

DRAFT Northern Leatherside Chub (*Lepidomeda copei*) Thermal Tolerance Analyses – Juvenile and Adult, Summer

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Introduction

Recommended summer chronic and acute thermal tolerance values for juvenile and adult northern leatherside chub 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 northern leatherside chub for various lines of evidence. These values are based upon a review of 1 paper, the details of which are summarized in Attachment A. 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 northern leatherside chub, EPA has not recommended a chronic thermal tolerance value. Based upon the available information, NDEP concluded that a chronic thermal tolerance value of 27°C is appropriate. The recommended value is within the upper range suggested by the literature. As discussed in the methodology, chronic temperature criteria are generally not set to ensure the most optimum conditions. In fact, Brungs and Jones (1977) recommends chronic criterion for a given fish species that is between the optimum temperature and the UUILT.

Table 1. Summary of Chronic Temperature Tolerances

Category	Temperature (°C)
Laboratory Optimal Growth Studies – Constant Temperature	
Optimum	23.2
Upper Optimum	28
Recommended Chronic Temperature Tolerance (MWAT)	27

Acute Thermal Tolerance Thresholds

Table 2 provides a summary of the range of acute temperature tolerance values for northern leatherside chub for various lines of evidence. These values are based upon a review of 1 paper, the details of which are summarized in Attachment B. As discussed in the methodology document, only the UILT and CTM values for acclimation temperature near the recommended chronic criterion (27°C) are to be included in the acute criterion development process. For northern leatherside chub, UILT and CTM values for acclimation temperature of 28°C are utilized for criterion development.

Table 2. Summary of Acute Temperature Tolerances

Category	Temperature Tolerances (°C)	Potential Acute Criteria (°C)
Laboratory Lethal Studies – UILT/UUILT		
UILT		
Acclim. = 15°C	26.5	
Acclim. = 18°C	28.7	
Acclim. = 23°C	30.4	
Acclim. = 28°C	30.2	28.2 ¹
UUILT	30.3	28.3 ¹
Laboratory Lethal Studies – CTM		
Acclim. = 15°C	29.6	
Acclim. = 18°C	31.8	
Acclim. = 23°C	34.6	
Acclim. = 28°C	35	29.3 ²
Recommended Acute Temperature Tolerance (MDMT)		29

¹UILT and UUILT values reduced by 2°C to provide 100% survival (See *Methodology*)

²CTM values reduced by 3.7°C to estimate quasi-UILT values. Quasi-UILT values then reduced by 2°C to provide 100% survival (See *Methodology*)

A review of the literature suggests that an appropriate acute criterion should fall between 28.2 and 29.3°C. 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 northern leatherside chub, EPA did not provide an acute thermal threshold recommendation. Based upon the available information, NDEP concluded that an acute thermal tolerance value of 29°C is appropriate. This value is within the range of values derived from the literature and is slightly higher than the chronic thermal tolerance recommendation of 27°C.

References

Billman, E.J., E.J. Wagner, R.E. Arndt, and E. VanDyke. 2008. *Western North American Naturalist* 68(4): 463-474

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.

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ATTACHMENT A

Detailed Summary of Chronic Thermal Tolerance Values for Northern Leatherside Chub, Juvenile and Adult, Summer

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Table A-1. Chronic Temperature Tolerances – Laboratory Optimal Growth Studies

Reference	Age or Size	Acclim. Temp. (°C)	Optimum Growth Temperature		Upper Optimum Growth Temperature	
			Temp. (°C)	Comment	Temp. (°C)	Comment
Billman et al. (2008)	Age-0	15.6	23.2		28.0	Growth rate = 80% optimum

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ATTACHMENT B

Detailed Summary of Acute Thermal Tolerance Values for Northern Leatherside Chub, Juvenile and Adult, Summer

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Table B-1. Acute Temperature Tolerances – Laboratory Lethal Temperatures, UILT/UUILT

Reference	Size or Age	Acclim. Temp. (°C)	Test Duration	UILT		UUILT	
				Temp. (°C)	Comment	Temp. (°C)	Comment
Billman et al. (2008)	Age-0	15	4-day	26.5		30.3	
		18		28.7			
		23		30.4			
		28		30.2			

Table B-2. Acute Temperature Tolerances – Laboratory Lethal Temperatures, Critical Thermal Maximum

Reference	Size or Age	Acclim. Temp. (°C)	Rate	Temperature (°C)	Endpoint
Billman et al. (2008)	Age-0	15	0.2°C/min (12°C/hour)	29.6	Loss of equilibrium
		18		31.8	
		23		34.6	
		28		35	