Comment on the paper “The Evaluation of Fisheries Management: A Dynamic Stochastic Approach”

José M. Maroto
Department of Estadística e Investigación Operativa II.
Universidad Complutense, 28223 (Madrid), Spain.
PHONE: +34913942898, E-mail address: maroto@ccee.ucm.es

This paper develops a discrete time multifleet bioeconomic model with variability in fish dynamics (uncertainty in the growth function of the resource). In particular, this paper presents an alternative stochastic approach, based on the calibration technique, to reproduce the observed population dynamics of the resource. This stochastic approach, in which the random shocks follow a Markov process, has been implemented in different settings in the economic literature. Hence, the main contribution of this paper lies in the fact that it is applied to real fisheries. On the basis of data from the European Southern Stock of Hake (ESSH), the main predictions and policy recommendations are:

a. The estimated growth random shocks, which are based on Tauchen’s method, reproduce the observed population dynamics of the resource quite well.
b. The present value optimizing policy (optimal policy) is not the standard constant-escapement policy. In particular, the optimal policy consists of applying a different exploitation rule depending on the stock level of the biomass.
c. The optimal policy shows that the ESSH has been managed in an inefficient way. In spite of the fact that the observed catches have been lower than would correspond to optimal exploitation, the observed exploitation rules for 1982-2002 have not been able to protect the resource due to the fact that the timing of captures has not been appropriate.
d. An ITQ system with quotas depending on the size and the productivity of the biomass is proposed. In particular, the artisanal fleet would buy all the permits, and consequently the trawler fleet would disappear, at optimal exploitation levels.

There are many interesting aspects to this paper, not only because of the results obtained, but also in view of the implicit future lines of research put forward.

It is well known that, in the absence of uncertainty and in a context of classical bioeconomic models with a linear production function (harvest function) on both effort and stock level, an optimal stationary equilibrium x* exists, and the optimal policy is a "bang-bang" solution (constant-escapement policy (CSP)): adjust the stock level toward x* as rapidly as possible. Beverton and Holt (1957), Schaefer (1957), Clark (1973, 1990), Spence (1973), Clark and Munro (1975), among others, have shown that, under fairly general conditions, a CSP is optimal, that is, the present value optimizing policy.

Beginning with Jaquette (1972) and Reed (1974), the most relevant literature on renewable resources management under uncertainty has extended the above result to stochastic models with one source of uncertainty. In Reed (1979), a CSP is shown to be optimal in a stochastic stock-recruitment model (uncertainty in growth) even in the case where the production function is non-linear for the stock level. Clark and Kirkwood (1986) consider Reed's model under uncertainty about stock in the current period (uncertainty in measurement). In this setting, they show that, in contrast to the conventional wisdom, the optimal harvest is less cautious than that obtained under a CSP for high enough levels of uncertainty. Roughgarden and Smith (1996) extend the previous models by considering uncertainties in growth, measurement, and harvest implementation. In their study, the effects of multiple uncertainty on fishery management are analyzed through a CSP. However, Roughgarden and Smith's method does not allow us to prove that a CSP is optimal, that is, the expected present value optimizing policy. The optimality of a CSP under multiple uncertainty is solved in Sethi et al. (2005). They show that uncertainty in measurement may have the greatest potential to affect optimal policy. They find that, except for the case of high uncertainty in measurement, a CSP is optimal.

In this sense, and based on the arguments given above, the main contribution of the current paper is to show that the optimal policy under uncertainty in growth is not the standard CSP. In particular, the optimal policy is always jumping from one stock level to another. This result is probably the consequence of non-linearity in the level of effort (decreasing marginal returns) (see Maroto and Moran (2008) for optimal cyclical policies, in the deterministic case, due to the presence of increasing marginal returns). This optimal policy is interesting for policy recommendation purposes. According to the authors, an ITQ system with variable quotas that depend on the size and the productivity of the biomass should be implemented in order to take into account variances in relative harvests (quotas) for each fleet over time due to productivity changes. This means that both optimal quotas and sharing out must adjust to random shocks on growth. For optimal stock and catch levels, the optimal sharing of quotas implies that only the artisanal fleet would operate in the ESSH fishery. This efficient sharing of total catches between the two fleets is the consequence of the greater relative weight of the stock with respect to effort in the artisanal production function. The larger the resource stock is, the larger the catches will be for the artisanal fleet. This is because this fleet benefits from the existence of larger sized and average weight individuals (Garza-Gil, 1998). This ITQ system seems a reasonable instrument, instead of constant TACs, for managing fisheries with heterogeneous fleets. Moreover, it seems a desirable ecological instrument due to the habitat destruction caused by the trawler fleet. However, additional research is needed in order to implement it in real fisheries. Below, I suggest future lines of research in this regard.

