Flow Regime and System Capacity

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Species Information

Common Name: Westslope Cutthroat Trout, Athabasca Rainbow Trout, Bull Trout
Genus: Oncorhynchus lewisi, Oncorhynchus mykiss, Salvelinus confluentus

Stressor Details

Stressor Name: Flow Regime (Peak Flow Events)
Units: % of landscape
Metric: Percent Human Footprint
Scale: linear
Function Type: continuous
Vital Rate/Process: System Capacity

Life Stage & Context

Life Stages: Adults
Geography: Rocky Mountain foothills, Alberta
Season: year-round

Descriptions

Overview

> Removing forest cover and altering natural landscapes can result in changes in the magnitude and frequency of peak flow events which can impact the sustainability of fish populations. For instance, increased discharge during spring runoff and additional peak flow events throughout the year may result in downstream displacement of emerging fry (Ottaway and Clarke 1981) and have negative effects on spring-spawning species that may be prey for trout (e.g., Seegrist and Gard 1972). Further, Jensen and Johnsen (1999) observed a negative correlation between year-class strength of two fall spawning salmonids and size of peak flood during the spring. There is also evidence that increased frequency of peak flow events can result in short- and long-term changes to river morphology that would impact trout, such as a reduction of habitat complexity and quantity of pool habitat (Lyons and Beschta 1983; Everest et al. 1985; Bonneau and Scarnecchia 1998) and the formation of an “oversized” channel. The potential for hydrologic change in watersheds was considered negligible when < 20% of the watershed was disturbed land (i.e., human footprint), low to moderate when 20–50% of the watershed was disturbed, and high when >50% of the watershed was disturbed (Figure 1). These thresholds are similar to Equivalent Clear-cut Area hazard categories recommended by Alberta Forestry and Agriculture (Stednick 1996; Guillemette et al. 2005; Mike Wagner pers. comm.). In the absences of other impacts, it was assumed that trout populations are resilient to a low degree of change and could persist, albeit at very low density, in watersheds where hydrologic change is high (Figure 1).

Function Derivation

> expert judgement

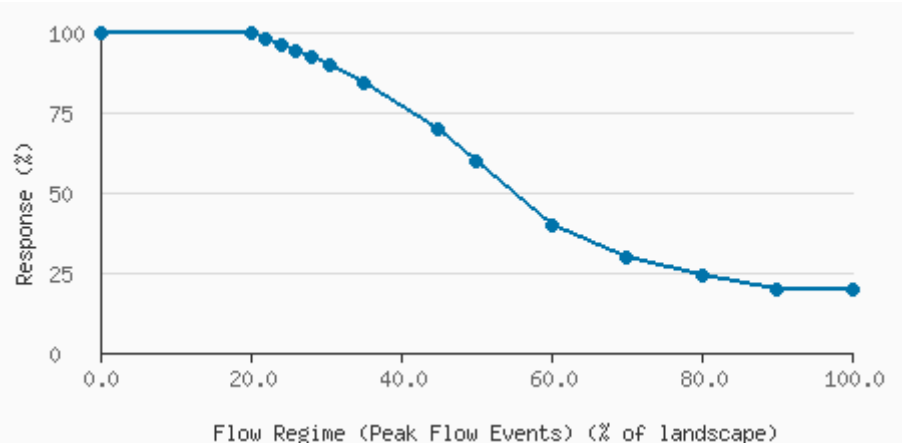
Transferability of Function

> This function was applied to the three species for which it was developed (Bull Trout, Athabasca Rainbow Trout, and Westslope Cutthroat Trout). It could be applied to other freshwater salmonids with caution.

Source of Stressor Data

Total human footprint area (%) within the watershed unit of interest was determined using ALCES Online ©.

Stressor Response Data



?Human Footprint (%)	Mean System Capacity (%)	SD	low.limit	up.limit	
100	20	0	0	100	
90	20	0	0	100	
80	24	0	0	100	
70	30	0	0	100	
60	40	0	0	100	
50	60	0	0	100	
45	70	0	0	100	
35	84	0	0	100	
30.5	90	0	0	100	
28	92	0	0	100	
26	94	0	0	100	
24	96	0	0	100	
22	98	0	0	100	
20	100	0	0	100	
0	100	0	0	100	

Citations

Bonneau, J.L., and D.L. Scarnecchia. 1998. Seasonal and diel changes in habitat use by juvenile Bull Trout (Confluentus salvelinus) and cutthroat trout (Oncorhynchus clarki) in a mountain stream. Canadian Journal of Zoology 76:783-790.

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Ottaway, E.M. and A. Clarke. 1981. A preliminary investigation into the vulnerability of young trout (Salmo trutta L.) and Atlantic salmon (S. salar L.) to downstream displacement by high water velocities. Journal of Fish Biology 19(2): 135-145.

Seegrist, D.W. and R. Gard. 1972. Effects of floods on trout in Sagehen Creek, California. Transactions of the American Fisheries Society 101:478-482. Stednick, J.D. 1996. Monitoring the effects of timber harvest on annual water yield. Journal of Hydrology 176:79-95.