DRAFT White Crappie (*Pomoxis annularis*) Thermal Tolerance Analyses – Juvenile and Adult, Summer
January 2016

Introduction

Recommended summer chronic and acute thermal tolerance values for juvenile and adult white crappie 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 white crappie for various lines of evidence. These values are based upon a review of nine 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. EPA's chronic value of 28°C falls within the upper range of potential criteria found in the literature, and is recommended as the chronic thermal tolerance level for adult/juvenile white crappie. 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	25
Laboratory Temperature Preference Studies	
Average Preferences	8 - 28
Upper Preferences	22.1
Temperature Preference Field Studies	24 – 31.3
Thresholds from EPA (MWAT)	28
Recommended Chronic Temperature Tolerance (MWAT)	**28**

Acute Thermal Tolerance Thresholds

Only one professional paper was identified as providing acute temperature tolerance values for juvenile/adult white crappie (Table 2; Attachment B). As discussed in the methodology document, only the UILT values for acclimation temperature near the recommended chronic criterion (28°C) are to be included in the acute criterion development process. Fortunately, the one UILT value available in the literature was for an acclimation temperature of 29°C and is deemed suitable for criterion development.

Table 2. Summary of Acute Temperature Tolerances

Category	Temperature Tolerances (°C)	Potential Acute Criteria (°C)
Laboratory Lethal Studies – UILT		
Acclim. = 29°C	33	31[1]
Recommended Acute Temperature Tolerance (MDMT)	**31**	

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

The results of one available professional paper suggest that an appropriate acute criterion would be 31°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 white crappie, Brungs and Jones did not provide a recommended acute value. Therefore, it is recommended that a value of 31°C be used for the protection of juvenile/adult white crappie.

References

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ATTACHMENT A
Detailed Summary of Chronic Thermal Tolerance Values for White Crappie, Juvenile and Adult, Summer

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

Reference	Age or Size	Acclim. Temp. (°C)	Optimum Growth Temperature		Upper Optimum Growth Temperature	
			Temp. (°C)	Comment	Temp. (°C)	Comment
Kleiner and Hokanson (1977)	Juvenile	unknown	25			

Table A-2. 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
Peterson et al. (1974)	Juvenile	3 - 5	8 - 10					
		24 - 27	26 - 28					
Reutter and Herdendorf (1974)	Juvenile/adult	20 - 26	19.4		22.2	Upper extent preferences based upon 1 stand. dev. above average		

Table A-3. Chronic Temperature Tolerances – Field Studies

Reference	Temperature (°C)	Comment
Eaton et al. (1995)	31.3	Based upon 95th percentile of 5% highest weekly average temperatures
Gammon (1973)	27 - 31	Based upon instantaneous temperature readings during electroshocking
O'Brien et al. (1984)	24 - 27	Upper limits of fish distribution in reservoir
Stauffer et al. (1976)	30	Based upon instantaneous temperature readings of collection in September 1974.
Yoder and Gammon (1976)	26 - 31	Based upon instantaneous temperature readings during electroshocking

Table A-4. Chronic Temperature Tolerances – EPA

Reference	Temperature (°C)	Comments
EPA (1977)	28	Recommended level as MWAT

ATTACHMENT B
Detailed Summary of Acute Thermal Tolerance Values for White Crappie, Juvenile and Adult, Summer

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
Kleiner and Hokanson (1977)	Juvenile	29	Unknown	33			