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Prespawn mortality in adult spring Chinook salmon outplanted above barrier dams

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Abstract – Dams without fish passage facilities block access to much of the historic spawning habitat of spring Chinook salmon (*Oncorhynchus tshawytscha*) in Oregon's Willamette River basin. Adult salmon are routinely outplanted above the dams to supplement natural production, but many die before spawning despite extensive suitable habitat. In 2004–2007, we examined prespawn mortality patterns using live detection and carcass recovery data for 242 radio-tagged outplants. Total prespawn mortality was 48%, but variability was high, ranging from 0% to 93% for individual release groups. Prespawn mortality was strongly condition dependent, consistently higher for females than males and higher for early release groups. Across years, warm water temperature in the migration corridor and at the collection site was associated with sharply higher mortality. Results highlight a need for better evaluations of the effects of adult mortality on population reintroduction and recovery and relationships among prespawn mortality, dam-related temperature change and salmon life history and behaviour.

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Key words: *Oncorhynchus;* prespawn mortality; supplementation; temperature; Willamette River

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Introduction

Dams without fish passage facilities block access to much of the historic spawning habitat of anadromous salmonids (*Oncorhynchus* spp.) in Oregon's Willamette River basin (Myers et al. 2006; Sheer & Steel 2006). The dams have contributed to population declines or extirpations of seven historically independent spring-run Chinook salmon (*O. tshawytscha* Walbaum) populations and the remaining aggregate population is listed as threatened under the U.S. Endangered Species Act (NMFS 1999). To mitigate for lost natural production, salmon hatcheries were established in most major Willamette River tributaries during the dam construction era (1940s–1960s). These hatcheries have accounted for approximately 90% of Willamette River spring Chinook salmon production in recent years (NFMS 2008).

Adult salmon have relatively good access to historic spawning habitat in the Clackamas and McKenzie River sub-basins, and populations in these rivers are partially self-sustaining. At most other sites, however, spawning in the wild has been limited to small numbers of naturally produced adults mixed with hatchery-origin fish that fail to enter hatchery traps. In recent years, managers have attempted to supplement this natural production by outplanting surplus hatchery adults. Returning adults in excess of broodstock requirements have been released into suitable habitat above and below dams in many major Willamette tributaries, including the North Santiam, South Santiam, McKenzie and Middle Fork Willamette rivers (Firman et al. 2004; Beidler & Knapp 2005; Schroeder et al. 2007). The outplant programme goals include re-establishing locally adapted populations, restoring a source of marine-derived nutrients to ecosystems upstream from barriers, and supplementing the prey base for native resident fish and wildlife (e.g., Schindler et al. 2003; Wipfli et al. 2003).

Prespawn mortality in both outplanted spring Chinook salmon and in mixed aggregations of hatchery and wild-origin fish has been a significant

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