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Title: Precision and bias of snorkel survey counts of coastal cutthroat trout (*Oncorynchus clarkii*).

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Abstract

Coastal Cutthroat Trout (*Oncorynchus clarkii*, hereafter cutthroat) data is often ancillary to the collection of salmon and steelhead data, and the status of this iconic species can be based on this type of "best available science". The Oregon Department of Fish and Wildlife (ODFW) has made counts of cutthroat annually since 2002 as part of a snorkel survey project designed to monitor juvenile coho salmon (*O. kisutch*). Scientists and managers contemplating the use of snorkel surveys to evaluate cutthroat populations should understand the precision, bias, and limitations of this method. We use data from ODFW snorkel surveys, and from studies that evaluated the ODFW protocol, to quantify the precision and bias of snorkel survey counts of cutthroat and inform the utility of snorkeling to monitor this species. Results indicated that snorkelers correctly distinguished cutthroat and steelhead (*O. mykiss*) parr. Counts of cutthroat correlated moderately (r = 0.801) with resurvey counts in the same stream reaches; stronger correlations were observed for steelhead (r = 0.906) and coho (r = 0.968) parr. Snorkelers detected a mean of 39% of the cutthroat estimated by mark-recapture, but variability was high, and the proportion decreased as cutthroat abundances increased. Quantifying snorkel count bias was also confounded by interannual variation in the portion of the population distributed into habitats that were not sampled by snorkeling. Snorkel counts correlated weakly with mark-recapture (r = 0.569) and electrofishing removal (r = 0.637) estimates. For monitoring cutthroat, snorkeling may have some advantages over methods that require capture. Snorkeling may be an appropriate or even optimal tool to monitor cutthroat occupancy in many streams. If snorkeling is used to estimate abundance, count bias should be determined by methods such as mark-recapture or mark-resight. Our results should inform management decisions that weigh monitoring costs with risks to the species.