Pool Availability and Arctic Grayling System Capacity

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Species Information

Common Name: Arctic Grayling
Genus: Thymallus arcticus

Stressor Details

Stressor Name: Pool Availability
Units: % of Pools
Metric: pool frequency in adult/subadult summer rearing habitats
Scale: linear
Function Type: continuous

Life Stage & Context

Life Stages: Adults
Geography: Upper Peace River Basin (British Columbia)
Season: Summer

Descriptions

Overview

This function was adapted to be used for Arctic Grayling in the Upper Peace River Basin by Hagen et al. (2026) from Hubert et al. (1985). The relationship describes the hypothesized effect of pool frequency on Arctic Grayling system capacity in adult/subadult summer rearing habitats.

Hagen et al. (2026) justifies pool availability as a stressor for Arctic Grayling as so:

"Access to pool habitat within clear stream reaches of moderate gradient appears to be a key habitat requirement for adult and subadult Arctic Grayling within the Williston watershed (Mathias et al. 1998; Blackman 2004; Bottoms et al. 2023) and elsewhere (e.g., Lower Nelson River watershed: Stewart et al. 1982; Big Hole River, Montana: Lamothe and Magee 2004; Kaya 1990). Adult and subadult Arctic Grayling (Figure 4) in the Parsnip River watershed utilize pool and glide habitats of >80 cm depth generally, with preferred locations being deeper water adjacent to the food-delivering thalweg flows (Blackman 2004). Using drone-based thermal mapping of the Anzac River, combined with reach- and landscape-scale snorkeling surveys, Bottoms et al. (2023) were able to demonstrate strong associations between Arctic Grayling and pool habitats. As described in Section 5, animations of hourly temperatures at the reach scale highlighted the spatial importance of pools as thermal refugia during temperature extreme events."

Hagen et al. (2026) describes the basis for the stressor-response curve using the following logic:

"An index of pool habitat quality was developed by Bottoms et al. (2023) based on scoring criteria for pool size, internal thermal heterogeneity, effects of shade, and relative depth. Future CEMPRA applications would benefit from pool index scores estimated across adult/subadult Arctic Grayling summer rearing habitats, but these data are unavailable currently. The stressor-response curve (Figure B 9) is a placeholder, adapted from Hubert et al. (1985)."

Function Derivation

Based on an existing Arctic Grayling habitat suitability model; empirical observations; Expert opinion (to adapt to Arctic Grayling system capacity)

Transferability of Function

The importance of pool habitat is supported by studies of Arctic Grayling in the Williston watershed and elsewhere. However, the hypothesized stressor-response curve has not been validated, and its transferability to other watersheds is uncertain.

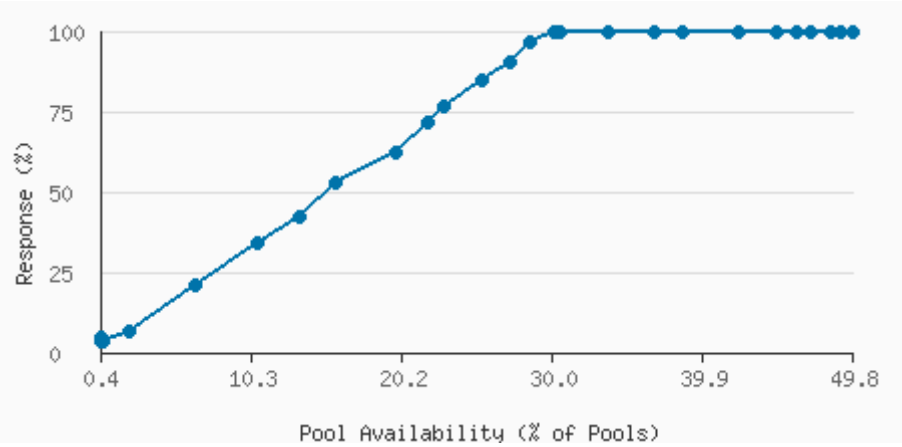
Source of Stressor Data

This stressor-response function was adapted to Arctic Grayling system capacity by Hagen et al. (2026) from Hubert et al. (1985).

