# Flow Regime and System Capacity

Downloaded on: 2026-11-09, From: https://mjbayly.com/stressor-response/flow-regime-and-system-capacity
Function Updated by ssullivan on Tue, 04/23/2024 - 00:52.

## 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

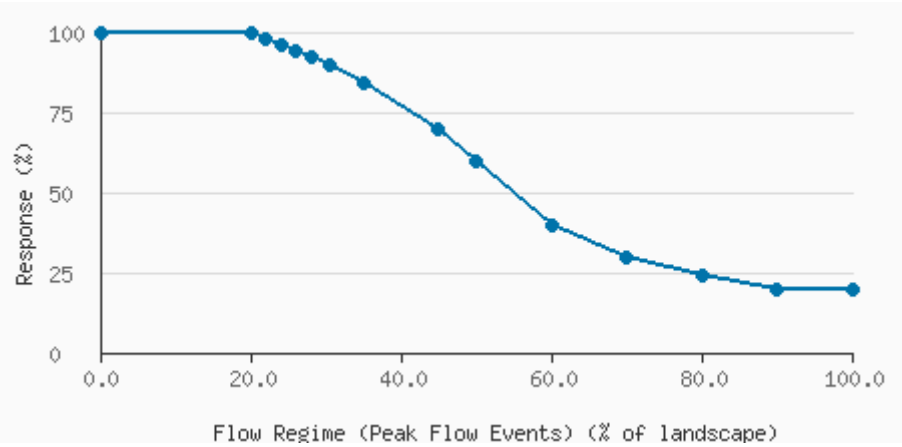
### Transferability of Function

> 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.

Everest, F.H., N.B. Armantrout, S.M. Keller, W.D. Parante, J.R. Sedell, T.E. Nickelson, J.M. Johnston, and G.N. Haugen. 1985. Salmonids. In Management of wildlife and fish habitats in forests of western Oregon and Washington Edited by E.R. Brown. USDA Forest Service, Portland, Oregon, 199–230.

Guillemette, F., A.P. Plamondon, M. Prévost and D. Lévesque. 2005. Rainfall generated stormflow response to clearcutting a boreal forest: peak flow comparison with 50 world-wide basin studies. Journal of Hydrology 302:137-153.

Jensen, A.J., and B.O. Johnsen. 1999. The functional relationship between peak spring floods and survival and growth of juvenile Atlantic Salmon (Salmo salar) and Brown Trout (Salmo trutta). Functional Ecology 13:778-785. Lyons, J.K., and R.L. Beschta. 1983. Land use, floods, and channel changes: Upper Middle Fork Willamette River, Oregon (1936–1980). Water Resources Research 19:463-471.

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.