Michigan Department of Natural Resources
Fisheries Research Report 2066, 2003

Statistical Catch-at-Age Framework for Chinook Salmon in Lake Michigan, 1985-1996

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Abstract.–Successful management of the Lake Michigan salmonine sport fishery requires an understanding of mortality rates, abundance, and age structure. A stock assessment model for chinook salmon is presented in order to estimate the population size and age structure from 1967-1996. The model predicted sport fishery harvest and age structure, fishery effort, and returns to weirs, from 1985-1996. Model parameters were estimated by matching these predictions to observations of these same quantities using a maximum likelihood approach within a statistical catch-at-age analysis framework. Mortality rates were estimated for four sources of mortality: 1) fishing, 2) baseline continuous natural mortality, 3) spawning mortality, and 4) other time-varying natural mortality. Results indicate a large decline in the abundance of chinook salmon ages 2-5 from 1987-1994, in agreement with observed declines in fishery CPUE data. Age structure in the fishery and in the weir harvest shifted towards younger ages and reflected a shift in the population age structure. These declines were caused primarily by an increase in time-varying natural mortality for ages 2-5. Ages 0-1 did not suffer significant time-varying natural mortality. Fishing mortality did not play an important role in the population decline. This model analysis supported existing hypotheses about the role of bacterial kidney disease (BKD) mortality on the Lake Michigan chinook population. Outputs from this modeling exercise could be used to determine stocking levels, and as parameter inputs for multi-species dynamic models and bioenergetics models.