can generally function in a wide range of temperatures, but they do have an optimum range, as well as lower and upper lethal temperatures for various activities (Beschta et al. 1987).

Temperature requirements of salmonids varies with life history stage and by species (Mihursky and Kennedy, 1967). Beschta et al. (1987) have discussed how adverse water temperatures can have impacts on the different life history stages of migration, spawning, incubation, and emergence. If water temperature is too high, salmonids may not migrate upstream for spawning. Once fish reach their destination the temperature has to be right for spawning to occur. Following spawning, an increase in water temperature may have adverse effects on incubation and may alter the hatching time as well as the survival and emergence of fry. Increased water temperature will influence the embryonic and juvenile stages more than adults (Lantz, 1971). The water temperature criteria for spawning, egg incubation, and juvenile rearing for anadromous fish in the Western United States are shown in a Table 1.

High water temperatures can also increase in metabolic rates resulting in increased food demand and can cause increased incidence of disease. An increase in water temperature may also favor non-salmonid species that may be better adapted to warmer temperatures. An increase in water temperature may also have a negative effect on the invertebrates (food source) in a stream.

A major mechanism for warming water is an increase in direct solar radiation coming from removal of canopy cover (Beschta et al., 1987). Both increased light and temperature may cause an increase of primary production because of higher algae production and increased decomposition of organic material (Beschta et al., 1987). This increase in trophic effects may lead to an increase in invertebrate production or a change in species composition. An increase of invertebrate production leads to an increase of drift (food) within the stream ecosystem. This increased food supply will increase fish growth and production up to a certain optimum temperature which may be different for each species. However, the metabolic rate of fish will also increase which can cancel the beneficial effect on increased food supply when exceeding optimum temperatures (Beschta et al., 1987).

Species	Upstream Migration (°F)	Spawning (°F)	Incubation (°F)	Juvenile Rearing		
				Preferred (°F)	Optimum (°F)	Upper Lethal (°F)
Chinook	---	42.1-57.0	41.0-57.9	45.1-58.3	54.0	77.4
Fall	51.1-66.9	---	---	---	---	---
Spring	37.9-55.9	---	---	---	---	---
Summer	57.0-68.0	---	---	---	---	---
Chum	46.9-60.1	45.0-55.0	39.9-55.9	52.2-58.3	56.3	78.4
Coho	45.0-60.1	39.9-48.9	39.9-55.9	53.2-58.3	---	78.4
Steelhead	---	39.0-48.9	---	45.1-58.3	50.0	75.4
Kokanee	---	41.0-55.0	---	---	---	---
Rainbow	---	36.0-68.0	---	---	---	---
Cutthroat	---	43.0-63.0	---	49.1-55.2	---	73.4
Brown	---	45.0-55.0	---	39.0-70.3	---	75.4

Source: Adapted from Beschta et al. (1987)
Note: °C = (°F-32)/1.8

It is difficult to put specific temperature limits on any stream because of the natural variability of stream temperature. Water temperature will vary diurnally, seasonally, and from stream to stream. Water temperature may also vary within a stream, such as where a cold water spring enters a stream, or within a deep pool.

Fish seem to acclimate themselves to these variations and have persisted over time. However, they will acclimate upward to high temperatures faster than downward to lowered temperatures (Mihursky and Kennedy, 1967). The slower, downward acclimation time may be important when considering streams that are open (removed riparian vegetation). Open streams will cool faster and be colder than covered streams at night, especially during cold weather (Lantz, 1971). The upper limits may not be lethal for short periods of time, for example, rainbow trout may be able to survive temperatures as high as 80°F for an hour or two, but longer periods may be lethal. Also, fish may find safe spots such as cold water springs, deep pools, etc., that may be more suitable than the rest of the stream (Beschta et al., 1987). The temperature within the stream bottom substrate (inter-gravel) may also be different than the temperature of flowing water. Usually the intra-gravel temperature will parallel streamflow, but lagged and buffered heating and cooling trends may exist (Shepherd et al., 1986).

Bibliography

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Note: This fact sheet only contains general information about fishery requirements. Additional sources of information include *Pacific Salmon Life Histories*, edited by C. Croot and L. Margolis, UBC Press Vancouver. For information on specific species see *Habitat Suitability Information: for species interested in...*, published by U.S. Department of Interior, Fish and Wildlife Service. See your local fishery biologist for information about fish in any specific stream.

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