DRAFT Flannelmouth Sucker (*Catostomus latipinnis*) Thermal Tolerance Analyses – Juvenile and Adult, Summer
April 2016

Introduction

Recommended summer chronic and acute thermal tolerance values for juvenile and adult flannelmouth sucker and their justification are discussed below. The recommended tolerance values were developed in accordance with the "*DRAFT Methodology for Developing Thermal Tolerance Thresholds for Various Fish in Nevada – Juvenile and Adult, Summer*" (September 2015).

Chronic Thermal Tolerance Thresholds

Table 1 provides a summary of the range of chronic temperature tolerance values for flannelmouth sucker for various lines of evidence. These values are based upon a review of 2 papers and publications, the details of which are summarized in Attachment A. There is obviously a wide range of temperatures from which to select an appropriate value and best professional judgment is called for. NDEP's approach is to accept the EPA recommendations from Brungs and Jones (1977) unless the literature review provides a compelling reason to utilize other values. However, in the case of the flannelmouth sucker, EPA has not recommended a chronic thermal tolerance value. Based upon the available information, NDEP concluded that a chronic thermal tolerance value of 29°C is appropriate. This value is within the range of values derived from the literature.

Table 1. Summary of Chronic Temperature Tolerances

Category	Temperature (°C)
Laboratory Temperature Preference Studies	
Average Preferences	14 – 26
Upper Preferences	25 – 34
Final Preferendum	25.9
Field Studies	
Average	24
Range	10 - 35
Recommended Chronic Temperature Tolerance (MWAT)	**29**

Acute Thermal Tolerance Thresholds

Table 2 provides a summary of the range of acute temperature tolerance values for flannelmouth sucker for various lines of evidence. These values are based upon a review of 2 papers and publications, the details of which are summarized in Attachment B.

For ease of presentation, the CTM values have been summarized by acclimation temperature. However, as discussed in the methodology document, only CTM values for acclimation temperature near the recommended chronic criterion (29°C) are to be included in the acute criterion development process. For flannelmouth sucker, CTM values for acclimation temperatures of 25°C are utilized for criterion development.

Table 2. Summary of Acute Temperature Tolerances

Category	Temperature Tolerances (°C)	Potential Acute Criteria (°C)
Laboratory Lethal Studies – CTM		
Acclim. = 10°C	31.2	
Acclim. = 25°C	37.0	31.6[1]
Field Studies	35	
Recommended Acute Temperature Tolerance (MDMT)	**32**	

[1]CTM values reduced by 3.4°C to estimate quasi-UILT values, and reduced by 2°C to provide 100% survival

A review of the literature suggests that an appropriate acute criteria should fall between 31.6 and 35°C. This is obviously a wide range from which to select an appropriate value and best professional judgment is called for. NDEP's approach is to accept the EPA recommendations from Brungs and Jones (1977) unless the literature review provides a compelling reason to utilize another value. However, in the case of flannelmouth sucker, EPA did not provide an acute thermal threshold recommendation. Based upon the available information, NDEP concluded that an acute thermal tolerance value of 32°C is appropriate. This value is within the range of values derived from the literature and similar to the level suggested by the CTM studies.

References

Brungs, W.A. and B.R. Jones. 1977. Temperature Criteria for Freshwater Fish: Protocol and Procedures. EPA-600/3-77-061. Environmental Research Laboratory, Duluth, Minnesota.

Colorado Water Quality Control Division. 2007. Colorado temperature database.

Cross, J.N. 1975. Ecological distribution of the fishes of the Virgin River. M.S. Thesis, University of Nevada, Las Vegas. Cited in: U.S. Bureau of Reclamation. 2008. Species Accounts for the Lower Colorado River Multi-Species Conservation Program.

Deacon, J.E., P.B. Schumann, and E.L. Stuenkel. 1987. Thermal tolerances and preferences of fishes of the Virgin River system (Utah, Arizona, Nevada). Great Basin Naturalist, 47(4), 538-546.

ATTACHMENT A
Detailed Summary of Chronic Thermal Tolerance Values for Flannelmouth Sucker, Juvenile and Adult, Summer

Table A-1. Chronic Temperature Tolerances – Laboratory Preference Studies

Reference	Age or Size	Acclim. Temp. (°C)	Average Preference Temperature		Upper Preference Temperature		Final Preferendum	
			Temp. (°C)	Comment	Temp. (°C)	Comment	Temp. (°C)	Comment
Deacon et al. (1987)	Juvenile, adult	10	14		25	Highest temperature occupied		
		25	26		34	Highest temperature occupied		
		na	na				25.9	

Table A-2. Chronic Temperature Tolerances – Field Studies

Reference	Temperature (°C)	Comments
Cross (1975)	10 – 35	Flannelmouth sucker have been commonly captured in water temperatures ranging from 10 to 35°C, with a mean of 24°C
	24 (average)	

ATTACHMENT B
Detailed Summary of Acute Thermal Tolerance Values for Flannelmouth Sucker, Juvenile and Adult, Summer

Table B-1. Acute Temperature Tolerances – Laboratory Lethal Temperatures, Critical Thermal Maximum

Reference	Size or Age	Acclim. Temp. (°C)	Rate	Temperature (°C)	Endpoint
Deacon et al. (1987)	Juvenile, adult	10	0.24°C/min (14.4°C/hour)	31.2	Loss of equilibrium
		25		37.0	

Table B-2. Acute Temperature Tolerances – Field Studies

Reference	Temperature (°C)	Comments
Cross (1975)	10 – 35	Flannelmouth sucker have been commonly captured in water temperatures ranging from 10 to 35°C, with a mean of 24°C