

# Combining control measures for more effective management of fisheries under uncertainty: quotas, effort limitation and protected areas

Gunnar Stefansson (gunnar@hafro.is)  
Dept. of Mathematics  
University of Iceland

Andrew A. Rosenberg  
College of Life Sciences and Agriculture  
University of New Hampshire

## Abstract

In this paper, we consider combinations of three types of control measures for the management of fisheries when the input information for policy decisions is uncertain. The methods considered include effort controls, catch quotas and area closures. We simulated a hypothetical fishery loosely based on the Icelandic cod fishery, using a simple spatially explicit dynamic model. We compared the performance with respect to conserving the resource and economic return for each type of control measure alone and in combination. In general, combining more than one type of primary direct control on fishing provides a greater buffer to uncertainty than any single form of fishery control alone. Combining catch quota control with a large closed area is a most effective system for reducing the risk of stock collapse and maintaining both short and long-term economic performance. Effort controls can also be improved by adding closed areas to the management scheme. We recommend that multiple control methods be used wherever possible and that closed areas should be used to buffer uncertainty. In order to be effective these closed areas must be large and exclude all principle gears to provide real protection from fishing mortality.