

Fallback, Reascension, and Adjusted Fishway Escapement Estimates for Adult Chinook Salmon and Steelhead at Columbia and Snake River Dams

C. T. BOGGS,* M. L. KEEFER, C. A. PEERY, AND T. C. BJORN¹

*Idaho Cooperative Fish and Wildlife Research Unit,
Biological Resources Division, U.S. Geological Survey,
University of Idaho, Moscow, Idaho 83844-1144, USA*

L. C. STUEHRENBURG²

*Northwest Fisheries Science Center, National Marine Fisheries Service,
2725 Montlake Boulevard East, Seattle, Washington 98112, USA*

Abstract.—During their upstream spawning migration in the Columbia River basin, some adult salmonids *Oncorhynchus* spp. ascend and then fall back over main-stem hydroelectric dams. Fallback can result in fish injury or death, migration delays, and biases in fishway counts, the primary index for escapement and the basis for production estimates and harvest quotas. We used radio-telemetry to calculate fallback percentages and rates, reascension percentages, biases in fishway escapement estimates due to fallback, and occurrence of behaviorally motivated fallback (correcting overshoot of natal sites) by spring–summer and fall Chinook salmon *O. tshawytscha* and steelhead *O. mykiss*. The study area included eight Columbia River and Snake River dams evaluated from 1996 to 2001. For all years combined, about 22% of spring–summer Chinook salmon, 15% of fall Chinook salmon, and 21% of steelhead fell back at least once at a dam. Fallback percentages for spring–summer Chinook salmon were generally highest at Bonneville and the Dalles dams and decreased at progressively upstream dams. Fallback rates for spring–summer Chinook salmon were positively correlated with river discharge. Fallback percentages for steelhead and fall Chinook salmon were less variable between years but were more variable between dams than those of spring–summer Chinook salmon. Reascension percentages at dams ranged widely between runs and sites and were negatively related to the number of fish that entered tributaries downstream from the fallback location. Fall Chinook salmon were the most likely to enter a downstream tributary after falling back, though this behavior was also observed in spring–summer Chinook salmon and steelhead. For all years and at all dams, fallback produced positive fishway count biases ranging from 1% to 16% for spring–summer Chinook salmon, 1% to 38% for fall Chinook salmon, and 1% to 12% for steelhead.

Adult salmonids *Oncorhynchus* spp. migrating upriver and exiting the fishways of Columbia and Snake River dams will occasionally pass back downstream over the dam via spillways, turbine intakes, navigation locks, debris sluiceways, or juvenile fish collection devices, an event referred to as fallback. Migrating anadromous fish are both positively rheotactic and shoreline oriented during migration (Groot and Margolis 1991). When exiting fishways and confronting the impounded water of a dam forebay, migrants may be attracted to water passing through spillways, sluiceways, and turbine intakes or may orient with the upstream face of the dam and enter these areas. Additionally, a salmon or steelhead *O. mykiss* that migrates up-

stream beyond its natal stream or hatchery and passes an upstream dam may fall back in an effort to return; this temporary straying or “overshooting” behavior has been described for many salmonids (Ricker 1972).

Fallback has been documented at all Columbia and Snake River hydrosystem dams, and attempts have been made to quantify its effects on upriver migrants (Liscom et al. 1977; Bjorn and Peery 1992). Although not all fish that fall back suffer mortality or injury, death and injury do occur (Wagner and Hilsen 1992), and salmon and steelhead that fall back at dams are less likely to reach spawning tributaries and hatcheries than those that do not fall back (Boggs et al. 2004). Fallback has been associated with significant migration delays through the Columbia River hydrosystem (Monan and Liscom 1975, 1979). Keefer et al. (in press) reported significant delays of several days to several weeks for radio-tagged Chinook salmon *O. tshawytscha* and steelhead that fell back.

* Corresponding author: cboggs@uidaho.edu

¹ Deceased.

² Retired.