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NOTE

Prespawn Mortality of Female Chinook Salmon Increases with Water Temperature and Percent Hatchery Origin

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Abstract

High rates of prespawn mortality, when adult salmon die after completing migration but prior to spawning, can lead to population declines and can impede recovery of threatened stocks. In this study, annual prespawn mortality of female Chinook Salmon *Oncorhynchus tshawytscha* ranged from 1% to 100% over 14 years in seven study reaches located throughout the upper Willamette River basin, Oregon. Prespawn mortality rates were positively correlated with the annual maximum 7-d average maximum stream temperature and the percentage of spawning fish of hatchery origin. Observed prespawn mortality rates varied considerably, but annual female prespawn rates were consistently >80% where maximum temperatures exceeded 20°C and the composition of spawning fish was >80% hatchery origin. In several spawning tributaries, prespawn mortality rates generally decreased at higher elevations. The proximate cause of prespawn death was not evaluated here, and observed patterns likely reflected additional factors that influence mortality either directly or indirectly, such as handling, dam passage, fishing pressure, instream habitat, energetic budget, fish density, and pathogen loads.

Semelparous species make a single, large reproductive investment and consequently death before breeding results in zero lifetime fitness. Semelparity in Pacific salmon *Oncorhynchus* spp. likely evolved in parallel with anadromy plus long-distance adult migrations that favored large body size (Crespi and Teo 2002). Large eggs and high fecundity allowed many salmon populations to persist despite high mortality, particularly in early life stages (Hilborn et al. 2003; Wilbur and Rudolf 2006). However, excessive mortality of adult salmon during freshwater migration and holding prior to spawning can lead to rapid population decline (Nehlsen et al. 1991; Spromberg and Scholz 2011) and has been a challenge in many salmon management and conservation programs (Cooke et al. 2004; Keefer et al. 2008; Hinch et al. 2012).

Adult mortality has been a persistent issue for threatened spring-run Chinook Salmon *Oncorhynchus tshawytscha* in Oregon's upper Willamette River basin (NMFS 1999). Recovery efforts for the aggregate Willamette River population have been hampered by both adult migration mortality (Keefer et al. 2017) and prespawn mortality (PSM) in tributaries (Keefer et al. 2010; Benda et al. 2015; DeWeber et al. 2017). Prespawn mortality occurs after fish have returned to natal streams but before spawning (Hinch et al. 2012; Bowerman et al. 2016). Within the Willamette River basin, considerable variation in PSM rates has been reported among locations and among years at a single location (Sharpe et al.

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