APPENDIX A

Documentation of Stochastic Dynamic Programming Model

Program and Documentation

by

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OVERVIEW

This is a brief description of the program developed on the CWRU, Biology Dept., PDP 11/34 computer for the calculation of optimal fishing efforts in a stochastic environment. The program, as presently coded, considers four age classes, yearlings, 2, 3, and 4+ year olds. Recruits are calculated to enter directly into the yearling class of the following year. Recruitment is a random variable depending on rate of spring warming as well as stock size. Fishing and non-fishing mortality are assumed to occur after reproduction. Population sizes therefore refer to the spring populations prior to harvest. The optimal fishing mortality rate is calculated as a function of the population of each age class. Optimal effort is, therefore, a function of four variables. Storing the value of this function for six different population levels of each of the four age classes results in $6*6*6*6 = 1296$ values being calculated. Memory and time constraints of the computer system therefore clearly limit the extension of this stochastic dynamic programming technique. Typically about 10 minutes are required for each year (or stage) calculated. Ten or more years are often required for convergence to a stationary harvest strategy. This program demonstrates that stochastic dynamic programing is a feasible and straight forward approach for the determination of optimal fishing strategies based on stock recruitment relationships. Population models with more than four of five state variables will require the application of other

optimization techniques.

      The computer program is written in FORTRAN. The program is structured using subroutines to calculate recruitment, death, and the objective function. This results in greater tractability of the program logic and enhances the flexibility of program alteration and testing.