



MANAGEMENT BRIEF

Tag Effects on Prespawn Mortality of Chinook Salmon: A Field Experiment Using Passive Integrated Transponder Tags, Radio Transmitters, and Untagged Controls

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Abstract

We conducted a field experiment to test the hypothesis that intragastric radio-tagging contributed to increased prespawn mortality (PSM) of adult Chinook Salmon *Oncorhynchus tshawytscha* after collection and transport to spawning sites above high-head hydroelectric dams. We assessed PSM rates of 970 wild and hatchery Chinook Salmon collected during trap-and-haul operations that were released untagged, tagged with passive integrated transponder (PIT) tags only, or double tagged with PIT tags and radio transmitters, and then recovered as carcasses in two Willamette River, Oregon, tributaries from 2009 to 2015. Results revealed no evidence that PSM rates were higher in PIT-tagged samples than in untagged (but not unhandled) control samples. The PSM rates in double-tagged samples were variable among years and between locations and indicated that radio-tagging effects were absent or small in effect size, on average, within each population. While we did not detect a consistent negative double-tagging effect across locations and years, results suggest that the potential for radio-tagging effects should be incorporated in study planning and design. We recommend that researchers use experimental designs that include control groups for directly evaluating tagging and handling effects on study outcomes.

gastric method minimizes handling and recovery times and most adults have ceased feeding (McCleave et al. 1978; Gray and Haynes 1979; Cooke et al. 2005, 2011). An inherent assumption of these studies is that radio-tagging does not affect fish behavior and ultimately survival. Concerns about fish tagging and handling effects are well documented and include delayed migration or downstream movement after release (e.g., Burger et al. 1985; Bendock and Alexandersdottir 1993; Bernard et al. 1999), transmitter regurgitation (Smith et al. 1998; Keefer et al. 2004), stomach rupture (Smith et al. 2009; Corbett et al. 2012), and delayed mortality (Naughton et al. 2005; Keefer et al. 2008). The timing and location of collection and tagging are also a concern because adult salmonid tissues degenerate as they sexually mature during their migration and mature fish may be more susceptible to tagging-related injuries (Corbett et al. 2012).

In this study, we tested whether intragastric radio-tagging of adult Chinook Salmon *Oncorhynchus tshawytscha* contributed to increased prespawn mortality (PSM) in Oregon's Willamette River basin. Spring-run Chinook Salmon in the Willamette River were listed as threatened under the U.S. Endangered Species Act (NMFS 1999), in part because construction of high-head hydroelectric dams has blocked access to historic spawning sites. An adult salmonid trap-and-haul program was initiated in the 1990s at Willamette Valley Project dams to use surplus hatchery broodstock to restore a source of marine-derived nutrients and supplement the prey base of native resident fish and

Radiotelemetry has been successfully used to study migration behaviors, passage times, and survival of adult Pacific salmon *Oncorhynchus* spp. in rivers throughout the Pacific Northwest (Keefer et al. 2005; Naughton et al. 2005; Cooke et al. 2008; Eiler et al. 2015). Most radiotelemetry studies on adult salmonids use gastric implantation rather than surgical implantation because the

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Received June 28, 2017; accepted October 19, 2017