Appendix 3B

Spawning Gravel Requirements for Cutthroat Trout

Spawning Gravel Requirements for Cutthroat Trout
Technical Memo

1.0 Introduction

Cutthroat trout spawn under specific stream conditions related to water temperature, substrate (gravel) characteristics, and other physical cues (e.g., water velocity). Female salmonids construct nests by first clearing away fine sediment to create a pocket that contains less sediment than the surrounding gravel (Hartman & McMahon 2004). Sediment intrusion into the nest can reduce intra-gravel permeability, thereby limiting the supply of oxygen to developing embryos (Reiser & White 1988). Numerous early (pre-1970) field and laboratory studies established that the amount of "fines" or fine sediments (usually < 6 mm in diameter) in spawning gravel is directly related to embryo mortality (reviewed in Chapman 1988), and the requirements of spawning trout (most often steelhead or rainbow) with regard to precise sediment content in gravel have since been studied extensively.

2.0 Cutthroat trout

Thurow and King (1994) first described the spawning requirements of Yellowstone cutthroat trout in southeast Idaho with regard to precise sediment content. They characterized spawning sites of Yellowstone cutthroat trout in a Snake River tributary (Pine Creek, southeast Idaho) and found that, on average, 20% of the gravel substrate was smaller than 6.35 mm and 5% was less than 0.85 mm. In general, cutthroat trout in their study spawned over substrate with a wider range of particle sizes (0.06-100 mm in diameter) than those found in the literature (Thurow & King 1994). Other studies (cited in Thurow & King) find that cutthroat prefer gravels from 19-76 mm (Cope 1957), 12-85 mm (Varley & Gresswell 1988), or 15-60 mm (Hickman & Raleigh 1982).

3.0 Other trout species in Idaho

Studies of other trout in Idaho add to the consensus that embryo survival is indirectly related to the percentage of fine sediment in spawning gravel, and at similar levels as were found for the Snake River Yellowstone cutthroat. McCuddin (1977) found steelhead survival in natural spawning areas decreased as the proportion of sand in the substrate increased above 10-20%. In that study, any percentage of 6-12 mm particles above 10-15% appeared to reduce survival, as did any percentage of fines (<6 mm) above about 20-25% (McCuddin 1977 *cited in Chapman 1988*). Reiser and White (1988) found a similar threshold for fine sediments. They incubated steelhead trout eggs in 16 mixtures of fine (<0.84 mm) and coarse (0.84-4.6 mm) sediments (representative of those found in the Idaho batholith) into laboratory gravel nests and found that embryos were more sensitive to increases in fines (<0.84 mm). They found a ratio of 30% fine sediment (and 70% gravel) was generally the lethal limit for steelhead embryos. Using sediments "imported" from streams in central Idaho, Tappel and Bjornn (1983) found that 90-93% of the variability in steelhead embryo survival (in the laboratory) was correlated negatively to the percentage of two different particle sizes in gravel: sediment less than 0.85 mm and sediment less than 9.5 mm in diameter, thus medium-sized sediment may also play an important role in survival of some species.

4.0 References

Chapman, D. W. 1988. Critical review of variables used to define effects of fines in redds of large salmonids. Transactions of the American Fisheries Society 117(1): 1-21.

Cope, O. B. 1957. The choices of spawning sites by cutthroat trout. Proceedings of the Utah Academy of Arts and Sciences, Arts, and Letters 34: 73-79. *Cited in Thurow & King 1994*

Hartman, G. F., and T. E. McMahon. 2004. "Aspects of fish reproduction and some implications of forestry activities." In Fishes and Forestry: Worldwide Watershed Interactions and Management, eds. T. G. Northcote and G. F. Hartman. Blackwell Science.

Hickman, T., and R. F. Raleigh. 1982. Habitat suitability index models: cutthroat trout. US Fish and Wildlife Service, Habitat Evaluation Procedures Group, Western Energy and Land Use Team. Fort Collins, Colorado. *Cited in Thurow & King 1994*

McCuddin, M. E. 1977. Survival of salmon and trout embryos and fry in gravel-sand mixtures. Master's Thesis. University of Idaho, Moscow, Idaho. *Cited in Chapman 1988*

Reiser, D. W., and R. G. White. 1988. Effects of two sediment size-classes on survival of steelhead and chinook salmon eggs. North American Journal of Fisheries Management 8: 432-437.

Tappel, P. D., and T. C. Bjornn. 1983. A new method of related size of spawning gravel to salmonid embryo survival. North American Journal of Fisheries Management 3:123-135.

Thurow, R. F., and J. G. King. 1994. Attributes of Yellowstone cutthroat trout redds in a tributary of the Snake River, Idaho. Transactions of the American Fisheries Society 123: 37-50.

Varley, J. D., and R. E. Gresswell. 1988. Ecology, status, and management of the Yellowstone cutthroat trout. American Fisheries Society Symposium 4: 13-24. *Cited in Thurow & King 1994*