Many of today’s fish stocks are officially managed through TACs established by regulatory agencies (among others, the ICES). It is well know that if the TAC is not adequately enforced by authorities the TAC system then gives rise to a regulated open access regime with economic incentives for fishers who compete for the catches. In this case, the fishermen harvest as much as possible until the TAC is exceeded which in turn implies overfishing and overcapacity. This is the case of the ESSH. Based on recent estimates, ICES (2007) classifies the stock as being overexploited. Indeed, the stock is in danger of collapse because it has reached a level where it suffers from severely reduced productivity. The recently adopted recovery plan aims to bring the ESSH above the biomass precautionary approach reference point within 10 years and to reduce fishing mortality. However, the combination of TAC overshooting (landings in 2005 and 2006 were 40% and 75% above the TAC, respectively), and the fact that fishing mortality has increased in recent years, raises a severe concern about the implementation of the recovery plan. In this case, recovery, if any, is likely to be slow and will depend on effective conservation measures. Unfortunately, this is a worldwide phenomenon. Hutchings (2000) stresses that, many fisheries which have suffered dramatic population reductions have experienced little, if any, recovery.

Given the above arguments, alternative incentive-based management strategies are needed in order to avoid the current failure of fisheries management. A well-designed management strategy based on individual transferable quotas (ITQs) can modify the perverse economic incentives of fishers so that open access no longer takes place. Under an ITQ system, each fisherman has an individual catch quota. The sum of the individual quotas equals the annual TAC which is established by authorities. A quota market will then develop due to the fact that the individual catch quotas are transferable. In this system, the ownership of the quotas will tend to become concentrated in the most efficient (low marginal costs) fleet. In this sense, the efficient sharing suggested in the paper seems reasonable. The artisanal fleet with low marginal costs at high optimal stock levels will value quota units more highly than the trawler fleet, which in turn implies that only the artisanal fleet would operate in the ESSH fishery. However, this ITQ system has economic consequences. In particular, the potential for decreasing employment in the trawler fleet, which depends on the costs of alternative activities from the fishery, should be evaluated.

On the other hand, an ITQ system with variable quotas that depend on the size and the productivity of the biomass requires “on line” quota determination by the authorities. This may be a desirable system but it requires intensive and expensive management, and can also increase uncertainty for the fishing industry (Clark and Kirkwood, 1986). Thus, flexibility in the adjustment of quotas in the ESSH fishery should be evaluated. Moreover, a well-designed ITQ system also requires precise information on the current stock level. However, in real fisheries the stock level is almost never accurately known due to the difficulty of observing fish in their habitat. When managers do not take into account uncertainties about stock in the current period (uncertainty in measurement), and catch quotas are set based on overestimated stock size, severe depletion of the resource is more likely when the actual stock is low.

Finally, the precarious situation of ESSH (after more than 20 years of severely reduced productivity, ICES (2007)) seems to confirm a depensatory mechanism in the population dynamics of the species (convexity of the growth function of the resource at low stock levels). The evidence for depensation is difficult to obtain due to the lack of information at low stock levels. However, according to Lierman and Hilborn (2001), this lack of evidence should not be interpreted as evidence that depensatory dynamics are rare and unimportant.

Concluding remarks

The results of this paper are interesting from both a theoretical and empirical point of view. Moreover, the possibility of future research in this area promises to be very interesting taking into account the actual worldwide crisis in fisheries. In this sense, conflicting interests between scientists, authorities, and fishermen should be avoided through alternative incentive-based management strategies which have to be enforced by the authorities and monitored by scientists.

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