

Transportation of Steelhead Kelts to Increase Iteroparity in the Columbia and Snake Rivers

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Abstract.—We tested the feasibility of transporting steelhead *Oncorhynchus mykiss* kelts (postspawned adults) around hydroelectric dams on the Snake and Columbia rivers to increase the returns of repeat spawners. Altogether, 5,878 kelts were collected, tagged with passive integrated transponder tags, and assigned to transported or in-river treatment groups at Lower Granite Dam ($n = 5,320$ [2002–2004]) on the Snake River and John Day Dam ($n = 558$ [2002]) on the Columbia River. Returns of repeat spawners differed by site and year: 11.1% (62/558) for the John Day Dam sample and 1.4% (27/1,959), 0.5% (6/1,241), and 0.8% (17/2,120) for the Lower Granite Dam samples in 2002, 2003, and 2004, respectively. Transportation tests indicated that kelts transported from the Snake River were approximately 2.3 times more likely to return than fish allowed to migrate in-river. Transport benefits were greatest for wild-origin female kelts, a demographic with high conservation value. There was no significant benefit for kelts transported from John Day Dam, although transported fish returned at a slighter higher rate (1.1 times). Comparisons between treatment groups (in-river versus transport) and locations (Snake River versus Columbia River) indicated that the greatest potential transport benefit may be for Snake River kelts owing to the population's low overall iteroparity rate and numerous potential kelt collection sites. The small sample sizes of returning fish limited our ability to examine more complex trends and environmental effects on return rates. Additional research is needed to fully evaluate the efficacy of kelt transportation in the context of regional steelhead recovery efforts.

Unlike most Pacific salmonids *Oncorhynchus* spp., steelhead *O. mykiss* may spawn more than once during their lifetime (Quinn 2005). Repeat spawning (iteroparity) is both a hedge against catastrophic reproductive failure and a life history strategy that provides population-level genetic and demographic benefits (Crespi and Teo 2002; Fleming and Reynolds 2004). In the Columbia River basin, repeat-spawning steelhead have been documented returning to natal streams for decades (Leider et al. 1986; Busby et al. 1996). Iteroparity rates for inland, summer-run (freshwater-maturing) steelhead populations in the 1930s and 1950s were estimated at between 2% and 6% (Long and Griffin 1937; Whitt 1954). Despite these early, predominately preimpoundment estimates, very little is

known about present-day postspawned steelhead (referred to as “kelts”) or to what extent repeat spawners might help rebuild depleted populations in the region, including those listed under the U.S. Endangered Species Act (ESA; Good et al. 2005).

To address these questions, a series of research projects was initiated in 2000 to broaden the understanding of steelhead kelts and iteroparity in the Columbia River basin. Methods were developed to accurately differentiate kelts from adult steelhead on prespawn migrations using rapid, noninvasive ultrasound imaging techniques (Evans et al. 2004b). Subsequent kelt abundance data revealed that thousands of Columbia River basin kelts attempt out-migration to the Pacific Ocean each spring (approximately April through June), and many of these fish are from ESA-listed populations (Evans et al. 2004a; Narum et al. 2008). Although abundant, many kelts die before reaching the free-flowing section of the Columbia River below Bonneville Dam (235 river

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