Direct Mortality and Bull Trout

Function Updated by mbayly on Thu, 04/24/2025 - 19:09.

Species Information

Common Name: Bull Trout
Genus: Salvelinus confluentus

Stressor Details

Stressor Name: Direct mortality
Units: % mortality
Metric: Total annual mortality
Scale: linear
Function Type: continuous
Vital Rate/Process: Survival

Life Stage & Context

Life Stages: Adults
Geography: Alberta foothills watersheds, excluding National Parks
Activity: All activities
Season: All seasons

Descriptions

Overview

> In the Joe model, direct mortality was separated into natural causes, entrainment and research and monitoring, although more variables can be added as required. Using these three mortality sources, the total annual mortality rate (A) can be calculated using the conditional rates of natural mortality (n), entrainment mortality (en) and research and monitoring mortality (r), by applying the following equation adapted from Ricker (1975):
>
> A=1-1-n1-en1-r
> The stressor-response curve for direct mortality (Figure 1) is based on the results from modelling using a modified version of the Bull Trout model of Post et al. (2003). Assuming a conditional mortality rate of 20% from natural causes (Post et al. 2003), a Bull Trout population shown to switch from growth overfishing to recruitment overfishing (assumed to occur at ½ of maximum system capacity) if the combined conditional rate of mortality from other sources exceeded 8% and extirpation was expected when additional mortality exceeded 12% (Figure 1). Similar to the Angling Effort (incidental angling mortality and illegal harvest) function, there is an assumption that there is a portion of fish in a population that are less vulnerable or invulnerable to direct mortality hence the system capacity does not reach zero. For all three species, the upper limit of direct mortality was not exceeded so the stressor-response curve does not have a flat-tail on the x-axis but this could be seen in the future if the threat of entrainment or research and monitoring increase.

Function Derivation

> Based on data for Bull Trout; Empirical data; Published/non peer-reviewed; Mechanistic theory

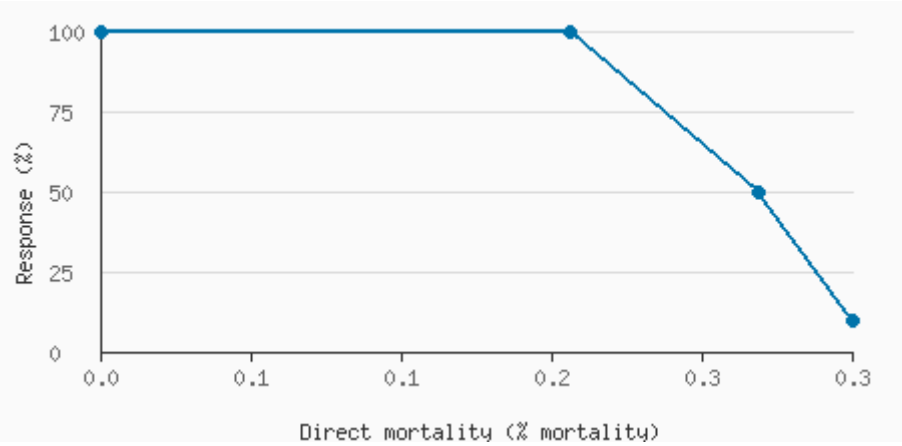
Transferability of Function

> This function was developed and applied to Bull Trout in Alberta foothills watersheds. Parameters used to derive inflection points are specific to Bull Trout on the Alberta east slopes, so it should be applied to other species with caution.

Source of Stressor Data

a. Entrainment Mortality
Fish can become entrained in irrigation canal headworks and killed if not rescued before the canal is dewatered at the end of the irrigation season. Entrainment rates are expected to be variable between canals, however, there have been no recent studies to determine the total number of entrained fish and the overall effect on population sustainability. The primary data source to inform the potential severity of this threat is the Trout Unlimited Canada annual fish rescue program, which includes most but not all canal headworks within the current Bull Trout and Westslope Cutthroat Trout range. Typically, no or small numbers of entrained Bull Trout (

Stressor Response Data



Direct Mortality (proportion)	Mean System Capacity (%)	SD	low.limit	up.limit
0	100	0	0	100
0.2	100	0	0	100
0.28	50	0	0	100
0.32	10	0	0	100

Citations

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Attachment B.

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