

Evaluating alternative methods for monitoring and estimating responses of salmon productivity in the North Pacific to future climatic change and other processes: A simulation study

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Estimation of the relative influence of climate change, compared to other human activities, on dynamics of Pacific salmon (*Oncorhynchus* spp.) populations can help management agencies take appropriate management actions. We used empirically based simulation modelling of 48 sockeye salmon (*O. nerka*) populations to examine how reliably alternative monitoring designs and fish stock assessment methods can estimate the relative contribution of climate compared to non-climatic factors. We explored a wide range of scenarios for ocean conditions, salmon productivity (adult recruits per spawner), and human-induced changes. We found that distinguishing climate-related effects on salmon productivity from non-climate sources will be difficult, especially if climatic changes occur rapidly and concurrently with major anthropogenic disturbances. Our results also show that stock assessments based on historical relationships between salmon productivity and climate-driven oceanographic conditions will likely perform poorly when those relationships change, even when such changes are anticipated and incorporated into stock assessment models in a timely manner. Thus, better understanding of the mechanisms underlying the relationship between climate and salmon productivity may be essential to avoid undesirable management outcomes. As well, an expansion of monitoring of juvenile salmon abundances on more salmon stocks is needed to help separate climatic from direct human effects.