MODELING THE STOCHASTIC DYNAMICS OF THE AGGREGATE STOCK IN COLLAPSED FISHERIES: THE CASE OF THE NORTHERN COD

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The knowledge of population dynamics of fish stocks at low population sizes is crucial in order to avoid the collapse and non-recovery of marine species. The lack of observations on the stock at low population sizes and the absence of adequate scientific information due to environmental uncertainty are the main barriers to understanding in this area.

One of the most dramatic collapses in the history of fisheries has been the collapse of the northern cod fishery. Northern cod, comprising populations of Atlantic cod (gadus morhua) of southern Labrador and eastern Newfoundland (NAFO divisions 2J3KL) was once one of the world's largest commercial fisheries. However, after decades of severe overexploitation, the stock collapsed to an extremely low level in 1992 when a moratorium on fishing had to be imposed. After 19 years of moratorium, the fishery still has not recovered

Motivated by the evidence that many collapsed stocks have failed to recover despite fishing mortality has been reduced, or even when a moratorium is currently in effect, we develop a spline methodological approach to analyze the stochastic population dynamics of fish stocks at low stock levels. The aim of this paper is to provide a simple mathematical model which allows us to analyze stochastic population dynamics of fish stocks at low stock levels. Unlike the conventional models, the concordance between the population dynamics of decline and recovery is not assumed, with a clear focus on modeling the stochastic aggregated stock (biomass) dynamics of collapsed species. The model can be used to analyze the consequences of all possible population dynamics at low population sizes, which can be different to those estimated at high stock levels, on the risk of collapse and non-recovery, in a setting of high degree of uncertainty. Considering the northern cod stock by way of illustration, we find that the lack of recovery of the species, despite the moratorium which still remains in force, is consistent with the hypothesis of weak compensatory population dynamics at low population sizes instead of the strong compensation estimated by conventional statistical methods.