US FWS Winter Flow Recommendations for Reservation of Water for Instreamflow
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The US Fish and Wildlife Service, Alaska (FWS) employs the natural flow paradigm in preparation of applications for reservations of water for instreamflows. The Instream Flow Council states that "the objective of an instreamflow prescription should be to mimic the natural flow regime as closely as possible"(Instreamflow Council, 2002). The structure and function of riverine systems are based on hydrology, biology, geomorphology, water quality, and connectivity which are maintained through a system's natural flow pattern. Reservations developed under this paradigm allow for the protection of fish and wildlife habitat, populations, and propagation while allowing water for other uses. The FWS generally requests the median flow (fifty percent exceedence, Q_{50}) for specific time periods to achieve this protection (USFWS, 2002).

However, Alaskan winters create streamflow and ice conditions that require special considerations (USFWS 2002) to ensure the protection of fish and wildlife habitat, migration, propagation and species diversity. Literature identifies flow below the seven day average low flow (7Q10) as harmful to aquatic life (Milhous 1982) and suggests that winter base flow equal to the 20% exceedence (Q20) maintain ecological functions in wet and dry years (Stamp et al. 2008).

For example, for the Uganik River the critical period for incubation and overwintering is January through March. The USFWS would request the 25% exceedance flow (Q25) for each of these months. The Q25 exceeds the 7Q10 as cautioned, adheres to the natural flow paradigm, and ensures sufficient water to sustain aquatic life during winter months. Such a reservation would achieve the goal of the Instream Council's Policy Statement "to maintain a rivers ecological functions and processes when determining flow levels for instreamflows" (Annear et al. 2004).

The literature cited below supports the importance of maintaining adequate winter flows for fish and wildlife habitat and water quality purposes.

- Cunjak (1996) found that reduced streamflow can deleteriously alter the availability of over wintering fish habitats in all stream types, particularly in ice affected systems where over wintering fish mortality already varies between 30-65% (Cunjak and Randall, 1993; Bustard, 1986).
- Streamflow volume directly influences winter water quality parameters including temperature, sediment and nutrient concentrations, dissolved oxygen, and pollutant concentrations (Dey and Annear 2003) (Reiser and Bjornn 1979).
- Reduction in stream flow results in the significant loss of refuges for overwintering fish, invertebrates, and incubating eggs (Cunjack, 1996; Reynolds, 1997).
- Altering the natural stream flow patterns during extended periods of low discharge can lead to the desiccation of eggs, low oxygen levels, freezing during low temperatures, and high embryo mortality. (Reiser 1981, Reiser and Bjorrnn 1979).
- For the period of over-wintering flow, the limiting factor that defines fish egg incubation success is the 7-day average winter low flow. As the stage of the stream drops during the winter months, fish eggs in the gravels along the margin of the stream become dry and/or freeze, then

die. The viable eggs are those in gravels below the water stage associated with the 7-day average winter low flow. The eggs near the upper parts of this flow will freeze and die unless thermic conditions of the gravels are adequate to prevent freezing of the substrate. Thus, discharge must be maintained at levels above the 7-day average winter low flow in order to maintain thermic conditions to prevent freezing of the substrate and to incubate fish eggs (Milhous 1982).

- The Instream Flow Council recommends that the 7-day average low flow (7Q10) not be used as a means of determining a minimum stream flow because flows below that value are inadequate to protect aquatic life or ecological integrity (Annear et al. 2004).
- In general, higher winter flows increase riffle areas and thereby increase the surface area suitable for invertebrate production, maintaining the food supply for over-wintering fish (Dey and Annear 2003).
- Milhous (1982) notes that the 7-day average winter low flow is a method for determining winter flows *harmful* to incubating eggs. This follows from research that shows values below the 7-day average low flow ($7Q_{10}$) are *inadequate to protect aquatic life or ecological integrity* (Annear et al. 2004).
- Research performed by Stamp et al (2008) suggests the 20% exceedance (80th percentile values) provides winter base flows that mimic natural hydrologic conditions and provides high diversity winter aquatic habitat, even in dry to wet years.

LITERATURE CITED

"Instream Flows in the Context of Riverine Ecology". (2002). *Instream Flows for Riverine Resources Stewardship*. USA. Instream Flow Council. 21 p.

Annear T., Chisholm I., Beecher H, Locke A., and 12 other authors. 2004. Instream flows for riverine resource stewardship, revised edition. Cheyenne (WY): Instream Flow Council. 268 p.

Bustard, D.R. 1986. Some differences between coastal and interior stream ecosystems and the implications to juvenile fish production. In Proceedings of the Workshop on Habitat Improvements, 8–10 May 1984, Whistler, B.C. Edited by J.H. Patterson. Can. Tech. Rep. Fish. Aquat. Sci. 1483: 117–126.

Cunjack, R.A. 1996. Winter habitat of selected stream fishes and potential impacts from land-use activity. Canadian Journal of Fisheries and Aquatic Sciences 53:267-282.

Cunjak, R.A., and Randall, R.G. 1993. In-stream movements of young Atlantic salmon (Salmo salar) during winter and early spring. In Production of juvenile Atlantic salmon, Salmo salar, in natural waters. Edited by R.J. Gibson and R.E. Cutting. Can. Spec. Publ. Fish. Aquat. Sci. 118: 43–51.

Dey, P. D. and T.C. Annear. 2003. Winter Flow Recommendations for the Shoshone River below Buffalo Bill Dam

Milhous, Robert. 1982. Working paper on the application of the physical habitat simulation system to water management, amended 1987. Aquatic Systems Modeling Section, Aquatic Branch, National Ecology Center. U.S Fish and Wildlife Service. Fort Collins, Colorado.

Reiser, D.W. 1981. Effects of Steamflow Reduction, Flow Fluctuation and Flow Cessation on Salmonid Egg Incubation and Fry Quality. Ph.D. Thesis. University of Idaho.

Reiser, D.W. and T.C. Bjorrnn. 1979. Habitat Requirements of Anadromous Salmonids. Pacific Northwest Forest and Range Experiment Station. Portland, Oregon.

Reynolds, J.B. 1997. "Ecology of Overwintering Fishes in Alaskan Freshwaters". Freshwaters of Alaska. SpringerNew York. 281-302. Print.

Stamp, M, D. Olsen, and T. Allred. 2008. Lower Provo River Ecosystem Flow Recommendations Final Report. 8: 54.

U.S. Fish and Wildlife Service, 2002. Uganik River Reservation for Instream Flow Application, Attachment B, pp. 2.