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SHORT COMMUNICATION

Evaluation of a trap-and-transport program for a threatened population of steelhead (*Oncorhynchus mykiss*)

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Abstract

Trap-and-transport programs for migratory fish attempt to mitigate for lost habitat blocked by impassable dams. These programs aim to assist with conservation and recovery of declining populations by accessing habitat protected from impacts downstream, such as introgression or competition with hatchery-origin fish. This study examined a trap-and-transport program that supplemented a native population of winter-run steelhead (*Oncorhynchus mykiss*) above Foster Dam in the South Santiam River, Oregon. The study examined whether outplanted adults transported from 2012 to 2016 reproduced successfully using 268 single nucleotide polymorphisms (SNPs) and an exclusion analysis in CERVUS. Genotypes from two SNPs in the GREB1L gene were used to associate each fish with maturation at return migration: premature migration (summer-run, non-native) or mature migration (winter-run, native). Parentage analyses demonstrated that 51% of outplanted steelhead successfully produced either juvenile or adult offspring. More than 68% of the natural-origin adults outplanted during the study were homozygous for mature migration alleles that are typical of native, winter-run steelhead, however, potential introgression from non-native, summer-run steelhead was detected in 26% of the outplanted adults. These results indicate that transported adult steelhead successfully produced juvenile and adult steelhead, and introgression associated with non-native steelhead may be introduced through the trap-and-transport program.

Keywords Trap-and-transport · Introgression · Single nucleotide polymorphism (SNP) · Parentage · GREB1L · Steelhead · *Oncorhynchus mykiss*

Introduction

Impassable dams block access to more than one-third of the historic habitat for anadromous fishes in the Columbia River Basin, USA directly contributing to the extirpation of many stocks (Nehlsen et al. 1991). Trap-and-transport programs around impassible dams are increasingly used to counter the effects of lost or degraded habitat in lower basin areas (e.g. Sard et al. 2015), and may provide a temporary or permanent means to boost declining populations of anadromous salmonids. Artificial transport provides a relatively low cost alternative to access habitat at locations where adult fish passage facilities are infeasible due to engineering design or fiscal constraints. Dams in the upper Willamette River block access to 55% of high-quality steelhead (anadromous *Oncorhynchus mykiss*) habitat in the basin (Shear and Steele 2006). Downstream from these dams, steelhead are subjected to numerous other impacts including hatchery fish, harvest, predation, ocean and climate conditions, and habitat degradation from urbanization, flood control, and flow alteration (NMFS 2008).

Trap-and-transport programs provide management benefits, but also challenges that could cause unintended impacts to the native populations. Trapping allows the ability to manage population composition by restricting transport of non-target fish, such as known hatchery-origin adults. This can protect the genetic integrity of the native population

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