# Plains Sucker – Temperature Summary

# Stressor: Mean August Stream Temperature (oC)

# Response: System Capacity (%)

# Species: Plains Sucker (*Pantosteus jordani*)

# Life Stage: adult

# System: Saskatchewan

# Function Derivation: landscape correlation, a single experiment, and expert judgement

Transferability of Function: This stressor-response function is suitable for use on Plains Sucker populations in the Saskatchewan-Nelson and Missouri River drainages in Southern Alberta and Saskatchewan. It should be noted that the thermal tolerance literature tends to assume different populations of the same species have similar physiological thresholds to temperature (Hasnain et al. 2010); however, this assumption hasn’t been specifically studied for Plains Sucker. Similarly, it may be reasonable to assume that the SR function can be applied to Cordilleran Sucker, given the similarity of their physical characteristics (prior to 2023 both species were classified under a single species, Mountain Sucker); however, there is no data to confirm this assumption. Further, Plains Sucker from the Black Hills reportedly have an upper thermal tolerance of 32.9°C-34°C (Schultz and Bertrand 2011), which is within the range reported for other catostomid species (30.7°C-37.2°C, Hasnain et al. 2010). However, given the range of preferred temperatures, caution should be taken when using this function on other catostomids, and it might be more advisable to gauge transferability based on thermal guild (e.g. temperature stressor-response functions for other cool-water species) rather than family.

# Detailed SR Function Description

Derivation of the function:

## This temperature SR curve defines the relationship between maximum annual stream temperature (MAST; °C) and percent system capacity. Stream temperatures are highly variable within and among watersheds and streams, with maximum temperatures ranging from 10.15°C-39.74°C in the Milk River drainage (usually in August or September; unpublished data). Lethal maximum temperatures in laboratory experiments can get up to 34°C [Schultz and Bertrand 2011]) and experimental agitation temperatures ranged from 9.17°C-31.16°C, though tolerance was influenced by body size (fish were from the Milk River drainage; unpublished data). Therefore, this SR function was derived using a combination of available field and experimental data. Maximum stream temperature was used for this SR function because we had data on upper thermal limits (agitation temperature) for Plains Sucker; however, it should be noted that this temperature SR function could be adjusted to represent the mean annual stream temperature as the independent variable but the stressor magnitude data must be also reported as mean annual stream temperature.

Source of stressor data to apply the function:

Practical application of the SR function necessitates that users obtain estimates of stressor magnitude (level) in the target system. We have data for stream temperature for ***XX*** sites within the Milk River drainage; however, these data are not yet published.

# Stressor-Response Function

**Figure 1:** Stressor-response (SR) functions for mean August stream temperature (MAST, °C) and Plains Sucker system capacity (%).

# Stressor-Response Table

**Table 1:** Inflection points and limits used to create SR function for Plains Sucker.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Mean August Stream Temperature (oC)** | **Mean System Capacity (%)** | **SD** | **Lower Limit** | **Upper Limit** |
| 0 | 0 | 0 | 0 | 100 |
| 1 | 0 | 0 | 0 | 100 |
| 2 | 0 | 0 | 0 | 100 |
| 3 | 0 | 0 | 0 | 100 |
| 4 | 0 | 0 | 0 | 100 |
| 5 | 0 | 0 | 0 | 100 |
| 6 | 100 | 0 | 0 | 100 |
| 7 | 100 | 0 | 0 | 100 |
| 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 |

# SR Curve Confidence and Sources of Uncertainty

The table below outlines criteria for assessing confidence in the SR function. ***NOTE:*** These criteria serve as guidance for raking confidence in different aspects of the SR function but are not meant to be rigidly prescriptive. Not all criteria will be applicable, and authors should use their discretion in adding additional criteria, provided they maintain clarity and transparency on the information used for assessing confidence.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Low Confidence** | **Moderate Confidence** | **High Confidence** |
| **Data Source for SR Function** | Evaluate confidence based on the precision, accuracy, quantity, and appropriateness of data used to build the SR function. Identify the origin of the function and associated data as ***professional opinion***, ***consultation workshops***, ***mechanistic/theory- based relationships*, *empirical studies***, ***field sampling,*** or an ***alternative***. Specify if peer-review was conducted and provide brief citations. | **-** Professional opinion from a limited number of experts, with loosely defined endpoints.  **-** Poorly matched laboratory studies.  **-** Hypothesized relationships from peer-reviewed literature that have not been empirically tested.  **-** Qualitative data only. | **-** Professional opinion from multiple experts and/or consultation workshops, providing moderate certainty in endpoints.  **-** Laboratory or mesocosm studies with moderate relevance to the system.  **-** Quantitative or semi-quantitative data. | **-** Direct data collection from the target system or a suitable proxy.  **-** Mesocosm or *in situ* experiments directly applicable to the target system.  **-** Multiple expert opinions reaching a consensus, providing well-supported mid- and endpoints  **-** Extensive, well-documented dataset used to construct the function. |
| Rationale --> | Please explain choice of ranking in this category. | | | |
| **Shape of SR Function** | Assess confidence that the shape of the SR function is accurate (***linear/non-linear***; ***slope***, ***inflections***, ***intercepts***, ***endpoints***, ***midpoints, thresholds***) | - Shape of function is likely correct, but there is high uncertainty in parameter estimates such as intercept, slope, and thresholds. | **-** Shape of function is likely correct with increasing confidence in parameter estimates, but significant potential for error. | **-** Relationship is well-supported and thoroughly documented.  **-** Model shows good fit. |
| Rationale --> | Please explain choice of ranking in this category. | | | |
| **Data Variance/**  **Consistency** | Is there significant variance (spread) in the data around the function? Do all data sources show consistent patterns? | **-** High variance in data and/or inconsistency in shape of function across the data set. | **-** Moderate variance in data, some gaps in range of data across function.  **-** Variation in the shape of functions across data. | **-** Data sources show high consistency in shape, slope, inflections, and intercepts of the SR function. |
| Rationale --> | Please explain choice of ranking in this category. | | | |
| **Applicability to System** | How well-matched are the source data and the target system? Are they the same species, watershed, season, life stage, etc.? | **-** Target species differed but is related to the species in data source.  - Geographic areas differ greatly between the source data and the target system (consider ecological similarities between disparate geographical areas). | **-** Target system involves the same species, but a different subspecies, ecotype, or population compared to the data source used for the SR function.  **-** Geographic proximity or partial overlap between the areas of the source data and the target system. | **-** Target system involves the same species, subspecies, or population as the data used to generate the function.  - Geographic areas are matched between the source data and the target system. |
| Rationale --> | Please explain choice of ranking in this category. | | | |
| **Potential Stressor Interactions** | Is there potential for other ***unaccounted*** variables to interact with the stressor and influence the shape of the SR function?  Which stressors are likely to covary with the stressor in a biologically meaningful way? | **-** Potential for multiple additional variables whose interactions cannot reliably be determined. | **-** Interacting variables are probable, but the main effect of the stressor is likely to dominate the response. | **-** Effect of stressor is likely to be largely independent of other variables. |

# Recommended Citation

Jarvis, L. 2022. Temperature stressor-response function for Plains Sucker. Department of Fisheries and Oceans CEMPRA model for Plains Sucker.

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# References

Jarvis, L. 2022. Cumulative Effects Model for Prioritizing Recovery Actions (CEMPRA): Plains Sucker case study.

Schultz, L.D. and K.N. Bertrand. 2011. An assessment of the lethal thermal maxima for Mountain Sucker. Western North American Naturalist 71(3).