# Plains Sucker – Flow Summary

# Stressor: Flow; Percent Mean Annual Discharge (% MAD)

# Response: System Capacity (%)

# Species: Plains Sucker (*Pantosteus jordani*)

# Life Stage: adult

System: Saskatchewan

# Function Derivation: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; however, it should be noted that preliminary analyses of experimental data suggest that there may be differences in physiological tolerances to flow between the Milk River populations and other waterbodies because Milk River populations are subject to increased flows annually from April-October and may have adapted accordingly (MacLeod 2023). It may be reasonable to assume 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. It should also be noted that experimental data suggest that Plains Sucker could hold their position at higher flow rates than White Sucker and Longnose Sucker (two other catostomids in the Missouri River drainage; MacLeod 2023); however, only one study was conducted and energetic costs were not considered***.*** Therefore, more data are required and caution should be taken when using this function on other species.

# Detailed SR Function Description

Derivation of the function:

Flow is represented here as percent mean annual discharge (% MAD). Plains Sucker can persist in relatively high flow (e.g. Milk River during summer augmentation) and low flow environments (e.g. pools with little to no flow). It is expected that the full stressor-response function for flow will be unimodal in shape, where extremely high flow rates will likely negatively impact Plains Sucker. For example, failure velocity experiments on Plains Sucker showed that fish failed to hold their position at flow rates ranging from 0.08-1.05 m•s-1 (MacLeod 2023); however, Plains Sucker have been found in rivers with mean summer or autumn flow rates that range from 0.3-16.1 m3•s-1. In terms of field data, we have biomass (catch-per-unit-effort; CPUE) data for 6 sites within the Milk River drainage, along with water velocities for the site on sampling day (Teillet et al. 2021). If MAD is calculated using the mean of these values (n=6, MAD=0.14 m/s) and % system capacity is scaled such that 100% system capacity is the highest biomass estimate from these data, then % system capacity peaks at ~132% MAD. Without more reliable data on biomass or abundance, MAD, the energy expenditure of swimming or maintaining position under various flow conditions, or the full range of stream flow experienced by Plains Sucker we cannot estimate an upper threshold at this time.

Source of stressor data to apply the function:

# MacLeod (2023) reported mean flow rates for the Milk River (mean augmented flow rate [April-September]: 16.06 m3⋅s-1; mean natural flow rate [October-March]: 2.36 m3⋅s-1) and Battle Creek (mean summer flow rate [April-September]: 0.46 m3⋅s-1 ; mean winter flow rate [October, February, and March]: 0.31 m3⋅s-1). These data were acquired from <https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey/data-products-services.html>. Locations were reported as follows: Milk River (11AA005) 1917-2019, 01/01-31/12; Milk River at the Western Crossing of the International Boundary (11AA025) 1931-2019, 10/02-10/11; and Battle Creek at the Alberta Boundary (11AB117) 1975-2018, 01/02-19/11 (Water Office, 2019). Sampling-day water velocities were also reported for 6 sites within along the Milk River (Highway 501 Bridge, Highway 62 Bridge, Township Rd 24A, Coffin Bridge, Deer Creek Bridge, Pinhorn Ranch) in Teillet et al. 2021.

# Stressor-Response Function

**Figure 1:** Stressor-response (SR) functions for flow, measured as percent (%) mean annual discharge (MAD) and Plains Sucker system capacity (%).

# Stressor-Response Table

**Table 1:** Relationship between percent mean annual discharge and percent system capacity for Plains Sucker.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Mean Annual Discharge (%)** | **Mean System Capacity (%)** | **SD** | **Lower Limit** | **Upper Limit** |
| 100 | 100 | 0 | 0 | 100 |
| 90 | 90 | 0 | 0 | 100 |
| 80 | 80 | 0 | 0 | 100 |
| 70 | 70 | 0 | 0 | 100 |
| 60 | 60 | 0 | 0 | 100 |
| 50 | 50 | 0 | 0 | 100 |
| 40 | 40 | 0 | 0 | 100 |
| 30 | 30 | 0 | 0 | 100 |
| 20 | 20 | 0 | 0 | 100 |
| 10 | 10 | 0 | 0 | 100 |
| 0 | 0 | 0 | 0 | 100 |

# SR Curve Confidence and Sources of Uncertainty

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Low Confidence** | **Moderate Confidence** | **High Confidence** |
| **Data Source for SR Function** |  | **X** |  |
| Rationale --> | This SR function was developed using expert opinion. Experimental approaches and/or field studies on different populations would increase confidence in the data. |
| **Shape of SR Function** |  | **X** |  |
|  Rationale --> | This SR function was developed using expert opinion. Therefore, the shape of the function is likely correct within the current range but the “true” upper bound may not reflect responses under natural conditions |
| **Data Variance/****Consistency** | **X** |  |  |
|  Rationale --> | Since the SR function was developed from expert opinion there is no data to compare to the curve, nor to show consistency within or among populations. |
| **Applicability to System** |  |  | **X** |
|  Rationale --> | This SR function was developed from expert opinion based on field observation of Plains Sucker, and thus are specific to the Missouri River drainage and Saskatchewan-Nelson drainage during summer months. There is no age-specific data available. |
| **Potential Stressor Interactions**  | **X** |  |  |
|  Rationale --> | There is a high probability that other variables, such as temperature, will influence the shape of the stressor-response function. The interaction between temperature (or any other environmental stressor) and swimming ability have not been studied using statistical analysis or in a controlled laboratory setting. Further, mean flow rates do not consider substrate or habitat heterogeneity, and thus the opportunity for Plains Sucker to find preferred conditions despite unfavourable flow rates. |

# Recommended Citation

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

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# References

McLeod M. 2023. Assessing the station holding ability of three benthic fishes exposed to flow augmentation: Implications for a species at risk. M.Sc., Department of Renewable Resources, University of Alberta, Alberta, Canada.

Teillet, M., Watkinson, D.A., Petry, S.F., and Enders, E.C. 2021. Report on Plains Sucker (Pantosteus jordani), Rocky Mountain Sculpin (Cottus sp.), Western Silvery Minnow (Hybognathus argyritis), and Stonecat (Noturus flavus) sampling conducted in 2020 in the Milk River drainage, Alberta. Can. Data Rep. Fish. Aquat. Sci. 1330: vi + 13 p.