3-4. Production Trends and Carrying Capacity of Salmon (Oral-33)

The Salmon MALBEC Project: A North Pacific Scale Study to Support Salmon Conservation Planning

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A multi-investigator team has synthesized data and expert knowledge in order to develop a simulation model--Salmon MALBEC (Model for Assessing Links Between Ecosystems)--to support Pacific salmon conservation planning at the scale of the North Pacific basin large ocean-draining river basins. MALBEC is designed to conduct risk assessments based on different conservation, hatchery policy, and/or harvest management strategies by integrating threats across the full life-cycle for major population groups. The model allows users to explore hypotheses about Pacific salmon at the North Pacific scale: the effects of competition among salmon stocks (and species) in the North Pacific, the response of salmon stocks and species to climate change, freshwater habitat change, and the possible effects of large hatchery programs on natural and hatchery stocks from other regions. The model is supported by a data base including regionalized annual run-sizes, catches, spawning escapements, and hatchery releases for 135 major pink, chum, and sockeye population groups around the North Pacific for the period 1950-2006. The model is being run with observed salmon and environmental data from 1950-2006, and with environmental (climate and habitat change) and policy scenarios for the period 2007-2050. MALBEC modeling results indicate that including time-varying and stock-specific productivity variations, which are likely related to historic climate changes, yield much improved fits to the observed abundance trends. Likewise, including density-dependent interactions in the ocean yields better fits to the observed run-size data than those simulations without density-dependent interactions in the ocean. This suggests that for any level of ocean productivity, the ocean will only support a certain biomass of fish but that this biomass could consist of different combinations of stocks, stock numbers and individual fish size. MALBEC simulations illustrate this point by showing that under scenarios of Pacific-wide reduced hatchery production the total number of wild Alaskan chum salmon increases, and that such increases are largest where density-dependent effects on survival are large and smallest where they are not. Under scenarios with reduced freshwater carrying capacities for wild stocks, the impacts of density-dependent interactions also lead to relative increases in ocean survival and growth rates for stocks using ocean habitats where density-dependence is large.