Pathways of Effect

Altered peak flows, sediment and surface erosion, reduced pool depth and frequency, reduced summer rearing habitat availability, loss of thermal refugia.

Stressor Response Data



Stressor (X)	Mean System Capacity (%)	SD	low.limit	up.limit
0.43	4.49	0.00	4.49	4.49
0.54	3.27	0.00	3.27	3.27
0.65	3.27	0.00	3.27	3.27
2.39	6.53	0.00	6.53	6.53
6.62	20.82	0.00	20.82	20.82
10.74	34.29	0.00	34.29	34.29
13.56	42.45	0.00	42.45	42.45
15.84	52.65	0.00	52.65	52.65
19.85	62.04	0.00	62.04	62.04
21.91	71.43	0.00	71.43	71.43
22.99	76.33	0.00	76.33	76.33
25.49	84.90	0.00	84.90	84.90
27.33	90.20	0.00	90.20	90.20
28.63	96.33	0.00	96.33	96.33
30.26	100.00	0.00	100.00	100.00
30.69	100.00	0.00	100.00	100.00
33.84	100.00	0.00	100.00	100.00
36.88	100.00	0.00	100.00	100.00

38.61	100.00	0.00	100.00	100.00
42.41	100.00	0.00	100.00	100.00
44.79	100.00	0.00	100.00	100.00
46.10	100.00	0.00	100.00	100.00
47.07	100.00	0.00	100.00	100.00
48.37	100.00	0.00	100.00	100.00
49.02	100.00	0.00	100.00	100.00
49.78	100.00	0.00	100.00	100.00

Citations

Blackman, B.G. 2004. 1997 Arctic grayling habitat use in the Table and Anzac rivers with ancillary information on other associated species. Peace/Williston Fish and Wildlife Compensation Program Report No. 296. 34 pp. plus appendices.

Bottoms, J.R., E.G. Martins, A. Dextrase, M. Auger-Methé, and C.M. O'Ferrall. 2023. Critical habitats of Arctic grayling in Parsnip tributaries. Fish and Wildlife Compensation Program – Peace Region, Prince George, BC. FWCP Project No. PEA-F23-F-3652.

Hubert, W.A., R.S. Helzner, L.A. Lee, and P.C. Nelson. 1985. Habitat suitability index models and instream flow suitability curves: Arctic Grayling riverine populations. U.S. Fish and Wildlife Service, Biological Report 82(10.110). 34 pp.

Kaya, C.M. 1990. Status report on fluvial Arctic grayling (*Thymallus arcticus*) in Montana. Prepared for Montana Department of Fish, Wildlife and Parks, Helena, Montana. https://archive.org/details/statusreportonfl1990kaya

Lamothe, P., and J. Magee. 2004. Reintroducing fluvial Arctic grayling (*Thymallus arcticus*): A summary report based on the efforts to reintroduce Arctic grayling to the upper Ruby River, MT. Montana Fish, Wildlife & Parks.

Mathias, K.L., A.R. Langston, and R.J. Zemlak. 1998. A summary report of the Table River surveys 1996 status report. Peace-Williston Fish and Wildlife Compensation Program, PWFWCP Report No. 180.

Stewart, R.J., R.E. McLenehan, J.D. Morgan, and W.R. Olmsted. 1982. Ecological studies of Arctic grayling (*Thymallus arcticus*), Dolly Varden char (*Salvelinus malma*), and mountain whitefish (*Prosopium williamsoni*) in the Liard River drainage, B.C. Prepared by E.V.S. Consultants Ltd. for Westcoast Transmission Company Ltd. and Foothills Pipe Lines (North B.C.) Ltd. 99 pp.