Beechie et al. 2021 Summer Temperature and Juvenile Survival

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Species Information

Common Name: Chinook Salmon
Genus: Oncorhynchus tshawytscha

Stressor Details

Stressor Name: Stream Temperature
Units: °C
Metric: June 1-21 average daily maximum
Scale: linear
Function Type: continuous
Vital Rate/Process: Survival

Life Stage & Context

Life Stages: Fry, Parr
Geography: Chehalis River, Washington
Activity: Rearing
Season: Summer

Descriptions

Overview

> "For spring and fall Chinook, we use the June 1-21 average daily maximum temperature to estimate the temperature effect on productivity of juvenile Chinook parr migrating down the mainstem Chehalis in June (migration data from Winkowski and Zimmerman 2019). We use June 1-21 because that is the time period of peak outmigration (Figure I.5). Very few fish are migrating in the last week of June, so we did not include that week in the temperature calculation. Based on data from Winkowski and Zimmerman (2019) we estimate that 45% of parr are affected (red box in Figure I.5), which is the number of Chinook parr counted in the first 3 weeks in June, divided by total Chinook parr counted for the season. The functional relationship between the June 1-21 average daily maximum temperature and spring and fall Chinook outmigrant productivity multiplier (Figure I.6) is:
>
> This equation is applied to the 45% of juveniles that are migrating from June 1-21." (Beechie et al. 2021, p. 230)

Function Derivation

> empirical data

Transferability of Function

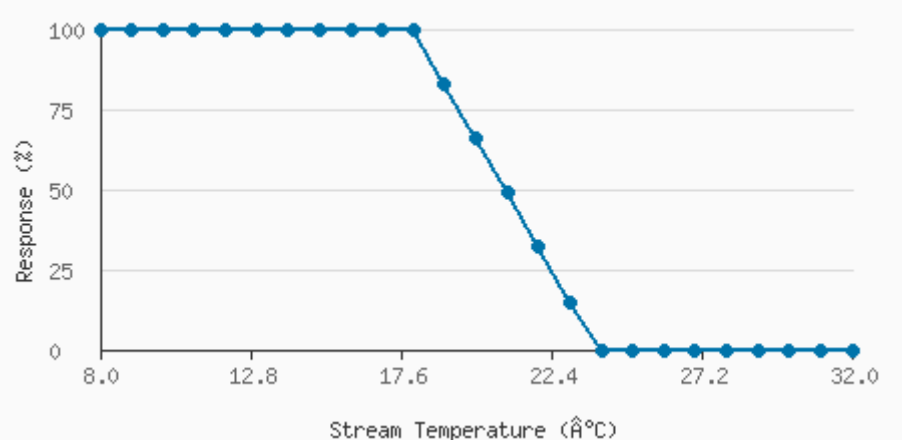
> This function was derived from temperatures and juvenile outmigration counts at a screw trap on the Chehalis River, Washington. It could be applied to similar systems with Chinook Salmon with caution.

Source of Stressor Data

> "Spring Chinook upstream migration productivity and coho, steelhead, and late migrant Chinook summer rearing productivity are a function of stream temperature. The input data sets for current stream temperature are from WDFW (Chehalis Thermalscape data for 226 tributaries) and Portland State University (PSU, mainstem from Crim Creek to Porter Creek). Temperature differences for historical and future scenarios are based on the shade and temperature model of

> Seixas et al. (2018) and climate change projections from NorWeST(https://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST/ModeledStreamTemperatureScenarioMaps.shtml). We model effects of the 7-day average daily maximum summer stream temperature (7-DADM) for coho salmon and steelhead juveniles, and spring Chinook adults, because these fish are in freshwater during the period of high temperatures. Most spring and fall Chinook migrate to the bay prior to high temperatures in summer, and therefore we only model a June temperature effect on the late Chinook juvenile migrants. Because juvenile coho and steelhead have different thermal tolerances, we model the temperature effect with a different functional relationship for each species." (Beechie et al. 2021 pp. 226-227)

Stressor Response Data



Temperature (June 1-21 ADM)	Juvenile Survival (%)	SD	low.limit	up.limit
8	100	0	0	100
9	100	0	0	100
10	100	0	0	100
11	100	0	0	100
12	100	0	0	100
13	100	0	0	100
14	100	0	0	100
15	100	0	0	100
16	100	0	0	100
17	100	0	0	100
18	100	0	0	100
19	83	0	0	100
20	66	0	0	100
21	49	0	0	100
22	32	0	0	100
23	15	0	0	100
24	0	0	0	100
25	0	0	0	100
26	0	0	0	100
27	0	0	0	100
28	0	0	0	100
29	0	0	0	100

30	0	0	0	100
31	0	0	0	100
32	0	0	0	100

Citations

Beechie, T. J., C. Nicol, C. Fogel, J. Jorgensen, J. Thompson, G. Seixas, J. Chamberlin, J. Hall, B. Timpane-Padgham, P. Kiffney, S. Kubo, and J. Keaton. 2021. Modeling Effects of Habitat Change and Restoration Alternatives on Salmon in the Chehalis River Basin Using a Salmonid Life-Cycle Model. U.S. Department of Commerce, NOAA Contract Report NMFS-NWFSC-CR-2021-01.

Winkowski, J., and M. S. Zimmerman. 2019. Chehalis River Smolt Production, 2018, FPA 19- 01. Washington Department of Fish and Wildlife, Olympia, WA.