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Title: Addressing the complexities of steelhead behavior when estimating adult abundance

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The ecology and movements of adult summer steelhead compound the complexities of the steelhead life cycle, creating difficulties when estimating abundance. The adults enter freshwater many months before spawning for a temporally extensive migration with many individuals wandering, leading to behaviors such as overshooting natal tributaries and straying. For large interior basins, such as the Snake River, these behaviors create biases in estimates of abundance and stock structure that are needed to inform conservation assessments and fisheries management decisions. Lower Granite Dam (LGR) in southeastern Washington provides an opportunity to extensively sample adult Snake River steelhead migrating upstream. Large-scale data collection of these fish takes place at LGR in the form of daytime window counts at the fish ladder, systematic sampling of steelhead trapped and sampled throughout the run (i.e., genetics, sex, length, and age), and passive integrated transponder detections. The Estimating Adult Salmonid Escapement (EASE) model uses these data to generate total abundance estimates of hatchery and wild fish, which are then decomposed into estimates by sex, size, and age for each genetic stock. This model is an improvement over previous models in that it collectively accounts for three main sources of bias: 1) nighttime fish passage at the dam, 2) rates of stock-specific fallback and re-ascension, and 3) genetic stock identification uncertainty. The EASE model yields improved stock-specific steelhead abundance estimates and diversity metrics. For example, incorporating rates of fallback and re-ascension enables the ability to more effectively account for differences among stock groups, such as the Lower Snake River stock that is more prone to overestimation due to higher rates of fallback and re-ascension. Modeling methods that account for stock-specific differences in migratory behavior are needed to address the complexities of steelhead abundance estimation.