THERMAL REQUIREMENTS OF EARLY LIFE HISTORY STAGES OF PACIFIC LAMPREYS (*LAMPETRA TRIDENTATA*) AND WESTERN BROOK LAMPREYS (*L. RICHARDSONI*)

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EXTENDED ABSTRACT ONLY – DO NOT CITE

Introduction

The importance of temperature in determining the distribution, abundance, and survival of animals has been widely demonstrated. However, little is known about the specific thermal requirements of lamprey species native to the Columbia River Basin. Recent alterations in the thermal regime of the Columbia River, specifically increases in spring and summer temperatures (Quinn and Adams, 1996), have prompted interest in habitat requirements of aquatic species in the Columbia River. Understanding how temperature affects individuals is crucial to understanding the basic ecology of a species. The influence of temperature on survival during early life stages is particularly important since this period is a critical determinant of recruitment for many fish populations (Houde, 1987). Therefore, we examined the effects of temperature on development and survival of early life stage Pacific lampreys (*Lampetra tridentata*) and western brook lampreys (*L. richardsoni*).

Materials and Methods

Adult Pacific and western brook lampreys were collected from the wild and transported to the Columbia River Research Laboratory where they were artificially spawned. For each species, one hundred viable zygotes were placed into each of ten replicate rearing vessels per treatment (10° C, 14° C, 18° C, and 22° C). Rearing vessels were supplied with a continuous inflow of sterilized

river water at 0.05 L/min. Individuals in each rearing vessel were examined daily through embryological and larval life stages until larvae had assimilated approximately 50% of their yolk reserves. The number of live individuals and their approximate developmental stage were recorded. A temperature unit model (TU_a) was developed to allow comparisons among treatments with animals at similar developmental stages. Analysis of variance was used to compare percent survival to 50% hatch (280 TU_a) and to 50% yolk depletion (550 TU_a) among treatments for each species and Bonferroni *t*-tests were used to make between treatment comparisons when overall differences were significant.

Results and Discussion

Temperature had a significant affect on survival to 50% hatch (280 TU_a) for Pacific ($F_{3,28}$=74.10, P<0.0001) and western brook ($F_{2,24}$=66.50, P<0.0001) lampreys with significantly decreased survival at 22° C when compared to other temperatures examined for both species (P<0.05; Figure 1).

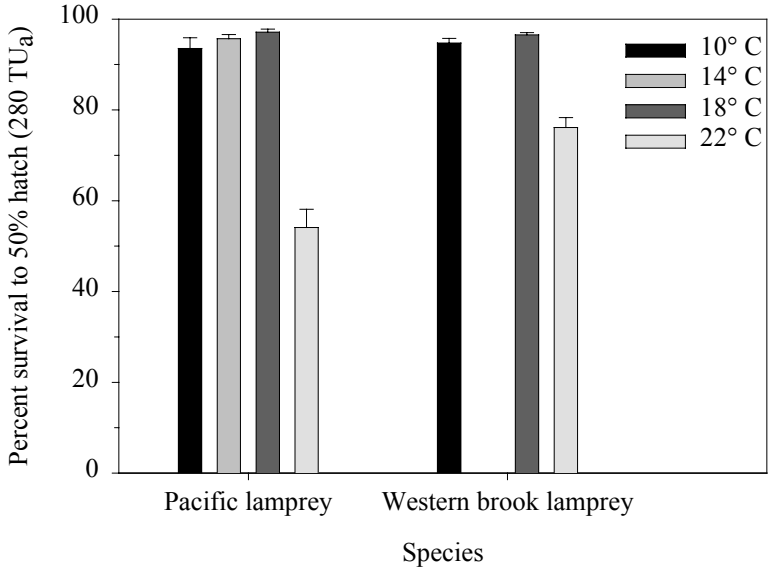

Figure 1. Mean percent survival to 50% hatch (280 TU_a) (+SE) for Pacific and western brook lampreys exposed to 10° C, 14° C, 18° C, and 22° C.

Temperature had a significant affect on survival to 50% yolk depletion (550 TU_a) for Pacific ($F_{2,21}$=53.00, P<0.0001) and western brook ($F_{2,24}$=70.16, P<0.0001) lampreys with significantly decreased survival at 22° C when compared to other temperatures examined for both species (P<0.05; Figure 2).

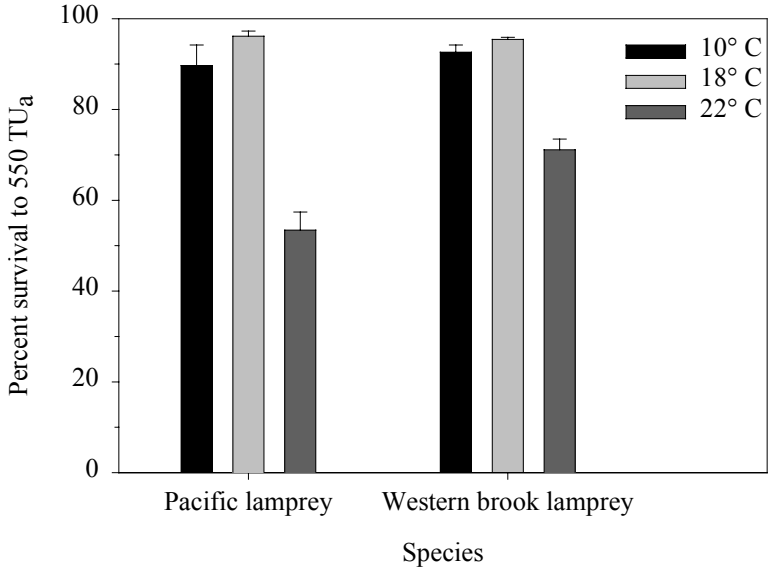

Figure 2. Mean percent survival to 50% yolk depletion (550 TU_a) (+SE) for Pacific and western brook lampreys exposed to 10° C, 14° C, 18° C, and 22° C.

Lampreys held at 22° C had reduced survival during embryological development (fertilization to hatch) as compared to lampreys held at other temperatures; however, little mortality was observed from hatching until 50% yolk depletion. These data suggest thermal optima similar to that of other lamprey species (e.g. sea lamprey, *Petromyzon marinus*). Piavis (1961) and Rodriguez-Munoz et al. (2001) reported optimal survival temperatures from zygote to burrowing larva (similar to individuals at 550 TU_a in this experiment) for sea lampreys to be 18.4° C and 19° C, respectively. Although similarities in optimal temperatures for survival exist among the species studied in this experiment and sea lampreys,

the range of temperatures for survival of Pacific and western brook lampreys appears to be greater than that observed for sea lampreys. Piavis (1961) observed no survival to the burrowing stage below 15.5° C or above 21.1° C and Rodriguez-Munoz et al. (2001) observed low survival from fertilization to hatching and no survival from hatching to burrowing for sea lampreys at 11° C. Results of this study indicate the sensitivity of early life stages, particularly embryological stages, to the affects of temperature and provide a means for assessing potential spawning and rearing habitats for Columbia River Basin lampreys.

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