

ARTICLE

## Survival and Straying of Hatchery Steelhead following Forced or Volitional Release

Lance R. Clarke,\* Michael W. Flesher, Shelby M. Warren, and Richard W. Carmichael

Oregon Department of Fish and Wildlife, 203 Badgley Hall, Eastern Oregon University, La Grande, Oregon 97850, USA

---

### Abstract

In this study, conducted over four release years, we compare the performance of hatchery steelhead *Oncorhynchus mykiss* that were force-released (FR) from acclimation ponds with that of fish given a 2-week volitional release (VR). After fish were released into streams, we monitored smolt out-migration travel times and survival to Lower Granite Dam on the Snake River using passive integrated transponder (PIT) tags in a subsample of each release group. To better understand the out-migration characteristics of volitionally departing fish, we also captured and PIT-tagged fish as they exited ponds in the first and last 24 h of VR. Across all release groups, travel time was 3% faster for fish that were forced from acclimation ponds than for VR groups; however, the average survival of VR groups (65.0%) was significantly higher than that of FR groups (58.6%). On average, fish that departed acclimation ponds in the first 24 h of VR took 6 d longer to reach Lower Granite Dam and had lower survival (50.3%) than those departing in the last 24 h (56.9%), though these differences were not statistically significant. We estimated smolt-to-adult survival and a stray rate index for the FR and VR groups based on recoveries of coded-wire-tagged adults. Across all releases, smolt-to-adult survival was not significantly different between groups (FR = 0.63%, VR = 0.59%), and the same was true for the stray rate index (FR = 10.9%, VR = 10.6%). Our finding that VR provided no postrelease survival benefit is consistent with the results of other published studies, but this is the first study to quantify the stray rate in relation to VR.

---

In an earlier paper, Clarke et al. (2010) showed that acclimating juvenile hatchery summer steelhead *Oncorhynchus mykiss* in waters of their release site in northeastern Oregon before stream release successfully increased smolt-to-adult survival (SAS) and reduced adult stray rates. In that study, steelhead juveniles were forced from acclimation ponds into the stream. However, in a forced release (FR), some hatchery juveniles may be evicted from the ponds before they have smolted and hence may be physiologically unprepared for out-migration (Gale et al. 2009). A volitional release (VR), in which juveniles actively leave holding ponds over an extended period, may better match release timing to the time of smolt preparedness for out-migration. A VR could benefit postrelease performance if survival of the released fish increases, or if stray rates decline from improved smolt imprinting.

To our knowledge, only two studies (Wagner 1968; Evenson and Ewing 1992) have compared the survival to adulthood of paired FR and VR hatchery steelhead groups; their results suggesting no survival benefit from VR. However, both studies took place in coastal rivers; the response of northeastern Oregon steelhead to novel rearing and release strategies may differ from that of other fish because juveniles of these stocks must contend with the cumulative stressors imposed by a 925 river kilometer (rkm; Wallowa River mouth to ocean) out-migration past eight dams on the Snake and Columbia rivers, or with the stress of being collected at Lower Granite Dam (LGD) and barged 460 rkm downriver to Bonneville Dam (Congleton et al. 2000). We could not find any literature information comparing steelhead stray rates between the two release strategies.

---

\*Corresponding author: lance.r.clarke@state.or.us  
Received September 14, 2010; accepted November 15, 2010