TITLE

Understanding precision and directional bias of fisheries abundance estimates across 24 commonly used salmonid survey methods

ABSTRACT

The effectiveness of fisheries management and conservation policies depends on surveys designed to estimate the abundance of target species over time. A variety of survey methods are employed for these purposes, each characterized by some inherent level of precision and potentially directional bias. While low levels of precision in survey methods lead to low confidence in point estimates of population abundance or forecasts, directional bias presents a more pernicious problem as it may lead to the mismanagement of imperiled species, invasive species, and commercially valuable populations, due to over- or under-estimation of their numbers. We estimated levels of precision and relative bias associated with 24 survey methods commonly used by the Oregon Department of Fish and Wildlife to estimate the abundance of 68 populations of Chinook (<i>Oncorhynchus tshawytscha </i>) and coho salmon (<i>O. kisutch </i>), and steelhead trout (<i>O. mykiss </i>), from 1980 to 2022. We used multivariate autoregressive state-space models (MARSS), which distinguish observation (sampling) error from process (environmental) error and assign separate variance parameters to each. We found that, while some survey methods are generally more precise than others (dam counts, weir counts, and redd counts are highly precise), the same survey methods can have very different levels of precision and biases when applied to different species (for example, area under the curve population inference is less precise and downward biased when applied to Chinook compared to coho).