Abstract

Hatchery-reared lake trout (Salvelinus namaycush) have been planted annually in Lake Michigan since the mid-1960's. These planted fish now support both sport and commercial fishing but have failed to reproduce successfully. One concern is that the level of fishing has increased to the point of threatening the goal of rehabilitating the stocks. We developed a mathematical simulation model to study the interactions between sport fishing, commercial fishing, and rehabilitation. The model was derived from a conventional dynamic pool model, but contains additional features which allow the analyst to simulate the planting of variable numbers of yearling fish each year, to compute the individual yields for sport and commercial fishing groups who compete simultaneously for the same stock, to apply a handling mortality factor to sublegal fish caught and released, and to compute the number of fish remaining in the stock along with their annual egg production. Our assessment focused on the effect of exploitation by one fishing group on the yield of the other group and on the effect of all fishing on the egg production of the stock. The lake trout population in the Frankfort to Good Harbor Bay area of the lake was used as a case study. The instantaneous fishing mortality for the sport fishery was 0.15 from 1972 to 1975 and 0.22 from 1976 to 1978. The commercial fishery began in 1979, and the combined fishing rate for sport and commercial fishing was 0.42 from 1979 to

1981. Mail survey estimates showed a decline in sport catch of about 50% from 1978 to 1981 while sport effort remained relatively constant. The model analysis showed that competition from the commercial fishery was the most likely reason for this decline in sport catch. If the combined fishing mortality rate remains at 0.42, egg production will decrease from a high of 45 million in 1978 to 20 million during the 1980's. Tests of different fishing regulations showed that egg production could not be substantially improved by imposing catch restrictions on one fishing group and not the other. Many of the fish protected did not survive to reproduce but were caught by the unrestricted fishing group. Joint regulations benefited egg production a great deal, but the restrictions necessary for successful rehabilitation were severe. The survival rate of lake trout in their first year of life was unknown, but simulations were conducted for selected management schemes using a reasonable range of survival rates from 0.05 to 0.005. Rehabilitation was defined for the simulations as the production of 25,000 wild fish of age 4, the approximate number now produced by stocking 100,000 yearlings. Only the complete closure of both the sport and commercial fisheries allowed rehabilitation to occur in less than 25 years for the entire range of first-year survival rates. If the first-year survival rate was as high as 0.01, rehabilitation occurred in less than 25 years when a size limit of 711 mm was imposed on both fisheries and current stocking rates were maintained. It also occurred in less than 25 years when a 660-mm size limit was imposed on both fisheries and the stocking rates were doubled. If the first-year survival rate was 0.05, rehabilitation occurred within 5 years, even if no regulations were applied to either fishery. However, such a high survival rate is probably too optimistic.