

Exploring an individual-based simulation model to investigate the changes in life-history characteristics of a fished population under size-selective fishing.

Robert Leaf

Department of Fisheries and Wildlife Sciences, Virginia Tech
101 Cheatham Hall
Blacksburg, VA 24061-0321

Yan Jiao

Department of Fisheries and Wildlife Sciences, Virginia Tech

Mike Prager

NMFS Southeast Fisheries Science Center

Jim Berkson

National Marine Fisheries Service, Southeast Fisheries Science Center, RTR Unit at Virginia Tech

The efficacy of stock management and rebuilding may be limited by ecosystem changes, compensatory mechanisms, and heritable morphological changes. Williams and Shertzer (2005) demonstrated, through computer simulation, that changes in asymptotic length, L_∞ , of a fished population can be substantial in some management scenarios. If morphological characteristics are influenced by genetics, then size-selective fishing pressure can, over generations, change the phenotypic characteristics of individuals in a population. In this study we examined the rate and extent at which phenotypic change may occur in a fished population as functions of fishing intensity ($F \text{ year}^{-1}$) and the value of h^2 (a measure of the similarity of offspring to parents as a result of the importance of the genetic contribution). We constructed an individual based model (IBM) of 100,000 individuals, each assigned unique growth and fecundity characteristics based on Atlantic cod (*Gadus morhua*). From a stable age distribution, the population was projected for ten years under natural and fishing mortality. We observed a reduction of almost 10% in the mean value of L_∞ when the population was subjected to large fishing mortality and had large values of h^2 . We analyzed the population using yield-per-recruit and egg-per-recruit models and observed that over the ten year projection, the maximum yield per recruit decreased and was obtained at a smaller size-at-entry into the fishery and at a lower fishing mortality rate. Similarly, the magnitude of egg-per-recruit declined over the projection. This preliminary work indicates that in some situations fishing mortality can cause substantial morphological changes in fished populations and that these changes can have considerable effects on the dynamics of the fishery.